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To keep the profession in touch with the current technical literature, and with the forestry movement in the United States and Canada.

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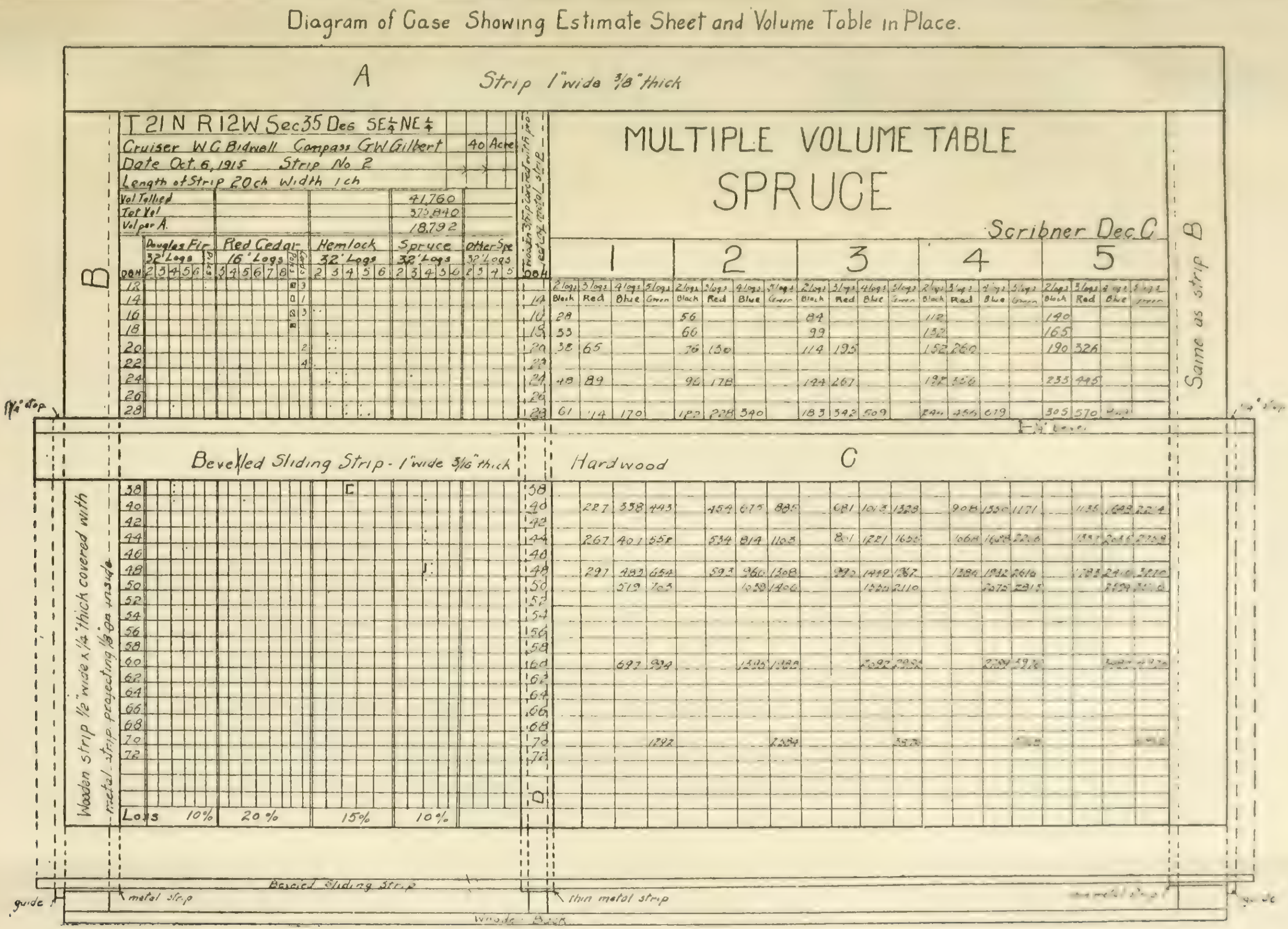

System for Computing Timber Estimates.

FORESTRY QUARTERLY

VOL. XIV MARCH, 1916 No. 1

AN EFFICIENT SYSTEM FOR COMPUTING TIMBER ESTIMATES

BY C. E. DUNSTON[1] AND C. R. GARVEY[2]

With the use of an adding machine and a simple device for holding timber estimate sheets and volume tables, it has been possible for two men to compute the estimates on about 4,000 sheets in approximately thirty days, a task which, without these aids, would have taken the same men not less than eighty days to complete. The field work of the timber estimate in question was carried on in the field season of 1915, and covered approximately 80,000 acres of the Quinaielt Indian Reservation. This Reservation, with an area of about 250,000 acres, is located just north of Grays Harbor on the Pacific Coast, in a region of heavy stands of Western hemlock, Western Red cedar, Sitka spruce, Douglas fir, Amabilis fir and a small per cent of Western White pine. The valuation strip survey method of estimating was employed, merchantable trees being tallied by diameter at breast height and number of thirty-two-foot logs. Since merchantable trees range in size from 14 to over 100 inches d. b. h. and from one to five thirty-two-foot logs, and since the major part of the cruised area contains a stand in excess of 50,000 feet b. m. per acre, it will be seen that the work of computing these estimates without the mechanical aid afforded by the adding machine and the case, herein described, for holding estimate sheets and volume tables, would have been a long and laborious undertaking.

A diagram of this case with a sample estimate sheet and spruce volume table in place appears in frontispiece. It consists of a thin board with narrow wooden strips *A* and *B* at top and side edges and a similar strip *D* which forms a partition between compartments for estimate sheets and volume tables respectively. The dimensions of this case may be varied to suit special requirements

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[2] Forest Assistant.

as to size and shape of estimate sheets and volume tables, both of which must be of such size as to fit snugly in their respective compartments. The sheets and volume tables are held flat in the case by narrow, thin metal pieces attached to and projecting about an eighth of an inch over the side and center wooden strips. A thin, beveled straight-edge *C*, which slides on the edges of the case parallel to the lines on the sheets and volume tables, is essential for preventing mistakes in reading volume figures.

Multiple volume tables are used in order to obviate the necessity of making multiplications in instances where several trees of one diameter-log-length class have been tallied on the same sheet. Each log-length class in the volume table has a distinctive color. Through this means it is possible to locate a desired column in the table at a glance, and the chances of making mistakes through reading from a wrong column are practically eliminated.

The computations are made by two men. One reads the total volume of the trees in each diameter-log-length space from the volume table and the other records these figures on the adding machine. When all the volumes of one species on the sheet have been called, the total is written in the space provided for it at the head of the species column. The volume tables are provided with an indented marginal index which facilitates changing them when several species are being worked up on the same sheet.

In cases where large tracts of timber are being estimated, it would prove an excellent plan to compute the estimates in the field in this same way. A small adding machine which may be easily transported could be used in most instances to good advantage. Everyone who has had experience in timber estimating will appreciate the advantages of completing the estimate calculations at the time field work is in progress, rather than at a later date in the office.

CONCERNING SITE

By Filibert Roth*

The classification of lands into more fertile and less fertile ones is as old as agriculture itself and antedates all written history.

The farmer today classifies lands into good and poor lands and uses the volume (rarely quality) of the crop produced as his measure. This measure is usually local; good corn land is determined by a different limit in Michigan than in Iowa or Texas. That the classification varies with the kind of crop and is therefore different for corn, wheat, potatoes, etc., is self-evident. And not only do we expect a much larger number of bushels of potatoes from good potato land, but good potato land is not necessarily good corn land, in fact, generally, it is not. With more extended intercourse and the development of agricultural research and literature the old local classifications of land are not always convenient or sufficient and more general classification has become desirable at least for certain purposes of comparison. In addition, the classification is being extended, and the farmer speaks of good corn country and good corn land as two things not at all synonymous, the idea of *corn sites* is developing.

Classification of land by the forester is old also, it is based on volume as standard, and developed locally. But unlike agriculture, forestry early combined land and climate into site, and instead of leaving the standard undefined, made it a matter of written record and of definite agreement and use. As in agriculture, the development of a science called for comparison of results and measurements, and after long controversy the question of site and the limits of site classes were settled in 1888 at least for Germany, by the Association of Forest Experiment Stations.

The following table gives yields in cubic meters per hectare of the stand 100 years old and the relative values where the yield of site I is set at 100.

				Relative Values	
Site	*Pine*	*Fir and Spruce*	*Beech*	*Beech*	*Average of all four species*
I	700	1100	720	100	100
II	550	900	580	81	81
III	420	720	460	64	64
IV	300	550	350	49	48
V	200	400	250	35	34

* Professor of Forestry, University of Michigan.

The following is evident: Beech ruled the situation. Well rounded values were chosen for site I, this choice was arbitrary within limits. The intervals were made on well rounded values and in a rather regularly decreasing series, as follows:

For Pine: 150, 130, 120, 100 cubic meters.

For Spruce: 200, 180, 170, 150 cubic meters.

Numerous, reliable tables based on careful measurements of well stocked and properly cared for stands served as skeleton in this classification.

Particularly interesting in this matter are:

Arbitrarily rounded values; regular decreasing intervals; unqualified use of the volume of the main stand at the age of 100 years; the fact that spruce and fir were not separated, so that trees with similar habits of growth are combined in the German classification.

That these standards would not replace local standards was clear from the outset. That they do not quite satisfy even for general comparison for all Germany is admitted today.

These standards were hardly expected to need modification with changes in silvicultural methods and consequent changes in normal or accepted yield tables.

Least of all, did it seem necessary to abandon the volume as basis, though it was well known and quite generally admitted long before 1888 that the volume of the main stand at 100 years was influenced by treatment, thinnings, etc., and that the height was a valuable criterion of site and that it was largely independent of methods of management and even of accident.

Since 1888, the Forest Experiment Stations have continued the study of growth and have improved the yield tables. Professor Schwappach, especially, has guided the work in North Germany, and his tables are the normal or accepted tables. It is interesting to see how far these tables adhere to the old standard of sites and how far the workers have been obliged to introduce height as a factor. The following table gives volume in cubic meters per hectare of the 100-year-old stand and the relative values, after Schwappach.

	Pine	*Spruce*	*Pine*	*Spruce*
Site	*Cubic Meters*		*Relative Values*	
I	470	826	100	100
II	398	683	85	82
III	323	547	69	66
IV	260	421	55	51
V	203	299	43	36

From these figures it is evident that: The volume of site I in pine or spruce is less than the volume of site II of the old standard. The intervals are no longer the same, in pine, not even approximately, and they no longer follow the regularly decreasing series. The proportion between different sites is approximately maintained. Volume is still the main guide or standard.

That Professor Schwappach felt the difficulty in using volume as basis in classification of sites is clear from his statement in "Die Kiefer," 1908, p. 45, where he discusses the derivation of the yield tables. Freely translated it is: "The *starting point* is the study and determination of the *height curves* of the main stand. The height is the factor least influenced by treatment." Also: "*I consider, therefore, the height,* leaving out some abnormal cases, *as the best criterion* of the *site* in the stands of middle age and older, while the *volume* of the *main stand* is *suited for this purpose if the stand has been properly cared for* and is in normal condition for a *long period.*" He then goes on to say that if the total volume produced, *i. e.*, main stand and sum of all thinnings are known, the volume answers very well as measure of site.

On page 47 he publishes the following table of heights for pine on different sites:

	I	II	III	IV	V
Age			*Height in Feet*		
80	84	71	60	47	36
100	92	80	67	53	40
120	100	85	72	58	44

Comparing these figures of height for the 120-year-old stand with the relative figures given before, it would seem that Schwappach used height primarily as measure of site.

That these changes should have come both in yield tables and site classification is not surprising, for the great changes in the practice of thinnings alone fully accounts for them. Thinnings have increased to the point where in a well regulated forest of pine with normal yields the sum of the thinnings each year exceeds the cut of ripe timber or final cut.

Here, in the United States, the matter of site and site classification is important. A "valuation survey" or forest survey covering several townships of land and costing thousands of dollars should certainly tell at least approximately what proportion of the land is good, fair or poor forest land.

How much this means in agriculture is strikingly brought out by a study of corn production in Ohio (*see* Bulletin 266, Ohio Experiment Station, p. 118), where it is shown that corn in Ohio costs 61 cents a bushel to produce whenever the yield falls below 30 bushels. Such land, then, has practically no value for corn, since the owner makes only expenses. On the other hand with good land producing 40 to 50 bushels, the corn costs the farmer only 29 cents per bushel and leaves him about 30 cents net income.

Similarly the income value of land used in raising pine in North Germany is, according to Schwappach (*Kiefer*, p. 150), under an 80-year rotation at 3 per cent interest rate: $74 per acre for site I; $45 for site II; $25 for site III; $5.50 for site IV; and is a negative quantity or a loss of $8.90 per acre in site V. The expenses are there, and even scrub woods need at least protection, and often much more than the good timber.

In a survey of a large forest area it is of no small importance to know whether a portion of the land can not be expected to pay at all, and what part is worth $5 and what $25 per acre.

Some effort has been made in the determination of site in this country. Just how much has been accomplished is not evident. In various recent publications of yield tables the matter of site has been considered, and it is interesting to examine a few of these with regard to the limits set and the basis employed.

Margolin in his study of White pine (*see* Woodman's Handbook, 1910, p. 198) establishes three sites as follows, for the stand 90 years old.

	Volume		*Corresponding Height*	
Site	100 *Cubic Feet*	*Relative Value*	*Feet*	*Relative Value*
I	127	100	97	100
II	110	87	93	96
III	92	72	89	91

Here, evidently a classification by volume has been used, following closely the scale represented in the recent Schwappach tables, leaving out inferior lands or sites IV and V altogether.

That the heights for the three sites vary so very little is surprising and indicates the necessity of further field study.

Sterrett in his studies of Loblolly pine (Bulletin 11, 1914) has given us some very interesting and useful tables in which the matter of site is fully recognized. He makes three sites which for the 50-year-old stand, the oldest given, are as follows:

	Sites Classified by Volume		*Corresponding Height*	
Site	*Total Volume Cubic Feet*	*Relative Value*	*Feet*	*Relative Value*
I	8000	100	87	100
II	6600	82	73	84
III	5100	64	60	69

The soils are described quite fully, but no statement is made as to the basis of classification, whether by volume or height. The table itself indicates that it is well based on ample field data and that height and volume in these even-aged, young and thrifty stands closely correspond. In fact, it will be seen that Sterrett's classification if based on the heights agrees almost perfectly with the classification as represented in Schwappach's tables for pine, the scale running: Schwappach: 100, 85, 69, 55, 43; Sterrett: 100, 84, 69.

The fact that we deal here with stands of different age, 100 years, as against 50 years, is not serious in view of the fact that Loblolly pine is very far developed even at 50 years. In any case it is evident that Sterrett's classification is as well based on height as on volume.

Mason, in Bulletin 154, 1915, on Lodgepole pine, page 31, gives a most interesting yield table for that species as actually determined from sample plots on the Deerlodge Forest, taking, however, "the best quality of sites."

In preparing a normal yield table or "table of average yield per acre of normal stands," he decides, on basis of observation and measurements, what a fully stocked stand should be. He then selects data of such stands from his material and constructs a yield table. Mason makes only two sites and as he states: "The original figures were secured on quality I sites, and the yields for quality II sites have been derived by multiplying the yields for quality I sites by sixty per cent which seemed a fair reducing factor."

Here, then, we have an entirely new method of classification of sites, site I based on actual measurement of good stands and site II arbitrarily given 60 per cent of site I values. This classification is new in making only two classes and in setting 60 per cent as a proper factor or making 40 per cent the proper interval. The height, which is so sensitive a criterion in mountain country, is not mentioned in this connection.

Chapman, in Bulletin 139, 1914, on Norway pine, gives a yield table (p. 21), in which again three sites are recognized. The table gives only age and volume in board feet for the three sites, leaving out height, diameter and even volume in cubic feet corresponding to these yields in board feet. The table begins with age at 40 years. Chapman describes his method, plotting the results of measurements of 85 tracts and drawing three curves, arbitrarily, to represent the different values.

For 120 years, probably a fair rotation here, the values run as follows; volume in board feet per acre as measure:

Site	*Volume M. Feet B. M.*	*Relative Values*
I	50.8	100
II	36.7	72
III	23.1	45

If the heights as recorded, page 17, as maximum, average, and minimum, are taken for 120 years, the values would be: actual height, 104, 94, 78; relative: 100, 90, 75.

Here we have a classification by volume into three classes with a distinctly new set of limits. The bulletin does not give the actual data, so it is impossible to judge to what extent the plots really covered different classes of lands. This lack of real data and the presentation only of averages and derived values is a serious omission in much of our recent forestry publications and is sure to militate against any general acceptance of the published values.

A very interesting table is presented by Chapman (p. 22, table 13), where he attempts to work out a yield table based on the number of trees per acre and their size, the number being based on the width of crowns as actually measured. The number of trees at 200 years seems extraordinary and it would be interesting to know if a stand of Norway pine has ever been calipered with a basal area of over 300 square feet per acre as this table requires.

The following brings together the few cases of site classification mentioned, the figures being simply relative, site I taken at 100, all but last column by volume.

	Schwappach German Pine		*Sterrett Loblolly Pine*	*Chapman Norway Pine*	*Mason Lodgepole Pine*	*Margolin White Pine*	*Sterrett Loblolly by Height*
	1888	1908	1914	1914	1915	1910	1914
Site							
I	100	100	100	100	100	100	100
II	79	85	82	72	60	87	84
III	60	69	64	45	..	72	69
IV	43	55	..	..	..	..	..
V	29	43	..	..	..	..	..

Keeping in mind that site classification has a very practical bearing, that the determination of sites on any property is a necessary and important part of survey, the question arises what the basis of classification should be and what qualities must this basis possess to be of value.

As far as the classification is concerned, the following seems agreed upon:

1. It must fit actual conditions, size and yield, and will therefore move within limits actually set by the timber itself.

2. It will be arbitrary within these limits; there may be 2, 3, or 5 site classes as man chooses and the intervals between these classes are set arbitrarily, they may be equal or not.

As regards the basis this seems true:

1. It must be applicable in any forest, in any stand, and, therefore, independent of the degree of stocking, excepting certain cases where overstocking leads to stagnation. It must apply as well to a broken stand of wild woods, to a mixed stand, to a stand containing several age classes as to the pure, even-aged stand.

2. It must be sensitive and reliable, and readily and fully indicate a change in site.

3. It must be applicable in ordinary field work, *i. e.* it must be simple enough to be used in ordinary work by ordinary men.

The volume of the fully stocked stand is not a satisfactory measure for the following reasons:

1. Even in the pure, even-aged, "man-made" stand, Schwappach admits that proper stocking and proper care must have worked together for "a long period." But how is the man to know this, and what is proper stocking and good care under these particular conditions? Who decides?

2. In the mixed stand the normal yield table is not normal, it is not accepted. What then is the volume of an 80-year-old stand to be? If we do not agree on this volume, how can it serve as a measure?

3. In our wild woods with several age classes, mixture of species, accidents of all kinds, with the average 40-acre lot normally irregular and only partly stocked, what use is the volume of a fully stocked, even-aged stand as a measure?

But even granted that it might be, how is any one to ascertain the age of such a stand?

The height of the dominant tree, the average height of the dominant part of any stand, is quite free from the difficulties involved in the volume of the fully stocked stand used as criterion.

Summing up, we may come to the following conclusions:

1. The height is a sensitive measure. A change of a few hundred feet in altitude at the proper point is promptly indicated in the change of height. White and Norway pine on Jack pine lands show the site clearly and unmistakably in their height and this at any stage of their life. It is the height which characterizes Scrub oak, Jack pine, Bog spruce and the timberline stands. European experience fully bears out this fact.

2. The height is independent of mixture and stocking. Height in a broken stand of White or Norway pine, of Loblolly or Longleaf, is not affected by this condition. Again, even in a crowded stand, within limits, the height of Spruce, Hemlock, Douglas fir, etc., and even our hardwoods, remains little affected, so that an old dogma built itself on this misinterpreted observation, crediting crowding with stimulus of height growth. The height of White pine in mixture with hemlock and hardwoods is entirely independent, each kind going its own gait and reaching its own normal limits, and so clearly expressing that a particular acre is site I for pine and site III or IV for maple or beech.

3. The height of a few trees and their age (the diameter-height relation is of no value here) is easy to determine, and where very large old timber exists the general age and size indicate correctly the site. Even the White pine stump may prove quite clearly the quality of the land.

As to the limits, they are set by the timber. The number of site classes will probably remain debatable ground. Four classes would seem quite sufficient, though the fifth class is convenient to include that class of forest where timber is scrub and all expenses are cut to the possible minimum, and where no real income of value is expected. Our Bog spruce, part of the Scrub oak, and Jack pine lands, a large area of timberline country come in this class.

So far, site classification has followed the old trail and attempted classification for each species. The German standard of 1888 combined spruce and fir and so recognized the important fact that we are dealing here with a classification of a simple dimension and that one set of limits of size may very well apply to all species which reach a certain size or yield at a certain age. In other words to all species which at 100 years have their dominant timber from 90 to 110 feet tall (or corresponding values for fully stocked stands) may well be applied one and the same classification standard, both as to limits and intervals. If this is granted it remains to be seen what species belong together and how many different standards are desirable. Germany works really with three standards, for five species; in fact other species are fitted in as the case warrants.

With the large number of species in the United States it might appear that a large number of standards are needed in keeping with the great variety in the rate and character of growth of timber.

The following suggestion is based on a considerable number of published values of height growth. The intervals between groups or standards *a*, *b* and *c* are taken, arbitrarily, of course, at 20 feet in site I; the intervals between classes at 20 feet, 15 feet and 10 feet for the three groups.

Standards of Site Classification
Based on the Height of Tree at 100 Years

Site	*Standard a*	*Standard b*	*Standard c*
I	110 *feet*	90 *feet*	70 *feet*
II	90	75	60
III	70	60	50
IV	50	45	40

Standard *a*, site I, has timber 100 feet and over in height at 100 years and would include chiefly the Pacific coast giants on their native sites.

Standard *b*, site I, 80 to 100 feet in height, includes Eastern and Western White pine, Sugar pine, Western Yellow pine in California and Oregon; Norway, Loblolly, Cuban, Longleaf, Shortleaf, Pitch and Jersey pines; Noble fir. Of hardwoods: Yellow poplar, chestnut, Black oak and Red oak, and probably most of our good hardwoods in Southern Michigan and the Ohio valley.

Standard *c* would include Western Yellow pine, and Douglas fir of the Rockies, Eastern spruce, tamarack, White fir, hemlock, Jack pine, White oak, hickory, Yellow birch, Sugar maple, beech in Northern woods.

What shall be done with eucalyptus, with cottonwood in river bottoms, with Piñon, Mesquite, and shall Redwood and Douglas fir have their own standard, are still questions to be debated.

It may seem like playing with a few figures to even suggest the above standards. But if tamarack in its native sites grows to be 35 to 75 feet tall at 100 years, varying in this with the quality of the soil, drainage, and if Jack pine fits into this same group, it is hard to see why in such classification of mere dimension we might not have some simplicity and uniformity and use the same foot rule in gauging any particular tract of land, whether swamp with tamarack or poor sand stocked with Jack pine.

However, all this is for the future and the important thing is to get a measure which the forester can use when he is asked to survey a tract of timber land.

ADDENDA

By H. A. Parker[1]

The above data have even a greater content for the purpose in hand than that utilized by Professor Roth. It is the purpose of this addition to bring out more fully the close relationship of height and volume, and especially the interesting volume-height relation of one genus, the pines, so widely distributed as the Scotch pine, the White pine, the Loblolly and Shortleaf pines, as appears from the following tabulation:

PINES

Relative Values—Volume

Site	(1) *Germany* (1888) *Scotch Pine Aged* 100 *Years*	(2) *Schwappach* (1908) *Scotch Pine Aged* 100 *Years*	(3) *Margolin* (1910) *White Pine Aged* 90 *Years*	(4) *Sterrett* (1914) *Loblolly Pine (Peeled)* 50 *Years*	(5) *Mattoon* (1915) *Shortleaf Pine Aged* 80 *Years*
I	100	100	100 (100)	100	100
II	79	85	87 (79)	79	79
III	60	69	72 (60)	61	57
IV	43	55	..	..	..
V	29	43	..	..	..

Relative Values—Corresponding Heights

Site	(1)	(2)	(3)	(4)	(5)
I	100	100	100 (100)	100	100
II	88	87	96 (87)	84	88
III	75	73	91 (76)	69	74
IV	60	58	..	..	..
V	45	43	..	..	..

[1] Student, Faculty of Forestry, University of Toronto.

The first data of Schwappach's were gathered under a very different thinning practice than the later ones, yet the relative heights were not far different, being just two points higher in the less severely thinned stands. But in comparing the heights and volumes or the volumes in the two cases alone, the difference is considerable, to the disadvantage of the older practice.

Under the intensive thinning practice, the relative volume values of the latter have been made almost equivalent to the relative height values.

Excepting those of columns 1 and 2, all the other values given in the above table are for unmanaged forests, or for forests where thinning practice has been only imperfectly or not at all developed. The relative volume values for White pine show a less range than those of Scotch pine for sites I, II and III. Is this not due to the fact that, granting White pine site I is equivalent to Scotch pine site I, White pine sites II and III are superior to Scotch pine sites II and III in the ratios of 87: 79 and 72: 60 respectively? Had the White pine sites been chosen so as to give volume values, say, 100, 79 and 60, instead of 100, 87 and 72, then the height values, 100, 96 and 91, proportionately reduced, would have been approximately 100, 87 and 76, which figures show a striking resemblance to those of Schwappach for height.

The relative volume values for Loblolly pine in column 4 are different from those given in the above article, in that they are for peeled material. They are almost identical with those of column 1, but the corresponding height values have a greater than average range. This may be due to peculiarities of growth and to the short age.

The values in the last column are from Bulletin 308 of the United States Department of Agriculture (Forest Service); they show similar volume-height relations.

These conclusions follow:

1. Given normal stocking, a certain kind of tree, age and site classification, there are definite relative volume values for the various sites, also definite corresponding relative height values.

2. The intervals between pairs of consecutive height values are less than those between corresponding volume values.

3. As a basis for site classification for normal stands not less than middle-aged, we may use either volume or height. But, as Professor Roth suggests, for abnormal stands the height is the better indicator.

SILVICULTURAL PROBLEMS OF CANADIAN FOREST RESERVES[1]

By B. E. Fernow[2]

Last summer, through the courtesy of the Director of the Dominion Forestry Branch, and in his company, the writer had the privilege of inspecting conditions in some of the Dominion Forest Reserves in the prairie provinces and of some parts of the Rocky Mountain Reserves.

This inspection was made with a view of enabling the writer as chairman of the newly established Advisory Board of the Forestry Branch, to formulate propositions for investigatory work as a basis for an eventual technical management of the Reserves.

While ten weeks travel can, to be sure, give only a very superficial insight into conditions and problems, contact with actualities and intercourse with the men in charge permits at least a judgment of the general requirements in the administration and management of these properties. * * * The visitor will, however, at once realize, that to fulfill their function, namely to furnish continuous wood supplies, a systematic *technical* management is a more or less urgent necessity and should be inaugurated as early as possible upon the basis of carefully prepared working plans.

So far, in the minds of the public not only, but of officials as well, the problem of the Forest Reserves has appeared of the same nature as that of the mere administration of timber lands; so far, indeed, hardly more than a timberland administration has been attempted, albeit with a somewhat more conservative disposal of available supplies. Of the practice of forestry, the technical art, there is as yet hardly a beginning. For such an administration as has been hitherto attempted technical men and technical knowledge are hardly required. The fact that most reserves are under the management of non-technical men bears out this contention: Forestry practice is still absent.

The application of forestry means efforts to reproduce the harvested crop, efforts to make the Reserves continuous producers, to manage them with a view to sustained yield, which can be

[1] Before Commission of Conservation of Canada, Ottawa, 1916.
[2] Dean, Faculty of Forestry, University of Toronto.

done only by application of silviculture, the art of forest crop production.

The principal reason for the absence of such forestry practice is probably an economic one. Most of the Reserves are located where, as yet, no market, or only a limited market, exists, and, moreover, the best timber, the marketable portion on most of the Reserves, had been placed in timber limits, which were haggled away before the Reserves were created, hence the administration was financially handicapped at the start.

In addition, the administrator of the Reserve, if he consulted the technical man, would have found out that to reproduce the forest crop costs money just the same as reproducing the farm crop, and as he is accustomed to deal at any rate only with present-day affairs, he is apt to let the future take care of itself and to confine himself to present-day timber sales of whatever available supplies are at hand. He thinks that if he has made provision against fire danger and for reduction of waste generally, perhaps restricting the cut to a diameter limit, he has done all that can be expected. Surely, these administrative measures are of primary importance and need first consideration but if this were to remain the proper attitude, the Reserves would fail of their object and altogether the prosperity of the country would suffer in the future.

The forester also takes into consideration the economic conditions under which he is to practise his technical art; he also is shy at avoidable expenditures, but he makes a long range calculation. His business is to provide for the future and hence he looks into and calculates with the future, and he knows from the experience of other nations that it requires expenditure and apparently dead work in the present to secure results for the future.

His finance calculation is for the long run!

We must not allow ourselves to be deterred by the fact that the forest crop is slow in maturing, that it takes many decades from the seedling to the log tree and not less than 60 to 120 years for a profitable crop to mature. On the contrary, this is the very reason for a timely beginning to start the crop. It is this time element which makes the forestry business unattractive to private enterprise and furnishes the argument for government to engage in it, the justification for setting aside Forest Reserves and for handling them for the sustained yield under systematic forest management.

Only a government with the duty to consider a long future, with providential functions, can afford to do this.

From the standpoint of the more or less immediate need of inauguration such systematic forest management, we may classify the Reserves into four or five classes.

There are some Reserves, located near well populated districts, whose natural supplies are already being heavily drawn upon, as *e. g.* the Cypress Hills Reserves in Alberta and Saskatchewan, the Pines and Nisbet Reserves in Saskatchewan, the Turtle Mountain Reserve in Manitoba. Here, there should be immediately inaugurated a well considered felling plan and a judicious reforestation program. Under present methods of mere exploitation the virgin supplies must be soon exhausted, unless adequate provision is made at once for a new crop.

Next, we have Reserves which, as yet, are but lightly drawn upon, but which within the next decade promise to come into market more fully, as the settlements come up to their boundaries and the settlers' wood supplies are giving out. Such are the Duck and Riding Mountain Reserves in Manitoba. Here, every opportunity for more careful study of the silvicultural problems should be embraced, and a thorough preparation for technical management should be begun now in anticipation of their coming fully into market soon.

Then there are a number of Reserves that were not set aside on account of their timber, which was either used up, burned up, or naturally absent, but on account of the unsuitability of the soil for farm purposes and the possibility of using it for timber crops. Such Reserves are the Sprucewoods Reserve in Manitoba, partly wooded, and the Manitou Reserve in Saskatchewan, largely without natural growth, and several other sand hill territories. Here, planting operations should be begun at once, first trial plantations with various species and methods, and, after experience has been gained, on a larger scale, with or without assistance, by natural regeneration as the case may be.

Lastly, there are extensive Reserves in the northern prairie regions and in the Rocky Mountains which are as yet so far removed from market as to place them last from the standpoint of the need of technical management. Here the problems are still mainly of administrative character: to prevent further deterioration of the properties, especially by fire; to regulate the use of whatever resources may be available, like, *e. g.*, pasturage; to improve these resources; to make them accessible, and, as far as technical interest is concerned, to study the silvicultural problems against the day when they must be solved.

All Reserves, however, once set aside for permanency, should be administered under systematic working plans, more or less elaborate, especially with reference to their utilization; and, if they are to do justice not only to the present, but also to future needs, such plans must eventually provide for the application of proper silvicultural methods for securing a continuance of wood crops.

There is no other productive business that needs so much planned and consevative procedure as the business of producing forest crops, for the reason that not only do these crops mature slowly, but there is little chance to advance and improve the crop after it is once started; its proper start, therefore, is the important thing. The manufacturer can change his processes in a few weeks, the farmer from year to year, but the forester, once his crop is started, may not change his procedure for a century, and there is only limited chance during the life of the crop to interfere with its development; therefore, the necessity of careful planning.

If our Reserves were all first-class, useful virgin timber, the working plans would be a simple affair. They would consist in prescribing the cutting of the year's requirements in such a manner as to secure reproduction—a natural regeneration. But this is by no means the condition, even in the well-wooded Reserves; only small portions consist of mature, useful timber, largely spruce; large portions, as a result of fires, represent young growth or are grown up to undesirable or at least less useful species, principally aspen; some of these aspen stands are rotten and useless; some areas are mere brushlands, and still others entirely waste—dilapidated woods which only a laborious building-up process can bring into desirable productive condition, and that means careful planning and eventually the necessity of expenditure in starting future crops.

In this connection, there is one feature of importance to which I may refer in passing, that pertains at least to some of the Reserves in the prairie region which is encouraging in this respect, namely the remarkable rapidity of growth, which excels that of the eastern provinces, and promises early maturing of a valuable crop. This statement has special reference to the White spruce, which on the deep soils which it occupies grows for a long time on the average at a rate of 5 to 6 years to the inch, making a 15-inch tree, 80 feet in height, in 80 years.

In order then, to inaugurate a systematic management of any property, the character and condition of the property needs to be known in detail; next, its administrative, its economic, and its technical problems must be recognized and solved.

These requirements in a forest property involve first of all a detailed forest survey, including a close stocktaking, and mapping; next, a suitable subdivision into smaller units or compartments for convenient handling; a study of the materials that can be marketed, and a study not only, but a stimulation of the market for the minor materials; next a study of growth conditions and their effect and results in regard to regeneration and in regard to increment. Based on this information, an admissible felling budget may then be calculated and the felling areas may be suitably located; finally, study and experiment is necessary to learn how the local silvicultural difficulties may be overcome.

These are the data which must be ascertained in order to formulate a working plan and to inaugurate a technical management. There is no need here, I hope, to insist on the necessity of employing men with professional training to collect these data and to apply them; no need to insist that permanency of tenure of office and continuity of organization are essential to successful execution of the plans.

I propose now to point out a few illustrations of the kind of silvicultural problems that must eventually be solved by experimentation, those that arise in attempts to secure a new crop of desirable character.

Each Reserve has its special problems, according to its character and composition.

The Aspen Problem

In the Riding and Duck Mountains, we find conditions and problems very much alike. The most valuable species here at present is the White spruce, hence it is this species for which the management would have to be devised, especially as at least 60 per cent of the soil is adapted to this species.

Unfortunately, numerically, another species, the aspen, is most prominent, as a result undoubtedly of fires which in past ages and also in modern times have reduced the spruce to only a limited amount; hence the spruce must be re-established in competition with the aspen.

There is no difficulty on this account, in the nature of the two species, for the spruce is a tolerant species and can stand the light shade which the aspen gives, almost without being retarded in its growth. The only problem is that of the profitable or at least costless removal of the surplus of aspen.

Aspen is by no means a useless weed tree. Not only is it valuable as a mere soil cover, recuperating the soil after fires, but it furnishes an acceptable fuelwood and pulpwood, and even an inferior grade of lumber, especially for flooring. Aspen also lends itself to use for small woodenware, boxes, crates, pails, excelsior. The establishment of industries near or in the Reserves using this material is probably possible and should be brought about by investigating the possibilities of securing a sufficient supply of the raw material and other factors favoring such industries.

Unfortunately, it is liable at an early age to rot. Large areas of mature aspen, which look as if they would cut satisfactory saw material, are to the extent of 50 to 80 per cent "punky," and so far as known useless. The silvicultural problem of re-establishing the spruce must wait upon the solution of the technological problem of finding a use for "punky" wood, or a use where at least a certain per cent of rot is not objectionable.

Such large areas of pure aspen of all ages are found in these and other Reserves that it will become an unavoidable necessity to work in part for aspen reproduction, and in that connection to solve the problem of reducing or stopping the progress of the disease, keeping it out of the younger growths that are not yet affected.

The aspen problem is, indeed, a general one throughout the whole Eastern Dominion; the development of its profitable utilizations should be made one of the studies of the Forest Products Laboratories.

The Underbrush Problem

There is little or no difficulty in establishing spruce under aspen because of the shade endurance of the latter, but another, worse, inimical agency comes in to make difficulty. The light shade of the aspen favors the establishment of a dense underbrush, especially of hazel, with an admixture of half a dozen other shrubs. This underbrush keeps out the spruce, keeps it from establishing itself by natural seeding, and would choke it out if planted, and hence must be removed before a young crop of spruce, and even of aspen, could be established. Experiments are needed to determine the cheapest effective method of dealing with this trouble.

The inquiry would be as to whether cutting or burning produce the more favorable conditions and at what time of the year it is best to do the one or the other.

Planting Problems

The desire of the forester is to secure his crop, if possible, by natural regeneration; that is, to so handle the mature crop that the seeds falling from it establish the new crop before the seed trees are all removed; this in order to avoid the outlay for planting. But there are large areas in these Reserves on which no old crop of desirable species is to be found, and it becomes necessary to establish such species by planting. The problem, then, is to find the most suitable species and the cheapest successful manner of propagation.

To gain an insight as to what species to introduce, trial plantations on a small scale are indicated.

It is my impression that not only in the aforementioned forestless Reserves, and where desirable species are lacking, but also in the well-wooded ones, planting will be found often preferable to reliance on natural regeneration.

While the apparent economy in relying on Nature's ability to establish a new crop is in favor of natural regeneration, avoiding the cash outlay necessary to start the crop by artificial means, sowing or planting by hand, in the end result the latter often proves the cheaper.

To use Nature as a planter requires knowledge, judgment and skill not only, but lucky weather conditions, satisfactory seed production and favorable conditions of the ground for germination and growth of the seedlings. This combination of favorable circumstances does not occur frequently. On the other hand, by growing seedlings in nurseries where they can be given the best care, and setting out plants, success can be forced, and especially time can be saved.

Hence, early attention should be given to finding out the best materials and methods of planting.

The Jack Pine Problem

Large areas of sandy soils are covered with a dense growth of pure Jack pine, standing so dense that each tree has little chance for development, hence the individual development is extremely slow. By reducing the number per acre, *i. e.* by thinning, as it is technically called, the remaining stand can be given opportunity for better development.

The problem is to find out at what time of the life of the stand to thin and how many trees to the acre promise the most satisfactory result.

The most valuable use of the Jack pine is for railroad ties, and it would, therefore, be desirable to grow tie trees. For this purpose, there is no need of freedom from knots, hence branchiness is no objection, and the increase in increment due to fully developed crowns that can develop in open stand may be secured without injuring quality. That means an early and severe opening up is indicated, only taking care not to expose the soil too much at a time.

The Jack pine is a rapid grower when young, but not persistent, hence this tendency should be utilized by giving it a chance to develop its rapid rate early. This may, perhaps, be done by reducing the number in the stand early to say, 300 or 400 trees per acre or perhaps even less.

The narrow-minded manager will object that the operation would not pay because, perhaps, he could not dispose of the material coming from the thinnings profitably, but if it could be shown that instead of having to wait 80 to 90 years for a 5-tie tree to develop, a full crop of railroad ties, 1500 to the acre, could be produced in 40 to 50 years, the profitableness of the operation might justify its inauguration even without the possibility of disposal of the thinnings. Experiments, then, for determining the most satisfactory density of these stands should be undertaken at once.

The possibility of shortening the time of production of sizeable materials by a rational thinning practice has even in Germany been fully realized only during the last 30 years, and now, not only are from 25 to 50 and more per cent of the final harvest crop secured by thinnings, without reducing the amount of the harvest crop, but the rotation as far as it is designed to produce sizes can be reduced at least 20 years.

It is, then, desirable to institute thinning experiments in other than the Jack pine stands.

The Muskeg Problem

Such experiments suggest themselves at once also for the Black spruce stands on the peaty muskeg areas which occupy such large extent in the Reserves, and usually grow in overcrowded condition, retarding the development to size of the single individual. Whether by thinning, the rate of growth can be changed could be easily found out. The probability, however, is that lowering the water-table would show better results.

Altogether, the problem of the proper use of these extensive peat bogs is one that should early occupy the attention both of the Forestry Branch and the Agricultural Department, for there is hidden in them a great resource that it has so far not been given to us to fully realize.

The Fallen Timber Problem

In the Rocky Mountain Reserves fires have killed large areas of mature growth, and as a result there are thousands of acres of windfalls covering the ground with a labyrinthian maze of down trees, which make the areas almost inaccessible and unmanageable for cropping. What can be done with this unfortunate condition? After some time this material rots, disintegrates and becomes a part of the soil, but in the alpine climate this process takes a long time.

Meanwhile, these areas form also dangerous fire traps.

Here again, the Forest Products Laboratories may be able to work out a solution, devising means of utilizing such material.

Altogether, the problem of finding use for minor wood materials is one that would often make it economically possible to solve the silvicultural problems.

There are, then, a host of problems which it takes time to solve. Their solution should be attempted at an early date. This is possible by experiment on a small scale before the necessity of solving them on a large scale arrives. But it should be realized that the answers to these inquiries by experiment come as slow almost as the crop itself for which they are made.

Therefore, the time to inaugurate them is now. Fortunately, the experiments outside of requiring careful and judicious planning can be made with very small expense, and considerations of economy, due to the exigencies of the war, need, perhaps, not delay them.

THE COSTS AND VALUES OF FOREST PROTECTION

By P. S. Lovejoy[1]

The analogies between the costs of protection in forests and the operations of commercial fire insurance are rather close, but tend to be misleading. An insured property must pay a certain premium each year. In the case of damage, the owner is reimbursed for his losses. The charges depend on the value of the property and the likelihood of its being damaged by fire or other agencies. The theory of insurance involves the assumptions that there will be fires, that the fires will cause damage, and that the number of fires and the resulting damages can be statistically foretold so that the premiums can be adjusted to the losses and the cost of doing business. But such insurance for the forest cannot be purchased in America.

In the forest, fires are expected, and the ratio of fire to damage is fairly well understood. The problems of salvage are similar to those of other kinds of property. With the accumulation of dependable statistics the forester will be able to forecast with large accuracy, the source, location, and number of fires, and their normal damage. As in insurance, there are annual charges to be paid, and the amount of such charges should bear a relation to the value of the property and the likelihood of its being damaged. But in insurance the annual charge buys indemnification in case of damage; in the forest it supports merely the protective organization. Save in a special business sense, insurance does not buy protection; it buys only reimbursement for losses. Expenditures for forest protection pay for the protection only and, in case of losses, the owner is not reimbursed and his sole object is to prevent or minimize losses. Save in that there are annual charges to be met, and that the charges are in definite relation to the values of the property and the likelihood of its suffering damage, there is little identity between the problems of insurance and of forest protection. The objects of each are quite different.

The cost of insurance is not the only expense to which the ordinary business is put on account of the likelihood of damage

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by physical agents. To secure safety from wind damage, for instance, more expensive buildings are required than would otherwise be necessary. There is a specific charge for fire protection proper. Taxes paid for the support of the city fire department, the city water system, paved streets which permit greater efficiency by the fire-fighting organization, the costs of supporting a telephone system, etc., all of which are useful for other purposes than protection, nevertheless should be considered as parts of the actual costs of protection. Such items as the costs of watchmen, alarm systems or automatic sprinklers are direct charges against protection. Charges for protection proper are therefore common to all usual business, as well as to forests. The sum of all such charges may frequently be greater, for the ordinary business, than the costs of insurance. Because they are not so obvious as the costs of insurance, they are often overlooked and it is assumed that the forest must bear costs not borne by other forms of property.

Sometimes a very large business "carries its own insurance." In such case, the phrase may be a figure of speech and no insurance of any kind may be effective, or when properly applied, the phrase indicates that the business each year sets aside sums directly comparable to the premiums of insurance, the sums so appropriated being accumulated into a fund to provide for the rebuilding or replacement necessary on account of fire losses. This practice is practicable where the property holdings are well scattered and no considerable proportion of the entire plant is likely to be wiped out at one time. The object of such procedure is to save the administrative costs of commercial insurance, which, of course, are included in the premiums; in effect real insurance is in force.

Forest owners have sometimes assumed that they were "carrying their own insurance," but this has probably indicated only that their financial affairs were in such shape that they could stand the losses from fire which they anticipated might occur. A factory can be rebuilt and a business re-established after a fire. A forest cannot be replaced in the same sense, and there would, therefore, be no object in setting aside sums corresponding to the premiums of insurance. The calculated financial damage suffered by an owner in case of forest fire may be reimbursed, as in a judgment in a fire trespass case, but the judgment cannot replace the forest. The phrase "carrying his own insurance" would seem to be wholly misapplied in the case of the forest owner.

Most of our American forests are subject to total destruction by fire, and practically all of them are subject to very serious damage. The amount of damage suffered in the past cannot be approximated save very crudely on a stumpage basis. A great amount of our burned forests have had only nominal stumpage values so that calculations on this basis are practically useless. Statistics bearing on the acreage burned over are more valuable. Calculations of the damage caused by fires, based on the cost of replacement of forest on the burned acreage, would, of course, indicate losses many times as great as those based on current stumpage values. Should an effort be made to calculate losses on the assumption that a given acreage of burned forest will ultimately be replaced and maintained as forest, the result would doubtless show a financial loss well into the billions of dollars. Plummer[2] estimated an average annual stumpage loss in the United States of $25,000,000 and that 10,000,000 acres a year were burned over. With any reasonable value assigned to the damages to young stands and to site, the indicated losses would certainly be more than doubled.

Fire insurance eases the situation for the insured individual who suffers loss, but, of course, the whole group of policy holders actually reimburses all loss. Insurance being general, the policy holders add the costs of insurance to the costs of their business and the general public actually pays the bill of losses plus the administrative costs of the insurance companies. An individual who pays for a certain degree of fire protection which proves inadequate, and who has not insured his property, on suffering fire damage has his business either wiped out or must replace the damage out of what would otherwise be profit. In every case there is an economic loss in addition to the money loss of the property owner. It seems to come to this: the general public must pay the bill whatever happens; the uninsured owner must add to his costs of operation the cost of protection plus losses. Since the forest owner cannot insure his property, the costs of protection plus the value of his losses is a legitimate

[2] Bulletin 117, U. S. Forest Service.

charge to be absorbed into his cost of doing business and to be reimbursed in the sale value of his product.

In the long run, the stumpage value of timber must equal the cost of producing timber. Our forests must be protected, and it will cost an aggregate of very great sums to protect them. If we are to have forests, and if they are to pay for themselves, the cost of protecting them is an integral part of the cost of production. In a rather vague way this is already recognized. A tract of uncut timber surrounded by inflammable slash, brings much less on the market than a similar tract included within the boundaries of an efficient Fire Protective Association. An owner bonding a timber tract where the fire danger is known to be high, must pay more for the money he borrows, because the bonding company will discount the issue so as to absorb what it assumes the risk to be. That is, the stumpage is worth less if unprotected. For the timber owner it is a matter of determining whether it is cheaper to pay for protection or suffer whatever losses may occur. A property subject to great damage or total loss, and non-insurable, if without protection, is certainly an exceedingly poor investment, and the quality of the investment will be in inverse proportion to the period of investment. An owner may be able to afford the risks for a few years previous to logging, but he can less afford unmitigated risks if he must wait for ten or more years for his timber to reach a satisfactory sale value. An owner contemplating indefinite or permanent forest maintenance without planning for the work and expenses of protection would be a speculator of low intelligence. Only the past rise in stumpage values, the concentration of great holdings in few, financially strong hands, and the practice of buying just ahead of logging have permitted timber investment under past and prevailing conditions to be a tolerable business venture.

With the growth of stumpage values, the elimination of the small scattered holdings and, above all, the forester's demonstrations of the possibility of fire prevention and control, it is the exceptional timber owner who is not ready to admit that he can afford at least a little for a protective organization, even though he expects to log his timber within a few years. The growth of Private Fire Associations in numbers and in acreage patrolled is proof of this conviction. But the ineffectiveness of much of the association work and the fact that the State organizations for fire prevention and control, in most of our timbered States, are still, as a rule, either hopeless pretenses or largely helpless for lack of adequate appropriations, show that there is still little real understanding of the situation. Since the advent of the forester to America the owner and the public have learned that fires are largely preventable and that much can be done to control them at reasonable cost. But even foresters do not seem to have given much attention to the questions: What degree of prevention and control is possible? What degree is practicable without prohibitive cost? What is prohibitive cost?

For ordinary business any charge is prohibitive if it confiscates profits, or if it reduces profits below the current rates of interest on investment. For the private timber owner, this would be the case. For State or National Forests it is not necessarily true that there must be a direct cash profit from the forests in order to justify their maintenance, but such a profit should usually be possible, and it should be assumed that there will be such a profit. Practically all of our privately owned forests are, financially, little more than timber reservoirs with a land by-product; their values are on a speculative rather than a stable, economic basis. The State and National Forests are to be, presumably, permanent forests, and are on a different financial and economic basis. For the private owner, therefore, a prohibitive cost for protection would be one which threatened to confiscate the profits of the speculation. For State and National Forests, if they are required to return interest on their investment, a prohibitive protection cost would differ from that of the privately owned forest by the difference in the interest required to be carried on each. If the State or Nation can borrow money for 2, 3 or 4 per cent, they would probably be satisfied with that much return from their forests. If the private owner must net 6 per cent, there would be a difference in the maximum, tolerable protection costs of 4, 3 or 2 per cent. In the long run, this might amount to a good deal, but for present practical purposes it is of little importance except in that, under present conditions, the private owner must look more closely to the costs of his protection than need State or Nation.

As far as the administrative forester is concerned, prohibitive costs are those beyond which the owner, private or governmental, refuses to go. But this is not a fixed limit, and when the forester is clearly able to demonstrate to himself and his principals that greater appropriations are amply justified, that, indeed, they redeem themselves at once, the forester can expect at least a great deal more than he is able to secure at present; all he needs. The owner of a factory does not put in a sprinkler system until he knows that there is such a thing, knows that it will work under his conditions, and knows that the reductions in the cost of his insurance and the greater security which his business will receive from the increased protection, will be justified. When the forester is able to show the owner that it will pay, and pay well, the owner will be willing to incur any expense whatever.

The possibility of the complete elimination of fires and fire damages from most of our forests may at once be given up. While it is theoretically possible, it may never be expected. At the same time, it is more than reasonable to anticipate that fire losses can be reduced to but little more than nominal. "As late as 1778 the necessity of keeping the . . . fire lanes open in the forests of Eastern Prussia is justified by the statement that 'otherwise the still constantly recurring fires could not be checked.' . . . 'Not a single acre of forest could be found in the province that had not been burnt in former or later times.'"[3] "In Prussian forest districts, in fifteen years, 405 fires were reported but only 191 acres in 1,000,000 were damaged out of the 7,000,000 acres involved."[4] On the strength of this testimony, and especially on the strength of what American foresters have already demonstrated to be possible under our own conditions, it is obvious that fire losses in our forests can be reduced to a point, which, according to past and present precedents, must be considered nominal. For instance, the St. Joe National Forest lost tremendous areas of its timber during a few days, in 1910. During the summer of 1915 Supervisor Holcomb reports: "We had in all a total of 103 fires, 51 of which were reported into headquarters within a period of 52 hours. All of them were lightning fires. . . The fires were all handled with absolutely no loss of timber of any appreciable value. The largest fire reached about eight acres. . . . The total expenditures were a little

[3] Fernow, History of Forestry, p. 48.
[4] Fernow, Economics of Forestry, p. 133.

over $4,000." It is no longer a question as to whether fires can be kept down. The only remaining question is as to how much the forester can afford to spend for fire prevention and control.

The importance of attempting to define the reasonable limits of protection expenses lies in that, with the State and National Forests especially, it is necessary to secure appropriations for the work. In the absence of general information on the subject, it is naturally very difficult to persuade legislative bodies to take unprecedented action. But it is to be feared that foresters themselves have paid but little attention to the matter, probably on the assumption that they could amply justify more than there was any chance of their getting. The same condition obtains to a greater or lesser degree among the Private Protective Associations, where the competent administrative officers have perennial difficulty in getting really adequate appropriations.

As with all other forms of property, forest protection will justify any expense up to the point where profits are confiscated. The forester should be able to demonstrate that, long before any such point is reached, he can furnish his forest with protection which protects adequately. In the European forests mentioned, it is not unusual to have a gross annual expense of about $1 to $3 per acre. Of this amount approximately 6.25 per cent, or about 25 cents, is spent for protection. The forests, of course, pay a satisfactory interest on their capital value, which is high. At this rate, about $250 per 1,000 acres, per year, goes for protection, which will include more or less work in connection with insects and fungi, trespass, etc., as well as fire protection work.

The average assessment among our Private Protective Associations runs between 2 and 5 cents per acre and year. Under unusual conditions, usually where large fires have to be fought, the assessment reaches as much as 10 cents per acre. It has seldom, if ever, been higher. Out of this, is paid the salary of the year-long force (usually very small), the summer patrolmen, packers, fire-fighters, etc., and relatively small sums for permanent improvements, such as trails, cabins and telephone lines, and equipment. In a number of cases the assessments are only a fraction of a cent per acre and practically no improvement work is attempted. Without adequate statistics it is impossible to rate the relative efficiency of the protective work of the Associations in proportion to their costs. As a rule, the losses are minimized by the reporting officers, and, because the timber embraced within the patrol areas of such organizations is usually the most valuable and accessible in the region, burned-over timber can usually be logged out promptly and before serious deterioration takes place, thus salving much of the loss. The private timber owner figures his investment and values in terms of merchantable stumpage only. As a result of these factors, the reported damage is usually light on association areas. Under the circumstances, the sum of actual protection costs, plus losses, seems seldom to exceed the assessments by more than a few cents per acre and the figures cannot be properly checked against those from forests which are permanent timber properties.

Figures as to costs and losses in the States where more or less protection work is done are as yet usually useless. Where the Fish-Fire-Game-Warden system prevails, the proper protection costs must be pro-rated out of the total costs. With a few notable exceptions, the State administrative officials are non-technical and untrained. Perhaps for this reason, the statistical records of the several States seldom even approximately follow the same form and frequently vary in form in consecutive years. The losses which are reported seldom assign a value to anything save merchantable timber, and, as in the case of the Private Associations, even this tends to be minimized. Lack of consecutive and competently prepared records makes most of the State fire records useless for the present purpose.

The published records of the Forest Service are the best available and are especially dependable since 1910. They leave much to be desired, however, in that expenses "for administration and protection" are lumped, and in that it is impossible to arrive at the net sums which are expended on the National Forests directly.

The total fire bill on any forest has two major items: 1. Expenditures in connection with fire prevention and control. These include a proportionate charge from the salaries of the permanent field force according as their time is chargeable to protection activities, the salaries of all fire patrolmen and fire-fighters and their assistants, such as packers, the cost of fire-fighting tools and equipment and of construction exclusively of value for protection purposes, such as lookout stations, and their equipment, lookout trails and telephone lines, etc. In addition a proportionate charge to protection should be made from the costs of constructing and maintaining the entire permanent improvement system of the forest, since every Ranger Station, trail road, bridge or telephone line may play an essential part in the protection system. 2. Aside from direct expenditures must be considered indirect costs. These would include the value of the losses occasioned by fire in the destruction of merchantable timber, the cost of forest replacement after fire, damage to improvements and range. Still other losses are apparent, as in the depreciation of site and the lowered sale value of stumpage where the investments of purchasers may be threatened or wiped out by fire, and the stumpages prices paid by them must compensate for the risks of operation. The sum of all these items of expenditure, loss and depreciation make up the total bill occasioned by the danger of fire—and there are other hazards besides fire to which the forest is exposed. Even the Forest Service does not, as yet, attempt to approximate more than a part of the direct costs and the more obvious losses occasioned by fire.

On about 160,000,000 acres of the National Forests, large areas are non-forested. Other great areas have more or less cover of unmerchantable timber. The Forester's Reports segregate "timbered" from "open" lands. For the nine years 1905-1913, an average annual loss of 3.94 acres per 1,000 acres on "timbered" and "open" lands is reported. Of this there is reported an average loss of 1.53 acres per 1,000 in the "timbered" and an average of 2.41 acres per 1,000 in the "open." Excluding the exceedingly unfortunate year 1910, the losses in "timbered" country averaged 0.47 acres per 1,000 and for the "open,"' 1.72 acres per 1,000, a total of 2.19 acres per 1,000 acres. Because of the great variation in weather and other conditions from year to year, over such a short period it is futile to attempt the comparison of records by years in trying to determine the relative progress in protective efficiency. This, however, is known to have been very great—doubtless many hundred per cent. The lowest reported losses were in 1906, with 0.7 acre per 1,000 acres. The greatest losses were in 1910, when 19.90 acres per 1,000 were burned.

If about 0.5 acre per 1,000 acres were burned each year, and if each burn should be in a new place, at the end of a rotation of 100 years some 50 acres per each 1,000 acres of forest will have been burned over, or 5 per cent. Irrespective of the value per acre, if the burned areas sample the forest, there is an annual charge of 5 per cent of the total forest income in losses alone. It is, of course, a prohibitive rate and in itself proves that present protection is inadequate. But the other charges must be added. The value of the timber losses per year, average $1,788,000. In 1910, they were $24,183,000. Exclusive of 1910, they averaged $150,000. Losses in non-merchantable young stands ("reproduction" in the Reports) averaged, for the four years, 1910-1913, $2,374,000 per year. In 1910, they were placed at $9,180,000. Exclusive of 1910, the average is $105,000. In addition, other losses for "forage" were reported. The average total losses reported for the 9 years are $2,857,000. In 1910, the total losses were $24,183,000. Exclusive of 1910, the average is $116,000.

The costs of fire-fighting are also reported by the Forester, but these do not include the salaries of the regular force or the expenses incurred by them in connection with fires. These amount to an average of $202,000 for the 7 reported years. Exclusive of 1910, the average is $162,000. In 1910, it was over $1,037,000.

The sum of the expenses and the losses caused by fire, as reported, total to an average per year, for 9 years, of $2,929,000. Exclusive of 1910, $178,000. In 1910, they totaled $25,220,000.

In order to approximate the actual total costs of the protective system it is necessary to include the value of the time of the regular forest officers and their expenses while engaged on fire work. There is no indication as to this total in the published reports. There should also be added a pro-rata charge against protection from the sums expended in permanent improvements such as roads, trails, telephone lines, lookout stations and equipment, fire-fighting equipment, etc. No data as to this item is available, but assuming that one fourth of the total appropriated "for administration and protection" reaches the Forests and is expended in protection, about 0.25 of a cent per acre was spent for protection in the fiscal year 1914, which was about average. In that year a total of about 0.2 cent per acre was spent for permanent improvements.

On the basis of these statistics it seems possible to conclude that Private Protective Associations are securing a fair degree of protection for their holdings at a total cost (operating cost plus losses) of less than 15 cents per acre per year, equivalent to a rate of about 2.5 per 1,000 on the sale value of the property subject to damage or destruction (assuming an average stand of 20M feet b. m. per acre and $2 stumpage). It would seem obvious that such a charge is but little more than nominal. It is less than the average rate for commercial insurance. It is also more than likely that much better protection than that secured can be secured for the same expense. Should it be necessary to expend as much as 25 cents per acre per year, in order to reduce the losses to a negligible amount, it would be difficult to show that the cost would be prohibitive or even unreasonable in proportion to the sale value per acre of forest. It could probably be demonstrated that this amount would be less than that paid by any other large business for protection plus an insurance policy which would indemnity for losses occurring in spite of the protective system. The fact that such a charge per acre would run into very large sums in the case of certain owners, would only go to prove that certain owners owned very large acreages of valuable timber lands. With the repeated proofs that fire can be prevented and fire losses reduced to indefinite limits, it seems likely that business acumen will shortly realize that, with standing timber, as in the case of factory owners, adequate protection from fire is far cheaper than the bill for poor protection plus losses, and that with good protection losses become negligible.

With the National Forests and to a large degree the State Forests, the situation is somewhat different, owing to the fact that the total acreage to be protected is very large in proportion to the acreage of highly valuable timber. In other words, the average value per acre of the forest is low as compared to the heavily timbered forests covered by the Private Associations. In the National Forests more than those of the States, the inherent difficulties of protection are vastly increased by the roughness of the country, its lack of development, the broken nature of many of the stands and the press of current administrative work not associated with protection. In spite of this, the protective work of the National Forests is the model to which all other attempts at fire protection tend to conform. Undoubtedly, the Forest Service gets more forest protection for its money than any other organization, in this country, or, indeed, in the world. But the Forest Service would be the last to admit that the quality of its protection was adequate, or nearly adequate.

The record shows 1.53 acres to each 1,000 acres of timbered land burned over each year for nine years. With a rotation of 100 years this is to assume that 153 acres in each 1,000 acres of timber will burn over during the rotation. Forestry is not a business which can stand a loss of 15 per cent on each turn-over of its stock. Assuming that there will be no more losses like those of 1910, even though similar seasons occur, and that the average losses can be held down to a rate of 0.47 acre per 1,000, the business of the National Forests cannot justify itself with a loss of 4.7 per cent during a rotation. Of course such a method of calculating is not strictly accurate, since it is not probable that all the areas burned over would be total loss or that each fire would run in a different tract, but the method is accurate enough to prove that the rate of loss must be greatly reduced. If European experience counts, as we are perhaps learning that it does, and if our forests are not to be expected to earn more than 3 or 4 per cent on their capital value, it is obvious that a loss of even 1 per cent on the income of the rotation is an exceedingly serious matter. One per cent on the rotation amounts to a yearly burn of 1 acre per 10,000, or 0.1 acre per 1,000 acres; which is about one ninth the loss on the National Forests in the very favorable year of 1912.

There was a reported loss of 19.90 acres per 1,000 in 1910. While the losses were extraordinary, the season can hardly be said to be without precedent, in view of the season of 1914. For every region and for the whole country, repetitions of such conditions are quite to be expected at intervals of, say, from 5 to 10 years. That means that very bad seasons are to be expected some 10 or 20 times during a rotation. Or it means that there must be a perfect record, with no losses for 20 years, if the damages are to be reduced to an average of even 1:1,000 acres per year. Such figuring is of use in attempting to form some notion as to the relative quality of the protection we are receiving and the extent of the effort and expense to which we must go.

The statistics quoted indicate that it may be possible with the present system on the National Forests, to hold the losses in average years, to about 0.5 acre per 1,000 acres, or 1 acre per 10,000. If the cost of this quality of protection can be determined, the desirability and the possibility of increasing the investment in protection may be made obvious.

Practically all of the permanent improvements constructed would be required for protection alone, were there no administrative needs for them. For correct book-keeping the cost should be pro-rated between the different lines of Forest work, but for present purposes they can all be charged against protection. This comes to 0.2 cent per acre.

For "administration and protection" a total of about 2.47 cents per acre is reported. It has been assumed that about a fourth of this reaches the Forests for protection work, or about 0.5 cent per acre.

With an average, annual loss through damage of $116,000, the average loss per acre is about .78 cents per acre.

With an average annual bill for fire-fighting of about $62,000 the average costs per acre are about 0.004 cents.

The totals for permanent improvements, protection force, losses and emergency fire-fighting costs, according to these calculations, reach less than 1.5 cents per acre. If the costs and losses of 1910 are included, the total averages about 2.6 cents per acre. This figure does not represent any fair index as to the total cost to the forest business caused by fire. That cost will be far greater. It should, however, indicate the disproportionately small amount which the Forest Service has been able to invest in actual protection work, and it proves the tremendous effectiveness of the organization.

It would be highly profitable to know what the ratio between cost and effectiveness in protection is. If the type and work of the protective forces remain the same, what would be the effect on losses of doubling the amount expended for protection? Would this lower the losses by 50 per cent? If such a ratio could be determined it might be possible to approximate the cost of an organization which would reduce fire damage to a satisfactorily nominal amount. It will be for a long time impossible to determine any such ratio from the statistics. Weather conditions, changes in effectiveness with the increase of experience in the fire force, etc., must be discounted, and the statistics must be uniform and running over long periods before such an attempt might be profitable.

But we are certain that doubling the miles of road or trail more than doubles the accessibility of a region. Two well located lookouts can cover more country than twice what can be covered by one lookout, and with much greater effectiveness. Ten men on a fire can put it under control more than twice as quickly as a five-man crew. The explanation may lie in the fact that fire tends to spread in several directions at once. The damage done (and the cost of control) is in ratio to the area burned over. Other things being equal, the area burned over is in proportion to the time elapsed between the start of the fire and the time it is attacked by an adequate crew of competent men. It may therefore be said that fire damage increases geometrically with the elapsed time between start and control. But the increase in cost of maintaining the protective organization would normally be an arithmetical increase. While this is all very theoretical, there seems reason to suppose that there is truth in it.

It seems likely that the ratio will be something as 2:5. That is, if with a cost of 2 cents per acre for protection proper, the average fire burns over 25 acres, by increasing the cost of protection to 4 cents, the acreage of the average burn may be reduced to 5 acres. Of course such reasoning cannot be carried to an extreme. The variable will not reach the limit, and it is to be expected that the law of diminishing returns will be encountered.

If the Forest Service is able to furnish the quality of its present protection at a cost of less than 1 cent, for five cents per acre it should be able to give a degree of protection under which the losses would be much less than one fifth of the present. For about 10 cents per acre per year, there seems reason to expect that a complete and proper system of improvements manned by fully equipped crews of experienced men could be put in and maintained so as to reduce losses to practically a nominal amount. If the capital value of the National Forests were so low as to average only $10 per acre, an investment in their protection of 10 cents per acre per year would represent 1 per cent. Where 1 per cent of the forest stock is far too great an annual loss to be tolerated, 1 per cent of the present capital value is practically insignificant because of the certain increase in stumpage values. If the value of stumpage only doubled once during the first rotation and stumpage bringing $1 per M feet b. m. now were only worth $2 in 100 years, the protection cost would still be justified. But an increase of a hundred per cent in average stumpage values may confidently be looked for during the next rotation, and the cost of protection against fire becomes then nominal. In any case, it is certain that the value of stumpage will not settle till the full cost of production has been reached. Production without protection is not possible and will not become possible. The costs of protection, therefore, are an integral part of the production costs and the value of stumpage must always be high enough to absorb them. That this is already being recognized in a vague way is shown in the higher sale value of tracts included within the protected area of the better Associations, as compared with similar tracts which are unprotected. It is, also, even more clearly shown by the greater discounts required by the better class of bonding companies in placing the bonds of timber corporations whose holdings are known to be subjecst to high fire dangers; this indicating that the security represented by such tracts is less than those having comparatively little fire danger, and that the investment values of such tracts are thereby lowered by the fire danger.

In connection with fire protection and its costs, it must be remembered that the forest is subject to many other preventable damages, the most important being trespass, fungi and insects. While the fire danger is the greatest and protection from fire is the most urgent item, a forest reasonably safe from fire is not necessarily at all safe. A charge against trespass protection is properly to be made from the funds expended for general administration. The necessary measures and the costs of protection against insects and fungi we know little about, as yet. That the costs of such operations may frequently exceed those for fire protection is not unlikely.

It is high time that American foresters stopped thinking of forest protection in terms of fire only, and high time that it was recognized that the present degree of fire protection is, even at best, wholly inadequate, and that the forest business can fully justify the costs of adequate protection, which will probably approximate 20 cents per acre per year, of which perhaps 10 cents will be chargeable to fire protection.

MAKING BOX BOARDS FROM SAWMILL WASTE

By P. L. Buttrick[1]

One of the most important subjects before the lumber trade is the disposal of "waste." In the days of low stumpage it did not greatly concern the lumbermen that they threw away about a third of the log in slabs, edgings and trimmings, which they burned to get rid of. As we look at it today, their operations lacked efficiency. Now that logs have become so much scarcer and stumpage so much more valuable, to say nothing of competition having become so much keener, they should take an interest in that mysterious thing called "efficiency." Efficiency means absence of waste. Yet it is impossible to cut round logs into rectangular boards without leaving a residue. This residue is called in sawmill parlance "waste."

It can, however, be used as a raw material for a number of wood products not strictly classified as lumber. The more important of these are: lath, shingles, staves, box boards, wood pulp, and various chemical products such as turpentine and tannic acid. Nevertheless, with the exception of lath, most of these products are still made directly from logs or cordwood cut for the purpose, and the waste is still largely destroyed. This has not been altogether the fault of the lumberman, since it often cost so much to manufacture from waste that it could not profitably be done. Today increases in value and consumption of these products and the rise in value of the raw material are beginning to make it financially possible for those manufactured from waste to compete with those from logs and cordwood.

Efficiency demands that this be done, and it is an economic gain to the public as well as to the lumbermen that it be done, since the closer we utilize our timber the less we are obliged to cut at a time, and so the longer it will last.

Since the manufacture of box boards from waste is not a very well known scheme of utilization, it is possible that the following account, based on an experience of some months at a factory, which utilizes waste exclusively, may be of interest to lumbermen, foresters and conservationists.

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The various products made from sawmill waste often demand quite different size, shape and quality of pieces, so that it is usually impossible, or at least unprofitable to utilize all waste from a given mill for a single product. Nevertheless, a box factory manufacturing a suitable grade of box boards should be able to utilize from 40 to 60 per cent of the normal waste from the average mill (provided, of course, that it cuts woods suitable for box boards), and to leave a sufficient unsuitable remainder to stock the lath mill.

There are few kinds of wood which cannot be made into box boards, although some, such as cottonwood and White pine, are exceptionally desirable. Among the more common hardwoods which can be used are cottonwood, Yellow poplar, Red gum, tupelo, basswood, buckeye, chestnut, butternut and others. Among the softwoods are White pine, spruce, balsam, Southern and Western Yellow pines, Western hemlock and certain of the cedars.

Box factories generally use fairly high grade lumber, and have not taken kindly to the idea of using sawmill waste. Hence such work as has been done along this line has been by the sawmills themselves, some of which have successfully established box factories of their own.

There are four classes of sawmill waste which can be used in the manufacture of box boards, or "shooks" as they are often called. First, trimmings and edgings from the main sawmill; second, culls from the planing mill; third, odds and ends which accumulate about the plant and yard; fourth, slabs.

Trade customs which make it necessary that practically all lumber be cut into lengths which are multiples of even feet, and the necessity for trimming boards to rid them of wane or other defects insure a constant supply of boards too short for ordinary uses. These make excellent material for boxes. Edging strips are not so valuable, as they are apt to be too narrow, but heavy ones can be used. Every planing mill turns out a certain amount of finished lumber which is imperfectly manufactured. Boards with skips in dressing, or with a tongue or a groove split off, or perhaps with a strip of wane left on are examples of such culls. Many such boards cannot be manufactured profitably, but are suitable for box shook stock. Every mill has its quota of dead stock, such as boards spoiled in seasoning, odds and ends of special orders, badly sap-stained pieces and the like. A box factory can work up a great deal of such material and thus save it from becoming a total loss. Slabs are a perennial problem at the sawmill. By installing a slab resaw and cutting them into short boards for the box factory the waste from this source can be greatly lessened.

The manufacture of box boards requires extra floor space and special machinery. The shop can best be arranged in connection with the planing mill rather than the sawmill itself. If the plant is large, the box factory can be made a separate unit of management. At smaller plants its management can be incorporated with that of the planing mill. The main machinery in a box factory consists of rip-saws, cut-off saws, planing machines and resaws. Nailing machines, splicers, matchers, equalizers and many other special machines are used for various kinds of work, but are not essential in a factory using mill waste. A twin-band resaw, however, might be useful if trimmings from timbers and dimension stock are abundant. The planers must be specially designed for the work and should be wide gauge short-bed machines capable of running large numbers of short irregular pieces at high speed. Any standard resaw such as intended for planing mill or box factory use should be satisfactory. There are numerous types of cut-off and rip-saws designed for box factory use. Hand-feed rip-saws are probably more satisfactory for box factories using waste than are power-feed machines.

A good arrangement and combination of machines would seem to be the following: 1 band resaw, in front of 3 planers, then 2 more resaws, all followed by 6 cut-off saws arranged in a line at right angles to the resaws and planers, and then 7 rip-saws in a line at right angles to the cut-offs. Special machinery is usually placed beyond the rip-saws. (It is generally well to provide storage room both for waste and for completed shooks.)

Such a factory should be able to turn out from 50,000 to 80,000 feet of shooks a day, and to utilize waste from a mill of from 200,000 to 300,000 feet capacity. For a mill of from 50,000 to 100,000 feet daily capacity, a resaw, a planer, 2 cut-off and 3 rip-saws should be ample. The resaw could, perhaps, be used jointly with the planing mill, since it would generally be less in use in the box factory alone than the planer. Smaller mills can sometimes resaw slabs and planing mill culls and sell them to box factories to be worked into shooks.

Provision must be made for the collection of waste from various parts of the plant and its delivery at the box factory. In the main sawmill, the easiest plan is to pick out suitable pieces from the waste as it passes along the main refuse conveyor on its way to the refuse burner. It may be dropped on to trucks or wagons, or—if there is enough of it—on to a conveyor arranged to carry it to its destination. If the plant also has a lath mill, the box factory should be given first choice in working over the refuse, since box boards are a higher grade product than lath. There need be no fear of there not being enough pieces left too narrow for box boards with which to supply the lath mill.

Box shooks must generally be made of seasoned lumber, else they will warp; consequently it is necessary either to send the waste to a dry kiln or to pile it in the yard to season for several weeks. The dry kiln is better, since the cost of the extra handling of such small pieces increases rapidly. The illustration shows how sawmill waste is stacked on kiln cars. The edging strips are used for moulding stock. Such a car is estimated to contain 6,000 board feet.

Planing mill culls can easily be loaded on trucks and moved directly to the box factory, since they are usually already seasoned. Planing mill trim, if enough exists to make it worth while, can go in on a special conveyor. Occasionally a wagon or a trash car can be sent over the yard and the dead stock and trash which accumulates be loaded into it and hauled to the factory. If a slab saw is installed in the main mill it is a simple matter to sort out all the short boards cut on it from the slabs and see that they reach the box shop.

Box boards used for tops, bottoms and sides are generally cut 5/16 or 3/8 inches thick. Ends and cleats are usually from 1/2 to 13/16 inches thick. It is generally possible to get 2 pieces for tops, bottoms, or sides from an inch board and 4 from a two-inch one. To obtain the required thicknesses, two-inch pieces are resawed, then planed and finally resawed again, since most shooks require dressing on one surface only. Inch boards are simply surfaced on two sides and then resawed, while pieces less than an inch in thickness are usually worked down entirely on the planers. Pieces of the required thickness for ends and cleats can sometimes be obtained directly from planing mill waste. For many uses it makes little difference if tongues or grooves remain on boards after they have been cut for box boards. This is more especially true in the case of rough crates where no attempt is made to remove them. After the boards have been reduced to the desired thickness they are cut to length on the cut-off saws and then ripped to width on the rip-saws, imperfections being cut out in both processes. The completed shooks are then bundled in convenient numbers and shipped to their destination, where the boxes are built up from the different pieces. They are seldom assembled at the factory, since their bulk makes shipment in the completed form too expensive. Shooks are seldom cut in advance of orders, since nearly every customer has his own requirements as to dimensions and specifications.

Expensive boxes calling for dovetailed corners, matched boards, sliding tops and the like have not so far been made commercially from sawmill waste. Until more experience and knowledge regarding the possibilities of this form of waste utilization has accumulated it is not likely that they will be. Small and medium sized packing boxes and crates do not require such expert knowledge or special machinery for their manufacture, and it is with them that box factories utilizing waste will specialize.

In manufacturing shooks from waste, great difficulty is experienced in securing enough wide stock. Narrow stock accumulates in abundance. Consequently, orders requiring wide boards such as one-piece sides, tops and bottoms for large and medium sized boxes are avoided. Nor are large boxes of any description considered desirable, since it is (or should be) difficult to obtain large pieces from waste. There is a large and steady demand for medium sized boxes for canned goods, tinned fish and meats, salt and frozen fish, soap, dried fruit, preserves, bottled liquors, cheap glassware, crockery and hundreds of other articles. Such boxes need not be made with special care or of very high grade material. They can easily and satisfactorily be made from sawmill waste.

Crates, which are made of narrow slats, are, however, the most desirable product for a box factory using waste. Oftentimes the slats can be made from waste pieces at the same width they were originally cut, or if not, at such widths that there is little loss in ripping them. Sometimes the ends of these crates can be assembled on nailing machines in the factory before shipment.

Such crates are used as containers for a variety of articles such as oil cans, syrup cans, empty bottles, pasteboard boxes, smoked meats, fruits, and light machinery.

There are in addition to shooks a number of other products which can easily be made from sawmill waste at a box factory. Stock for chair rungs, table legs and other wood turnery articles of a like nature, and for novelty uses of various kinds can be made of pieces too small or narrow for box boards. By installing a band or circular rip-saw, moulding strips may be sawed out of thick clear edging strips. Lumbermen seem to be agreed that there is no profit in making mouldings from stock boards. The use of edgings should yield a return.

The making of box shooks from sawmill waste is such a new enterprise that few men, either in box factories or sawmills, fully understand it. A box factory superintendent who has never used anything but standard lumber is apt to be out of sympathy with the idea of using waste. For this reason it may be better to place a man from the sawmill in charge, who is without previous prejudices, since in either case a man must be broken into the work. The same is true to a certain extent of rip-sawyers and other skilled workers.

The success of a box factory using waste depends to a large extent upon the run of orders. Orders for shooks of dimensions which cannot readily be obtained from waste may greatly increase the cost of manufacture, or make it necessary to use standard lumber to fill them. Except at very large plants, a box factory will not be of sufficient capacity to keep a special box salesman busy disposing of its output. Since lumber salesmen seldom have much knowledge of boxes or of the patterns which can be made from waste it is desirable that the superintendent have the power to refuse or cancel orders which it is not for the interest of the factory to accept. Mills with waste enough to manufacture only a small quantity of shooks might be able to make arrangements through regular box companies.

There is always the danger that the box factory will come to be regarded too much in the light of a catch-all, and material will be sent to it that could be more profitably utilized in other ways. There is no economy in sending mis-manufactured boards to the box factory if they can be remanufactured or trimmed without a loss of more than a third of their footage. Yet it is generally easier for the planing mill to send such material to the box factory than to deal with it themselves. Likewise, it is easier for the box factory to use such material than to use waste, hence it is not likely to protest. In the sawmill itself, the knowledge that heavy slabs and edgings and long trimmings will all be used in the box factory may encourage carelessness on the part of sawyers and others unless a sharp watch is kept. At the average mill which has no other way of utilizing waste, enough of it must necessarily accumulate to stock the box factory without permitting lax cutting to obtain it.

It should not cost more than from $10 to $12 per thousand feet of shooks to manufacture them from sawmill waste. The average selling price of a grade made from Southern Yellow pine is about $15. However, it will generally prove that shooks cannot be as cheaply manufactured from waste as from standard lumber—or at as great a profit. This need not dismay the lumberman who is cutting woods suitable for box manufacture, for ordinarily his waste is of no value and it is an expense to him to dispose of it, so if, by a small investment in labor and machinery, he can turn it to even a small profit, it is that much added to his income. As before remarked, the use of waste in this way is an advantage to the public, since the close utilization of our timber resources is the practice of conservation, and therefore an economic gain to all.

TEACHING DENDROLOGY IN THE HAWAIIAN ISLANDS

By Vaughan MacCaughey[1]

The study of trees and their timbers has won a place of recognized technical standing, not only in the curriculum of foresters, but also in the training of the engineer. In every realm of structural engineering there has been felt increasingly the necessity for accurate knowledge of timber sources and timber products. The rapid shrinkage of the world's great lumber supplies is enforcing rigid economy in the use of wood for structural purposes, and this economy is reflected in a growing knowledge of the specific properties and uses of wood. In the engineering courses offered by the College of Hawaii, a one-semester, three-credit course in dendrology is required for graduation.

The unique and interesting flora of the Hawaiian Archipelago; the peculiar geographic and biologic isolation of this island world; the diversified forests, varying widely in composition, rainfall, altitude, and economic uses; the entire dependence of the local lumber markets upon supplies from California and Puget Sound—these and other conditions give a distinctly local atmosphere to the teaching of dendrology in Hawaii. Many of the students have never been away from their island home, and to them the names of maple, elm, ash, hickory, pine, and oak are almost as lacking in concrete associations as the names *kukui, lehua, koa, kiawe, lama,* would be to the average mainlander.

The course in dendrology is organized around four phases or aspects of the subject, as follows: First, the structure and life history of the tree as an individual; the physiological processes of the tree; modes of reproduction; ecologic adaptations. Second, the formation and development of the forest as a whole; the forest floor, canopy, wood-volume; the life of the forest; conservation. Third, the forests and important forest trees of the Hawaiian Islands; of the mainland United States; and great forest areas in other parts of the world. Fourth, detailed studies of the histologic structure of representative woods; and the

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identification of woods by means of sections for the microscope.

The topical outline of the course by weeks is as follows:

1. The life of the tree as an individual organism
2. Structure and organs of the tree
3. Classification of trees
4. Methods for identification of trees
5. Life of the forest as a whole
6. The lumber industry
7. The forests of Oahu
8. Forests of the other Hawaiian Islands
9. Forests of the mainland United States
10. Important forests in other parts of the world
11. The minute structure of wood
12. Properties of wood
13. Methods for identification of woods
14. The "Hardwoods"
15. The Conifers
16. Other important commercial woods
17. Hawaiian woods of economic value
18. Thesis, review, and final examination

The work of each week consists of one lecture, one laboratory or field period, one reading assignment—all with accompanying note-book records.

The field work is an essential and distinctive feature of the course. The College of Hawaii is remarkably situated with reference to dendrological field studies. The island of Oahu, upon which is the city of Honolulu, is a volcanic doublet, 25 by 35 miles, skirted in part by a wide coral plain and reef. The Waianae Range, which forms the western portion of the doublet, is of much greater age than the recent windward Koolau Range. The Waianaes include a striking series of biological zones, from extensive arid plains and valleys, up to a boggy summit of 4,000 feet elevation. The Koolau Range is deeply carved into a picturesque succession of beautiful valleys, gorges, knife-edged ridges, and peaks, all covered with dense rain-forest. These two ranges compose the main mass of the island—originally two islands—and between them lies an elevated central plateau, deeply dissected by tortuous gorges. The coastal plains are diversified as to geologic formations and plant societies, and certain districts are studded with conspicuous secondary volcanoes of tufa and ashes, long extinct.

From the standpoint of dendrological studies all these varied regions are quite accessible; many of them are within half a day's walk, and the most remote can be reached within a single day. In addition to the automobile roads, plantation roadways, wagon trails, and foot trails, there are two railway lines, a number of stage lines, and a comprehensive motor-car service. There are also available a number of excellent topographic maps, including trail maps. Food supplies and potable water are obtainable throughout the island. It is therefore a relatively simple matter to make a dendrological or other scientific expedition to any given region, to transport needed apparatus and equipment, and to continue the studies and collecting for as long a period as is essential.

There is doubtless no other region in all the world—insular or otherwise—similarly blessed with all the conveniences of modern civilized society, where so many diverse types of tropical environment are so easily available within small compass. Within a radius of half a dozen miles of the College campus, for example, there occur the following well-defined ecological districts:

Manoa Valley: one of the largest of the Oahu valleys, with a spacious, well-forested amphitheater of erosion; broad, wet-crop floor; and precipitous ridged walls.

Waikiki Flats: extensive coastal plain area, artificially flooded, and planted with various wet-land crops; rice, taro, lotus, banana, etc.

Ka-imu-ki District: elevated, arid, with secondary craters, basaltic lava flows, and volcanic debris.

Waialae: arid coastal region, penetrating adjacent valleys.

Extinct Craters: Diamond Head, Punchbowl, Round-top, Sugarloaf, Tantalus, Ka-au, etc.

Koolau Range: average elevation 2200 feet, summit 3,000 feet; dense mantle of indigenous montane rain-forest.

Introduced Plantings: Prosopis, Eucalyptus, Acacia, Pithecolobium, Casuarina, Bambusa, etc.

Valleys and Streamways: Moanalua, Kahauiki, Kalihi, Nuuanu, Pauoa, Makiki, Manoa, Palolo, Waialae, etc.

Foothills and Lower Ridges: eroded remnants of original volcanic dome; chiefly xerophytic.

Littoral Zone: including coral, lava, and tufa beaches.

The coral reefs and other marine formations are not listed here. This list is not intended to be complete, but it will serve to indicate the unique variety of life conditions and plant habitats that occur within easy reach of the College.

Another distinctive feature of the Honolulu region is that it is freely accessible for field work every day in the year, due to the equable climatic conditions of Hawaii. The absence of winter, the total absence of frost and snow, the great rarity of storms, and the balmy quality of the showers, make it possible to conduct field studies on any day of the year. There is no inclement weather. There is no dormant or leafless season; plant life flourishes throughout the year, and field observations and collecting suffer no change because of abrupt seasonal changes.

The natural background of the College thus affords a delightful outdoor laboratory for dendrological work. The following list of some of the commoner native trees that compose the forests in the vicinity of Honolulu will show the floristic peculiarities of this background:

Aleurites moluccana, kukui, candle-nut tree
Acacia koa, koa, Hawaiian mahogany
Metrosideros polymorpha, lehua
Pittosporum glabrum, hoawa
Pisonia umbellifera, papala kepau
Charpentiera obovata, papala
Dracaena aurea, halapepe
Cibotium chamissoi, hapur, tree fern
Santalum ellipticum, iliani, Sandalwood
Jambosa malaccensis, chin ai
Ilex sandwicensis, kawau
Cheirodendron gaudichaudii, olapa
Bobea elatior, ahakea

The laboratory periods are chiefly devoted to identification; all work with wood specimens and sections. Much use is made of the excellent slides and mounts prepared by Hough; these are of special value to us, as our students have not even a superficial knowledge of the trees that furnish the timber supply of North America. For reference purposes, much use is made of the large photomicrographs by Weale, of London, of which the College has a complete series. The purpose of the laboratory exercises is to familiarize the students with the important types of woods; the histologic characters used in timber identification; and the details of wood structure upon which its economic properties depend.

FOREST PROVISIONS OF NEW YORK STATE CONSTITUTION

By C. R. Pettis[1]

The constitutional convention of the State of New York, which was held in 1893, adopted a provision (Article 7, Section 7) which read as follows:

"The lands of the State, now owned or hereafter acquired, constituting the forest preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed."

The reason for the act of this Assembly cannot be understood without a few words in regard to the land policy of the State of New York. The policy of the province and state had been to dispose of its lands. As early as 1708 the entire Catskill area was patented by Queen Anne, while large areas in the Adirondacks were first sold by the English colonial government, although some of them were later forfeited to the state under the "Acts of the Attainder."

The early state government found itself in possession of extended tracts of land in the Adirondacks. Some of these were set aside as bounties for soldiers; small areas were reserved for the encouragement of gospel, school and literary purposes; while vast areas were sold. The money received was but a pittance. In some cases the consideration was a few cents per acre. The conveyances were usually by townships of approximately 26 to 30 thousand acres, or even larger areas. Many names that appear in the history of this state were patentees. Sir William Johnson and Alexander Ellis, the latter, president of the Hudson Bay Co., were large grantees. There seemed to be a desire to create large estates in this wilderness and no less a person than Joseph Bonaparte was one of the principals. An immense amount of money was spent in attempts at colonization and development. The dreams of Arthur Noble, John Brown of Providence, Macomb and many others of a developed estate in the wilderness failed. The first quarter of a century after the grants were made by the state government, there were substan-

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tially no taxes upon these properties. About 1820 the owners commenced to feel the continued expense of taxation, without deriving revenue from their lands, and their interest in the properties decreased. This became so general that the State found it necessary to enact laws which would require the payment of the taxes, and in case the taxes were not paid a statutory machinery was established providing for the sale of the land for the unpaid taxes. During the same period acts were passed for the improvement of streams for driving purposes, and miscellaneous lumbering commenced.

The following years lumbering increased and in many instances the finest of the pine was cut and the owners permitted the land to revert for taxes. In case no one was found who would pay the taxes assessed against the land and take the property, the State had to pay the taxes and, of course, took the land. The purpose of the State at that time was to secure, through taxes, money for the support of the government. The Comptroller, the State's fiscal officer, was charged with the duty of collection and had charge of sales. He would hold the land for a period of years and if a purchaser appeared would, therefore, sell the land for the amount which the State had against the property. His function was to secure cash revenue. These purchasers usually acquired the land simply for the purpose of taking off another cut of timber and would then permit the land to again revert for unpaid taxes, the State would again become the owner, and in many instances this process was repeated several times.

In the late 70's a Commission was appointed to make an investigation and report upon the desirability of establishing a park in the Adirondacks, and about this time there was some agitation and recommendations by the Governors in regard to this property.

It was not, however, until 1883 when Chapter 13 was enacted prohibiting the further sale of any lands in what is now the major portion of the forest preserve counties, that this practice was prevented. With the enactment of this law the State found itself in possession of approximately 800,000 acres of land indicated upon the books of the Comptroller by land grants, patents, townships and lot numbers without any definite knowledge as to their location, value, etc. In the following year a small appropriation was made and a committee was appointed to make an examination and report. The result of their efforts was a fixed policy, viz., that the State should hold this land, and that there should be a competent body to administer the same. In 1884 a Forest Commission was established.

The timber speculators, having been stopped by this law which prohibited the further sale of land, then through divers means would make application to the Comptroller for cancellation of the State's tax deed or apply for redemption, and a few hundred thousand acres of the State's lands were lost in this way. These applications were usually based upon very flimsy technicalities. One of the most common ones was that the assessment roll of a town upon which the tax levy was based was verified on some other day in August than the third Tuesday prescribed by the statute.

The next step to defeat the retention of the lands was questioning the validity of the tax titles. In order to reduce this trouble certain laws to "cure" technical defects in the tax sales were enacted. The enactment of these laws required much effort, several years' time and then finally their constitutionality was questioned. It was only after the determination of numerous points in these cases by the state courts and when their constitutionality was finally determined by the United States Supreme Court that the State's title to large areas was finally decided. There are today numerous lesser questions of different phases of the subject, which have not been decided upon by the court and are being raised.

The newly created Forest Commission found themselves surrounded by numerous difficulties. The law transferred to their jurisdiction approximately 800,000 acres of land scattered over portions of sixteen forest counties. They had but five or six men who knew substantially nothing as to the location of the lines. There were very few maps and field notes which could be found of record. The force had the greatest difficulty in building up records of surveys, descriptions of property, chains of title, field work in locating lines, and then after property was located, they had to procure the necessary evidence to convict parties of trespass. Inasmuch as trespasses were very common it was difficult to secure necessary proof because there were so many parties implicated. No one was willing to give any substantial evidence, because in many instances, the witness himself would be guilty in this or some other case. The green timber was called "Adirondack Corn."

The result was that in the succeeding ten years they had an impossible task with the assistance granted. Trespasses were not stopped, but were, on account of the work of the Forest Commission, becoming better known; the "curative acts" were being passed upon by the courts and the excitement was tense. Simultaneously the Constitutional Convention convened. It adopted Article 7, Section 7 of the State Constitution, above quoted, as a protective measure. It was a new section. About this same time the State embarked upon the policy of purchase of land for an Adirondack Park, and for the period during 1890 to 1900, two and one-half million dollars was expended for this purpose. The first appropriation in 1890 was for $25,000 and provided that the price to be paid should not exceed $1.50 per acre. Under this appropriation they were able to buy lands upon which the spruce had been cut to approximately 10 inches in diameter, and these lands today are among the most valuable acquisitions, which the State has made.

The succeeding ten years saw the consolidation of the forest department with the fish and game interest and also the creation of a separate board for the purchase of land. During this period, there were many political changes in the complexion of the Commission, and some of the most prominent politicians of the state were from time to time appointed commissioners. About 1904, a new plan was adopted whereby the State's title to land was questioned, and pursuant to powers conferred by a special statute the commissioner was authorized to compromise any question of title. Numerous compromises were made, stipulations entered into and judgments entered by which the State lost large areas of valuable property and in exchange received other less valuable lands, or the compromise was affected upon the ground that the contestants would agree that the State was the owner but they reserved to themselves the softwood timber 10 inches or over with the right to remove the same within ten years. These compromises are now being set aside and the questions of title judicially determined.

During this same period purchases of land were made. In some cases there were occupants upon the property and no reservation was made to protect them. In other instances, the

State's title was in dispute; in some cases, parties were attempting to destroy the State's title and the people either went upon the land in dispute or in some cases, it is alleged they went there at the request of parties who were attempting to destroy the State's title for the purpose of protecting the property for them, and these people or their successors have made improvements and for years lived thereon. In some cases, farms have been acquired and people have remained thereon or new tenants moved in. Large numbers of small hunting camps have been built; cheap shacks have been built upon lake shores as summer homes; farmers living adjacent to State land have moved their fences back to increase their pastured area and about 780 occupancies of various kinds and of long and short duration have grown up on state land.

There has been agitation in the press and in the public mind for several years as to the desirability of leasing camp sites and, therefore, the matter of occupancies have been permitted to remain pending a decision of the question by the constitutional convention.

During the twenty years that have elapsed since 1894, the Forest Preserve has increased in size from 720,744 acres to more than 1,800,000 acres. In a similar manner, the proportion of timber under State ownership increased. It is estimated that in 1895 approximately 10 per cent of the timber in the forest preserve section was owned by the State, while it is estimated that over 30 per cent of the total stumpage in the same area is today owned by the State. The population of this section has increased. The timber on private lands has decreased, and today we find localities that are in great need of wood for fuel, the price in many instances being as high as $3.00 per cord for 16 inch wood. Within these localities are thousands of cords of wood lying upon state land going to decay each year, while the citizens of the State are required to pay excessive prices for wood or coal.

An examination shows that there are approximately one thousand miles of water frontage in the Forest Preserve exclusive of the Lake George Islands, and that 584 miles of this frontage is suitable for camp sites. An inventory made by the forest rangers shows that there are approximately 8,066,000,000 feet of lumber of all sizes and pulp in the Forest Preserve, although this is believed to be a very low estimate.

A Constitutional Convention convened at Albany during the past summer and appointed a conservation committee which held hearings and made a report to the Convention. There seemed to be a general antipathy to any modification of the constitution, which would permit the lumbering of State land. The criticism was so severe in some instances, that professional foresters were accused of being subservient to the lumbermen; the forest schools looking for employment for their students; and forestry itself nothing but destructive lumbering.

The matter of occupancies was considered and the committee, finally recommended, by nearly a unanimous vote that camp sites be leased to persons who were occupying land subsequent to December, 1909, but after a vigorous discussion on the floor of the Convention, it was defeated by a vote of 66 to 60.

In the opinion of the writer there can be no doubt but that it was a decided mistake to veto leasing of camp sites. There are sites enough for both rich and poor. The private lands are held at a speculative price and only the wealthy can afford to purchase. There is no doubt but that a lessee is a protector of the property and the game, while the transient has only a passing interest. The Empire State is not so wealthy that she needs to refuse an honest and substantial source of income. Leasing of camp sites would have solved the most difficult administrative problem, would have been an excellent means of protecting this property worth many millions of dollars, and would produce a large revenue.

The proposed new conservation amendment adopted by the Convention and submitted by referendum to the people is as follows:

ARTICLE VII

Section 1. *The department of conservation shall consist of nine commissioners to serve without compensation and to be appointed by the governor by and with the advice and consent of the senate for terms which shall expire in nine successive years, the first ending on the first day of January, one thousand nine hundred and seventeen, and their successors shall be appointed for terms of nine years. Vacancies shall be filled for the unexpired term. One commissioner shall reside in each judicial district. No person shall be eligible to or shall continue to hold the office of commissioner, who is engaged in the business of lumbering in any forest preserve county or who is engaged in any* *business in the prosecution of which hydraulic power is used or in which water is distributed or sold under any public franchise or who is an officer or holder of the stock or bonds of any corporation engaged in such business within the state. They shall be subject to removal by the governor on charges, after an opportunity to be heard. Subject to the limitations in this constitution contained, the department shall be charged with the development and protection of the natural resources of the state; the encouragement of forestry and the suppression of forest fires throughout the state; the exclusive care, maintenance and administration of the forest preserve; the conservation, prevention of pollution, and regulation of the waters of the state; the protection and propagation of its fish, birds, game, shellfish and crustacea, except migratory fish of the sea within the limits of the marine district, with the power, subject to the veto within thirty days of the governor, to enact regulations with respect to the taking, possession, sale and transportation thereof, which shall have the force of law, when filed in the office of the department of state and published as the legislature may provide, until and unless the legislature shall thereafter modify such regulations. The department shall also be entrusted with the enforcement of the general laws of the state respecting the subjects hereinbefore enumerated and exercise such additional powers as from time to time may be conferred by law. The department shall appoint and may at pleasure remove a superintendent. It may also appoint all other necessary subordinates.*

Section 2. [Old matter is first two sentences of former section seven of former article seven.] The lands of the state, now owned or hereafter acquired, constituting the forest preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the *trees and* timber thereon be sold, removed or destroyed. *The department is, however, empowered to reforest lands in the forest preserve, to construct fire trails thereon, and to remove dead trees and dead timber therefrom for purposes of reforestation and fire protection solely, but shall not sell the same. Nothing herein contained shall prevent the state from constructing a state highway from Saranac Lake in Franklin county to Long Lake in Hamilton county and thence to Old Forge in Herkimer county by way of Blue Mountain Lake and Raquette Lake.*

Section 3. [Part of former section seven of former article seven, without change but t.] The legislature may by general laws provide for the use of not exceeding three per centum of such lands for the construction and maintenance of reservoirs for municipal water supply, for the canals of the state and to regulate the flow of streams. Such reservoirs shall be constructed, owned and controlled by the state, but such work shall not be undertaken until after the boundaries and high flow lines thereof shall have been accurately surveyed and fixed, and after public notice, hearing and determination that such lands are required for such public use. The expense of any such improvements shall be apportioned on the public and private property and municipalities benefited to the extent of the benefits received. Any such reservoir shall always be operated by the state and the legislature shall provide for a charge upon the property and municipalities benefited for a reasonable return to the state upon the value of the rights and property of the state used and the services of the state rendered, which shall be fixed for terms of not exceeding ten years, and be readjustable at the end of any term. Unsanitary conditions shall not be created or continued by any such public works.

Section 4. The legislature may authorize the use by the city of New York for its municipal water supply of lands now belonging to the state located in the towns of Hurley and Shandaken in the county of Ulster and in the town of Lexington in the county of Greene, for just compensation.

Section 5. The legislature shall annually make provision for the purchase of real property within the Adirondack and Catskill parks as defined by law, the reforestation of lands and the making of boundary and valuation surveys.

Section 6. [Last sentence of former section seven of former article seven.] A violation of any of the provisions of this [section] *article* may be restrained at the suit of the people or, with the consent of the supreme court in appellate division, on notice to the attorney-general at the suit of any citizen.

NOTE:—*Matter in italics* is new; matter in brackets [ ] is to be omitted.

The Constitutional Convention itself through the work of the committee on state officers recommended a consolidation of approximately 150 state offices, bureaus, etc., into seventeen departments. Conservation was to be a department by itself and to have jurisdiction over forest, fish, game, water power, potable waters and regulation of stream flow.

It was argued that an attempt should be made to take the affairs of the Commission out of politics and that this could be done by the formation of a Commission modeled on the lines of the Board of Regents of this State, which has jurisdiction over educational interest; that by the appointment by the Governor and confirmation of the Senate of nine commissioners, one from each judicial district of the State; a non-partisan board would be created which should be a buffer between the legislature, politics and a non-partisan administration.

Section 2 prohibits any cutting of timber or trees, except that the Commission may cut trees for fire trails and remove dead and down timber for the purpose of reforestation and fire protection solely, but prohibits the sale of such timber. The opinions of the Attorney General of the State have indicated that the Commission already has the authority, under the police powers of the State, to go ahead and cut fire trails or trees in order to protect the forests from fire. Therefore, this provision does not give any added power. It is difficult to understand the reason for prohibiting the selling of dead trees and timber cut for reforesting and fire protective purposes. It was argued by some members of the Committee that if the material was sold it would be an inducement to set fire in order to permit the cutting of wood, but in my judgment, this is not a preventative or an inducement, because it has been found in trespasses and otherwise that wherever the parties pay as much or more than the material is worth that there is no incentive to trespass. The fact that such material cannot be sold would mean either that it would have to be burned or given away. If given away, there would be a greater incentive to fire, and if burned in communities where people were in great need of fuel, it would create such an unpleasant feeling towards the Commission that more fires would likely result.

This provision also permitted the construction of the State Highway from Saranac Lake to Long Lake. The reason for this is that the Attorney-General of this State has held that neither the State itself nor a municipality can take a part of the Forest Preserve for its own use for the construction of a necessary road, the idea being that the prohibition provided in the present constitution is so strict that the land cannot be taken for a road.

The Adirondacks are a great playground for our people. With the advent of the automobile, improved roads have been built and in some places it is necessary to change their location. The Attorney-General has ruled that such roads cannot be built outside of the existing highway bounds. The region is now accessible except from the southwest and it was the purpose of this clause to permit the building of such a road for the necessary distance across the Forest Preserve.

Section 3 is the same as now included in the present constitution and is an amendment which was adopted by referendum November 4, 1913, and permits the taking of three per centum of the Forest Preserve for regulation of stream flow and municipal water supply.

Section 4—The City of New York has expended approximately $190,000,000 in the Catskill region for the construction of a reservoir and conduits therefrom for a water supply to New York City. There are two small parcels of land, to which the State acquired title on account of unpaid taxes within the flow line of this reservoir, and therefore, the City of New York in the maintenance of this reservoir is violating the constitution of the State. It was the purpose to permit the use of this land by the city. There might be added other cases where no damage would be done in taking a small amount of water from state land for the use of small communities.

Section 5 was to make a mandatory provision as to appropriation by the legislature for the purchase of land, for reforestation, boundary work and valuation surveys. The first idea was to incorporate and provide for a definite appropriation each year. This section does not require any definite amount, and probably the legislature could comply with the provisions of the constitution by making an adequate appropriation.

There is no question but that there has been politics in forestry affairs in New York State; but the next question is would the proposed plan remove it and would it result in efficiency.

Forestry in New York is much different from the educational administration. The former is both making policy and carrying it out, while the latter is chiefly administrative. There are questions which must be passed upon every day and orders issued. A single commissioner is now given authority and he is held responsible. How many unpaid members are going to be as diligent? It was sarcasm to raise the question at this time when there is in office a Commissioner, who never was in politics, is not interested in politics, is giving service at a sacrifice and is administering the affairs of the Department without politics and in opposition to past methods. There is probably no department in any state or national service with less politics than the present Conservation Commission, which it was proposed to "take out of politics."

The campaign for the adoption of the constitution was carried on most energetically. The Convention submitted a budget system, "shorter" ballot, reorganization of state department, conservation and many other propositions in one question. The principal opposition to conservation was on adoption of the nine-headed commission.

The election returns were a verdict of 540,000 majority against the adoption of the proposed constitution, which meant two out of every three voters in opposition. What caused this terrific slaughter is hard to say, but if the propositions had been submitted separately some of them would have been adopted.

The only conclusion which can be drawn is that the people of New York are not in favor of opening their Forest Preserve to lumbering.

THE PROFESSIONAL AND ECONOMIC SITUATION OF THE TECHNICAL FORESTER AS SEEN BY THE FORESTER IN SWITZERLAND

Translated from La Forestière, 1914

By R. H. Campbell[1]

A Swiss forester devotes his activity exclusively to the service of the state, or to the communes, that is, to public administration. Private forests are of entirely local importance and so small that there is not a single proprietor who can by himself use a manager. Further, Swiss foresters are limited almost exclusively to employment in their own country. There are scarcely twenty men who during the last thirty years have found permanent occupation in foreign countries. It is a completely erroneous idea, although widespread, to believe that our young foresters can find advantageous positions outside of the country.

It is necessary to remember that in order to be eligible for any forestry post whatever in the country every technical forester has to undergo a state examination at the end of long professional study.

The engineer, the architect and the chemist do not have to undergo a similar obligation, and it can be said that the whole world is open to them for the exercise of their profession, but let it be well understood there is nothing of deprivation for the Swiss forester in the fact that he is called to work exclusively in his native land. But it seems that in all equity the public and the state ought to recognize him as in a position corresponding to his scientific culture, to his activity, which should be equal to that of the representatives of the three professions above cited. For it is altogether too simple to seek to settle the question by repeating to the forester in every tone: "A beautiful profession, yours, and how healthy it ought to be, always running about in the woods!" Healthy assuredly, but above all for those who are strong. On this subject one often hears singular theories. Some parents imagine that if their son, who is of a weak constitution, could become a forester, his health would become bet-

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ter. This is nearly always a grave error. The physical effort which the forester has to make hardens a healthy body and makes it still more vigorous, but that effort is generally beyond the strength of a man of feeble constitution who cannot keep it up for a long time.

It is a beautiful profession, that of the forester, without doubt. Those who love the stands of timber and interest hemselves in them, who feel the poetic charm of the life in the woods and know how to accommodate themselves to the simplicity which it requires, would not now change it for any other. A fountain of youth for those who have to manage the forest and live there. The forest is to such a one the source of emotions always fresh, the dispenser of energy of which the forester often has need in order to struggle against the difficulties which he meets as an official. That is a happy thing, for—it is necessary to say it—there is no other profession or group of officials among us, which has had to struggle against so many prejudices and suffer from so many adversaries. This is particularly true in the mountain regions. The population there, habituated at all times to the use and abuse of the woods freely, have considered the interference of the federal administration in their forest domain as a restriction of their rights. If the force of the ill humor of the mountaineers has made itself felt against the forest officials charged with the application of the new law that is nothing but human. Alas, there was a time when it was the proper thing—not only in the newspapers but even in the halls of the Grand Council—to talk against "the green bailiffs," and we pass over in silence the numerous personal insults, the intentional depredations on forest plantations and on other important works.

It is possible to say now that the first discontent has been to some extent appeased and that the people judge the situation in a more equitable fashion. They can now take note of the utility of the action of the forest service, of the zeal and of the disinterestedness of which it has made proof. We must recognize also that here and there some foresters have shown excess of zeal, and in their desire to move quickly have not given sufficient consideration to old customs and established habits.

To these strugglers of the early days for a cause of public usefulness we bring the expression of our gratitude. There is probably not a single other domain where it has been necessary and where it is still necessary, as in that of the forest, to fight against prejudice and stupidity. Everyone thinks himself fit to judge and to criticize the forester's work. It is admitted without contradiction that to construct a railway, for example, it is necessary to have recourse to an engineer; that a chemist is indispensable in directing the manufacture of chemical products. It would be equitable also to submit to the forester's care the management of the forests of which they have charge, since this is their business. It can be conceived that a friend of nature, if he is also a good observer, can acquire an almost complete acquaintance with the general treatment of the forest, but in a given case he will not know how to apply this knowledge in operations which the circumstances require. For that, it is necessary to know how to take account of many factors often difficult to determine, which the specialist alone is able to do.

It is not a very long time ago that many of the mountaineers refused to admit that a forest could be created by means of plantations, and nevertheless these are people to whom the forests are very familiar. Others go on stating with assurance that to become a fine tree the spruce should be eaten by the rabbits each years during twenty, thirty and forty years and even more. Moreover, in the Neuchatel district of the Jura for example, the opinion has prevailed for a long time that the black woods (coniferous trees) and the white woods (broad-leaved trees) would not be able to succeed in mixture; because these trees are enemies excluding one another. In the En Haut country there exists a similar prejudice according to which the beech (one of our most valuable species and that which has the most marked fertilizing power) is to be considered an objectionable intruder in a stand of coniferous trees. Again, it is well known that clear cutting in the mountain forests has destroyed the woods of various mountain regions. In spite of this, in spite of the teachings of the past, this method of clear cutting which has the sole merit of being the most simple, would certainly be the oftenest applied if the forester were not there to oppose it, so difficult is it to uproot old habits, old customs, even the worst; and too often when it is a question of the public forests individual selfishness prevails over the interest of the community.

It must be recognized, however, that during the last decades public opinion has made great progress in this respect. Public opinion no longer permits persons to enrich themselves unduly at the expense of the public forest, and it comes now powerfully to the aid of the forest administration in its struggle against this ancient abuse.

Let us examine now in what the activity of the forester in the forest consists, outside of administrative and police duties. It is necessary to set forth in relief the characteristics of the work of the forester, if it is to be compared with that of other technical men.

The engineer, the architect, the chemist and the surveyor work under conditions which permit of the fruits of their activity being judged immediately and without difficulty. It is not the same with the forester. The great public does not notice, so to speak, anything of his activity in the forest. It sees plants standing of all sizes. It notes with pleasure the construction of new roads. Its attention will be drawn to the logs and the fagots made upon a tract by a felling. It is a special joy to admire the good order of a well-managed nursery. These obvious exhibits of the forester's activity interest the public most. As to the *essential* work of the foresters, there is generally little idea. It is also difficult to make the public in general understand in what it specially consists. This comprehension pre-supposes a knowledge of the natural, biological development of the forest through all the phases from its birth to its exploitation. Only a trained eye can seize the perceptible differences, slow to show, in the development which extends through three generations and more.

Suppose a forest in which there has been made in winter a moderate thinning cut. The products of the exploitation have been taken away and the tract has been well cleared of all the débris. When in May or June the passer-by comes again to this spot when the forest has put on its spring dress, again it seems to him so beautiful, so harmoniously simple, that he often does not understand whence has come the supply of all the wood recently exploited and he has no idea of all the physical and mental work which the maintenance, in spite of the cut, of the beautiful picture which enthuses him represents. He is inclined to believe, knowing that the trees grow by themselves, that that comes about without difficulty and entirely naturally. He imagines too often that the planting of little firs is one of the principle occupations of the silviculturist, and he does not take account of the fact that it is by what is designated under the name of cultural operations that the forester acts on the development of the forest. By cultural operations it is necessary to understand in the general sense of the term all the operations which have to be repeated at the different stages in the development of a forest stand to make it in the last analysis a forest, healthy, strong, growing well, containing trees of value and beauty at the same time. These operations will vary, it goes without saying, with the age of the stands to be treated. There are particularly the fellings which are to take out progressively all the poor trees or those of defective form. They ought to favor the growth and development of the most beautiful and most valuable trees. These selections ought to keep as a constant aim the favoring of the best subjects, thus practising natural selection. In well administered forests these operations commence in the early youth of the stands even under the cover of the old stands still in place. Then come the thinnings which are repeated periodically and increasing in intensity up to the moment of the regeneration of the old stand. Everything ought to be done with constant care to increase the production of wood and to have it in the most valuable trees.

These operations which ought to be carried on by a competent staff require on the part of the managing silviculturist incessant action. The cultural operations under their diverse forms constitute the most efficacious action of the forester upon the forest. They are also and very much so the most interesting part. It is by them that he can model in some sort the woods to his taste and on them imprint his own work. This is also the criterion by which in the administration the standing and the abilities of the manager can best be judged.

In many of our forest administrations silviculturists in office without interruption for twenty, thirty, forty years, have had thus the chance of being able to fashion their forests toward the ideal which they have set for themselves. Of all that, which is the essence of the work of the forester, the uninitiated has scarcely an idea.

THE ALGERIAN FOREST CODE[1]

By T. S. Woolsey, Jr.[2]

The Algerian Forest Code was promulgated on February 21, 1903, to take the place of the Forest Code of 1827, which had been supplemented by the laws of July 17, 1874, and December 9, 1885, designed to cover the local fire and free use problems. The present Forest Code of 1903 is the product of careful study by a commission appointed in 1892 to modify existing forest laws to make them more applicable to local conditions. But, after investigation, this commission recommended an entirely new code, since modification of the amended law of 1827 proved impracticable. "Whatever may be its faults," Guyot considers the present code "a remarkable monument, since private and public interests had to be reconciled."

But, at least one local officer in Algeria preferred the former law because it was more forceful and more drastic, better calculated, in his opinion, to enforce forestry practice on a native population. Unquestionably, the new law is simpler, easier to understand, less severe, and much more flexible than the old. At the same time, it is more complete in its provisions against deforestation, against the careless use of fire in or near forests, against the theft of forest produce. It is divided into eleven parts as follows:

PART I. Forest Régimé.
PART II. Waters and Forests Administration.
PART III. State Forests.
- SECTION I. Boundaries.
- SECTION II. Management.
- SECTION III. Auctions of Bark, Felling Areas and Sales by Agreement.
- SECTION IV. Exploitation.
- SECTION V. Check of Cutting Area.
- SECTION VI. Auctions and Rentals of Grazing, Mast, Miscellaneous Forest Products and Agricultural Land.
- SECTION VII. Wood Rights in State Forests.
- SECTION VIII. Expropriation.

PART IV. Communal and Public Institution Forests.
PART V. Joint Tenancy Forests.
PART VI. Private Forests, Reforestation Areas and Clearings.
PART VII. Police and Conservation of Woods and Forests.
- SECTION I. Provisions Applicable to All Woods.
  - (Re: Damage other than fire.)
  - (Re: Fires.)
- SECTION II. Provisions Applicable Only to Woods Placed under Forest Administration.

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[1] To simplify computations, 1 frank has been given the value of $.20, 1 hectare 2.5 acres, 1 meter 1 yard.

[2] Consulting Forester, Albuquerque, N. M.

PART VIII. Prosecutions for Misdemeanors and Offences.
SECTION I. Prosecutions Undertaken in the Name of the Waters and Forests Service.
(Re: Prosecution.)
(Re: Examination.)
SECTION II. Prosecutions for Misdemeanors and Offences in Woods not under Forest Administration.
PART IX. Penalties and Sentences Applicable to Woods and Forests in General.
(Re: Penalties.)
(Re: Enforcement of Penalties, etc.)
PART X. Execution of Judgments.
SECTION I. Judgments Concerning Misdemeanors and Offences in Woods under Forest Administration.
SECTION II. Judgments Concerning Misdemeanors and Offences Committed in Woods Which Are not under Forest Administration.
PART XI. General Provisions.

Part I. Forest Régimé

In Algeria, the forest administration includes woods and forests belonging to the state, to the commune, to public institutions, and those forests in which the state communes or public institutions have "proprietary rights conjointly with private individuals," as well as ground "either covered with brush or bare, the reforestation of which has been recognized and declared to be of public benefit."

In addition, certain forests in litigation between the classes of owners enumerated above, or within the territory under military control, are provisionally placed under forest administration.

Part II. Waters and Forests Administration

Forest officers employed in Algeria are subject to the laws and promotions of the Waters and Forests Service of France proper. They work under the Governor-General of Algeria, and promotions in grade and class are upon his recommendation.

The subordinate force includes "natives who have served in the French Army, or Civil Service, and the sons of the native employes," who can be admitted as native forest guards when 22 years of age if they have learned the French language. When a man works for the Service, he cannot accept any other appointment, "either administrative or legal."

Curiously enough, under Part II is included the regulations concerning marking hatchets. The special marks on these hatchets are registered at the record office, so that it is possible to identify by the mark on any tree what official did the marking.

Part III. State Forests

Section I. Boundaries—A regular procedure is outlined to govern the establishment of boundaries. When forest officers decide upon the correct boundary, "this delimitation shall be announced two months in advance by an order of the prefect." After this period has elapsed, forest officers can proceed with the boundary work whether the bordering owners are present or not. Ones who wish to file protests in regard to any boundary established, have one year in which to do so, but, if no protest is made within the specified time, the boundary as established is finally marked by Service officers.

When disputes arise during the boundary delimitation, they are brought into the proper court and judged according to the evidence submitted.

"When the separation or settlement of the boundaries shall be effected by simply setting corners, the expenses shall be shared equally; when it shall be effected by planting hedges, these shall be carried out at the expense of the petitioner, and made entirely on his land." (Article 14.)

It is interesting to see boundaries in Algeria marked by cactus hedges. These are permanent in character and serve as fences and seem to give very good satisfaction. Occasionally they serve as fire breaks.

Section II. Management—According to Article 17:

"No extraordinary felling whatsoever shall be made in the state woods, nor any felling in the reserved fourth, or of stands reserved by the management for growth to high forest, without a special decree, under penalty of the sales being declared null and void, except in the case of an appeal from the purchaser, if it takes place, against the officials or officers who shall have ordered or authorized such fellings."

Section III. Auctions of Bark, Felling Areas, and Sales by Agreement—According to Article 18 of the Code:

"No ordinary or extraordinary sale shall take place in a state woods, except by public auction, announced at least fifteen days in advance. . . ."

It is also provided, when cutting operations are completed, all roads, ditches, bridges, or tunnels "built for transport or for felling purposes shall become the property of the State without any indemnity whatever." In special emergencies and when forest products cannot be sold at public auction for any reason, "sales by mutual agreement can always be authorized. . . ." It is specifically provided, however, that any sale which is not made by public auction or by mutual agreement is considered "a secret sale, and declared null and void." When a public auction is held, the maximum value of the product to be sold is estimated by forest officers and the auction is conducted in the presence of all prospective bidders by naming the maximum price and decreasing the amount called, until some bidder exclaims: "I take it!"

According to Article 22:

"Any disputes which may arise during auctions either as to their validity, or as to the solvency of those making bids or giving securities, shall be decided immediately by the official presiding at the auction."

This arrangement is designed to prevent long drawn out controversies in regard to auctions after they have been completed. Very stringent regulations were enacted to prevent officers and employes of the Waters and Forests Service, or other officials connected with the sales, their "relations and connections in direct line, the brothers, brothers-in-law, uncles and nephews . . . throughout the territory for which officers and employes are commissioned," from taking part, directly or indirectly in sales of forest produce.

It is especially interesting to note, that, according to Article 24:

"Any secret association or negotiation between dealers in wood, cork, or other forest products, tending to lower or disturb the biddings, or to obtain the products at a lower price, will lead to the application of the penalties cited under Article 412 of the Penal Code, in addition to all damages, and if the auction has been transacted in favour of the secret association, or the parties to the aforesaid negotiation, it shall be declared null and void."

This regulation was necessary because of illegal combinations between dealers to prevent bona fide bidding.

According to Article 27:

"Every bid shall be considered final the moment it has been uttered; under no circumstances can it be outbid."

Successful bidders give bond for the amount of their contract and for the payment of damages or fines.

Section IV. Exploitation—After the auction of forest material has once been made, it is specifically provided that "no tree or portion of a tree shall be added thereto under any pretext whatever." For a violation of this rule, a purchaser is liable for three times the value of the material marked as well as a refund of the material cut illegally.

Moreover, it is provided that: "The officers of the Waters and Forests who shall have permitted or tolerated such additions or changes shall be fined in the same manner, and shall be liable to prosecution and penalties for mal-practice and peculation." After a sale has been made a purchaser cannot commence cutting until he has received a written permit to do so. In Algeria, where the native population is addicted to thieving, it was necessary to make special, stringent regulations to prevent theft, and, according to Article 39:

"The purchasers by auction, or by agreement who shall fell, or remove any wood, bark or cork, before sunrise, or after sunset unless they have obtained a special permit from the Forest Service, will do so under penalty of a fine of not less than $20.00."

To insure compliance with the contract, Article 42 provides:

"In case the purchasers by auction, or by agreement fail to carry out within the stated time, and according to the manner prescribed by the regulations, the work herein enumerated (designed) to bring the cork oak into full bearing or protect the stands from fire, to remove and cord the branches trimmed, to clear the felling areas of briars, brambles and weed growth, to repair the logging roads, ditches or fences, this work shall be executed at their expense, at the convenience of the Waters and Forests officers by authorization of the prefect who shall thereupon approve the expense account, and render a writ of execution for payment against the purchasers."

Section V. Check of Cutting Area—When a cutting area has been completed, the regulations provide for a check of the stumps by an officer of the Service. His report is accepted as final unless it can be shown to be in error.

Section VI. Auctions and Rentals of Grazing, Masts, Miscellaneous Forest Products and Agriculture Land—According to Article 53:

"In State Forests, declared exempt and free from rights for wood, mast or hog grazing and pasturage can be put up to auction for a maximum period of three years."

But, before proceeding with an auction of grazing privileges, they must first be offered to the local permittees by means of a sale by mutual agreement. In other words, the priority right of the local population is recognized in grazing privileges and the auctions are only held if what are termed in the U. S. Forest Service class A permittees are not interested. In case no one bids at an auction of grazing privileges, then permits can be negotiated by private agreement.

It is interesting to note that drive-ways are prescribed for going to and from allotments, and, in case of grazing trespass, "the herder shall be besides condemned to a fine of twenty cents to one dollar and, in case of a repetition of the offence, to imprisonment of one to five days."

Miscellaneous forest products such as native grasses valuable for fodder are sold in accordance with the provisions of Section III, heretofore described.

The lease of land for a maximum period of 18 years can be authorized by the Governor-General of Algeria. This land may include blanks, or clearings, existing in the federal forests and the lease may be by public auction or by means of mutual agreement. It is significant that the title to agricultural land within forests is retained by the Waters and Forests Service.

Section VII. Wood Rights in State Forests—The law specifically provides that right holders must have been recognized at the time this law was promulgated (1903), and that no other rights or servitudes can be granted under any pretext whatever, except that "the rights which the natives enjoy by virtue of tradition shall be maintained until the application of the senatorial decree," or "in case of absolute necessity . . . with due regard for pre-existing rights, a decree of the Governor-General . . . shall concede to natives displaced for purposes of colonization rights in the forests of their new territory equivalent to those enjoyed in the first place."

Arrangements are made for the wiping out of old rights by special grants of land, wood, or money payments. Rights other than those of pasturage can be redeemed by giving over to those who have common rights a piece of forest land where they can exercise these rights. On the first of August each year, forest officers announce the number of cattle to be grazed, and the local territorial officials draw up the individual lists of right holders, with the allotment for each individual. According to Articles 68 and 69:

"Article 68. The right holders in any case can only enjoy the rights of pasturage for their own cattle.

"The herds, other than those used for exploitation, belonging to cattle dealers, even if those dealers are right holders, as well as herds on shares (*en achaba*), are excluded from the benefits of rights."

"Article 69. The roads by which cattle may go and come from pasturage, shall be designated by the Waters and Forests Officers. These roads shall be considered as having at least a width of 20 yards.

"If these roads cross any coppice, or any young growth of high forest which is not enclosed, ditches or enclosures may be constructed at the joint expense of right holders and the Service, and in accordance with the directions of the Waters and Forests officer, in order to prevent the cattle from straying into the woods."

Right holders cannot bring sheep, goats or camels into forests without being penalized and the specific fine and imprisonment of herders who are guilty of handling stock in trespass is provided for. Provision is made, however, by specific order from the Governor-

General to authorize sheep grazing in certain forests, and to throw open closed areas for temporary use. "Under exceptional circumstances, the introduction of the goats of right holders into the fire lines of state forests can be authorized." Unquestionably, this regulation is designed to clear inflammable débris from fire lines.

Those who have wood rights can only remove the timber "after permission has been granted them by the warden or forest officers," otherwise it is considered to have been taken in trespass. Under certain circumstances, however, forest officers are authorized to provide right holders with timber, either collectively or individually.

According to Article 74, the sale of free use material is strictly forbidden:

"Right holders are forbidden to sell the wood or other products granted to them or to employ them in any manner other than that for which the rights have been granted to them, under penalty of a fine of $1 to $10."

Section VIII. Expropriation—Special provision is made in Article 76 for the right of eminent domain on land needed for the purposes enumerated below:

"The expropriation of land which must be reforested or reclaimed, shall be recognized as necessary, and shall be declared a measure of public utility, under the following circumstances:

1. For the maintenance of lands on mountain slopes;
2. For protecting the soil against erosion by rivers or torrents;
3. To insure the existence of springs and water courses;
4. To render stable the coast dunes and those of the Sahara, and for protection against the erosion of the sea, and drifting of sand;
5. For the defence of territory in the frontier zone which shall be determined by a regulation of the Civil Authorities;
6. For the sake of public health.

"If the declaration of public utility is pronounced, the expropriation shall proceed in conformity with Algerian legislation."

It is also provided that when access to state forests is across private land, a right of way can be secured by eminent domain. This includes roads or railroads established for facilitating the felling or removal of timber. There is a keen need of a similar law in the United States.

Part IV. Communal and Public Institution Forests

The forests belonging to communes and public institutions in Algeria are under the control of federal forest officers and

"Communes and public institutions cannot undertake any clearing in their woods without special and express authorization by the Governor-General;

any persons who have such fellings shall be liable to the penalties declared under Part VI against private individuals for offenses of a similar nature."

Communal woods cannot be divided up among inhabitants nor can communes themselves demand subdivision of a forest property owned conjointly and with another commune. Communes and public institutions are required to pay the state 10 per cent of all gross revenue to cover the cost of forest administration. The general sale procedure is the same as in the case of state forests except that local officials must be consulted to a certain extent.

Part V. Joint Tenancy Forests

Where forests are owned jointly by the state, communes, public institutions, or private owners, practically the same procedure is followed as with state or communal forests.

Part VI. Private Forests, Reforestation Areas and Clearings

Rights of the owners of private forests are restricted for the common weal. Clearing is not allowed without specific examination and official permission. But, when the service objects to clearing, the report goes to the Governor-General, "who shall decide after deliberation with the government counsel if the objection shall stand." This signifies how important it is considered by the French Forest Service to prevent further deforestation in Algeria.

The reasons against deforestation given in Article 99 are the same as those which justify expropriation quoted in Article 76 and it is clearly stated that: "clearing can only be opposed in case the preservation of the woods is recognized as necessary."

The penalty for illegal clearing amounts roughly to from \$15 to \$50 per acre cleared; "moreover, if ordered to do so by the Governor-General, he shall replant the acres denuded within three years," and if this planting or sowing is not carried out within the time prescribed, it can be executed by the Service and levied against the owner. Private owners can, however, clear woods less than 20 years old unless they cover regular forestation areas, parks or gardens, unfenced woods less than 25 acres in area (provided they are not on mountain slopes), or woods occurring within colonization areas.

But, according to Article 104:

"Excessive exploitation, grazing after fellings, coppicing operations or fires, which may cause the total or partial destruction of the forest in which they have been practised, shall be treated as deforestation, and in consequence those who have ordered them shall be subject to the penalties set forth under Articles 100 and 101.

"All owners of stock allowed to enter, or found in woods less than six years of age, shall be fined in accordance with the rules set forth under Article 177, paragraph 2."

Woods or brush within forestation areas, of course, cannot be denuded without special authorization in accordance with the provisions set forth in Article 76, already quoted in full. Private owners who desire special guards to watch their forests have them approved by the sub-prefect, and those who wish to free their forests from rights or servitudes can do so under the same conditions prescribed for the federal forests.

The damage to roads by stock in the western United States is well known. In Algeria, in accordance with Article 114: "The right holders shall contribute to the maintenance of the roads over private property where they exercise their rights."

Areas sown or planted on mountains or on sand dunes are exempt from taxation for a period of 30 years and, where woods or forests have been burned over through no negligence of the owner, the part destroyed is exempted from taxation for 10 years. This latter rule might lead to abuse.

Part VII. Police and Conservation of Woods and Forests

Section I. Provisions Applicable to All woods.

(*Re:* Damage other than fire.)

A fine of from $1 to $100 is prescribed for the injury, destruction, change, or obliteration of boundary marks or fences, and, if a considerable length of fence or boundary demarcation is moved or obliterated the offender can, in addition, be imprisoned for from three days to three months. In addition, civil damages can be collected. Moreover, the repair and return of the fence or boundary mark damaged is obligatory as is imprisonment, in case of a repetition.

According to Article 118:

"All unauthorized quarrying or removal of rock, sand, mineral, earth, turf, heather, gorse, grass, green or dead leaves, manure found on forest soil, acorns and other fruits, seeds of woods and forests, shall be punished by fines of 40 cents to $1 for each harnessed animal employed, of 20 to 40 cents for each pack animal and 20 cents for each man.

"In case of a repetition of the offence, the maximum fine shall always be enforced and the offender can, in addition, be sentenced to from one to three days' imprisonment."

While the Bridge and Roads Service has the right to excavate for public works, yet their contractors are bound by the same rules as private individuals.

The fine for illegal cultivation is from \$4 to \$16 per acre with a minimum of 40 cents. If the offence is repeated an additional sentence of 8 days' imprisonment must be enforced.

According to Articles 121 and 122:

"Article 121. Any persons found in the woods and forests at night, off the highways and ordinary roads, with bill-hooks, axes, hatchets, saws or other instruments of a similar nature, shall be sentenced to a fine of \$1 to \$2 and have the aforesaid instruments confiscated.

"The maximum fine shall be enforced in case of a repetition of the offence."

"Article 122. Any persons whose wagons, stock, pack or saddle animals, shall be found in the forest off the highways and ordinary roads, shall be sentenced as follows:

"To a fine of \$1 to \$2 for each wagon found in a forest of over 10 years growth, and \$2 to \$4 if the wood is less than that age.

The foregoing fines are given as illustrations of the severity of this code in dealing with the native population. Presumably, after thorough trial, such severity was found absolutely essential to successful protection of public and private forests. The methods of imposing the fines are particularly explicit and simple, and the general rule of holding a man trespassing as guilty until he has proved himself innocent is adhered to, judging from the provisions of Articles 121 and 122, which are particularly significant. The conditions for the exploitation, sale, and removal of forest materials is according to the decrees of the Governor-General, and violations may be punished by a fine of from 20 cents to \$20 and, in addition by 1 to 5 days' imprisonment and confiscation of the products. In case of repetition, imprisonment is obligatory.

(*Re:* Fires.)

A great deal of money is being spent in Algeria on fire protection. Most of this goes for the construction of fire lines. The fire laws are especially strict. It is illegal to kindle fires or carry torches outside logging houses or buildings within a distance of 200 yards of forests, and from July 1 until October 30 this applies even to owners of forests themselves, and forbids the manufacture of charcoal or the distillation of tar or resin. From November 1 to June 30, charcoal, tar, or resin manufacture is permitted provided the operation is separated from the forest by a suitable trench. The rights of adjoining property owners to protection from the carelessness of their neighbors is recognized by Article 124:

"An owner of wooded or forested land (which has not been brushed out) or of land covered with dead wood, can be forced by the owner of a similar adjoining property, to construct and maintain, on his side, on the boundaries between the two estates a (fire) line cleared of all brush, and of all coniferous wood, and to keep it thoroughly cleared of brush. This (fire) line, whose width may vary from 10 to 100 yards shall be constructed half on each side of the adjoining boundaries, by agreement between the interested parties, and in case of disagreement, by the Prefect, the Conservator of the Waters and Forests acting for him. Actions concerning the construction and the maintenance of such protective lines shall take place, be put in practice, and judgment delivered in the same manner as in the case of boundaries."

The setting of fires is only allowed after authorization by a forest officer and "if it is a question of ground situated less than 200 yards from the woods or forests during the period from November 1 until June 30 and less than 500 yards between July 1 and October 31," burning cannot be allowed. Moreover, if, in spite of the precautions cited in Article 124, fire extends to neighboring properties, the originator of the fire is liable for all damages. A violation of this rule makes the violators liable to imprisonment from one to five years.

In order to secure fire fighters from the native population, conscription is allowed during the most dangerous season, July 1 to November 1. "This watch duty shall be obligatory for the right holders and, if they are insufficient, for all able-bodied men residing in the commune or section of the bordering forest. They shall not, necessarily, be paid." During this danger season, the Governor-General can detach troops commanded by officers and subalterns to cooperate with forest officers in fire protection, and by Article 129:

"Any European or native requested to help in putting out a fire, who has refused his services without legitimate reasons shall be liable to the penalties carried by Article 136."

Article 136 provides for a fine of $4 to $100 and imprisonment from 6 days to 6 months. Right holders are punished by suspension of their rights for from 3 months to 5 years. Moreover, when it appears that fires are set maliciously and simultaneously in a number of places by preconsidered action on the part of the natives, this infringement of forest law may be treated as an act of rebellion and can lead to sequestration, in accordance with the royal decree of October 13, 1845. All grazing permittees are forbidden to use burned-over land for grazing purposes for a period of at least six years. In private woods, however, this can be waived by the Governor-General at the request of the owner, after consultation with the Forest Service.

Railway companies within or bordering forests are forbidden to allow grass or herbaceous growth on their rights of way from June 1 to November 1, on penalty of a fine of from $4 to $60.

"Article 132: . . . Moreover, fire lines may be (required to be) constructed along the track, cleared of all brush and, if it is considered necessary, of all conifers, and constantly maintained in good condition. These fire lines shall be 20 yards in breadth, commencing at the railway right of way and shall be constructed within six months from the date of the official order for their construction."

If these lines are not constructed, they can be constructed by forest officers at the expense of the company.

In case of fire, the ranking forest officer takes charge, and in the case of his absence, the ranking mayor or civil servant. This is particularly interesting, as it illustrates the widespread campaign against fire which extends outside the jurisdiction of the Waters and Forests Service. In case of backfire, it is specifically provided that this ". . . can never give grounds for damages. . . ."

While these laws seem particularly stringent, yet, when the character and ignorance of the native population is considered, necessity for severe punishment is apparent to anyone who has visited Algeria.

Section II. Provisions Applicable only to Woods Placed Under Forest Administration—No fire-using industry can be established within 500 yards of a forest without authorization from the Prefect, under penalty of a $20 to $100 fine and the demolition of the buildings, nor can any tent or hut, built of inflammable material, be erected within 100 yards of a forest or wood under penalty of a fine of $1 to $10. When this ruling is impracticable the maximum distance is reduced under certain conditions to 50 yards.

Part VIII. Prosecutions for Misdemeanors and Offences

Section I. Prosecutions Undertaken in the Name of the Waters and Forests Service.

(*Re:* Prosecution.) According to the first paragraph of Article 139:

"The Waters and Forests Service undertakes, not only in the interest of the State, but also in the interest of the other owners of woods and forests placed under forest administration, to prosecute for misdemeanors and offences committed in these woods and forests."

The right is reserved to forest officers to compromise trespasses and offences, even after judgment has been delivered. Civil suits or fines may be compromised. Forest officials present their cases before the courts and argue them. They also have the right of appeal.

(*Re:* Examinations.)

Forest employes can seize trespassing cattle, or work implements, including wagons and teams. The only restriction upon their activity in following up trespass cases is that they cannot enter native houses, courts or enclosures unless in the presence of certain officials. This special ruling was made in order not to violate the native hearth. They have the right of arrest in the case of unknown natives who are caught in the act of trespass.

According to Article 153:

> "Offences or trespasses against forest property shall be proved either by reports, or by witnesses in default of reports, or in case these documents are insufficient."

The report of a European forest officer is accepted as evidence unless it is proven incorrect. Forest employes can, moreover issue all necessary summons, judicial notice of writs, without formal subpoena, but this must be accompanied always by a copy of the official report. On the whole, these laws are designed to simplify and expedite legal action which is primarily taken against the native population.

Section II. Prosecutions for Misdemeanors and Offences in Woods not Under Forest Administration—Forest officers are required to enquire into and report upon trespasses against private forest property. They are assisted by the rural police and in general by the officers of the judiciary police. Even trespass reports of French guards privately hired are held as sufficient evidence of trespass unless contrary proof is given, but reports of private native guards are only considered as "information."

Part IX. Penalties and Sentences Applicable to Woods and Forests in General

(*Re:* Penalties.)

Specific fines are provided for cutting down trees of whatever size and, specifically, for cartloads, packloads, or faggotloads carried by men. For example, a fine for a man carrying a faggotload is from 10 to 40 cents, and in addition, he can be sentenced to a maximum of five days' imprisonment. The fine is increased if committed in cork oak forests. The injury of trees and the removal of bark from cork oak is specifically fined. In every case, the fine is more severe upon repetition within a year. Grazing trespass in forests over 10 years of age is fined 4 to 20 cents for a hog, sheep or calf, 8 to 40 cents for a steer, cow, goat or horse, 20 cents to $1 for a camel. If the forest is less than 10 years old, the fines are doubled. "In addition, the herder may be sentenced to imprisonment for from 5 days to 6 months. In case of a repetition of the offence, or if it has been committed in the night, the maximum fine shall be enforced." These specific grazing penalties will be particularly interesting to forest officers in the western United States where grazing trespass is particularly difficult to assess, since the fine must be based primarily upon the value of the forage destroyed, often an insignificant anount. Under these circumstances, it is unfortunately true that occasionally a sheep man will consider it good business to trespass and pay the costs. A United States law against illegal grazing patterned after the explicit Algerian code would certainly simplify settlement of grazing trespass. Counterfeiting or tampering with brands is punished by imprisonment of 3 months to 2 years.

Where, in addition, there is civil award for damages, this can never be less than the fine imposed by the court, but, according to Article 182: "Private owners are entitled to restitution and damages; fines and confiscations are always reserved for the State."

Part X. Execution of Judgments

Section I. Judgments Concerning Midsemeanors and Offences in Woods Under Forest Administration—According to Article 187: "The recovery of forestry fines is entrusted to the General Tax Collector."

Forest officers can allow trespassers to settle civil payments and costs by work on rural roads or in the forests. Even imprisonment for debt is exercised under this law to a maximum period of one year.

Section II. Judgments Concerning Misdemeanors and Offences Committed in Woods which are not Under Forest Administration—Even in this case, "The recovery of fines shall be effected by the General Tax Collector," and insolvent trespassers are allowed to work out their fines by road work.

Part XI. General Provisions

According to Article 190:

"The laws, regulations, decrees, and orders laid down as to matters dealt with by the present law are abrogated as to every point in which they are contrary to the regulations of this code, reserving to the code the rights previously acquired. . . ."

It will probably be some years before complete and satisfactory laws are enacted in all States of the Union. Necessarily, on account of our form of government, there will be many discrepancies and differences between the laws enacted in the various States, and it is at least of interest to thus examine in some detail the laws enacted in Algeria in 1903 to provide against forest offences after a careful study by a government commission.

CURRENT LITERATURE

Senile Changes in Leaves of Vitis vulpina L. and Certain Other Plants. By H. M. Benedict. Memoir 7, Cornell University Agricultural Experiment Station. Ithaca, N. Y. 1915. Pp. 89.

Investigations have established the occurrence of fairly definite senile changes in animals, but very little work has been done in the attempt to demonstrate the presence or absence of such changes in plants. The latter condition of affairs may be due to the passively assumed belief that woody perennials, such as trees, because of their annual renewal of tissue through the agency of persisting embryonic cells, would be immortal, were it not for the inimical conditions contingent upon their increasing size, such as liability to breakage and thus to disease infection, distance from the soil, exposure to excessive water-loss, and so forth. To quote the author: "The importance of determining whether there is any real senile change in plants lies not alone in the scientific need of such knowledge, but also in its direct bearing upon the long disputed question regarding the effect of continuous vegetative propagation of seed-producing plants. For, if the new growth from which cuttings are made, has not been affected by the time that has elapsed since the plant came from the seed, then its tissue is no more senile than the seedling tissue; if, however, the embryonic tissue which has been so actively growing and dividing since it originated from the parent plant, has itself suffered the senile deterioration that accompanies activity in animal cells, then the tissues arising from this embryonic tissue must partake of its senility."

The greater portion of the author's investigations was made upon the leaf of the wild grape. About 20 pairs of vines of different ages, growing in similar conditions were selected and 10 leaves were taken from each pair. Care was taken to get fully matured healthy specimens. Each set of pairs was taken from the same height and as nearly as possible in the same light exposure. The size of the meshes of the photosynthetically active cells lying between the network of veinlets was taken as a standard. These areas are called vein islets. The size of the vein islets was determined by means of enlarged photographs. The author found that the size of the vein islets decreased with the increasing age of the plant on which the leaf was borne. Thus in plants 3 to 5 years old, the average size of the vein islets was 0.4914 square *m. m.* from 14 to 25 years old, 0.2969 square *m. m.*; 28 to 35 years old 0.2211 square *m. m.*, and in plants from 50 to 70 years old the average size of the islets was 0.1638 square *m. m.* A similar result was obtained when cuttings from plants of different ages were grown in water cultures and in soil cultures; as the leaves produced in these cultures were subjected to identical conditions, the possibility that the result obtained in the native, field grown plants may have been due to varying conditions of their environment was eliminated. Leaves of certain cultivated varieties of grapes were examined, the age of the plants being the same, but the duration of the cutting propagation being different. For example, one variety of grape which had been vegetatively propagated for 70 years disclosed 66 intersecting veinlets in 2 *cm.* While another variety which had been asexually propagated for 114 years, showed 82 intersecting veinlets in the standard length.

The leaves of about a dozen species of trees were examined in the same manner, and they contributed corroborative evidence as to the effect of age in decreasing the size of the vein islets. For example, in case of chestnut trees, on the leaf of a tree, 5.1 *cm.* in diameter, the average size of the vein islets was 1 square *cm.*; a tree 12.7 *cm.* in diameter, vein islets 0.7 square *cm.*; a tree 25.5 *cm.* in diameter, vein islets 0.5 square *cm.*; a tree 61.2 *cm.* in diameter, vein islets 0.4 square *cm.*, and the leaves of a tree 91.2 *cm.* in diameter showed vein islets having an average area of 0.3 square *cm.*

A decrease in the size of the vein islets indicates an increase in the number of veinlets in a unit area, and an increase in the number of veinlets means an increase in the amount of vascular tissue at the expense of the photosynthetic tissue. It has been shown by other investigators that the veinlets are of little or no importance in the mechanical support of the leaf. Therefore, if the decrease in the number of photosynthetic cells results in a decrease in photosynthetic activity, the change of venation with age is a loss without any compensation. The author performed some experiments on this point and found that leaves of the same size and with the same exposure to light from plants of different ages varied according to age in their daily increase in weight through the accumulation of food products. For illustration, the average daily gain in weight for leaves from vines 5 to 8 years old was 9.3 per cent, while the average daily gain for leaves of vines 20 to 25 years old was 1.9 per cent. The investigator also found by experiment that there was a decrease in the rate of respiration with increase in age of the plant on which the leaf was borne; also a probable increase with age in the number of stomata and a decrease in the size of the stomatal aperature; and a probable decrease with age in the size of the palisade cells.

The author concludes that certain tissues of the plants studied exhibit senile degeneration comparable to that in animal tissues. This is shown graphically by two curves, one showing the decrease in the size of vein islets and the other showing the senile decrease in the rate of growth of guinea pigs. The curves disclose a remarkable correspondence in the two phenomena. It is interesting to note how the pendulum swings! More than 100 years ago, Knight made this statement: "I am therefore much disposed to attribute the diseases and debility of old age in trees to an inability to produce leaves which can efficiently execute their natural office. It is true that leaves are annually reproduced, and, therefore, annually new, but there is, I conceive, a very essential difference between the new leaves of an old and of a young variety." Since that time practically all the men who have investigated the problem asserted that Knight's conclusion was wrong for the reasons stated in the first paragraph of this review. The present author, however, is apparently the only one who reached his conclusion through a mass of experimental data.

Some 20 pages of this very interesting paper are given to a discussion of the causes of senile changes. After showing that most of the theories of animal physiologists are inadequate—at least as applied to plants,—, the author develops his theory that senility is due to the progressive decrease, as age advances in the permeability of the protoplasm, thus producing an increasing degree of inability to absorb food materials from without as well as an increasing retention of toxic waste products within the cell.

C. D. H.

Ueber das Treiben der einheimischen Bäume, speziell der Buche. By G. Klebs. Heidelberg. 1914. Pp. 166.

This work is of peculiar significance in the theoretical field, but, nevertheless, it is of importance to the forester, as it brings nearer to our understanding the hitherto puzzling appearance of change between the period of rest or the growth of the beech sprouts.

Formerly, attempts were made from the scientific point of view to interrupt at will the winter rest period of our woody growths. By etherization, by warm water treatment, and in other ways, attempts were successful in inducing a number of woody plants to sprout in the middle of winter. No result was attained with the beech. From numerous experiments, it was concluded that a period of rest, harmonizing with climatic conditions, takes place "from inner causes," which may be altered but not done away with. Klebs succeeded by uninterrupted electric lighting, using lights of strength of 200 to 1,000 candle power, in inducing beech plants and cuttings to sprout as desired during the usual rest period, sprouting continuously from November to spring and forming far more leaves than were evidently in the bud at the beginning of the experiment.

The conviction reached by the author was that the relation between the supply of carbo-hydrate and food salts to the growing points determined whether growth or rest takes place in our trees. The influence of light is also brought into relation in his experiments. In the light space the breathing was always more intensive than the carbonic acid assimilation, so that the food salts were able to flow to the buds and excite them to unfold. Quantitative differences in the supply of food stuff of the different buds explain the changing behavior of the experimental twigs. Klebs explains behavior of beech in nature thus: the buds develop in spring as a result of the increase of light, in conjunction with sufficient food salts from the ground. Summer budding ceases because the competition of the leaves and of the cambium interferes with the food supply to the buds, and the accumulation of the assimilates stops the energy of the growing points. The mid-summer growth signifies the victory of the strong light effect. Sleeping buds are those which do not possess the faculty of acquiring for themselves the flow of food salts going past them to the end buds. Removal of competing buds, however, causes them to sprout.

Klebs, also, made observations on the anatomical structure of the leaves and annual ring formation. He is inclined to explain with R. Hartig and Wieler the differences between late and early wood from variations in the nourishment of the cambium cells. Since, however, in his winter experiments he found wood of early and of late character, he decided to replace the terms "early" and "late" by "wide" and "narrow" wood. Oaks, ash and ironwood are also briefly introduced, but no necessary rest under all circumstances is apparent with them. Only with the ironwood, the light seems to possess a similar influence as with the beech.

However, Klebs' view concerning the dependence of rest and growth on outward conditions does not hinder him from ascribing an inherited structure to a plant of which its properties are the expression. Our woody growths have, according to their inherited structure, the faculty of growing on continuously or of resting at times, at any time of the year. Which of these faculties becomes active is dependent upon light and nourishment at that time. It is not so much the periodic change between rest and growth that is a quality of the beech, but the faculty of allowing this change to occur under definite conditions.

It is the task of the future, says Klebs at the end of his important work, to learn to know for every plant the relation of its specific structure to the outer world so exactly that its capabilities may be developed at will any time.

Klebs deserves great credit for having completed such thorough examination. He has materially advanced our knowledge of the life phenomena of forest trees.

J. D. A.

Lumber and Its Uses. By R. S. Kellogg. The Radford Architectural Company. Chicago, Ill. 1914. Pp. 352. Ill.

With considerable success, the author has undertaken to condense within the limits of a single volume, a statement of the multitudinous ways in which lumber enters into modern life and industry. While combining the information contained in the various reports on wood-using industries that have been published, much more is accomplished than a mere cataloguing of uses. The object of the book is to make readily available to the users of wood a brief but comprehensive survey of the numerous species of wood which the forests of the United States offer in such abundance. The author argues, with reason, that in spite of the displacement of wood by substitutes, the intrinsic qualities of wood are such that no general substitution is conceivable and that these qualities need only to be aggressively advertised to counteract the trend toward substitution.

About one-half of the book is given over to a consideration of the uses of lumber and the commercial woods of the United States. Under the first heading, various products which have lumber as their basic raw material are considered, the annual consumption indicated, the essential qualities of the wood suitable for such products are described, and the various species so used, together with the annual consumption of each, is stated. Under the second heading, the species themselves are considered separately, their properties are briefly mentioned, and in most cases two tables are appended, the first showing the distribution of the cut among various major classes of products, and the second, the specific products manufactured from each species.

In the other half of the volume, lumber is considered in a general way aside from the specific uses. Although of necessity brief, the author has been able to give an extremely useful survey of the physical properties of wood, of grades and standard sizes, shipping weights, and the seasoning of timber; wood preservation, paints and stains and the fire-proofing of wood are also considered at some length. Recognizing the cursory treatment of most of these subjects, the author devotes special attention to indicating the sources of more detailed information, giving not only a list of government publications bearing on the subjects, but also pointing out the interest taken by lumber manufacturers' associations in supplying information about the woods produced by their members and the ways in which they are prepared to aid the wood-user to secure authoritative information.

The low price of $1, at which the book sells, is made possible by the use of a low grade paper and plain but substantial binding. This is in keeping with the object of the publication, which is frankly the advertisement of lumber, and for which purpose a wide distribution is desirable.

W. N. M.

Recent Results Obtained from the Preservative Treatment of Telephone Poles. By F. L. Rhodes and R. F. Hosford. Presented at the 314th meeting of the American Institute of Electrical Engineers, St. Louis, Mo., October 19, 1915. Pp. 44.

This pamphlet gives an analysis of 18 years' experience of the American Telephone and Telegraph Company with poles treated by pressure, open tank, and brush methods.

Experimental series of creosoted poles were installed as parts of lines used for regular service, with untreated poles included as controls. These were periodically inspected and detailed observations made on their condition and all possibly related factors noted. The experimental series were located mostly in Nebraska, New York, Georgia, Alabama and Mississippi, and large numbers of poles were concerned. The species used were Southern Yellow pine, chestnut, Eastern cedar, and "juniper" (*Chamaecyparis thyoides*).

The earliest experiments were begun in 1897 and 1899, using whole length (pressure) treatment, chiefly with Yellow pine. In all the later series butt treatments only were given, both brush and open tank methods being used. These investigations were carried on in cooperation with the U. S. Forest Service.

As yet, the writers consider it too soon to give much more than general conclusions, but the data presented in the various analyzed tables of condition are of great interest. On account of the wholesale and systematic character of the investigations, future progress reports will be of much value.

J. H. W.

The Ashes: Their Characteristics and Management. By W. D. Sterrett. Bulletin 299, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1915. Pp. 88.

The introductory portion of this bulletin emphasizes the economic importance of this group of trees. The annual cut of ash lumber in the United States is around 250 million feet, estimated 45 per cent White ash, 37 per cent Green, and 18 per cent Black ash. The White ash comes largely from the Central States, the Green ash from the lower Mississippi valley, and the Black ash from the Lake States.

Tables are given for the separation of the species by botanical characters, and showing the relative importance for commercial or silvicultural purposes.

The different species are discussed as to their occurrence (types and habitat), biologic requirements, reproductive characteristics, susceptibility to various forms of injury, and silvical characters.

Tables are given for the three leading species, relating diameter, height and age, on various sites in various States.

Yield tables from 62 sample plots, aggregating 17 acres, in comparatively pure, even-aged stands (about half in plantations), show 38,000, 28,000 and 18,000 board feet per acre on sites I, II and III respectively, at 80 years.

A calculation is presented showing the interest on investment to be expected from quality I, II and III stands for stumpage values of \$5, \$10, \$15 and \$20 per M feet, and for total investments ranging from \$5 to \$30 per acre. According to this, the best financial rotations fall between 30 and 60 years. "Where quality I yields and \$20 stumpage are to be obtained, the operator may spend as much as \$20 per acre in buying land and establishing a stand of ash and still get 6 per cent on the investment. Where quality II or average yields and \$20 stumpage are to be obtained, it is possible to get 6 per cent interest on an investment of \$10 per acre. Quality III yields with \$20 stumpage will only pay a little over 5 per cent on an original investment of \$5. It may be said in general that growing ash timber as a profitable investment is practically limited to lands which will produce good yields of ash and which do not cost over \$10 or \$15 per acre."

For commercial timber growing the White and Green ash are the more desirable. Directions are given for reforesting by either natural or artificial means, the author preferring the former method where feasible.

An appendix of 26 tables comprising bark, form, volume, and yield tables for the leading species is added.

On the whole this bulletin is of a superior character.

J. H. W.

Willows: Their Growth, Use and Importance. By G. N. Lamb. Bulletin 316, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1915. Pp. 52.

This bulletin opens with a description of the dozen or so species reaching fair tree size. Of these, the only native one of economic importance is the Black willow (*Salix nigra*), which is a large tree of rapid growth and widely distributed. Accordingly, the major portion of the bulletin is devoted to this species, with special reference to the lower Mississippi valley, where it reaches its best development in the alluvial bottom lands.

Tables of height and diameter growth are given for such site conditions. Mature stands averaged 18 to 24 inches in diameter and 85 to 120 feet in height. A study of 255 trees gave an average height of 32 feet at 5 years, 50 feet at 10 years, and 96 feet at 35 years. The average diameter breast high was 12 inches around 20 years, and 20 inches around 40 years of age.

Volume tables and tables of yield on small sample areas are given. A set of form tables is also given, based on 252 trees in 5 States, giving taper measurements for diameter classes from 8 inches to 36 inches at intervals of 1 inch, and height classes from 60 to 130 feet at intervals of 10 feet.

It is only within the last few years that the production of willow lumber on the lower Mississippi has become important enough for the lumber to be placed on the market under its own name. At present, its mill price is about $16 per thousand, mill run. The lumber is used mostly for box shooks, furniture and cabinet drawers and backing, and various special uses. Willow is also manufactured into slack cooperage stock, the coarser grades of excelsior, charcoal for special uses, artificial limbs, willow furniture and baskets, etc.

The use of willows for protection is discussed. The species is very suitable for protecting soil from erosion by running water or wave action. The most extensive employment for this purpose is for bank revetment work along the lower Mississippi system, where an average of 350,000 cords per year is required. Willows are also used as sand binders, and are the favorite tree for wind-breaks and shelter belts in the central prairie states.

The last ten pages are devoted to the subject of planting willows, under the various headings of soil requirements, species suitable, handling of cuttings, costs and yields.

J. H. W.

Zygadenus, or Death Camas. By C. D. Marsh and A. B. Clawson, and H. Marsh. Bulletin 125, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1915. Pp. 46.

This bulletin covers completely in a comparatively short space the description of the poisonous species of the genus Zygadenus, the losses of live stock in the United States from the plant, going into the pharmacological side of the effects of the plant upon different classes of stock, symptoms of poisoning and a number of practical remedies, with tables showing the results of detailed experiments with death camas upon stock. The publication is intended to supply general information on the relation of Zygadenus to the losses of live stock on the western ranges, and is suited for distribution throughout the western one-third of the United States. A complete description of the poisonous species of Zagadenus is given, with plates, showing the visual characteristics of the plant. Zygadenus is known commonly throughout the West by a large number of names, as death camas, lobelia, soap plant, alkali grass, water lily, squirrel food, wild onion, poison sego, poison sego lily, mystery grass and hog's potato. Nine species of Zygadenus are known to be poisonous. The species is found very widely distributed throughout the United States and even as far north as Alaska. The plants are most abundant from the Rocky Mountains west to the Pacific Coast, and so are of importance and interest to forest officers in the West, since the annual loss of live stock on the National Forests from this plant is considerable.

The results of the extensive experiments with the plant on different kinds of stock are given in detail. Hogs apparently eat the bulbs with no bad effects; cases of cattle dying from eating the death camas are not common; many cases of horses being made sick from it have been reported, but deaths are rare; while sheep are most frequently poisoned, due, the authors think, to sheep being close herded on areas where death camas is found. There have been cases—not a few—of children being poisoned from eating the bulbs.

Experimental work has been carried on in Colorado for five seasons to show the effect of Zygadenus poisoning on different classes of stock, and in Montana for three seasons. The tables showing the methods used in this experimental work and the results are of practical interest. The symptoms observable in different classes of stock experimented on are of distinct value to forest officers and live stock owners as well. Some 12 remedies for death camas poisoning are given, with practical suggestions how to prevent losses of stock, the important thing being the ability to recognize the plants and keep stock away from them.

The bulletin concludes with a bibliography of literature cited.

J. D. G.

A Discussion of Log Rules—Their Limitations and Suggestions for Correction. By H. E. McKenzie. Bulletin 5, California State Board of Forestry. Sacramento. 1915. Pp. 56.

This is an important contribution to the literature of this subject. The fundamental principles of board foot log rules as developed by Daniels and by Clark, and discussed in Graves' *Mensuration*, are here again set forth in a still more complete and convincing form. A formula is given for the calculation of an elastic log rule which may be modified with change of widths of saw, average width of timber sawed, and average thickness of lumber.

Diagrams and analyses are given of the Spaulding, Scribner, and Doyle Rules, and the waste allowance shown in per cent of the product for logs of different diameters. For the Doyle Rule this varies from 191 per cent for 10″ logs, to 23.6 per cent for 50″ logs. It is shown that in principle the Doyle Rule is mathematically sound, but that it errs in providing too great an allowance for slabbing, and too small a loss in sawdust.

The author then develops a formula in which the slabbing allowance is found by subtracting a constant from the diameter, as in the Doyle Rule, and computing the board foot contents of the resultant enclosed cylinder. The sawdust allowance is based on the principle of saw kerf on the side as well as surface of each board and reads:

Volume of saw kerf = width of kerf × area of kerf.

The latter area amounts to width plus thickness of board plus width of kerf itself as may be seen from a diagram. The volume of the board plus kerf equals width of board plus kerf × thickness of board plus kerf. From these expressions the per cent of volume in sawdust is obtained, and the net per cent of product.

The method is probably a slight improvement over previous plans. Excessive taper in small logs, tending to increase the output, is allowed for by adding a constant.

In applying this rule, at Lassen, California, a saw kerf of 1/8″ width board of 12″, and thickness of 5/4″ was used. The constant subtracted for slab was 1″ from the diameter, instead of 4″ as in the

Doyle Rule. The constant for taper was +2. This gave a formula of $.942\ (D - 1)^2 + 2 = B\ M$ for 16-foot logs. A taper allowance of 1″ for 8-foot was allowed for other lengths.

The resultant log rule shows an almost constant excess of between 6 and 7 per cent over that given in Clark's International Rule, a result largely attributable to the 1¼″ thickness of lumber used as against 1″ in the International. For other widths of saw and thickness of dimensions, different results would be obtained.

For adoption as a State standard, these variable or elastic factors would have to be eliminated and a definite agreement reached. There cannot be as many log rules as there are different factors in sawing. The function of a log rule is to set a commercial standard for measurement. There will always be overrun or underrun from most mills, for any log rule, preferably the former. Inaccurate and falsely constructed log rules, however, should eventually give way to rules based on correct principles, and this bulletin is an aid to those seeking this result.

After analyzing the principles and formulae applying to many standard log rules now in use, the author shows when it is possible to convert a volume table of tree contents expressed in one rule into terms of a different rule, and when this transformation is not possible. This depends upon the construction of the respective rules. Tables made on the following rules can be so converted by using the proper factors, which are discussed:

Constantine, Saco River, Derby, Square of Three-fourths, Partridge, Vermont, Inscribed Square, Stillwell, Ake, Square of Two-thirds, Two-thirds, Orange River, Cumberland River, Bangor, Boynton, Parsons, Warner, Spaulding, Wilcox, Ropp, Favorite, Nineteen-Inch Standard, New Hampshire, Cube Rule, Twenty-two-Inch Standard, Twenty-four-Inch Standard, Seventeen-Inch Rule.

The Doyle and Scribner Rules cannot be transposed.

H. H. C.

Forests, Forestry, and the Lumber Industry in the United States of America. By M. Tkatchenko. Petrograd, Russia, 1914.

The author of this book, containing 273 pages and a large number of splendid illustrations and maps, is known to many foresters in this country. Mr. Tkatchenko spent almost an entire year in the United States and visited many of the National Forests, forest experiment stations, and the large lumber centers of the country. His report, which now appears as an official publication of the Russian Department of Forestry, shows a thorough understanding of American forest conditions and will undoubtedly prove of immense interest to the Russian foresters. As a matter of fact, except the impressions of Mr. Tichonov on American forestry, written nearly 17 years ago, Russian literature lacks publications on American forest conditions. Mr. Tichonov's articles touch upon a period in the development of forestry in this country which may not be so very remote in time, yet belong to a stage which we have long outlived and is a matter of history. Mr. Tkatchenko's book must, therefore, be considered as really the first Russian presentation and discussion of American forest problems. There are a few inaccuracies here and there, but on the whole it gives a true picture of the historical development of forestry in this country and an estimate of the activities of the Forest Service.

The book, however, lacks an analytical discussion of our forest practice in the light of Russian experience. American foresters, therefore, will not find in this book anything that will make their own work clearer to them or suggest any improvements. Possibly one of the statements which may interest American lumbermen and foresters is that Mr. Tkatchenko sees an opportunity for Russian hardwood lumber to be shipped to the Pacific Coast. According to Mr. Tkatchenko, the Pacific Coast is in need of hardwoods which do not grow there naturally and which are expensive to ship from the East where hardwood lumber, anyhow, is being exhausted. His opinion, therefore, is that a Russian exporter of hardwoods to the Pacific Coast may find there a market for his product. Another curious conclusion which he makes for the benefit of his Russian readers is the need of an editor in the Russian Department of Forestry who would go over all the different reports before they are published. American foresters, who have always admired European freedom of the authors to express themselves in their own way, even at some expense of printing, would be inclined to doubt the wisdom of introducing an editor in the Russian Department of Forestry who would act as a censor of manuscripts submitted for publication.

R. Z.

Second Annual Conference of the Woods Department, Berlin Mills Company. November, 1914. Pp. 48.

For elegance in bookmaking this report, issued for private distribution, takes easily first rank. In its make-up it is most worthy of the great company by which it is issued; paper and print and illustrations are first-class; and as far as they go, the articles, offerings by various members of the Woods Department of the Berlin Mills and allied industries, are "all right." But so far as forestry interests are concerned, they do not go far enough! What the forester would like to know is what the company is doing in introducing forestry and other conservative methods, since the company employs, according to its roster, not less than four men called "foresters," and has employed foresters, as far as the reviewer has knowledge, for more than a decade. Instead of the very general discussion on "Applied Forestry," by de Carteret, we would like to know how much of this theoretical knowledge has it been possible to apply in the woods; instead of the general article on "Forest Fire Protection" we would be interested to know what means the company has employed and with what success. And so with all seven articles of the contents; they lack the flavor of actual practice. Of course, we appreciate that the object of these meetings and of this report are of a private nature and probably mainly to bring the men—76 were reported in attendance—of the department together for the development of an *esprit de corps*; but, since the General Manager, Mr. W. R. Brown, is not only a Director of the American Forestry Association, but also a member of the New Hampshire Forestry Commission, and Vice-President of the Society for the Protection of New Hampshire Forests, we hope to induce him to consider whether some time he might not let us know about the actual application of forestry in the work of the company as far as such publication cannot harm the interests of the company.

One article which perhaps deserves special attention by foresters is Mr. S. S. Lockyer's "Logging Plan for a Hypothetical Valley," accompanied by maps, which perhaps hints at the actual work done by the foresters of the Company, and which shows a conscientious analysis of the situation, and systematic procedure.

B. E. F.

Extracts from the Bulletin of the Forest Experiment Station, Meguro, Tokyo. Bureau of Forestry, Department of Agriculture and Commerce. Tokyo, Japan. 1915. Pp. 221.

This elegant publication brings on 221 pages, with many excellent illustrations, tabulations and diagrams, the result of investigations during the period of 1905-14, at the Japanese Forest Experiment Station. Under 21 headings, as many different subjects are treated, some of general biological and other scientific interest, some of more local interest; each reported upon by some member of the Station, ten in number. The English, while perfectly intelligible, is sometimes quaint and unusual.

Dr. Shirasawa discusses the influences of derivation of seed, of course on Japanese material, and comes to some conclusions which do not quite tally with German and Swedish findings, *e. g.*, that seeds from young (20-30 year) trees are larger and show a better growth than that from older trees. Otherwise, the conclusion that the best tree seeds should be taken from a locality resembling in climate the place where the seeds are to be sown confirms the well-established European experience. An investigation into storing seeds does not bring out anything new.

The chemist furnishes analyses of fallen leaves and an investigation into the proper season of applying fertilizers to seedlings in the nursery.

Timber physics investigations refer to transverse strength of Japanese woods, in which the banal effect of knots is accentuated, and foresters are advised to pay attention to pruning; the caloric power of wood and electric resistance of wood, where it is shown that woods of high specific gravity offer far less resistance than those having low specific gravity, provided the amount of moisture is the same.

The charcoal-burning practices are described and investigations into temperatures and their results reported which coincide with the old findings of Violette; also the wood vinegar production as a by-product of charcoal-burning is discussed.

Researches on the culture of some edible fungi, *Cortinellus edodes* and *Tremella fuciformis* are of special interest.

Notes on fatty and essential oils, the tapping of lac, a number of fungus diseases, damage by white ants and coccids occupy some 70 pages. Then follows a very learned mathematical and philosophical discussion on the analytical interpretation of growth curves and its application for the construction of yield tables for *Cryptomeria japonica*, and form height tables for the principal conifers and some broad-leaved trees of Japan. Especially the former discussion reveals a highly scientific procedure with proper consideration of the pertinent literature, producing new formulae for the expression of growth relations. Nothing as learned has as yet appeared in the American press!

This publication sets a pace which is most promising not only for Japanese forestry, but for forestry literature in general.

B. E. F.

OTHER CURRENT LITERATURE

The Northern Hardwood Forests: Its Composition, Growth, and Management. By E. H. Frothingham. Bulletin 285, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1915. Pp. 80.

A treatise on the character of northern hardwood forests, their economic importance, and management. An appendix contains volume tables in board feet and cubic feet, and also form tables.

The author states that for the present, at least, management of these forests is largely a matter of Federal, State, or municipal, rather than of private, concern, since the practice of forestry by private owners is practicable only in the case of certain quick growing, valuable species, or where wood of small sizes is in steady demand, for slow-growing species under short rotations, or on estates maintained for recreation, hunting, or park purposes, in which the cost of maintenance is not charged against the stumpage value.

State Forestry Laws, Indiana, Minnesota, New Jersey, Washington. U. S. Department of Agriculture. Contributions from the Forest Service. Washington, D. C. 1915 and 1916. Pp. 5, 14, 7, 8.

Trail Construction on the National Forests. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1915. Pp. 69.

A valuable manual on this important subject.

Water Power Projects, Telephone, Telegraph, Power Transmission Lines on the National Forests. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1915. Pp. 90.

Regulations of the Secretary of Agriculture and instructions regarding applications for permits for water power projects under the Act of February 5, 1901, and for easements for telephone, telegraph and power transmission lines under the Act of March 4, 1911.

Cleveland, Deschutes, Pike, and Siuslaw National Forests. U. S. Department of Agriculture. Washington, D. C. 1915.

Maps and directions to tourists and campers.

Zacaton as a Paper-Making Material. By C. J. Brand and J. L. Merrill. Bulletin 309, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1915. Pp. 28.

The information contained in this bulletin was noted in F. Q., vol. XIII, pp. 574 f.

Larch Mistletoe: Some Economic Considerations of Its Injurious Effects. By J. R. Weir. Bulletin 317, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 27.

Utilization of American Flax Straw in the Paper and Fiber-Board Industry. By J. L. Merrill. Bulletin 322, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. Pp. 24.

Directions for Blueberry Culture, 1916. By F. V. Coville. Bulletin 334, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1915. Pp. 16.

The Bagworm, An Injurious Shade-Tree Insect. By L. O. Howard and F. H. Chittenden. Farmers' Bulletin 701, U. S. Department of Agriculture. Contribution from the Bureau of Entomology. Washington, D. C. 1916. Pp. 12.

Proceedings of the Society of American Foresters. Volume X. Number 4. Washington, D. C. October, 1915. Pp. 341-484.

Contains: In Memoriam: Robert Langdon Rogers; The Need of Working Plans on National Forests and the Policies Which Should Be Embodied in Them, by B. P. Kirkland; Regional Forest Plans, by D. T. Mason; Working Plans, by H. H. Chapman; New Aspect of Brush Disposal in Arizona and New Mexico, by W. H. Long; Brush Disposal in Lodgepole-Pine Cuttings, by D. T. Mason; Some Notes on Forest Ecology and Its Problems, by R. H. Boerker; Five Years' Growth on Douglas Fir Sample Plots, by T. T. Munger; Light Burning at Castle Rock, by S. B. Show; Uniformity in the Forest-Fire Legislation Affecting Railroad Operation and Lumbering, by P. T. Coolidge; Reviews.

Report of the Selby Smelter Commission. By J. A. Holmes, E. C. Franklin and R. C. Gould. Bulletin 98, Bureau of Mines, Department of the Interior. Washington, D. C. 1915. Pp. 528.

A contribution to the literature of metallurgical smoke in its relation to plant growth and to public health and comfort. It outlines what is believed to be a satisfactory method of dealing with legal controversies over the damage inflicted by mining and metallurgical establishments.

Our Foreign Trade in Farm and Forest Products. Prepared by P. Elliott. Bulletin 296, U. S. Department of Agriculture. Contribution from the Bureau of Crop Estimates. Washington, D. C. 1915. Pp. 51.

Of special interest to foresters are the statements in regard to logs, lumber and timber, naval stores, gums, and minor forest products, pp. 46-8 inclusive.

Fifth Annual Report of the New Hampshire State Tax Commission. Tax Year of 1915. Concord, N. H. 1915. Pp. 126.

The Red Rot of Conifers. By F. H. Abbott. Bulletin 191, Vermont Agricultural Experiment Station. Burlington, Vt. 1915. Pp. 20.

Report of the Circuit Tree Planting Committee. Massachusetts Forestry Association. Boston. 1915. Pp. 16.

Empire Forestry. Volume 1, Number 1. New York State College of Forestry. Syracuse, N. Y. January, 1915. Pp. 79.

Contains the following articles: The New York State College of Forestry at Syracuse University; Some Phases of Forestry in China; White Pine Plantations vs. Blister Blight and Weevil; Description of Canadian Woods Life; Forestry Club; Reconnaissance Survey in the Palisades Inter-State Park; The Gypsy Moth Problem in New England; Cruising in Quebec; Fire Patrolling in Vermont Under Weeks Law; Reconnaissance and Estimating in Lewis and Oswego Counties; Activities of the Student Body; Destructive Distillation of African Mahogany; Notes from the New York State Ranger School; A Description of Summer Work.

Forty-sixth Annual Report of the Park Commissioners of the City of Buffalo. Buffalo, N. Y. 1915. Pp. 118.

Some Economic Factors Influencing the Forestry Situation. By A. F. Hawes. Reprinted from Popular Science Monthly, August, 1915. Pp. 181-6.

Wood-Using Industries of West Virginia. By J. C. Willis and J. T. Harris. Bulletin 10, West Virginia Department of Agriculture. Charleston. 1915. Pp. 144.

Organization of Co-operative Forest Fire Protective Areas in North Carolina, Being the Proceedings of the Special Conference on Forest Fire Protection Held as Part of the Conference on Forestry Nature Study. Prepared by J. S. Holmes. Economic Paper, No. 42, North Carolina Geological and Economic Survey. Raleigh. 1915. Pp. 39.

Georgia State Forest School, Forest Club Annual. Volume I. Athens. 1916. Pp. 73.

Devoted to a miscellaneous set of popular articles on the Conservation of Natural Resources.

Forest Valuation. Volume II of Michigan Manual of Forestry. By Filibert Roth. Published by the author. Ann Arbor, Mich. 1916. Pp. 171. Price $1.50.

A Synopsis of the Game and Fish Laws of Michigan for 1915-16. Northern Forest Protection Association. Munising, Michigan.

Second Biennial Report of the State Forester of Kentucky, 1915. J. E. Barton, State Forester. Published by the Direction of the State Board of Forestry. Frankfort. Pp. 140.

Manual of Instructions for County Forest Wardens and District Forest Wardens. By J. E. Barton. Frankfort, Ky. 1915.

Standard Grades and Classifications of Cypress and Tupelo. The Southern Cypress Manufacturers' Association. New Orleans, La. 1916. Pp. 31.

Southern Yellow Pine Timbers Including Definition of the New "Density Rule." Southern Pine Association. New Orleans, La. 1915. Pp. 47.

Southern Yellow Pine Timbers Including Definition of the "Density Rule." Approved and Adopted by the Southern Pine Association. New Orleans, La. 1915. Pp. 19.

Deforestation and Reforestation as Affecting Climate, Rain and Production. By M. Wicks. Bulletin 17 (new series), Texas Department of Agriculture. Austin. Pp. 11.

Eighth Annual Report of the Washington Forest Fire Association, 1915. Seattle. 1915. Pp. 20.

Contains the following reports: Financial statement, Secretary's, Chief Fire Warden's; also a table showing burned areas and losses during the year, and a list of standing committees, and one showing the membership.

The report shows that a total of 97,352 acres were burned over during the year, 12,930 *M* feet of timber being killed and 4620 *M* feet of timber being destroyed. The losses from fires during 1915 were less than for any year, except 1913, since the Association was organized.

Proceedings of Forest Industry Conference of the Forest Protective Organizations of the Pacific Coast, Composing the Western Forestry and Conservation Association. Reprint from the *Timberman.* Portland, Ore. 1915. Pp. 30.

A Mill Scale Study of Western Yellow Pine. By H. E. McKenzie. Bulletin 6, California State Board of Forestry. Sacramento. 1915. Pp. 171.

The Manufacture of Ethyl Alcohol from Wood Waste: Preliminary Experiments on the Hydrolysis of White Spruce. By T. W. Kressman. Reprint from Journal of Industrial and Engineering Chemistry. August, 1914. Pp. 625, ff.

The Possibilities of Hardwood Distillation on the Pacific Coast. By R. C. Palmer. Reprint from Metallurgical and Chemical Engineering, October, 1914. Pp. 623, ff.

Forest Protection in Canada, 1913-14. Compiled under the direction of Clyde Leavitt, associated with C. D. Howe and J. H. White. Commission of Conservation of Canada. Ottawa. 1915. Pp. 317.

Game Preservation in the Rocky Mountains Forest Reserve. By W. N. Millar. Bulletin 51, Dominion Forestry Branch. Ottawa, Canada. 1915. Pp. 69.

Timber Conditions in the Smoky River Valley and Grande-Prairie Country. (Being a continuation of "*Timber Conditions in the Little Smoky River Valley.*") By J. A. Doucet. Bulletin 53, Dominion Forestry Branch. Ottawa, Canada. 1915. Pp. 55.

Report of the Superintendent of Water Powers for the Year Ending March 31, 1914. Part VIII, Annual Report, 1914. Department of the Interior. Ottawa, Canada. 1915. Pp. 309.

Combination or General Purpose Barns. Bulletin No. 1, Farm Building Series. British Columbia Department of Lands, Forest Service. Victoria, B. C. 1915. Pp. 54.

Sheep Barns. Bulletin No. 5, Farm Building Series. British Columbia Department of Lands, Forest Service. Victoria, B. C. 1915. Pp. 34.

Piggeries and Smoke Houses. Bulletin No. 6, Farm Building Series. British Columbia Department of Lands, Forest Service. Victoria, B. C. 1915. Pp. 38.

Poultry Houses. Bulletin No. 7, Farm Building Series. British Columbia Department of Lands, Forest Service. Victoria, B. C. 1915. Pp. 35.

Implement Sheds and Granaries. Bulletin No. 8, Farm Building Series. British Columbia Department of Lands, Forest Service. Victoria, B. C. 1915. Pp. 38.

Directory of the Milling Industry in Canada. Compiled by E. S. Bates. Industrial and Educational Press, Limited. Montreal, Canada. 1915. Pp. 116.

Progress Report of Forest Administration in the Punjab for the Year 1913-14, with a Quinquennial Review. Lahore, India. 1914. Pp. 20 + civ.

Annual Progress Report Upon State Forest Administration in South Australia for the Year 1914-15. By W. Gill. Adelaide. 1915. Pp. 13.

Report on State Nurseries and Plantations for the year 1914-15. By J. McKenzie. Department of Lands and Survey, New Zealand. Wellington. 1915. Pp. 69.

Of interest in this report are the notes on "Various Schemes for Training Officers in England and Scotland."

Structural Qualities of British Columbia Fir (Pseudotsuga taxifolia). By H. R. MacMillan. (Special Paper.) Reprinted from Minutes of Proceedings of the South African Society of Civil Engineers. Cape Town, S. A. 1915. Pp. 15.

Report of the Agricultural Department, St. Lucia, 1913-15. Issued by the Imperial Commission of Agriculture for the West Indies. Barbadoes. 1914. Pp. 33.

Report of the Agricultural Department, St. Lucia, 1914-15. Issued by the Imperial Commission of Agriculture for the West Indies. Barbadoes. 1915. Pp. 30.

Waldbrandversicherung. Ein Leitfaden für die Versicherungsnahme und Schadenregulierung. Von Dr. C. Ludwig. Aachen. 1914. Pp. 80. Mk. 2.50.

Die Bodenkolloide. Eine Ergänzung für die üblichen Lehrbücher der Bodenkunde. Von Dr. P. Ehrenberg. Dresden and Leipzig. Pp. 563. Mk. 14.50.

Contains the essentials of the new chemistry of colloids.

Biologie der Pflanzen. Von R. v. Wiesner. 3d (increased) edition. Vienna. K. 11.40.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

Swiss Forestry

Dr. Martin resumes his critical discussion of methods, technical and political, of various forest administrations on the basis of his travels by a long chapter on conditions in Switzerland compared with those in Germany.

We advise any American forester who contemplates visiting the continent for study to take advantage of informing himself in advance under the guidance of this competent critic.

Switzerland is forestally exceedingly interesting on account of the great variety of conditions. Differences of altitude, exposure, slope with a variety of climatic conditions vary the behavior of species. Soil conditions are exceedingly varied in chemical and physical directions according to the rock from which derived. Political conditions also vary, and the history of forestry in the different cantons varies, as well as present administrative and managerial conditions. Switzerland teaches better than any other land that it is necessary in developing forest management to bring to issue two different directions: centralization and decentralization, general rules of management and regard to special local conditions.

The discussion takes up first site conditions, then silvicultural methods, regeneration and thinning practice; aims and methods of forest organization; finally, aims of forest policy.

The forest per cent is 20.6, or relating it only to the productive area 27.7 per cent, very unevenly distributed. The State owns only 4.6 per cent; the bulk, 66.8 per cent is in municipal ownership, leaving only 28.5 per cent to private owners. We can single out only a few points of interest.

The site optimum is, of course, for oak in the lowest, broad valleys and southern exposures; for beech and fir at 400 to 800 *m*, for spruce between 800 and 1200 *m*. The timberlimit, indicated by *Pinus cembra* and Larix, and not far from these, for the spruce lies in the Alps between 1650 and 2200 meter, and on the Jura at 1500 *m*. These elevations are considerably higher than those of the German mountains.

In Germany, humidity is the important factor found in minimum, hence silvicultural methods have to look carefully to avoid drying of the site, in Switzerland such care is entirely unnecessary, even to the extent of favoring exposure to the sun.

The differences of climate are indicated by the occurrence of fig, olive and chestnut forest forming in the southern cantons up to the cessation of tree growth at timberlimit, through the broadleaf forest of oak and beech, the mixed broadleaf and conifer, then the spruce and finally the White pine and larch.

Frost danger is small in the mountains, due to fogs and late opening of vegetation. Wind danger is also less than one would expect, due to the break of the wind by the mountain configuration. Significant, however, is the Föhn, corresponding to our Chinook winds, which sometimes necessitate to locate felling series from North to South. Otherwise localized direction of wind must be studied.

The soils vary, alluvial and diluvial deposits continue to form. Tertiary formation is found in the parts between Jura and Alps and chalk formation especially around the foot of the Jura. Silurian and Devonian formations are rare, but the crystalline gneisses and slates abound, as well as the various granites, while porphyry and basalt are rare. Here a close connection between soil quality and rock is observed.

Spruce is most widely distributed and forms about 40 per cent of the forest. Stands are characterized by even growth, completeness, large stem number, large cross section area and volume, and low bark per cent, excellent quality, even grain, freedom from damage. Its management is very easy, since it keeps a close cover, preventing undergrowth, has the capacity to recuperate from suppression and responds to thinning practice of any kind readily. Pure stands are financially best, admixtures bring economic detriment, except with beech, merely in small proportion; even below 5 per cent. Going up from the optimum between 800 to 1,000 *m*, growth conditions rapidly change, decreasing in development in all directions until close stands cease to exist and in 200 years is accomplished what can be produced in 100 years on its proper site. A 189-year old stand at 1830 *m* elevation exhibited still 440 stems with a basal area of only 258 square feet, a height of 60 feet and an average diameter of 11 inches, not less than 17 years to the inch.

The question whether to propagate spruce in the warmer situations than its optimum is a most important one. The success in this respect in Switzerland is phenomenal if compared with German results. Stands with an annual increment of 430 cubic feet between 30 and 40 years of age have been recorded, and the average of measurements in the hill country, shows a culmination of average increment on I site with 408 cubic feet in the 30th year, on II site with 326 cubic feet; even the poorest site shows at 60 years an average of 130 cubic feet.

Nevertheless, after the 60th year these remarkable rates collapse, the stands open and undergrowth appears, rot starts; hence after all, in these sites pure spruce stands are undesirable and the species must become merely an admixture.

Fir also finds favorable sites, but occurs more rarely in pure stands. In the city forests of Biel at 850 *m* a stand with a basal area of 297 square feet and 13,320 cubic feet, 23 inch average diameter at 140 years is cited. The adaptation to the warmer sites together with the ease of propagation, that fir improves the soil, is not liable to damage, can utilize the light for increased increment, is a first-class producer, and adapted to mixed forest, leads the author to formulate the silvicultural policy to aim at mixed fir-spruce-beech growth with the fir predominant in the milder, the spruce in the cooler situations. Especially for selection forest, the fir is most fit.

Larch—a sound one 800 years old is mentioned—finds its best site between 1200 and 1800 *m*, although it goes over 2400 *m*, where, however, it would take at least 200 years to make a 16-inch tree. *Pinus cembra*, a timberline tree, hardly occurs in dense forest; its resistance against the ills of organic and inorganic nature, in which it excels all other species, and its valuable wood make it valuable in these high elevations, also as bulwark against avalanches.

Of Scotch pine more is found than one would expect, up to 1700 *m*. It is the best species for afforestation of mountain wastes and sunny heads and slopes.

Beech is mainly valuable in mixing with the conifers and as soil improver. Lately, its technological use has increased. Its silviculture in the mild situations is easier than in most parts of Germany, due to absence of frost and greater tolerance in the humid climate. The other broadleaf trees are of minor importance.

That growth conditions are more favorable in Switzerland than in Germany is shown by a comparison of yield tables. To be sure, those of the alpine sites differ greatly from those of the hill country. The comparison with the latter shows a great difference in numbers per acre, hardly any in height, but again considerable difference in volumes. The following figures refer to spruce on III site, the Swiss site, though corresponding in height, producing at much better rate.

	Stem Number	Height	Diameter	Basal Area	Volume	Thinnings Amount	Per Cent of Final Yield	Current Increment	Average Increment
60 *Year:*									
Swiss...	842	56	7	208	7865	2360	23	226	173
German.	596	53	7	151	5506	2431	31	215	132
100 *Year:*									
Swiss...	352	84	11	247	11798	6292	35	152	182
German.	258	83	11	169	7822	6750	46	137	146

As regards sytems of management, Martin points out a difference of attitude regarding selection forest in Switzerland and Germany.

In the latter country, the objection to and the reduction of the selection forest dates from the 17th and 18th centuries, with Cotta and Hartig leading the objectors in the 19th century; the acknowledged advantages of the system being decidedly outweighed by the disadvantages except in certain locations.

In Switzerland the selection forest occupies over 35 per cent of the total forest area, in private forest even over 41 per cent, and many Swiss foresters sing its praise and the cantonal forest administration of Bern has stopped converting its selection forests into even-aged timber forest. The soil, it is claimed, is best protected. In a sample area, 186 per cent fir, 11 per cent spruce, 3 per cent beech, by measuring crown diameters the crown cover per hectare was found for the main stand (over 36 *cm*) 2702 *qm*, for the side stand (21-35 *cm*) 3691 *qm*, for the undergrowth (12-21 *cm*) 2310 *qm*, to which add for the young reproduction 4500 *qm*, or altogether a crown of 13,200 *qm*, *i. e.* one third of the hectare is twice covered, which is possible only due to the tolerance of fir and its ability to establish in the shade its young generation. But such conditions are by no means to be found everywhere, for instance not in most German conditions, where deterioration of the soil through undesirable undergrowth is frequently met. In the selection forest assistance in this respect is impracticable, while in the uniform forest with clearing this is possible by underplanting and otherwise so that it can be asserted, *soil conditions in many German forests have improved through change to a clearing system and planting of pine.* The city forest of Zürich is also cited, where a clearing system has been in vogue four centuries and soil conditions are mostly excellent.

The claim that selection forest on account of the protection of the soil was a better producer could also not be maintained; the retardation under the shade in the early development is never lost; the form of the crown in the selection forest is not as favorable to the utilization of the light as the less spreading, conical crown of the timber forest. Spruces with their slender, conical crown in close crown cover at 30 to 50 years can produce up to 425 cubic feet per annum, more than any figures reported from selection forest; the average production in the Swiss hill country is 256, 215, 172, 143 cubic feet for the four site classes, as good a product as any selection forest.

Similarly, the value production, if average conditions are taken and not only the best trees, lags behind the timber forest; more taper, more branchwood and knotty material balance the possibly greater diameter development.

Nevertheless, selection forest may be managed profitably under favorable conditions; both volume and value increment in the young age classes being very small, due to suppression, they improve in later life, so that at 120 years with 12 inch diameters the two increments present still 5 per cent and at 140 years with 16 inch diameter still about 4 per cent.

While economic considerations will hardly lead one to the selection forest, its undoubted value lies in its resistance to damage by wind, snow, frost, fire, etc.

Judgments on the value of these methods of management can, however, have no general value; they can have reference only to given cases and conditions. Admitted must be that in Switzerland the moments which condition the selection forest are much more strongly present than in Germany.

In similar fashion, Dr. Martin discusses the practices of Swiss foresters in regeneration, species by species. A consideration of the question whether natural regeneration or artificial reforestation is preferable leads to a cautious résumé.

To secure satisfactory natural regeneration, certain conditions must exist; if they do exist then this regeneration is in every essential respect satisfactory; but if they are lacking, the attempt to practise it leads to economic sacrifices and evils which grow worse the longer one persists.

Die wichtigsten forsttechnischen und forstpolitischen Verhältnisse und Massnahmen in der Schweiz mit Bezugnahme auf den gegenwärtigen Stand der Forstwirtschaft in Deutschland. Tharandter Forstliches Jahrbuch, 66 Band, 1915, pp. 159–94, 253–80, 329–49, Fortzetzung.

Swiss Forest Conditions

In connection with the above critical discussion of Swiss forestry practices readers will be glad to have the official publication, *Die forstlichen Verhältnisse der Schweiz,* published by the Swiss forestry association in 1914, covering the statistics, history, legislation, description, organization and practices in detail on 242 pages. A brief review may be found in the journal referred to below.

Allgemeine Forst- und Jagd-Zeitung, July, 1915, pp. 171–6.

Management of a Forest in Alsace

A. S. (probably Schaeffer, formerly Chief of Management at Grenoble, and now Conservator) gives an interesting management review of a "forest in Alsace," which covers ground captured by the Allies. The oak comprises the most important species, although the beech has an important place, especially for soil cover. When this forest was taken over by the Germans at the end of the Franco-Prussian war, it was chiefly coppice under standards and simple coppice.

For a long time, apparently, the frequent clear cutting of coppice lowered the soil quality and decreased the percentage of valuable species. The ground ran wild to a certain extent and the beech reserves suffered from bark scald. The average yield for 30 years on an average rotation of 27 years was 6.44 cubic metres per hectare. In addition to the sale of wood, the collection of dead wood was authorized in summer one day a week and in winter two days a week. The open fields and the hunting privileges were rented. Originally, the transformation to high forest of the entire area was recommended and the Germans continued this conversion, but, on account of demands of the local commune, restricted the conversion to a quarter of the area. The remainder was treated as coppice under standards, but the rotation for the coppice was reduced from 27 to 24 years to permit an increased annual cut in the coppice made necessary by the increased restriction of cutting in the area under conversion. The openings were being restocked as rapidly as possible with fast growing species, notably beech, spruce and ash, and, to a less extent, with oak, elm, maple and alder. In order to increase the percentage of the beech, the soil was raked around and under seed trees before seed years.

It will be interesting to see what changes, if any, are made in the management of this forest and other Alsatian forests by French Administration after the war is over. Apparently the Germans made no radical changes from the method of treatment followed by the French. T. S. W., Jr.

Revue des Eaux et Forêts, December 1, 1915, pp. 745–751.

The Karst

J. Reynard gives an interesting account of the famous Karst plateau on the left bank of the Isonzo River, where the Italians and Austrians are now fighting. The deforestation of this region is well known. Formerly, the Karst was covered with splendid oak and beech forests which were cut by the Romans and the Republic of Venice for the construction of their navies. This overcutting was followed by heavy grazing by goats and sheep which resulted in almost complete deforestation on account of the accompanying conflagrations. Reynard explains that the Karst plateau is valuable for nothing except forests and that, although Austria commenced reforestation, there are still large denuded areas. He points out that if that region is captured by the Italians, their first duty will be to take up more actively its forestation, since it is today almost uninhabited and requires forests for protection against the famous Bora tempest. T. S. W., Jr.

Revue des Eaux et Forêts, December 1, 1915, pp. 756–757.

Alluvial Plains Forest in the Punjab

Coventry contributes an exceedingly interesting article on the so-called Jand forests in the Punjab, British India. The similarity of local conditions between these areas and the semi-desert brush land in the southwest and in southern California is quite marked. In the Punjab, the hot weather lasts from April 15 until the middle of October. The hottest month is June, when the average mean temperature for the month is 93° F. Maximum temperatures of 115° to 120° F. are frequent occurrences. Scorching winds blow during May and June and sandstorms are frequent. The rainfall varies from 5 inches to 30 inches, decreasing as you proceed from the hills. The general slope is in a southwest direction from the hills to the Indus River, varying from 2,000 to 300 feet in elevation. Topographic features are high, newly formed plains, due to erosion of the soil by flood waters; lowland, subject to river inundation; intermediate land above flood level; high bar land with deep water level. The soil is quite fertile and with irrigation produces excellent crops, except where there is an excess of sodium salts.

The Jand (*Prosopis sicigera*) rarely exceeds 30 to 40 feet in height, or a diameter of 12 to 15 inches. It is intolerant, with scanty foliage. Its most important characteristic is its exceedingly long taproot which has been known to penetrate to a vertical depth of 64 feet. It forms root suckers and coppices freely. Where goat grazing is allowed, it assumes a bush-like growth due to constant browsing. It makes excellent firewood and charcoal. Associate species are the wan (*Salvadora oleoides*) and haril (*Sapparis aphylla*). It is possible to travel through hundreds of miles of these forests "and yet not find a single young seedling." The usual explanation for this has been from grazing or a change of climate. There are large areas where Jand forests must have occupied the ground in spite of the low rainfall. That they have been able to do so, is on account of the long taproot which reaches the sub-soil water supply. Attempts to raise Jand artifically without irrigation has failed. With irrigation, plantations have been successful. The writer concludes that practically all the plains must have once been covered with these Jand forests, pure and in mixture with other species. With the increase of cultivation, the forests were driven to the more arid areas and "the time, in fact, does not seem far distant when probably the whole of the Jand forests in the Punjab will be wiped out of existence by being replaced by cultivation."

T. S. W., Jr.

The Indian Forester, September, 1915, pp. 307–315.

The Olive of The Punjab

H. O. Coventry writes interestingly of the native Punjab olive (*Oleo cuspidata*). In India it withstands heat, drought, and moderate frosts during the winter months. The mean annual rainfall varies from 15 to 30 inches. It grows on high alluvial plains and low lying hills, but requires a good depth of soil. Reproduction from seed is poor on account of grazing, but it coppices and root suckers readily. The overgrazing naturally results in the absence of humus. The forests are used for firewood, poles and for fodder. The firewood return is estimated to average about 300 cubic feet (stacked) per acre. The tree attains a height of 30 to 40 feet and a diameter up to 24 inches; it develops a long taproot and is slow in the first few years' growth. This species should unquestionably be tried out by experimenters in southern California, since, apparently, it would be admirably adapted to some of the hills around Los Angeles and San Diego. T. S. W., Jr.

The Indian Forester, November, 1915, pp. 391–8.

BOTANY AND ZOOLOGY

Ethology of the Fauna in Beech Forest

Under this rarely used term Dr. Sedlaczek of the Austrian Experiment Station depicts the character of the animal world in the beech forest in a most fascinating and practically useful manner on around 80 pages. To explain the term the author states: "biology, the doctrine of the life activities of animals, may be divided into two parts: physiology, which treats of the functions of organs, and ethology, which describes the life of the animal as an individual, and especially its relations to the environment." "The object of ethological studies is to explain scientifically the occurrences in the outer life of a definite group of animals and thus to secure a safe basis for practical application," in the present case for forest protection. (This would make ethology the philosophical part of ecology and phenology! Ed.)

Usually these studies, as far as forest protection is involved, have concerned themselves with the ethology of the single species. The author, perhaps for the first time, discusses groups of species, indeed the entire fauna in combination in connection with their special habitat—what is called biocoenosis.

By combining all the animal forms which live under the same life conditions, such as a forest type at one and the same period of the year offers, he hopes to secure principles for the biology of the forest fauna.

The elements of such ethological system are:

1. The influences which the condition of the soil of a given site exercise;

2. The influences of humidity, free water and soil water, modified by site and weather conditions in different seasons;

3. The influences of air, temperature, light, also changing with the season;

4. The influences which vegetation exercises, on one hand depending on the same factors which are determinative for the fauna, but nevertheless forming an independent factor in the development of the flora.

The author then enumerates forest types and locality types, each of which would present different faunas, in part consisting of elements which in the particular site are always and persistently present, and in part only temporarily, changing with the season.

In every such habitat the elements of the fauna are again differently distributed, and *e. g.* in the forest can be classified according to their existence in certain layers.

Such characteristic groups are:

I. Animals of the soil (terricol fauna):

- *a.*) All animals living underground;
- *b.*) The species living on roots;
- *c.*) Inhabitants of humus;
- *d.*) Those living in the litter.

II. Animals of the soil flora and undergrowth:

- *a.*) Most larger game animals;
- *b.*) Reptiles and amphibians of the forest;
- *c.*) Gastropoda (snails);
- *d.*) Insects of soil fauna and undergrowth;
- *e.*) Spiders and other small animals.

III. Animals which inhabit the trees above ground:

- *a.*) Ornis (birds);
- *b.*) A few mammals;
- *c.*) Insects:
  - *1.*) On trunks;
  - *2.*) In the wood;
  - *3.*) In the crown.

Next, a division of the year into periods is necessary to study the relationship of the animals and its change with the season. This division cannot be made analogous to that of the botanist, because the development of the fauna, although to some extent synchronous with the flora, does not entirely coincide; flowering and animal propagation, ripening and births occur at different periods. Winter does not occasion such cessation in the animal world as in the flora. Early summer is the time in which all animals are in their babyhood, hence this is the time to begin the study.

The most characteristic forest fauna will be found in a stand of a shade-enduring species like the beech. The author then proceeds to describe in great detail, according to the schedule above regarding the layering or grouping of the environment, the fauna of the beech forest in early summer, in high summer, in autumn, in winter and in spring.

His description is not a mere enumeration of species, but full with glimpses into the life of the animals and their mutual interdependence, each season ending with a discussion of the bearing of the information on forest protective measures, which are critically discussed from biological and practical points of view.

It would lead us too far to given even a sample of the fascinating story which the author develops, especially as it deals with species and conditions foreign to us, but the study of the method is recommended to our forest ecologists.

Die Ethologie der Tierwelt des Buchenwaldes. Centralblatt für das gesammte Forstwesen, January-February, March-April, May-June, 1915, pp. 24–50, 102–30.

Laws of Tree Growth

In a detailed discussion, on the basis of a large array of data in tabulations and curves, von Guttenberg disproves the three theories which attempt to explain the form of trees, namely Pressler's, Metzger's and Jaccard's. As is well known, Pressler explains the tree form, physiologically, by conditions of nutrition, as a function of the active crown; Metzger bases his theory on static laws, recognizing the form as a reaction to wind pressure —a girder or pillar constructed with a view of offering resistance to bending pressure. Jaccard returns in part to the physiological explanation and sees the cause in the requirement of equal water conductivity throughout the annual ring. None of these theories explains satisfactorily all the exhibitions of form, varying from species to species, from age to age, from site to site, from stem class to stem class.

The author uses a large number of stem analyses of spruce, fir, pine, larch, beech, oak, tabulated for comparison of diameter and area development at different heights of trees of all sorts of conditions, and finally draws the following conclusions.

1. The form of stems unquestionably in the main is built according to static laws, since the stem as carrier of the crown, must be able to resist the pressure of air movements against bending and against overthrow; but by no means is it necessary to react so precisely as Metzger would make us believe. Nature is wasteful, and even here does not work economically.

2. Pressler's assertion that the food materials elaborated by the foliage distribute themselves evenly along the shaft from the crown downward, that, therefore, area and volume increment at any cross section below the crown is approximately the same, in the crown, however proportionate to the leaf surface above the section, is—even if we leave out the unlawful accumulation at the root collar—not entirely supported by the facts, since the area increment even in the middle part of the stem generally decreases upward and occasionally remains the same for a distance.

The same may be said regarding Jaccard's or Deccopet's theory, that equal water conductivity requirement is determinative, for this also supposes an equal area increment in all cross sections from the crown downward, especially since Guttenberg found that the width of the annual ring and, therefore, still more the area increment, increases in the lower part of the stem from 16 to 26 feet downward.

3. The behavior of diameter increment in the stem at varying heights differs with different species and, therefore, the resulting tree form must be considered as a characteristic belonging to the species.

In youth, the *ring width* decreases and that rapidly from the breast height to the top. Later, the same condition exists up to a point which changes with age, beyond which the ring width increases at first slowly, towards the crown at increasing rate. In pine and oak, this first decrease of the ring width and diameter in the lower part is most rapid and up to a highest point at 24 to 30 feet, less in beech and least in fir. Beyond this point of smallest ring width, the increase in spruce, fir and pine is progressive up to nearly the tip, so that the ring width is largest in the upper part, on the average 2 to 2.5 times the width at breast height.

In beech and oak on the contrary, after the increase in the middle part, in the crown and toward the top a rapid decrease of diameter increment takes place, so that it may sink below that of the increment at breast height.

From the point at breast height down almost in all cases, and especially in spruce, an increase of ring width is found, so that at one foot from the ground, stump height, it is in spruce 20 to 40 per cent, in other species 10 to 20 per cent, larger than at breast height. Only exceptionally, in the youngest age classes the stump shows the same or even a smaller ring width.

4. The *cross section area increment* decreases generally from base to top, and that rapidly up to 10 or 16 feet, only little in the middle part, and again more rapidly toward the top. In the youngest age classes this decrease is rapid. Only in pine and fir, and occasionally in spruce has an equal or even slightly increasing area increment been observed in the middle portion of the stem.

5. The influence of site shows itself in that on poorer sites, with smaller height development, the diameter increment (ring width) increases more rapidly and the area increment decreases more rapidly than on better sites. Also the increase is less on the poorer sites of both increments than in the tall stems of the better sites.

6. Density, closer and opener stand, has an influence, at least on spruce, in that the lower stem classes show a still greater increase of ring width towards the top, up to 3 and 3.5 times that at breast height than the better stem classes, and while in the latter the area increment in the middle portion invariably decreases, in the lower stem classes it remains even or even increases somewhat. The root collar is also more developed in

the dominant trees. Hence the well-known cylindrical form of the lower tree classes.

7. In older trees, which are liberated, a considerable change in increment and form takes place. The ring width invariably decreases upwards except, perhaps, in the middle portion, where it may remain even, and especially toward the root collar the ring width increases, the taper is accentuated. The same is observed in trees that grow up in the open. These changes in older trees are characteristic for the different species; only the spruce lacks somewhat in this respect.

8. Due to the difference in the disposal of substance each species shows a characteristically different form. Beech and fir are columnar, cylindrical to the base of the crown, then in the fir a parabolic top piece, in the beech a slender conical, and in later age neiloid form follows. Pine develops its top similar to fir, but in the lower trunk, especially below breast height, it is rapidly tapering, hence its form factor is considerably lower than that of fir. The spruce is slightly more tapering than the fir and beech, but very much less so than the pine, except again in the top pieces, hence its form factor lies between pine and fir.

(We would conclude that Pressler's theory is still good in explaining in general the development of tree form with slight changes which may be due to the dynamic needs accentuated by Metzger and Jaccard. Rev.)

Die Formausbildung der Baumstämme. Oesterreichische Vierteljahrsschrift für Forstwesen, 1915, pp. 217–62.

SOIL, WATER AND CLIMATE

Forest Influence on Snow

Five years of records near Flagstaff, Arizona, indicate that the snowfall in the forest and adjacent grass and farm land park is the same; but that the rate of melting is different. In the park the minimum temperatures are lower and the maxima are higher than those in the forest. Thus the soil in the park is generally frozen before the winter snow cover is established, while in the forest the soil may freeze only in a few spots. Any water from melting snow in winter forms an ice layer at the base of the snow cover in the park, but sinks into the ground in the forest. In winter on account of the generally higher temperatures and the heating of the local bare spots and trees, the snow melts more rapidly in the forest than in the park. In spring, on the contrary, the formation of slush, the strong sunshine, and higher wind velocity in the park cause the snow to melt a week, or even more than two weeks, before the last drifts of snow in the forest. The frozen soil and the basal ice layer in the park allow the water to run off very rapidly, while only occasionally is there any surface run-off in the forest. The value of open forest for water conservation is evident.

The Influence of a Western Yellow Pine Forest on the Accumulation and Melting of Snow. Science, 1916, p. 213.

SILVICULTURE, PROTECTION AND EXTENSION

Cultural Experiments in Spacing

Dr. Schwappach reports on experiments in five lines of cultural experimentation, namely as to the influence of method in planting; the influence of different spacing; the result of mixing Scotch pine and *P. rigida;* the resistance to snowbreak in different spacings; the influence of early severe thinnings on spruce stands.

The author points out that most attempts to determine influence of method, relative value of planting tools, questions of cost, and a number of other similar inquiries have proved failures, often because too many experiments were started at once; because as far as costs are concerned, the small nursery experiment is not translatable into broad practice; because the influence of different methods and use of different tools is soon lost, and differences in results occur with the same method as striking as with different methods.

Of the large number of experiments made in Prussia under observation for 30 years, only 14 are tabulated as of some value, and of these only 11 are of special use, mostly those with different spacings in pine and spruce. Plantations of pine with one-year, two-year seedlings and transplants, and three-year with ball do not show a notable difference, but on the whole the one-year pine deserves preference. The planting with ball is characterized by special height development of the 100 stoutest stems; otherwise shows no advantage.

In comparing the spacing of 3 feet and 5 feet, the wider spacing is found to favor height, diameter and basal area development, but from the age 27 to 31, the closer stand had the larger increment. At first the wider spacing showed spreading habit, but this has corrected itself satisfactorily.

Plantations of pine varying from 4444 to 10,000 plants per hectare at 34 years showed practically the same number of plants; but the looks of the stands varied; the wider spaced show irregular development, branchy, poor shaft form.

In a specially good example of spacings at 1, 1.25, 1.50 meter square, the closest spacing is most unfavorable, the widest spacing shows greatest increment and diameter, but poor form, while the middle spacing (4 feet) developed best height and basal area and better form.

Much more influence is found from spacing on *poor* sites than on good sites, the greater plant number, *i. e.*, the closer spacing, being unfavorable, and especially reducing the height growth. To secure close and in every way satisfactory polewood stands by no means the large number of plants usually planted seems necessary, 2400 to 4,000 giving the best result. Bunch planting has no value.

In spruce plantings the wider spacings, especially the 5-foot ones are superior in every respect to closer ones, but by the 30th year a thinning becomes necessary to permit sufficient crown development. The wider spacing helps even the height development. The general success of the wide spacing is specially noticeable on *better* sites, different from pine.

Curiously enough through a misunderstanding of American nomenclature *Pinus rigida,* one of our poorest "Pitch pines" was introduced in large quantity into Germany. It is now found, that the more abundant leaf fall of *P. rigida,* the early soil cover which it can afford, and the rapidity with which the Scotch pine outgrows it, make it desirable in mixture, when it shows a considerable increase in current increment as against pure stands (basal area .714 *sq. m.* as against .480).

An experiment to test snow-break danger shows that square spacing which permits even crown development on all sides is preferable to unequal spacing; also produces better increment. A comparison between a dense plantation of spruce which needs early thinning and an open plantation *à la* Schiffel, namely

$3\frac{1}{4}$ x 6.5, soon reduced to 6.5 foot square (1800 plants) shows in all directions advantage of the latter in increment of height, diameter, volume and in even development over a plantation with 2660 plants except in clearing of branches.

Die Ergebnisse forstlicher Kulturversuche. Zeitschrift für Forst- und Jagdwesen, February, 1915, pp. 65–84.

Value of Early Thinnings

Old teachers of silviculture and practitioners have held as an incontrovertible tenet that to secure good soil conditions crown cover must not be interrupted. Dr. Albert points out with Ramann that the critical period for pine on poor sites when it makes the most demand on the soil falls about the 30th year. Hence, a little before that time site conditions must be improved by thinnings—reduction in numbers, equalizing of crown space.

To furnish definite data to demonstrate the influence of such early thinning, pine thickets 20 to 25 years old were thinned, in some areas removing the brush, in others leaving it, and then investigating for two years the water conditions of the soil from week to week at 8 and 16 inch depth, sampling with borer and preserving the layering of the soil; check tests being made in each case and average curves constructed, which immediately showed the influence of the different treatment.

As was to be expected, the decrease in stem number produced not insignificant and continuous increase of water in the soil, and the leaving of the brush increased this considerably. This occurred at both depths. Numerically, the influence of the thinning increased the water contents 1.12 to 1.23 at the 8-inch depth; .71 to .74 at the 16-inch depth, to which for brush cover need to be added .59 to .64 and .53 to .88 respectively. These differences are not as small as they appear, for if translated into area figures it means 90 *cbm* per hectare, which for poor sand soils is a considerable addition. Sometimes the increases were as much as 3 per cent in the upper, and 2 per cent in the lower, strata during the summer months. It was also apparent that a larger accumulation of winter waters occurred in the thinned stands, reduced interception and evaporation from the crowns being responsible.

Comparison is also made with rainfall data, which confirms the influence of treatment.

Comparing an open field and the areas covered with brush brings out more fully the influence of the latter treatment: in the field from April to December the evaporation factor was 4.10 and 3.80 per cent, at the two depths under the brush 6.70 and 6 per cent respectively, showing a considerable influence of the latter treatment, which also reduces weed growth.

The early thinning under the conditions investigated presents itself as a rational procedure, as well as the leaving of the brush.

Ungünstiger Einfluss einer zu grossen Stammzahl auf den Wasserhaushalt geringer Kiefernböden. Zeitschrift für Forst- und Jagdwesen, April, 1915, pp. 241–8.

Aims of Seed Selection

After a lengthy discussion on the propriety of using the term *Zuchtwahl* (for which a good English equivalent seems to be lacking) as expressing the selection for breeding purposes of seeds from certain sites and individuals, Dr. Reuss claims that the subject from the forester's point of view was first broached and the term used in 1890 by Dr. Cieslar and himself; that to Dr. Cieslar belongs the credit of having in 1887 confirmed Bauer's finding that to the heavier seed corresponds a qualitatively better development of the plant; of having recognized the heredity of rate of increment; of having, in 1899, recommended the need of securing seed from similar site; of having recognized climatic varieties and the need of using seed from climatically similar stations; all of which facts have become basic and generally accepted.

The author himself began careful experiments in the direction of study of heredity in 1879 as regards the influence of the age of the mother tree, using spruce, of 12 to 143 years old, in a series of 15 trial plantations which are still under observation. The result was in favor of seed of medium old and older trees. He then cites findings of Cieslar (1895), according to which the weight of spruce seed generally declines with altitude, while according to Reuss with age of mother tree the weight of seed increases (the younger trees containing also much dead seed), hence the difficulty of judging seed derivation by weight.

While Engler and Kurdiani consider color of pine seed constantly hereditary, Reuss found that in spruce with age of mother tree the seed is darker. He then cites four or five authors disagreeing as to the influence of size of the seed on the young plant. All this discussion is to show the complexity of the problem of heredity and selection.

The author cites evidence of the heredity of growth forms, such as pyramidal shape, twisted grain, pendulous branching.

The résumé of the lengthy discussion is worded as follows: "The forestal selection for breeding, *i.e.*, the selection of the mother tree for seed, must have regard not only to climatic derivation of the seed, but also to the individual character of the mother tree, and make sure that the seed comes not only from perfectly mature (*zuchtreif*), but sound trees, which from the standpoint of the breeder appear without objection, and which up to the time of its use is kept in full breeding quality (*Zuchtgüte*)."

The author contends that consideration of the individuality of the seed tree has always prevailed in selecting the mother trees in natural regeneration. The same consideration must be given in collecting seed only from the best stock, and that means in the end collecting on own account.

But the author warns against drawing conclusions regarding heredity too hastily, for it is necessary to observe the development up to mature age.

Aufgaben und Ziele der forstlichen Zuchtwahl und ihre Neigung zur Kursänderung. Centralblatt für das gesammte Forstwesen, March-April, 1915, pp. 81–102.

Depth of Sowing

Forstmeister von Seelan undertook to find out the most favorable depth for sowing acorns. To this purpose he prepared six beds on entirely uniform soil, which was fresh, loose, limy loam, into which he sowed in rills 2, 4, 6, 8, 10, 12 *cm* deep, 240 acorns each, giving 2 *cm* space, laying acorns on their sides and covering loosely with soil without pressing—a method which he had successfully used on a large scale, using a hoe, lifting the surface and letting the chunk of earth drop back.

A table shows the progress of germination, the number surviving until spring, their total weight and per hundred weight with explanatory remarks regarding the character and development of the plants.

The 4 *cm* depth gave the earliest and most numerous germination and the largest number surviving (although the difference was not very great). Also the quality of the plants as regards root development and stem from this depth was best, but in weight the 2 *cm* and 8 *cm* produced the heaviest per hundred, and the latter the heaviest total weight. The 2 *cm* depth produced fewer, but good plants. The plants from greater than 4 *cm* depths showed a smaller number, a poorer development, and those from 10 and 12 *cm* depth, especially the latter, a much smaller weight. The author concludes that 4 *cm* (less than 2 inch) is the best depth, on lighter soils more, on heavy soils less.

Wie tief soll man Saateicheln legen? Zeitschrift für Forst- und Jagdwesen, October, 1915, pp. 601-4.

Thinnings in Douglas Fir

Kubelka's article on experimental thinnings of Douglas fir, which constitutes Part 2 of Bulletin XXVIII of the Austrian Experiment Station at Mariabrunn, is reviewed by Dr. Wimmer.

The thinnings were made in a stand of Douglas fir planted 1.3 x 1.5 meters apart in 1887 at an elevation of 600 meters on sandstone formation. In 1905, when the stand was 18 years old, thinnings of 3 grades were made:

I—light thinnings (*par le haut*) in the dominant

II—medium thinnings (*par le bas*) in the subdominant

III—heavy thinnings (*par le bas*) in the subdominant.

Kubelka concludes that a heavy thinning results in the greatest increment, and therefore recommends that Douglas fir be closely spaced when planted (4,500-5,000 plants per hectare) but that the thinnings be so made that the trees chosen for the final stand have a wide spacing.

A. B. R.

Mitteilungen aus dem forstlichen Versuchswesen Oesterreichs. Allgemeine Forst- und Jagd-Zeitung, May, 1915, pp. 122–5.

Lime Effect on Growth

An investigation was started at the Royal Agricultural College, Circencester, in 1914, by Hopkinson and Elkington, the object of which was to ascertain the effect of varying quantities of calcium carbonate on the growth and development of certain conifers. Douglas fir (*Pseudotsuga douglasii* Carr) was the species selected, since it is supposed to be calcifuge. Two-year seedlings were obtained from a district where the soil contained insufficient calcium carbonate to affect their growth. Artificial soils were made from sand free from lime, 5 per cent of leaf mold obtained from a beech wood, and varying quantities of calcium carbonate in the form of ground chalk. The soils were placed in specially prepared concrete pits, which were similarly situated and all adjoining, and the seedlings, 25 to a pit, were planted at equal distances from one another. The seedlings were planted in March and measured in the following May. Their heights were again taken in the May of the present year.

The conclusions which can be drawn from the experiments are summarized as follows:

1) Douglas fir grows well in sandy soil with small amounts of calcium carbonate;

2) Increasing quantities of calcium carbonate, up to 8 per cent, have a distinct retarding effect on their growth;

3) Above 8 per cent of calcium carbonate, some factor, whose influence has not yet been established, dominates this retarding effect of the lime. R. Z.

Investigation into the Retarding Effect of Lime on the Growth of Conifers. Agricultural Students' Gazette, New Series, Volume XVII, Part 4, July, 1915, pp. 176-8.

Red Cedar Forest in Germany

The well-known pencil manufacturers, Faber, 40 years ago, planted 15 acres of *Juniperus virginiana* near Nürnberg. The trees on the outer edge of this successful plantation are now 26 feet in height and 7 inches in diameter, the interior trees 5 inch, showing a very fair rate of growth. The plantation was made on a light sand soil with 3-year-old, twice transplanted stock in 3.5 feet spacing.

Other attempts at introducing the species near Munich and in other severer climate proved a failure, mild climate appearing assential.

Der Zedernwald bei Stein-Nürnberg. Forstwissenschaftliches Centralblatt. June, 1915, pp. 286-7.

Mushrooms and Forestry

While in Germany mushrooms have always played a rôle in the food supply and are regularly found in the market, the need, created by the war, in making every source of food supply more intensely available, has directed attention to the possibility of utilizing and propagating this vegetable to a greater extent. A number of articles in journals and a number of books on edible fungi, their recognition, their value, their cultivation, their preparation, etc., have been the result.

It is stated that over 100 species of edible fungi exist in Germany, of which hardly ten are in the market, while only six poisonous species need to be known. To make sure that no poisonous fungi are offered, the city of Koenigsberg lately instituted a fungus examination office where, free of charge, identification is made for citizens, and against a small charge for outsiders.

Dr. Falk in a long article covers the ground quite fully. He points out that since about one quarter of the German soil is under forest, withdrawn from food production, it is incumbent on the mycologist to determine how a rational soil culture can make the forest useful in this direction. Since strawberries have become articles of horticulture, and huckleberries on account of their raw humus formation are a damage to the soil, fungi alone may be made objects of culture, for which they are specially fit in the forest, since they are independent of light, hence adapted even to dense young stand; moreover, the best condition not only is furnished them by a true forest soil, but they improve the soil by preventing with their mycelia the formation of raw humus. Whether this may be asserted as regards the mycelia of edible fungi is, to be sure, not yet quite certain; at least they can not be damaging to the soil. This is certain, that due to the now extensive exploitation of the natural growth of edible fungi without attempt of their propagation, the non-edible fungi and bacteria are favored. Hence means must be taken to favor the edible ones, either by improving their growth conditions or by actual, more or less intensive cultivation.

The improvement would consist in removing non-edible fungi by merely pushing them over and allowing edible ones, if existing, to remain until they naturally decay and fully seed the ground. This method would not lead to a rapid extension.

It is pointed out that the spores are too minute to be collected from the caps, and at the same time for natural seeding it is necessary for the fungus to stand upright, since the spores are not dispersed, or only with difficulty if the hymenophores (gills) are not placed vertically. In some species a few degrees deviation from the vertical arrests spore dispersal. If, therefore, one wanted to use the mushroom itself for seeding, it would be necessary to place it on pointed sticks, so that the cap stands horizontal, a little higher than it stood, for wider dispersal. This is best done in windstill weather, since otherwise an uneven seeding would result.

Another way is to collect the spores by cutting the fungus off so that the cap will stand only slightly above the glass or paper on which it is placed, leaving small space between the glass and cap; then washing the spores together with plenty of water and sowing them from a watering pot with fine rose.

Intensive culture is indicated from a forester's point of view, where raw humus is beginning to form. The crop must then be started by inoculation in patches which are not yet humified, when it will spread and presumably change the raw humus.

The sowing should then be made with mycelium, which has been grown in pure cultures; the stumps in the woods of freshly felled trees furnish a good substratum. The Mycological Institute of the forest academy at Eberswalde is now prepared to furnish seed material in plenty of several species, such as *Psalliota campestris, silvatica; Armillaria excoriata; Tricholoma graveolens, gambosus, borealis;* besides *Agaricus campestris.* Cultures of Boletus and truffle have not yet succeeded.

By analysis of various vegetables and lean beef in comparison with Agaricus, it appears that the fungus contents may most nearly approach the vegetables in nitrogen, especially in the fresh state, on account of the water contents. In the dry substance the three materials compare as follows in regard to nitrogen: mushroom 7.59 per cent; vegetables 3.94 per cent; meat 13.98 per cent. Yet, since in frying and cooking, mushrooms lose more water than meat does, the composition of the two foods when prepared comes closer, and the position as regards nutritive elements places the fungus in all directions halfway between the two. Whatever of nitrogen compounds is soluble may be considered digestible.

A thorough investigation into the composition of mushroom extract compared with beef extract was made, when it appeared that the dry substance of mushrooms contained three times as much material extractible with water as the meat extract.

The value of the mushroom as food (nutrition plus palatableness) is to be measured by the extract materials.

The author refers to the use of yeast extract as substitute for meat extract, in commerce under the name of Sitogen and Ovos, which approaches in extractibles the mushroom extract, but not in delicacy of taste. While the three extracts do not differ very essentially in amounts of organic substance, nitrogen contents and ash, the composition of the extractibles is very different; especially the presence of Mannit sugar in the mushroom extract is characteristic.

In general, mushroom extract must be considered equal in value to beef extract.

For food, mushrooms should always be used in unripe condition.

One section of the article is devoted to the preparation and conserving of mushrooms. The author inveighs against the French conserving method which gets rid of all extractible materials in order to secure a good-looking, white material. To secure a satisfactory extract the mushrooms must first be killed by drying or boiling water, and then be extracted with *cold* water.

A whole mushroom cook book is published by Professor Macku, and a number of illustrated identification books have lately come on the market.

Ueber die Kultur, den Extractgehalt und die Konservierung essbarer Pilze. Zeitschrift für Forst- und Jagdwesen, October, 1915, pp. 583–601.

Damage by Lightning

The Hessian Oberforstrat Joseph brings together the results of observations during 1914 of lightning damage in the forests of the grand duchy of Hesse-Darmstadt. The data were gathered by the rangers. The most interesting statistics are as follows:

Number of trees struck by months: March 1, April 5, May 13, June 186, July 184, August 10; total 399. With the exception of 2 trees, these were all struck in the afternoons.

Trees Struck

Species	*Per Cent*	*Species Per Cent of All Forests*
Pine	48.5	38.1
Oak	29.8	12.9
Spruce	11.4	14.9
Larch	4.0	0.4
Beech	3.4	31.3
Fir	0.4	0.2
Alder	1.7	1.0
Birch	0.2	1.0
Aspen	0.2	1.0
Poplar	0.2	1.0

A. B. R.

Beobachtungen über Blitzschläge. Allgemeine Forst- und Jagd-Zeitung, July, 1915, pp. 165–70.

Notes on Deodar

Quite the most interesting reference to Indian silviculture that has come to my notice is the article on "The Deodar," by C. G. Trevor. It is based on data presented at an important forest conference.

After describing the prolific seed crop, he shows clearly how heat, sun, hailstones, insects, and excessive humus does away with the seedling.

"This is the reason why seedlings are so often found growing on roadsides or other places where the mineral soil has been exposed."

Excessive dampness or extreme shade also causes the loss of seedlings, as well as grazing and trampling, undergrowth, matted grass and other minor causes. The soil often becomes chemically or physically unsuited to the species, owing to excessive humus and vegetable débris. Trevor contends, however, that the physical state of the soil is of the greatest importance to secure reproduction.

"It therefore follows that the factors enumerated below must be suitable:

a) Physical condition of the soil,
b) Moisture,
c) Light,
d) Protection."

Trevor then follows with a discussion of the silvicultural systems in practice, the selection method, the group method, the regular or shelterwood compartment method, which, he states, "appears to have very great advantages" on account of the "importance of the even-aged woods, definite areas under regeneration, tending of the seedling, and its demands on light."

Under reproduction, he discusses measures (which seem quite intensive for Indian conditions) to improve regeneration. Regarding excessive vegetable deposit, he says:

"It will have been broken up to a certain extent by the felling and removal of timber which has just taken place; it will be still more reduced by the collection and burning of felling refuse. . . . If still excessive, it may be raked up and burned, or hoed up and mixed with the soil."

With cheap labor, of course, more can be done than in this country, but this seems more intensive than the average deodar forest would justify.

Speaking of moisture, Trevor explains that excessive dampness is as fatal as excessive drought. Correct conditions will be secured only when there is partial light and the seedlings take hold of the mineral soil. As regards light, he feels, "that ample light is most beneficial to the seedlings, and that it can thrive without any overwood at all."

His conclusion is:

"From the foregoing facts it appears that an ideal method of regenerating deodar (especially applicable to Kulu and other forests on easy ground) is to regenerate on the principles of the regular method under a moderate shelterwood and to rapidly remove the same as reproduction is obtained. Under this method a mixture of deodar and Kail can be obtained with the greatest ease. It is only necessary first to admit sufficient light for the reproduction of deodar and thereafter, when sufficient has been obtained, to make a heavy felling, retaining a few Kail as seed bearers, when complete reproduction of Kail will be obtained. This has actually happened in practice in more than one instance."

Under the heading, "Protection," "It has been proved that goats are most destructive to all forest growth," but the grazing of horn cattle "is often of advantage," yet he points out that extensive grazing is dangerous, "in fact, this damage may be so severe as to entirely destroy the total crop."

"It may therefore be expected that grazing may be permitted up to the commencement of regeneration, but, thereafter, should, as far as possible, be excluded from the regeneration area."

He deprecates the selection system, so generally used, since so little can be done to improve regeneration. He comments on the necessity for seeding and "minor improvement fellings, consisting in the cutting of shrubs and malformed advanced growth." Cleanings and thinnings, early, often, and late—"*par le haut*"—are advocated. Finally, he summarizes the crop which can be secured on a 120-year rotation. As an example of systematic silviculture in India, it is perhaps the most notable article that has been published in the "Indian Forester" for the past ten years.

T. S. W., Jr.

The Indian Forester, November, 1915, pp. 439–62.

Improving Natural Reproduction of Sal Seedlings

For some time, the death and dying back of sal (*Shorea robusta*) seedlings has presented a silvicultural problem to Indian Forest officers. Under the direction of the Forest Botanist, R. H. Hole has conducted a study of the damage in the neighborhood of Dehra Dun. Mr. Hole found that the injury by porcupine, deer, insects and fungi were factors of minor importance; that while frost "undoubtedly does great damage in open grass lands," it is a minor factor to the damage in the forests themselves. The most serious factors are poor soil aeration, especially during July and August, and drought, which is particularly destructive during the months of September to June, inclusive. Drought, however, is a natural phenomenon which cannot be corrected. The chief facts ascertained regarding bad soil aeration are:

(1) Too high a percentage of water coupled with a small volume of air space may injure up to 100 per cent of sal seedlings. (2) This damage is chiefly confined to shady areas and does not affect seedlings growing in the open. (3) The damage depends chiefly on the presence of organic matter, "especially dead sal leaves." (4 to 8) The damage is inoperative on well drained sand, and is greatly decreased if the ground is clear of dead sal leaves. The damage is not co-related with the deficiency of plant food and apparently "under the impact of heavy rains which interfere with the access of air and water into the soil, the damage is especially serious." Mr. Hole points out that ideal conditions for the development of sal seedlings are: (1) "A well aerated seed bed free from raw humus; (2) full overhead light; (3) light side shade sufficient to prevent damage from frost and to keep the soil as moist as possible during the season of short rainfall."

To produce these favorable conditions, "clear felling in strips or patches, combined with artificial sowing and seeding during the first rains" is recommended. Under present conditions, clear felling in narrow strips and small patches seems entirely practicable. "The experiments carried out, however, indicate an alternative method of aiding the establishment of reproduction, viz., by the continued removal of humus and dead leaves by leaf fires or other means." No final conclusions, however, can be authoritatively given until the different systems have been tested out on a considerable scale.

Hole discusses the application of the Dehra Dun investigation to other localities and reviews at some length the application of these advanced silvicultural measures which in the past have been lacking in Indian silviculture. T. S. W., Jr.

The Indian Forester, October, 1915, pp. 351–361.

Girdling in Deodar Forests

It has been the practice for some years to girdle species such as kail (Blue pine), and other weed trees interfering with deodar reproduction. These girdlings were especially intensive in the Chakrata division at the headwaters of the Ganges. Daya Tam now reports that the Himalayan bears, enjoying the sweet sap which flowed from girdled trees, have commenced to girdle on their own hook, much damage thereby resulting. T. S. W., Jr.

The Indian Forester, October, 1915, pp. 382.

Shelter Wood System for Teak in Burma

H. T. Blanford gives an interesting reply to Walker's article contained in the April *Indian Forester,* on *The Uniform System in Burma.* The main point in controversy seems to be whether to continue the application of the selection system or whether "the uniform system" should be applied. Blanford argues that Walker has clearly misunderstood the recommendations of the Burma Forest Conference which he reviews, namely, "That improvement fellings, to be useful, must be concentrated and repeated"; . . . "that in this way only will it be possible to work over the whole area of suitable forests with required intensity, once in the course of a rotation"; that these intensive improvement fellings entail a little sacrifice and "may eventually lead to the formation of a series of even-aged gradations at the end of the first rotation." As Blanford points out, Walker's chief objections were reduction of yield; impossibility of artificial generation over 1/150 of the area; danger of anthrax to the elephants used in lumber operations. Those interested in a study of silvicultural systems will find much of value in Walker's article and Blanford's reply.

T. S. W., Jr.

The Indian Forester, April, October, 1915, pp. 105–111, 366–371.

Germination of Teak Seeds

Mascarenhas describes an interesting experiment in germination of teak seeds: (1) When soaked in cow dung for 15 days; (2) ordinary seed; (3) charred seeds collected from burned areas.

The seed was planted on March 5, and "profuse germination" of the charred seeds was observed within a fortnight, and by the end of June the plants were nearly a foot and a half in height. At the end of April, the seed soaked in cow dung showed signs of germination, and the plants were 6 inches in height at the end of June. The germination of the ordinary seeds was unsuccessful. T. S. W., Jr.

The Indian Forester, May, 1915, p. 147.

Over-grazing in the Central Provinces

Ali Beg discusses in some detail the over-grazing by native cattle in the Hyderabad State. According to the statistics available, it appears that, during 1901, there were but 1.9 to .5 acres per animal grazed, resulting in the destruction of forage, damage to the forests and deterioration in the cattle. According to a field study, there should be at least 3 to 5 acres of grazing land per head of stock, but local grazing rights precluded an immediate decrease. After a careful study, it appears that grazing units are to be formed, on portions of which grazing will be entirely prohibited. No grazing will be allowed by stock belonging to villages located a distance from a forest, and but one head per three acres in areas under regeneration, and one head per one and a half to two acres in grass areas is to be the maximum number allowed per land unit. It is unfortunate that the article is not clearly written because a clear presentation of the regulation of grazing in India would have been of great interest to American foresters. T. S. W., Jr.

The Indian Forester, June, 1915, pp. 176-190.

Insect Damage in India

Beeson describes damage to Chir pine (*Pinus longifolia*) by a species of Tomicus. The methods of control recommended are:

1. All trees felled and not removed by April 1 should be barked. The bark should be removed from the whole length of the bole and main branches and burned with the top and small wood.
2. All trees felled during April and subsequently which are not removed within one month of felling should be barked, and the bark burned with the tops and small branchwood.
3. All refuse (branchwood down to 12 inches girth) remaining on the felling area after April, which is not removed within one month, should be burned.

The remedial measures suggested include the removal and burning of dead, dying and freshly attacked trees, removal of bark where beetles have laid their eggs, the treatment repeated again after a fortnight to ascertain if damaged trees have been overlooked. T. S. W., Jr.

The Indian Forester, September, 1915, pp. 317–325.

MENSURATION, FINANCE, AND MANAGEMENT

Spruce in Higher Altitudes

A work based on over 40 years of investigation and observation, Dr. von Guttenberg's "Growth and Yield of Spruce in the Alps," is of special value in bringing out laws of growth in the mountain country; moreover an unusual number of measurements lies at their basis, namely 220 sample areas within a limited territory and about 160 careful stem analyses. The latter cover considerable space in the volume and perhaps are the most valuable part of the work in exhibiting laws of growth.

While the chapter on the development of the single stem is complete and may be considered basic, the same can hardly be said for the second chapter on the development of the stand, the data for which were secured by only single measurements of the stands, and relying largely on stem analysis. These tables, therefore, can be considered only preliminary, but in the absence of similar tables for such a growth region nevertheless valuable.

The site classification into five classes was made entirely upon the basis of height, since as regards volume the greatest variety was encountered; on apparently the same site here a dense regeneration, there an open stand, the two with entirely different volumes. This necessitated reliance on height and made it difficult also to decide what to consider normal. This difficulty was increased by the fact that none of the stands were under management and hence no knowledge exists of what the possibilities of increment under proper thinning practice might be.

Characteristic of alpine situations and remarkable seems that the spruce exhibits into old age a constantly rising increment; the current increment on medium and poor sites, for stands as well as single trees, not culminating as yet at 150 years.

Guttenberg states it as a law that the increment in youth is the smaller but also the more persistent the higher the altitude. The fact of the very slow height development in early youth in alpine situations is accounted for not only by the short period of vegetation, low temperature, deficient chlorophyll development and greater light requirement, but by the mechanical effect of the snow until the head reaches above snow line.

The increment studies at Paneveggio in Southern Tirol, which at an elevation of 6,000 feet exhibit heights of over 130 feet, show to what extent more favorable geographical location counteracts the effect of altitude, so that the common teaching that an altitude difference of 100 *m* influences plant development the same as a difference of one degree latitude needs revision.

Guttenberg was the first to point out that while the standing room influences form and basal area of spruce, it has no influence on the height: spruce in the open attains the same height as in close forest. This is important in thinning practice when compared with pine or broadleaf species which in the open develop into branches and rounded off crowns.

Guttenberg's stem analyses also show that Pressler's dictum, that the basal area increment is a function of the crown or amount of foliage above the area, does not hold for spruce in these situations, but that static moments (after Metzger) cooperate. Also, Weber's formula does not apply on the alpine spruce, but Koller's formula $y = \frac{px^a}{q^x}$ represents well the curve of normal height increment.

Schwappach, in reviewing the work, brings into comparison the results in timberwood production for 60- and 120-year stands from four localities.

	Main Stand			Up to Age			
		Basal	Volume	Thinnings	Total Increment	Current	
	Height	Area	Timber	Volume	Volume	Increment	
Age	*Feet*	*Sq. Ft.*	*Cu. Ft.*	*Cubic Feet*			
				SITE I			Guttenberg
60	75	237	8394	1931	10325	257	Alpine
						242	Tirol
	52	178	4419	1101	5520	172	Alpine
						177	Tirol
	83	288	10997	1959	12956	297	Swiss
	82	184	7579	2531	10110	275	Schwappach
120	118	296	16073	5119	21193	123	Alpine
						107	Tirol
	98	253	11454	3804	15258	139	Alpine
						126	Tirol
	124	345	18018	8294	26312	140	Swiss
	118	209	10711	11440	22151	137	Schwappach
				SITE III			
60	50	177	4290	872	5162	152	Alpine
						150	Tirol
	38	145	2674	572	3246	...	Alpine
						122	Tirol
	58	208	6607	915	7522	209	Swiss
	53	141	4118	1314	5434	186	Schwappach
120	84	241	9567	3003	12570	94	Alpine
						83	Tirol
	77	220	7822	2631	10453	110	Alpine
						103	Tirol
	93	257	11526	5491	17017	92	Swiss
	93	160	7036	6793	13828	97	Schwappach

Dr. Adolf Ritter von Guttenberg, Wachstum und Ertrag der Fichte im Hochgebirge. Zeitschrift für Forst- und Jagdwesen, September, 1915, pp. 577–80. Centralblatt für das gesammte Forstwesen, March-April, 1915, pp. 130–4.

Treatment and Yield

Dr. Hemman points out that after the war all resources will have to be strained to the utmost, and the forests will have more than ever to do their best. Fortunately, experimentation has gone on long enough to permit a judgment how far felling budgets can be increased, and particularly what kind of treatment may lead to best result. Hitherto, the regulator and the manager, the organizer and the silviculturist have not worked in harmony.

The author has brought together in tabular form what yield tables show under different treatment, which, therefore, should be the aim of the manager.

We give the data in translation for I and III site, as suggestive to our experimenters.

COMPARISON OF YIELDS UNDER DIFFERENT TREATMENT

Number of Trees	Average Diameter of Stand Inches	Average Height of Stand Feet	Average Volume of Stand Cu. Ft.	Volume Average Tree Cubic Feet	Total Thinnings Cubic Feet	Total Yield Cubic Feet
SITE I						
1. Oak, 160 years, in open management (Wimmenauer).						
29	25	123	6221	211	9853	16073
2. Oak, 160 years, under moderate thinning in subdominate (Wimmenauer).						
56	24	117	10382	176	5935	16316
3. Oak, 160 years, under regular thinning in practice (Schwappach).						
51	23	105	7965	158	8709	16674
4. Pine, 140 years, in open management (Wimmenauer).						
40	33	116	6163	140	11111	17274
5. Pine, 140 years, under moderate thinning (Vorkampff-Lorey).						
12	18	116	10210	70	6449	16660
6. Pine, 140 years, under severe thinning (Schwappach).						
90	17	104	6549	70	7450	14000
7. Pine, 140 years, under moderate thinning in subdominant (Schwappach).						
126	17	109	8952	70	5005	13957
8. Beech, 140 years, under severe opening in dominant (Wimmenauer).						
56	20	127	8180	140	10811	18990
9. Beech, 140 years, moderate thinning in subdominant (Wimmenauer).						
81	20	127	11326	140	6764	18090
10. Beech, 140 years, moderate thinning in subdominant (Eberhard).						
138	16	113	.....	70	5806	16245
11. Beech, 140 years, moderate and severe thinning in subdominant (Wimmer).						
...	..	...	10124	...	8566	18690
12. Beech, 140 years, moderate and severe thinning in subdominant (Schwappach.						
...	..	125	9081	...	6406	15487
13. Beech, 140 years, moderate and severe thinning in subdominant (Grundner)						
91	19	121	10625	105	6635	17260
14. Fir, 120 years, moderate thinning in subdominant (Lorey).						
174	19	110	16159	88	6793	22952
15. Fir, 120 years, moderate and severe thinning in subdominant (Eichhorn).						
162	18	112	15315	88	9166	21622
16. Spruce, 120 years, severe and open thinning in dominant (Schwappach).						
115	18	118	10711	88	11440	22151
17. Spruce, 120 years, moderate thinning in subdominant (Schwappach).						
190	17	113	14440	70	8037	22437
18. Spruce, 120 years, severe and open thinning (Grundner).						
114	19	120	12184	105	11340	23524
19. Spruce, 120 years, moderate thinning in subdominant (Lorey).						
206	17	117	15987	70	6221	22208

	Number of Trees	Average Diameter of Stand Inches	Average Height of Stand Feet	Average Volume of Stand Cu. Ft.	Volume Average Tree Cubic Feet	Total Thinnings Cubic Feet	Total Yield Cubic Feet
SITE III							
1. Oak, 160 years, in open management (Wimmenauer).	45	19	97	4404	105	5935	10879
2. Oak, 160 years, under moderate thinning in subdominate (Wimmenauer).	86	19	94	7579	88	3661	11240
3. Oak, 160 years, under regular thinning in practice (Schwappach).	89	16	76	4690	53	5105	9796
4. Pine, 140 years, in open management (Wimmenauer).	81	18	87	4762	53	6149	10911
5. Pine, 140 years, under moderate thinning (Vorkampff-Lorey).	133	15	87	6106	35	3704	8090
6. Pine, 140 years, under sever thinning (Schwappach).	117	14	77	8004	35	5205	9209
7. Pine, 140 years, under moderate thinning in subdominant (Schwappach).	179	13	84	5977	35	2789	8766
8. Beech, 140 years, under severe opening in dominant (Wimmenauer).	105	14	95	5420	53	5563	10982
9. Beech, 140 years, moderate thinning in subdominant (Wimmenauer).	162	13	95	7307	35	3418	10725
10. Beech, 140 years, moderate thinning in subdominant (Eberhard).	202	12	91	7064	35	2960	10024
11. Beech, 140 years, moderate and severe thinning in subdominant (Wimmer).	...	..	..	6864	..	4590	11454
12. Beech, 140 years, moderate and severe thinning in subdominant (Schwappach).	...	..	93	6335	..	4705	11054
13. Beech, 140 years, moderate and severe thinning in subdominant (Grundner)	117	16	96	7879	70	3747	11626
14. Fir, 120 years, moderate thinning in subdominant (Lorey).	243	14	87	10425	35	3975	14440
15. Fir, 120 years, moderate and severe thinning in subdominant (Eichhorn).	239	14	84	10139	35	5520	15659
16. Spruce, 120 years, severe and open thinning in dominant (Schwappach).	187	13	93	7036	35	6793	13828
17. Spruce, 120 years, moderate thinning in subdominant (Schwappach).	324	12	85	10210	35	3375	13585
18. Spruce, 120 years, severe and open thinning (Grundner).	182	15	93	9081	53	5949	15029
19. Spruce, 120 years, moderate thinning in subdominant (Lorey).	288	12	91	10182	35	3790	13971

Ueber die Abhängigkeit der Ertragsregelung und Bestandspflege vom Versuchswesen. Allgemeine Forst- und Jagdzeitung, May, 1915, pp. 112–6.

Simplified Practical Forest Valuation

Oberforstrat Frey demolishes the method of forest expectancy and cost values in determining the value of a forest for practical purposes. He contends that exchange value, the result of compromise and agreement of two subjective estimates in the market, is the only rational one—a judgment based on commonsense, tangible values and not on the fanciful interest rate and time calculations of the expectancy method. The latter starts with the idea of the empty acre and intermittent incomes; the author considers that *forest* management can only be considered when a *forest* is in existence, just as agriculture requires a farm, mining a mine, and innkeeping an inn. With unforested soil one would have to wait 40 or 50 years before forest management becomes possible. Soil *and* stands in inseparable combination are the means for producing annual wood increment and a forest industry, hence forest valuation must proceed differently from stand valuation.

It might be supposed that the money value of the present annual forest yield capitalized (the forest rent value) represented the capital value of the forest, but the author rejects this method of valuation as practically untenable because it requires the arbitrary choice of an interest rate, when *e.g.* using 2 per cent the capital value would be 50 times, using 4 per cent only 25 times the annual rent.

In a forest which can furnish a yield annually, the value of the stands, *i.e.* the stock on hand, is by all odds the greatest asset; hence an exchange or sale value is first to be ascertained for them.

To do this the author develops a method he had elaborated in a publication of 1888 and later writings, namely valuing all stands by relating them to the stumpage value of the mature timber. Maturity, according to the earlier arguments of the author not here repeated, must not be determined by the arbitrary calculations of the soil rent theory, but it has arrived for a stand when the value of the stumpage of that stand per acre is equal to the value of the average per acre of actual stock of the forest. While, then, for all *old* stands their stumpage value is the proper sale value, for all younger stands practically applicable approximate values can be secured by multiplying the *average annual value increment at maturity with the age of the stand.*

Individual judgment, such as must always be at work in valuation, may modify these values for the younger stands, but they furnish a good basis for such judgment, from the one-year stand to the oldest.

For any forest, then, on which forest management can be carried on the present money value of the actual stock on hand can be determined in a manner which will permit all valuators to come nearly to the same result.

The value of the total stock (*st*), which must permanently be on hand, to secure with any rotation (r) an annual money return (Y_r) can be also secured by multiplying this return by half the rotation ($st = \frac{r}{2} y_r$).

For ascertaining the sale value of the soil (S), an estimate alone is necessary, and the author proposes that it be based on the value of the most distant and poorest agricultural land in the locality, unless special circumstances give it a higher value.

The exchange or sale value of a forest, then, whose total annual increment can be harvested in saleable material is simply $St+S$, increased or decreased according to the subjective valuation of the exchangers, but, of course, never below the money value of the stock, which is the fixed capital. If desired, the interest at which this capital works can be figured by the annual interest formula: it means that at the present and so long as the values remain as they are, this is the rate at which the business pays. The fact that whoever 50 years ago invested in forest property, content with 2 or 3 per cent, makes 6 to 8 per cent (in a particularly cited case 15 per cent), is merely due to the change of values; in other words, like all other things the value of forests changes. If, however, the present value of stock on hand is figured with present prices the interest relation, of course, also changes most likely to that which had existed previously and the same 2 or 3 per cent seem to be the result.

Pointing out that the soil rent theorists, finding that long rotations furnish small to negative soil rents, try to meet the difficulty by choosing low interest rates and reducing rotations to the detriment of the national wealth, he recommends on the basis of his method of calculation to manage the existing forests "with possibly highest rotations in dense position till maturity and under a natural regeneration system"—a questionable attitude, not a necessary corollary to his finance calculation!

Zur Lösung der Waldwertrechnungsfrage. Zeitschrift für Forst- und Jagdwesen, May, 1915, pp. 279–90.

New Forest Valuation Formula

Riebel points out that the usual soil and stand expectancy value determination, which starts out with the idea of an intermittent return, is faulty when applied to a whole normal working block. While the usual method of calculation may fit the case in static inquiries, it does not fit for sales, exchanges, division of properties, damage suits and all practical market questions: the new owner in the price-making does not care what it has cost to produce the stand, what soil rent and administration cost has been charged against it, what revenues the previous owner has already derived from it; the concrete present value, possibly derived from attainable future yields alone interests him, hence soil value, cultural and administration cost should be disregarded; they should be found in the end result.

He then develops a new way of approaching the problem by the following analogy: somebody has a claim for a certain capital (kn) to be paid him n years hence; he can then make an arrangement with a bank to secure under assumption of a certain interest rate (p) from now on an annual equal rent (r), but for some reason for m years this rent has not been drawn, and it becomes necessary to determine the value of this accumulation of rents to the year m, then, since $r = \frac{kn.op}{1.op^n - 1}$, the final value of m times recurring rents up to the year m is $\frac{kn.op}{1.op^n-1} \times \frac{1.op^m-1}{.op} = kn \frac{1.op^m-1}{1.op^n-1}$ for kn we can set the value of a tree or a stand and expect the same result.

For instance, a 90-year-old tree would have \$20 value, how much is its value at 30 years, figuring at 3 per cent? $20 \frac{1.03^{30}-1}{1.03^{90}-1} = \$2.15$.

The same formula applies to the final harvest crop occurring in the year u or the thinnings (D) occurring in a, b, etc., years. The final formula for the stand value in the year m, becomes

$$St_m = \left(\frac{A_u}{1.op^n - 1} + \; . \; . \; . \; \frac{\Sigma D_q}{1.op_q - 1} \right) 1.op^m - 1$$

And this formula applies to all systems of management, whether uniform or uneven-aged, selection forest, etc., in the simplest way; and the formulae for normal stock, for soil value may also be developed from it.

The author applies the old and new formula on a number of concrete cases for comparison to show the difference in method and result, the latter after the old method being very variable according to the soil values used.

The new calculation is not only simpler and excludes any arbitrariness (except the p?), but gives the concrete present sale value independent of costs and passed incomes.

The three typical examples show that the new formulae are adapted for calculating rational soil values, stand values, normal stock values, etc., for all forms of sustained yield forest, and especially for selection and composite forest, especially giving weight to the consideration that in stand values and normal stock determinations costs can not be calculated, since they are already charged in the soil value.

Ein Beitrag zur Praxis der Waldwertrechnung. Centralblatt für das gesammte Forstwesen, January-February, 1915, pp. 1–15.

UTILIZATION, MARKET AND TECHNOLOGY

Logging Costs

The costs that are listed below represent a part of a general study of the lumber industry of the Pacific Northwest that is being made by the Departments of Agriculture and Commerce in cooperation with the lumbermen. The figures do not include the cost of stumpage, interest of any kind, discounts on logs sold, towage to mill, nor taxes on the standing timber. Average haul is 23 miles.

AVERAGE COST DELIVERING LOGS FROM TREE TO PUGET SOUND

(Based on Figures from 20 Camps)

Output (1913) and Investment

Percent of total output (approximate)	75
Average output per year per camp	45,000,000 ft. B. M.
Average output per day per camp	200,000 ft. B. M.
Average fixed investment	$140,000.00
Average working capital	$35,000.00
Average labor cost per M board feet	$3.09

Cost per M feet, Log Scale

Felling and bucking, labor	$0.683
Woods to car, labor (yarding, loading, running line)	1.259
Railroad (spur) and pole construction, labor	.586
Train crews, labor	.206
Dumping and rafting (includes contract work)	.211
Supplies and maintenance (labor and materials) of R. R. dump and boom	.177
Supplies and maintenance (labor and materials) of equipment, tools, buildings, etc	.307
Fuel of logging engines, locomotives, shops, etc	.239
Wire rope	.137
Depreciation, equipment	.240
Depreciation, main line railroad grade, boom and buildings	.066

Scaling		.049
Return of boom sticks		.046
Log freight		.882
General expense:		
Salaries and commissions	$ .139	
Taxes	.029	
Industrial insurance	.096	
Sundry expenses	.076	.340
Total average cost per M feet log scale		$5.428

O. L. S.

West Coast Lumberman. July, 1915.

Waste in Lumber Due to Drying

Manufacturers who know admit that there is a waste of 30 to 35 per cent due to improper methods of handling the lumber in drying. When not properly piled for air-drying, the overhanging boards check, twist and bend; stickers of uneven thickness and when not placed directly over each other, cause twisting and bending. The lack of knowledge of proper means for kiln-drying cause twisted, checked, warped and honey-combed lumber. When this lumber reaches the saw the defects removed as waste reach the large percentage mentioned above. Most of this waste could be prevented by properly handling in the yard.
O. L. S.

Hardwood Record, November, 1915.

Excelsior Manufacture and Uses

Excelsior is manufactured from any wood having a light colored, tough, straight fiber, such as basswood, poplar, balsam, spruce and willow. The greater quantity is made from basswood and poplar. The wood, cut into four foot lengths and bark peeled off, is piled and allowed to air season for about a year. Green or damp wood is unsatisfactory because it clogs in the machine and is apt to mould when compressed into bales. Air-seasoned is preferred to kiln-dried; the latter is considered to be more brittle. Before going to the machine it is cut into 16-inch pieces.

Two types of machines are in use—the upright and the horizontal. Both kinds are adjustable for different grades of excelsior shavings and wood wool. The grades of excelsior shavings vary from one-thirty-second to one-eighth of an inch wide by about one-one-hundredth of an inch thick. The machines can be adjusted, however, to cut one-sixty-fourth to one-half inch wide and from five-one-hundredths to one-fiftieth inch thick. Higher production per day of the coarse material is offset by the higher price commanded by the finer grades. A cord of wood produces approximately one ton of excelsior. The upright double head machines require five horsepower each and have a capacity of about one ton per day. The horizontal, eight block machine has a capacity of about five tons per day.

Excelsior sells at about $20 per ton and wood wool at about $30 per ton. The cost of production varies from $3 to $5 per ton.

O. L. S.

Canada Lumberman and Woodworker, October, 1913.

Sawdust[1] as Means of Food

Forstmeister Schinzinger reports the results of investigations of the Prussian Academy of Sciences looking toward the use of forest products for human nutriment.

Ordinary sawdust positively can not be digested at all by either man or animals. The reserve food supply of our trees consists chiefly of starch, sugar, oils and, to a slight extent, of albumens. These foods are stored only in the living sapwood. Woods with noticeably large percent of sapwood are maple, birch, elm, basswood and poplar. These are the species most worth considering as sources of human and animal food.

The food content is greatest in October. Experiments showed per 100 units of dry wood substance 20 to 25 units of starch and sugar, 10 of oils, 2 of albumen; the rest is wood fiber.

To make the foods available, the woods must be pulverized, or else the food stuffs separated out chemically.

The foliage of broadleaf trees is of proven value as fodder for animals. This reaches its maximum value in August and then decreases rapidly. Since photosynthesis takes place during the day, the foliage should be cut at night. Twigs up to ½ centimeter in diameter can be digested by cattle.

For winter feeding, the small twigs are best because of difficulties in storing the leaf-hay. For this purpose, the one- to three-year-

[1] *See also* F. Q., Vol. XIII, p. 568.

old shoots are cut with pruning shears or brush hooks, tied in loose bundles and placed under cover. It takes a week for these bundles to dry, and the bundles must be shifted frequently to prevent mildew or other fungus attack. The dried bundles can be stored in barns but piled loosely, so that there is a good circulation of air. The best species for such feed are poplar, elm, basswood, birch, ash, chestnut, buckeye and mulberry. Beech is not suitable, neither are the conifers. A. B. R.

Holzmehl und Volksernährung. Allgemeine Forst- und Jagd-Zeitung, August, 1915, pp. 190–3.

Sawdust Paving Brick

Through a series of experiments to obtain a satisfactory paving brick from sawdust, a Florida lumber company has evolved one from cypress sawdust and hydroline. The bricks are made under a pressure of 50 to 100 tons; they weigh about one-half as much as the vitrified brick, *i.e.,* about five pounds each; and are ready for shipment in twelve hours after manufacture. O. L. S.

Southern Lumberman, July, 1915.

Wood Utilization

A short list of books, bulletins, and magazine articles in which are found further references to wood utilization contains the following:

Utilization of Wood Waste, by E. Hubbard; Wood Products, Distillates and Extracts, by P. Dumesny and J. Noyer; Journal of the Society of Chemical Industry, 1911, by Walker, p. 934; Journal of Industrial and Engineering Chemistry, by Frankforter, Vol. 3, p. 4; Chemical Engineer, 1912, pp. 223 and 231; Eighth International Congress of Applied Chemistry, by Hirty, Vol. 12, p. 101; United States Bureau of Chemistry Bulletins, Nos. 105, 144 and 159. O. L. S.

Southern Industrial and Lumber Review, April, 1913.

Durability of Railroad Timbers

A committee of the American Railway and Bridge Association give averages for durability of timbers as follows:

Name of Timber	*Durability* *In Soil*	*In Air*
Cedar	20 years	
Chestnut	12	
Cypress	20	20 years
White oak	10–15	15
Longleaf pine	10	12
Douglas fir	8	16
Tamarack	8	10
White pine	7	10
Spruce	7	10
Norway pine	6	10

The Southern Pacific Railroad has 105,000 creosoted Douglas fir piles in trestles, of which two thirds are over 12 years old, ranging up to 23 years; not more than 500 have been taken out on account of decay.

O. L. S.

Canada Lumberman and Woodworker, November, 1913.

Treatment of Ties in British India

A series of interesting experiments in the treatment of ties is reviewed by R. S. Pearson. Unfortunately, the data presented is not complete, but, no doubt, those interested in a study of this subject could secure the original and complete record by correspondence.

T. S. W., Jr.

The Indian Forester, May, 1915, pp. 148–150.

Wood Lighter than Cork

Mention is made of a tree named ambach, belonging to the Mimosa family, covering swamp areas in the region of Lake Chad, Africa. While the specific gravity of dry cork varies from 2 to 24, that of ambach varies from 1 to 34. At the same time it will grow from 12 to 15 feet in height and 8 to 10 inches in diameter in one year; the fibre texture is so close that it can be cut into planks for tables and doors. If the report of discovery is exact, this species should have great commercial value.

T. S. W., Jr.

The Indian Forester, September, 1915, pp. 338–339.

German Wood Trade

An elaborate article on the timber trade conditions in Germany for the year 1914 is of interest in fixing the ante-bellum market prices. In the introduction the writer refers to the world war "which proper feeling in antagonism with reason had a thousand times declared an impossibility, and which Germany for more than 40 years, often under most difficult conditions, had prevented." "Both Austria and Germany, during these 44 years, since the Franco-Prussian war have shown that they wished to develop the energies of their people in peaceful economic competition." The commercial envy of Great Britain over the German competition in the world market is recognized as the ultimate cause of the war. This competition is also found in the wood-working industries, which in Great Britain employ over 250,000 people, with an annual product worth over $115 million, which is all consumed at home, together with $7 million import, while Germany, producing in part its raw material, employs 685,000 workers and exports $40 million alone of furniture and woodenware.

It appears that the year 1914, as it was, began with a depression in the market, and the wood industry even before the outbreak of the war was at low ebb. The war, of course, stopped all work for export, but the needs of the military departments helped over the trouble, a careful distribution of orders being inaugurated.

During the 20 years from 1895 to 1914, prices for log material have increased a round 20 per cent. This is for rafting timber, which rose from 16 cents to 19.5 cents per cubic foot. For pine boards in the five years up to 1913, the rise had been up to 40 per cent according to sizes, but in the war year prices dropped nearly 10 per cent.

It is interesting to note how prices vary with the size: *e. g.* pine, 16 foot mill run boards f. o. b. mill of

widths		6	7	8	9	10	11	12 inches
brought	in 1914	26	27	27.6	27	27.5	26	28 cents per cubic foot
	in 1909	19	20	21	21	22	21.6	24 " " " "

These prices would make the average prices per M feet board measure run from $18 for 6 inch to less than $22 for 12 inch boards, over 20 per cent higher than the small size material. Such prices come near enough to our own.

Das Wirtschaftsjahr 1914. Centralblatt für das gesammte Forstwesen, January-February, March-April, 1915, pp. 000–000, 149–157.

STATISTICS AND HISTORY

Russian Forest Statistics

From the Yearbook of the Russian Forest Department for 1911 we quote the following data. The total area of forest under government management was around 260,000,000 acres in Europe, 12,000,000 acres in Caucasus, 600,000,000 acres in Asia, but of this 872,000,000 acres only 50 per cent are real woodland, and only 50 per cent are in sole ownership of the government, which controls 132,000,000 acres of wood area in Europe, about 5,000,000 in Caucasus and 150,000,000 acres in Asia; the whole territory being divided into 1419 supervisorships and 22,156 protective circuits. The size of the latter varies from 260,000 to 300,000 acres in Europe, but up to 2,500,000 in Asia! For this forest protective service, $2,600,000 were spent for the 10,600 guards. The central office of the forest department is headed by 13 technical men and 62 subalterns, besides a council of 9. Other technical men are in the forest corps 860, in the local administrations 3262; in the Forest Institute 42; and topographers and surveyors 272; a total of 4520, of whom 3937 are technical foresters.

The Forest Institute (only higher forest school) had in 1911 647 students. There are 39 lower schools with 737 students, 470 of whom receive entirely, 160 partially free, tuition.

Salaries were improved in 1912; still they are low, the highest $3,000 for the Vice-Inspector down to $250 for "forest conductors"; supervisors secure from $800 to $1350, besides emoluments for houses, traveling expenses, etc., and farm land. According to plan 1,000 new supervisorships were to be organized in the first decade after 1900; actually by 1911 only 58 had materialized.

Of the total wooded area of 450 million acres only about 60 million are under working plans, mostly in Europe, and 180 million only explored. There are 126 survey parties making working plans, with 662 technical men employed in this work.

The sale of wood is mainly made on the stump, which is important, since much of the material placed in the budget is not sold.

For 1911, the budget called for.........	9,571,391 cubic faden*
from former years remained unsold	6,195,361
hence there should have been cut..	15,766,752
but actually there was only cut..	7,233,088
hence remained unsold........	8,543,664

Presumably, this amount should be cut under sustained yield, but does not find takers.

The total income of the forest administration for 1911 was around $42 million, the expenditures being $12.5 million, leaving $29.5 million net, an increase of $5 million over 1902. If we take the European figures by themselves, this works out about 12 cents per acre net. The best result in Poland was, however, in the neighborhood of $4 for a whole district.

The purchasers of timber still pay a tax for reforestation, preferring to forfeit the charge than reforest themselves, as was originally intended. Here, as in the cutting, the plans do not materialize; nearly 2 million acres that ought to have been reforested remained unplanted by 1911, and of the budget of $63,000 set out for planting other areas than that of the timber merchants, also only $20,000 were spent.

Stealing timber is the rule of the day. In 1911, 733,723 cases of trespass had to be adjudicated, the damage aggregating $4 million with penalties $4.7 million, but only 350,000 cases were settled and $850,000 collected. Forest fires occasioned nearly one million dollars of damage. The conservation law now has force on over 150 million acres. There are 67 committees in charge with a membership of 662, with 12 secretaries, 64 foresters and 5569 police officers employed in carrying it out. The activity of this service in 1911 is expressed by the declaration of protective forest of 25,000 acres; the approval of working plans for 34,000 acres protective forest and for 1,700,000 acres of other forest; the ordering of planting for over 100,000 acres; the approval of change of use for 570,000 acres, and the prevention of devastating fellings on 340,000 acres. Over 1,250,000 acres protective and planted were freed of taxes.

* 1 cubic faden equals about 220 cubic feet solid.

Some 20,000 cases of infractions of the conservation law came before the committees in 1911, but not more than 7600 were adjudicated.

In the same publication, one chapter brings a sketch of the forests of the Caucasus, and four chapters are devoted to discussions of fixation of shifting sands in various parts of the empire. These shifting sands are the result of forest destruction and excessive pasture. There are differences in condition calling for different treatment, various grasses, willows, poplars, pine, black locust, oak, maple and mulberry find use in this work. In Astrachan, since 1904, some 140,000 acres have been recuperated at a cost of around $200,000, mostly borne by the State, the communes contributing about 15 per cent.

Aus dem Jahrbuch des Russischen Forstdepartements von 1911. Zeitschrift für Forst- und Jagdwesen, May, 1915, pp. 309–15.

Forest Organization in Poland

A very interesting historical reference is made by von Wangenheim, a descendant of the well-known forester, to whom the American forest botanists owe some recognition.

It is, perhaps, not known that in the third division of Poland (1795), Prussia secured nearly all the territory which the German armies now occupy, Warsaw included, but in 1815 was forced to give it up to Russia.

In 1798, von Wangenheim, the older, then Oberforstmeister at Gumbinnen, received instructions to organize the 1,500,000 more or less of forest properties, located in the two departments of Bialystock and Plock in "New-East-Prussia."

The full language of the instructions is given, which are remarkable in the absolute reliance on Wangenheim's judgment and the free hand which the government gave to the organizer as regards method of organization, determination of felling budgets, personnel to be employed; merely giving him an idea of the general policy to be pursued.

Among other interesting provisions, the following language is characteristic: "The forest ordinance for East Prussia and Lithuania, of 1775, may be used as a basis for a similar one for the new province with the needful modifications dictated by local conditions. Especially the penalties are to be toned down, for *as regards the morality of actions one must consider the nationality for which the law is made.*"

In this forest ordinance all that refers to forest police is to be included, "without reference as to royal, municipal or nobility forests, since his Majesty expressly desires that private forests also shall be properly managed."

The instruction also includes the statement of expense account, which was a daily rate of about $2.50, including team, and a promise for special remuneration for the work at home.

No account is given of the execution of this work and the final organization, which undoubtedly collapsed with the cession of the territory.

For the time being these forests are again under Prussian administration.

Grundzüge für eine Einrichtung der bisher polnischen an Preussen gefallenen Forsten Neu-Ostpreussens von 1798. Zeitschrift für Forst- und Jagdwesen, September, 1915, pp. 535–43.

POLITICS, EDUCATION AND LEGISLATION

Important Changes in Bavaria

In 1888, Bavaria created underforester schools (*Waldbauschulen*). Three of five were abandoned at the close of the year 1914-1915, and only two, at Kelheim in southern Bavaria and at Lohr in Northern Bavaria, remain.

The reason for this abandonment is found in the excess of supply over demand, even though the number of students in these government schools was restricted.

The character of instruction at the remaining schools is unchanged. For entrance, a common school education is required and the passing of an examination which involves also the satisfactory proof of fitness for the ranger career. The course covers four years. The first 12 weeks are probationary. A rigid medical examination of all students is made annually. Instruction in forest management has been curtailed; instruction in stenography and typewriting added. A. B. R.

Aufhebung mehrerer Waldbauschulen, etc. Allgemeine Forst und Jagd-Zeitung, September, 1915, pp. 221-3.

MISCELLANEOUS

Prussian Forests in War

War conditions have induced the Prussian forest administration to issue alleviating instructions to the managers of State properties. Moratoria for rents and wood purchases are permitted under circumstances. Brushwood may be given to the poor at one quarter its usual cost.

All the oak bark and spruce bark for tanning purposes is contracted to the War Leather Association (in which the government is partner) under easy conditions. For oak bark in three grades the price is set at $1.70, $2.00, and $2.25 per hundred weight; spruce bark at 75 cents, in the woods air seasoned.

A serious deficiency exists in rosin, which has been mostly imported, and is especially used for manufacture of lubricants and of writing paper. There are three possibilities of securing rosin, namely by tapping spruce as used to be done long ago, by distilling any coniferous wood, by scraping the rosin exuded on spruce when damaged by game animals.

Curiously enough, the latter method is supposed to give at least most rapid results; while the second method is being experimented with. Instructions are issued how to scrape the rosin, which is to be 70 per cent pure and is taken over by the "rosin accounting office" at about $2.50 per hundred weight f. o. b.

In experimental areas about 80 pounds per acre at a cost of $1 to $1.25 per 100 pounds could be secured.

In March, 1915, the administration pointed out that in order to assure sufficiency of bread grain and potatoes for human needs the number of pigs would have to be reduced. To prevent, however, later a meat famine, breeding stock and young stock should be carefully preserved, for which purpose the forest pasture should be opened up, herding the pigs wherever larger communities are involved, even to the extent of transporting the herds by train. The pasture is to be free of charge, to be continued till late fall or early winter.

Pasture is also opened up for cattle, sheep and goats, and the wood for building shelter, etc., is to be given free of charge.

To eke out the pasture, brushwood of hardwoods is to be furnished by the forest administration from thinnings or special provision. For this only the woodchoppers' wages are to be paid. Acorns, which had been, or could be, secured for sowings are to be used for feeding purposes, and grassy ground, which was to be planted, is to be left for pasture.

Permits for gathering berries, mushrooms and grass are reduced to one third the usual cost.

Felling areas are permitted to be given over to farm use for one to three years, especially for potato culture. This land is given free of charge, unless the recipient fails to put in his crop, when he is obliged to pay a penalty.

Aus der Preussischen Forstverwaltung. Allgemeine Forst- und Jagdzeitung. May, August, 1915, pp. 126–8, 196—200.

French Forests and War

Dr. Schulze discusses the damage done to forests in France, the bulk of the article, however, merely relating the history of forests in the past. It will take many decades to make good the damage.

The forest is a factor in warfare of first importance, more so now than ever in the past, for its cover is now of value not only to front and sides, but above, against aircraft. A forest is an advantage if a battery is to be brought into position and to be kept unobserved by aeroplanes, cut brush being used to hide it. In the open field the disposition and number of troops is readily ascertained; in the forest they can be hidden, but also the danger of an enemy sneaking up unobserved may be a disadvantage. The French themselves have destroyed considerable forest tracts to prevent their use by the enemy and also to secure free field for shooting; the forests of Montmorency, Bouvigny near Arras and Berthonval have suffered severely. Large amounts of planks and logs to make roads passable and wood of all shapes for building structures in the trenches have been used up, partly imported, partly cut at home in the forests of La Haye, of Meaux near Nancy and Arencourt. Thousands of trees have been destroyed by artillery fire. Fires, intentional or accidental, have wasted many acres. While the Germans have made free use of materials, having established portable sawmills behind their front, and even burning charcoal for their field kitchens, the French army administration has not hesitated to disregard the wishes of the forest administration.

While the territory from northeast of the Seine to northwest of the Oise is flat and mostly forestless, south of the Oise and Aisne becomes hilly and better forested and forms the transition to the well wooded territory of the Argonnes and Vosges mountains. It is suggested that this topographic and forest condition accounted for the German invasion by another route, through Belgium; but in 1870 this forest condition was used to advantage in covering the movement of troops.

While the exigencies of the war on both sides excuse the destruction of the impediment which the forest offers, or make its utilization necessary, it appears that the inhabitants themselves use the opportunity of robbing the forests while the forest police is absent.

Die französischen Wälder und der Krieg. Zeitschrift für Forst- und Jagdwesen, August, 1915, pp. 497–512.

French Forest Service in the War

In the Revue des Eaux et Forêts of September 1 (p. 699) is given a list of the loss to the Forest Service after a year of war. This comprises 46 men, including one inspector, 7 assistant inspectors, 27 forest assistants and students, 5 students who were just admitted to the forest school at Nancy, and 6 officers who have disappeared (possibly captured), but concerning whom no official information has been received. Judging from the account of the work done by foresters each month, the French Forest Service is making an enviable record, since quite a number of them have been not only cited in the orders of their brigade, but for exceptional bravery in the army corps orders of the day.

T. S. W., Jr.

Prisoners of War as Lumberjacks

On May 6, 1915, the Minister of War, at the suggestion of the Minister of Agriculture, facilitated the employment of prisoners for lumber operations in France, with the provision that not less than 50 men would be employed in one place. The employer guarantees food and lodging and pays the sum of 8 cents per prisoner per day; 4 cents going to the prisoner and 4 cents for his clothing. If the employer only furnishes lodging and beds without food, he must pay, in addition, 20 cents per day. If neither food nor lodging is supplied, the total cost to the employer of each prisoner is 30 cents per day, (1 fr. 57). In case of laziness, it is provided that the 4 cents will be withheld from the prisoner.

T. S. W., Jr.

Revue des Eaux et Forêts, November 1, 1915, pp. 731–733.

Effect of War on Wood-Using Industries

For the year 1912, there were 61,230 wood-using factories in France, employing 323,837 workmen. In August, 1914, there were only 652 shops running that employed but 8,481 workmen. In October, 1914, the number was 938 and 12,971. In January, 1915, there were 1,117 factories employing 18,404 workmen. Thus, the war immediately resulted in closing 64 per cent of the factories. That the number of workers is not less than it is, is undoubtedly due to employment of women.

T. S. W., Jr.

Revue des Eaux et Forêts, December 1, 1915, pp. 757–758.

Forestry in England

An unsigned, but interesting, comment on *Forestry and the War,* by Sir William Schlich is here summarized. Schlich stigmatizes English forestry as "too much talk and too little action." The conclusion seems to be reached that there is need for a national School of Forestry, together with a systematic management, "and the advice and control by this school of crown woodlands and the extension of this latter by the gradual planting up of these areas acquired by purchase from year to year." It is certainly a criticism of the English government that so much forestry is practised in its colonies and so little in the mother country.

T. S. W., Jr.

The Indian Forester, May, 1915, pp. 143–146.

Monopoly cum Royalty System of Sale in India

Ranade describes the working of what he terms "Monopoly cum Royalty System of Sale," where the purchaser, by paying a certain sum of money, obtains the right to cut timber at a fixed price per unit and per variety and size of timber, the current rates being ordinarily about half the value of the material. The Forest Service guarantees to the purchaser a certain minimum amount of timber. From Ranade's description of the sales routine, it would appear that the system would be entirely feasible in the United States. By requiring a considerable "monopoly" payment, the advantage accrues to the government of protecting itself against loss in case the contractor fails to complete the sale. Those interested in the study of government timber sales should read this article.

T. S. W. Jr.

The Indian Forester, August, 1915, pp. 251–257.

Accidents and Liabilities

The Industrial Commission of the State of Washington worked out a series of diagrams to show the relative hazards of various lines of work. Logging, electric systems, coal mines and paper mills show the greatest hazard, especially as regards loss of life; shingle mills are shown highest in accidents resulting in permanent disability. In all, about two dozen occupations are rated and the diagrams given in full in *West Coast Timberman,* July, 1913.

O. L. S.

Typhoid Prevention in Camps

The Industrial Surgeons' Association of Washington, composed of physicians and surgeons, who care for fully 90 per cent of the sixty odd thousand employes in the lumber industry, has issued a bulletin on typhoid. It estimates that 75 per cent of the cases of typhoid are fly-borne. It has been demonstrated that fly-proof toilets, proper garbage disposal, proper manure disposal, and safe water supply will reduce typhoid danger to a minimum, if not prevent it absolutely.

O. L. S.

West Coast Lumberman. July, 1915.

Forest Leaves, XV, 1915,—

Tree Planting Experiments. Pp. 41-2.

Gives interesting figures of the cost of planting on four different soils and situations with six different tools at the Cloquet Experiment Station, Minnesota.

Journal of Agricultural Research, V, 1916,—

A Serious Disease in Forest Nurseries Caused by Peridermium filamentosum. Pp. 781 ff.

Pulp and Paper Magazine of Canada, XIII, 1915,—

Notes on the Design and Equipment of a Paper and Pulp Mill Laboratory. Pp. 503-10.

"The object of these notes is to give an idea of the arrangement of 'any old room' in a mill for the purpose of carrying out the usual technical tests required by a mill making chiefly newspaper, but also mechanical and chemical pulp. They are intended to apply chiefly to mills, whose location, generally speaking, is more or less remote from large cities and sources of chemical and scientific supplies."

The article is liberally illustrated with diagrams and photographs.

The Journal of the Board of Agriculture, XXII, 1915,—

The Composition of Wood and Plant Ash. Pp. 766-8.

Analyses showing amounts of potash and some other salts.

The Indian Forester, XLI, 1915,—

The Present Conditions of Applied Forestry in Canada. Pp. 171-7; 226-38.

Monthly Bulletin of Agricultural Intelligence and Plant Diseases, VI, 1915,—

Method of Preserving Acorns for Sowing. Pp. 956-7.

NEWS AND NOTES

From the Annual Report of the Secretary of Agriculture for the year 1915, we quote the following statements having reference to the National Forests and to the grazing situation:

Before the national forests were created practically no effort was made to protect the timber on public lands from destruction by fire, notwithstanding the fact that the situation was peculiarly hazardous. During the last decade a fire-protective system has been developed. Extensive improvements have been made, including more than 25,000 miles of roads, rails, and fire lines, 20,000 miles of telephone lines, many lookout stations, and headquarters for the protective force. In the year 1914, when conditions were exceptionally unfavorable, nearly 7,000 fires were fought successfully. They threatened bodies of timber valued at nearly $100,000,000, but the actual damage was less than $500,000. This work not only is saving public property; it is conserving the material for local economic development and for permanent industry. . . .

"During the last 11 years the number of permits for free timber to settlers has been multiplied 13 times and the number of sales 27 times. The amount cut annually by settlers under these permits is more than four times what it was in 1905, while that under commercial sales has increased eight-fold. Nearly 51,000 lots were disposed of during the last year. Probably not less than 45,000 persons or corporations obtained timber directly from the national forests.

More than half of the timber now cut annually is used in the vicinity of the forests. This includes all that taken free and under sales at cost, and approximately 45 per cent of the commercial cut. Hundreds of mining districts throughout the West, from small projects requiring an occasional wagonload of props or lagging to the great copper district of central Montana, which consumes about 380,000 pieces of mining timber annually, are supplied. Railroads also are furnished a large part of the ties and other material required for their lines in the Rocky Mountain regions. A million and a half ties now are cut from the forests yearly.

The national forests also meet the demands of the general lumber market. More than 300,000,000 feet are cut annually for the nation-wide trade. Since 1908 there have been taken from them 5,000,000,000 board feet of wood and timber products.

The greater part of the summer range in the Western States is in the forests. Under the regulated system the forage is utilized fully, without injury to the tree growth and with adequate safeguards against watershed damage. There were grazed last year under pay permits 1,724,000 cattle and horses and 7,300,000 sheep and goats. Several hundred thousand head of milch and work animals were grazed free of charge, and more than 3,500,000 head of stock crossed the forests, feeding en route, also free of charge. Not including settlers who have the free privilege or persons who have only crossing permits, there are 31,000 individuals who have regular permits. During the year ended June 30, 1905, there were only 692,000 cattle and horses and 1,514,000 sheep and goats on 85,627,472 acres. The number of animals now sustained in proportion to the area of the forests is 50 per cent greater than it was 10 years ago. Since 1905 the number of persons holding grazing privileges has increased nearly 200 per cent. This is due in part to the enlarged area of the forests, but can be attributed principally to wider use by settlers and small stockmen. When the regulated system was established the forest ranges, like the open public lands today, rapidly were being impaired. The productivity of the land for forage in most places has been restored and everywhere is increasing; the industry has been made more stable; stocks comes from the forests in better condition; range wars have stopped; ranch property has increased in value; and a larger area has been made available through range improvements. It is probable that 100,000,000 pounds of beef and mutton are sold each year from herds and flocks occupying the ranges. That the forests have promoted the development of the stock industry is indicated.

In another part of the report the Secretary refers to the grazing on public lands outside the National Forests, "of which there are about 280,000,000 acres, are not supporting the number of meat-producing animals they should. In the absence of any control by the Government these lands have been overgrazed. That they can be restored to their former usefulness is proved by what has been accomplished on the national forests and in Texas. On the forests under regulated grazing the number of stock has been increased 50 per cent. Practically the same increase has been secured in Texas under its leasing system. There should be a classification of the remaining lands at the earliest possible date to determine their character and to secure information upon which to base plans for their future improvement and use and for the distribution among settlers of those portions upon which it is possible to establish homes."

"Of the existing 1,800,000 water horsepower in the Western States, 50 per cent is in plants constructed in whole or in part on the forests and operated under permit from the department. Plants under construction will develop about 200,000 additional horsepower, while over 1,000,000 more is under permit for future construction. The chief obstacle to further immediate water-power expansion is the lack of market, for plants in operation in the West now have a surplus of power of which they can not dispose."

There is also a discussion on mining in the National Forests, and their use as recreation grounds, and on the return of agricultural lands to settlement. "During the last five years about 14,000,000 acres have thus been released. In addition, individual tracts are classified and opened to entry upon application of home seekers. Since the work was begun more than 1,900,000 acres have been made available for the benefit of 18,000 settlers."

Reference is made to the purchase of forest areas in the East. "An appropriation of $11,000,000 was made for these purchases, to be expended during the fiscal years 1910 to 1915. The funds made available under the first appropriation are nearly exhausted. In its report to the Congress for the fiscal year 1914 the National Forest Reservation Commission recommended that purchases be continued until about 6,000,000 acres shall have been obtained and that the Congress authorize appropriations through another five-year period at the rate of $2,000,000 a year."

The two Alaska National Forests are more specifically referred to. "The Tongass comprises approximately 15,000,000 acres in southeastern Alaska, while the Chugach, covering the timbered area about Prince William Sound and thence westward to Cook Inlet, contains about 5,500,000 acres. Most of the timber on them is of the coast type, Sitka spruce, hemlock, and cedar being the predominant species. On the Tongass single spruce trees not uncommonly reach a diameter of 6 feet, a height of 200 feet, and a yield in merchantable material of 20,000 board feet. Limited areas carry 100,000 board feet to the acre, and 40,000 to 50,000 feet over considerable areas is common. The timber is accessible, of excellent quality, comparatively easy to log, and close to water transportation. The presence of available water power will facilitate the development of wood-using industries. While the Chugach Forest has less favorable conditions for timber growth and a less heavy stand than the Tongass, nevertheless in it there is a large amount of merchantable Sitka spruce and hemlock, which will have an increasing importance for railroad construction, mining, and other industrial purposes. Large areas have an average stand of 15,000 to 20,000 board feet to the acre, and the best run as high as 50,000 feet. The volume of timber on the two forests is estimated to be between sixty and eighty billion board feet, about one-eighth of the total estimated quantity on all the forests."

Representative Lever, of Southern California, has introduced in the House a bill, the purpose of which is to extend to the employes of the U. S. Forest Service the provisions of the act granting to certain employes of the United States the right to receive compensation for injuries sustained in the course of their employment. The purpose of the bill is to give compensation to those employes of the Service who are injured while fighting forest fires.

The Santa Rita Grazing Reserve near the Coronado Forest in Arizona, and the Jornodo Grazing Reserve in New Mexico, formerly under the jurisdiction of the Bureau of Plant Industry, have been turned over to the Forest Service for the continuance of the experiments. Grazing Inspector James T. Jardine and Grazing Examiner C. E. Fleming, of the Washington office, have been inspecting these grazing experimental areas during the past summer.

The annual meeting of the Society of American Foresters was held on January 22, 1916, in Washington, D. C.

The forenoon and the late afternoon were devoted to the reports of the various committees. During the early part of the afternoon an open meeting was held at which the following papers were presented: "The Possibilities of Silviculture in America," by Dr. B. E. Fernow; "Vegetation Zones of Argentine and Adjoining Regions," by Dr. Cristobal Hicken.

At the business meeting of the Society a number of important matters came up, among which the amalgamation of the *Proceedings* of the Society and the FORESTRY QUARTERLY provoked most of the discussion.

The meeting endorsed the following recommendations of the executive committee:

1. That an amalgamation of the *Proceedings* and the FORESTRY QUARTERLY be made, whether or not an increase in dues is necessary to accomplish it.

2. That the plan of control of the combined publications conform to that given for the *Proceedings* in the present Constitution of the Society (Article V, Section 5), subject to amendment as to the number of members on the Editorial Board, upon the recommendation of the Board after organization.

3. That the details of publication and policy of the journal be left with the Editorial Board.

On motion by Mr. Dana, the meeting expressed itself as in favor of an increase in dues for Active members from $3 to $5 per year. On motion by Mr. Dana, the meeting also expressed itself in favor of levying no dues on Associate members and at the same time of ceasing to send them the *Proceedings* of the Society except on special subscription. All of these matters were referred to the Executive Committee for its action and later reference to letter ballot by the entire Society.

The recommendation of the Executive Committee that no steps be taken by the Society to incorporate was indorsed. The recommendation that the budget system adopted last year be continued was also indorsed.

Dr. Fernow moved that the recommendation of the Executive Committee, that the matter of indorsing the Federal Migratory Bird Law be referred to the entire membership for letter ballot, be amended to provide for the indorsement of this law by the present meeting. The motion was agreed to and the law thereby indorsed without further action.

The meeting expressed its approval of the recommendation of the Editorial Board that a change be made in the name of the *Proceedings* and referred the matter to the Executive Committee for consideration in connection with the amalgamation of the *Proceedings* and the FORESTRY QUARTERLY.

The meeting indorsed the recommendation of the Committee on Admissions that the creation of a new class of members, to be called "Fellows," is undesirable, for the present at least. The proposal of the committee that a new class of members, to known as "junior" members, be created was discussed at considerable length.

The progress report of the Commitee on Terminology was presented by the Chairman, Dr. Fernow.

The recommendation of the special committee on the establishment of a section in Washington, that such a section be established, was indorsed and the desirability of holding as many general meetings of the Society as possible was emphasized.

Mr. Clapp spoke of his attendance recently at the annual meeting of the American Association for the Advancement of Science. He recommended that the Society adopt the policy of holding a meeting of the Society in connection with the annual winter meeting of the Association for the Advancement of Science as often as practicable, and that the program be arranged in time so that it might be printed with the rest of the Association program. His recommendations in these respects were indorsed by the meeting.

The result of the recent election of officers was announced by the Acting Secretary, Mr. Murphy, as follows:

President, B. E. Fernow; Vice-President, E. H. Clapp; Secretary, Findley Burns; Treasurer, S. T. Dana; Executive Committee: W. B. Greeley (5-year term); R. C. Bryant (4-year term); Clyde Leavitt (3-year term); D. T. Mason (2-year term); F. A. Silcox (1-year term).

In the evening a smoker, attended by 67 members and friends of the Society, was held at the University Club, at which a number of informal talks were given.

Following the example of the joint lumbering and forestry meetings at San Francisco in October, the plan has been adopted this year in Canada of holding a number of related annual meetings conjointly. These meetings occurred at Ottawa, Ontario, January 18, 19 and 20, 1916. The annual meeting of the Commission of Conservation was held January 18 and 19, the forestry portion of the program being presented on the first day. At this meeting, papers on various aspects of forestry work in Canada were presented by Messrs. B. E. Fernow, Ellwood Wilson and J. B. Harkin. The report of the Committee on Forests was presented by Clyde Leavitt, Forester for the Commission. The Canadian Society of Forest Engineers met at the Laurentian Club on the evening of January 18, dinner being followed by a general discussion of the forestry situation in New Brunswick. The Candian Lumbermen's Association held their annual meeting January 19, and the Canadian Forestry Association January 20. At the latter meeting, papers were presented by Messrs. W. R. Brown, E. J. Zavitz, R. H. Campbell, S. L. Decarteret and W. J. Vandusen. A full report of the several meetings will appear in the February and March numbers of the *Canadian Forestry Journal.*

On the evening of January 19, the four organizations above named held a joint banquet at the Chateau Laurier, at which addresses were presented by Sir George E. Foster, Minister of Trade and Commerce; Sir Wilfrid Laurier, Leader of the Opposition; Hon. W. J. Roche, Minister of the Interior; Hon. Michael Clark, M. P.; Dr. Frank D. Adams, Dean of Applied Sciences, McGill University, and Hon. O. T. Daniels, Attorney General of Nova Scotia.

At the session of the Pan-American Scientific Congress held at Washington during the first week of the year subjects of special interest to lumbermen were discussed. Papers given of special interest to foresters were: Forest Problems and Economic Development of South America, by R. Zon; Conservation of the Natural Resources of Wealth, Agriculture, Irrigation and Forest Culture, by Senor Raoul Brin; The Attitude of the Government in the Matter of National Forests: Relation of Forest Culture to the Future Development of Central and South America, by E. L. Quiros.

The outstanding feature of forestry progress in Canada during the past year is the announcement by the Government of New Brunswick that definite steps are being taken toward beginning the forest survey and classification of crown lands, for which legislative provision was made early in 1913. P. Z. Caverhill has been appointed Provincial Forester, to take charge of this important work. Mr. Caverhill is a graduate of the forest school of the University of New Brunswick, being a member of the first graduating class, in 1910. Since that time he has been connected with the Dominion Forestry Branch and the British Columbia Forest Branch, and has held various positions of responsibility.

The crown lands of New Brunswick comprise an area of over 10,000 square miles, or approximately one third the total area of the province. The provincial government derives an annual revenue of over half a million dollars from these lands. A careful stock-taking, together with a thorough and scientific investigation of the questions of reproduction and rate of growth, will be required to determine the means necessary for the perpetuation of the forest and of the revenues resulting from its exploitation. It is expected that the Dominion Commission of Conservation will co-operate to some extent, in connection with the more technical features of the work in the field.

The latest Canadian lumber company to engage the services of a professional Forester is J. B. Snowball & Company, Limited, Chatham, N. B. This Company has employed Mr. J. R. Gareau, a graduate of the Quebec Forest School, Laval University, to have general supervision over the woods operations on the Company's limits. He will also make a map and timber estimate of these limits, as well as enforce close utilization of all merchantable material. Cutting operations will be regulated with a view to ensuring the perpetuation of the forest, and particular attention will be paid to fire protection. Other companies in eastern Canada employing professional foresters are the Laurentide Company, the Riordan Pulp and Paper Company, the New Brunswick Railway Company, and the Canadian Pacific Railway.

The Crown Lands Department of Nova Scotia report a total of approximately 13,000 acres burned over by forest fires during the season of 1915. On a considerable portion of this area, no merchantable material was destroyed, so that the total estimate of damage done by these fires is but \$15,000. Nearly all of this damage was done by a single fire, in the vicinity of the Intercolonial Railway.

The system of forest fire protection in Nova Scotia is among the most effective in Canada. An important feature is the provision that no person shall make, kindle or start a fire for the purpose of clearing land, or other like purposes, nor set up nor operate a portable steam engine within 60 rods of any woods, between the fifteenth day of April and the first of December next following in any year, without first having obtained leave in writing from the chief ranger or sub-ranger. Such leave is granted only when, in the judgment of the ranger, the action may be taken safely.

Similar provision for the regulation of the setting out of settlers' fires exists in British Columbia, on Dominion Forest Reserves in the West, in Quebec, and in a portion of New Brunswick. It does not exist in Ontario, nor on Crown Lands or lands in private ownership outside of Forest Reserves in the Prairie Provinces.

During the drouth of May, 1914, a very destructive fire from the Canadian Pacific Railway burned over several hundred acres (about 400) near Gordon Bay, Parry Sound District, Ontario.

Miss A. E. Sinclair, the principal owner of the devastated area, took action in the Supreme Court of Ontario. The trial was held in Parry Sound in June, 1915, Hon. Mr. Justice Clute, presiding; Mowat, Maclennan and Parkinson acting for Plaintiff. The case was tried by jury.

A unanimous verdict was rendered that the plaintiff recover from the defendant $2235 for 65 acres, and further that the defendant pay to the plaintiff costs amounting to $554.55.

Subsequently the Canadian Pacific Railway settled with another of the claimants, paying $515 damages and $50 toward costs.

The verdict was rendered on the basis that the evidence went to show that there was *"a reasonable certainty"* that the fire was set by a spark from a Canadian Pacific Railway locomotive.

Enormous damage has been done by forest fires in the Smoky River Valley and the Grande Prairie country, in northern Alberta, according to a report just published by the Dominion Forestry Branch. The examination, made under the direction of J. A. Doucet, covered an area of 8,000 square miles previously well stocked with forests of various species, including Lodgepole pine, White, Black and Engelmann spruce, Alpine fir, tamarack, aspen and birch. Of this area, only a very small percentage can ever be used for agricultural purposes, on account of unfavorable soil and topography. The agricultural lands are for the most part limited to the prairie, of which there are considerable areas, and in the development of which the timber resources would be of the greatest value.

The report shows that the results of the many repeated fires in this region have been apalling: Out of the 8,000 square miles well wooded even within the last hundred years, only 648 square miles, or 8 per cent, still retain a forest cover 100 years old or over. These are the only portions which can be regarded as having a virgin cover. Thus, 92 per cent of the area has been burned over from once to many times during the past hundred years.

About 8.5 per cent of the total area bears timber from 50 to 100 years old, averaging 70 years, while 14 per cent bears timber of small pole size, averaging 25 years of age. Less than 20 per cent is covered with young reproduction, while 3690 square miles, or 46 per cent of the total area examined, is covered with brule, mostly swept by fire within the last 30 years.

Taking in the young reproduction area, the percentage of the territory swept by fires during the last 50 years is brought up to about 65 per cent. In some places, the soil cover has been entirely removed, and it will take a long time before another forest can take root; in others, the heavy slash endangers the young growth and what little is left of the old forest.

It is estimated that within the territory covered by the report, not less than 16,000 million feet of merchantable pine and spruce timber has been destroyed by fire during the last 30 years. At an average valuation of 50 cents per thousand, this represents a loss to the country of $8,000,000, in addition to the serious depletion of game and fur-bearing animals.

The report closes with a strong recommendation for the establishment of Forest Reserves and for the allotment of sufficient funds to provide for adequate fire protection.

A despatch from Victoria, B. C., states that a bill will be introduced at the next meeting of the British Columbia Parliament providing for a bond issue by the Provincial Government to be used in building 30 four-mast semi-Diesel auxiliary schooners. These schooners will have a carrying capacity of about 2,000,000 feet of lumber each. They are to be turned over to lumber manufacturers of British Columbia, who are to assume the bonds and pay for the schooners as bonds fall due. They are to be operated in the lumber trade of the entire Pacific coast. Keels of 6 or 8 of these vessels are to be laid in British Columbia by April 1, and the remainder are to be built as the demand increases. It is reported that these vessels will take about 200,000,000 feet of lumber annually, whereas the present exportation is only about 60,000,000 feet.

Mr. H. R. MacMillan, Chief of the British Columbia Forest Service, who holds a special commission under the Department of Trade and Commerce to study the extension of foreign markets for Canadian lumber, has forwarded to Dr. J. S. Bates, Superintendent of the Forest Products Laboratories of Canada, from Johannesburg, South Africa, a small specimen of wood for identification. This was a piece of wood from an ore bin which had seen 20 years hard usage in one of the Johannesburg mines and is still in an excellent state of preservation. Microscopic examination by the wood technologist of the Laboratories showed that the specimen was Douglas fir. It is interesting to see that Douglas fir has shown up so well in this particular service test and is another proof of the high quality of the foremost Canadian structural wood.

The decision of the various Dominion Government Departments and of the Canadian Pacific Railway to use Canadian timber only, to the exclusion of imported timber, is a decided advantage in the utilization of Canadian timber and, therefore, marks a definite gain for the cause of conservation in Canada.

Southern pine, even in the year of 1915, when Canada was at war and when there was a great decrease in the consumption of lumber, was imported to the extent of 95 million feet, having a value of over 3 million dollars. In previous years, very much larger quantities were imported and this in the face of an adverse trade balance for Canada and in the face of a supply in Canada of better timber at an equal or lower cost, grown and manufactured entirely within the Dominion.

The Dominion Government have in past years used many million feet of Southern pine in the various public works, but henceforth Canadian timber will be used to the exclusion of the foreign imported article. Douglas fir will replace Southern pine in such works as Quebec harbor improvements, Montreal harbor improvements and Hudson Bay terminals. Douglas fir has been used entirely in the Toronto harbor works, as a clause was inserted in that contract calling for Canadian material. The action of Baron Shaughnessy in ruling that Canadian timber only should be used in works of the Canadian Pacific Railway shows that large private users are also finding it consistent with present conditions to use Canadian products. Other users throughout Eastern Canada, large and small, will follow the lead of the two largest users. Architectural and engineering professions also are rapidly swinging from Southern pine to Douglas fir and from the imported woods to the home grown product.

The Dominion Forest Products Laboratories at McGill University, at Montreal, which have been in operation for nearly a year, were formally opened on December 3 by the Minister of the Interior. Several representative speakers took part in the program. The testing machines, the paper plant, the museum and the laboratories were found, upon inspection, to be complete and capable of valuable work.

Mr. W. H. Houston has been appointed Lumber Commissioner for British Columbia for the Prairie Provinces, with offices at Regina, Saskatchewan.

A ranch owner near San Jose, California, according to *Popular Mechanics Magazine,* trims his eucalyptus trees with the aid of a high powered rifle. It is 120 feet from the ground to the lowest branches of the giant. The owner, it is said, takes the easy method of lopping off unnecessary limbs by a few moments of pleasant marksmanship.

With a most laudable spirit the government of the Province of Ontario has made an adequate appropriation for making a close survey to locate and perhaps eradicate the White pine blister rust, which unfortunately has found entrance into the

Province before the law preventing the importation of White pine seedlings had been in operation.

It is also contemplated to improve this law, having force for the whole Dominion, by excluding not only all five-needled pines, but importation of the other host, the currant, as well.

State Forester A. F. Hawes of Burlington has received a telegram from Senator Carroll S. Page announcing the passage, by Congress, of a $20,000 appropriation for the eradication of the blister rust disease of the White pine. With this sum the United States Department of Agriculture will make a careful examination of the Eastern States to find out whether there are any cases of the disease in addition to those already known, and will be able to carry out the work of eradication.

Over 12,000,000 specimens of two parasites which prey on the gipsy moth and brown-tail moth were released in 201 towns in Maine, New Hampshire, Massachusetts and Rhode Island during the fall of 1914 and the spring of 1915, according to the Annual Report of the Bureau of Entomology, United States Department of Agriculture.

As a result of scouting work carried on by the entomologists in 223 towns in New England, the gipsy moth was found in 4 towns in Maine, 23 in New Hampshire, 3 in Vermont, 10 in Massachusetts, and 10 in Connecticut, making a total of 50 towns where the insect had not been previously reported. This scouting consists in an examination of all roadsides, residential sections, orchards and woodlands. Where colonies are found, the egg clusters are treated with creosote and the trees are banded with tree tanglefoot and sprayed with arsenate of lead.

The spread of the brown-tail moth during the past year has been inconsiderable, the indications being that this pest has not infested any territory other than that already reported. In cooperation with the United States Lighthouse Service, the work of collecting moths at night along the coast of Connecticut and Long Island has been continued.

Other activities of the Bureau in relation to the gipsy moth include the inspection of forest products, nursery stock, and stone and quarry products shipped from gipsy-moth territory, as well as extended investigations along other lines.

The forest academies of Eberswalde, Münden, and Tharandt are closed during the war, but the Universities of Munich, Giessen and Tübingen keep open and register students even if absent.

Even the Catalpa has an enemy that can become serious, namely the Catalpa sphinx, a large yellow and black caterpillar with a stout black horn. It is described in Farmer's Bulletin 705, U. S. Department of Agriculture. Hand picking and spraying with a combination of arsenicals and Bordeaux mixture is recommended. A wasp-like fly, in evidence in September and October, is a parasite, during the presence of which the caterpillars should not be killed, but rather collected in a barrel covered with wire netting, in which they may hatch the parasite.

Two useful compilations have been made, which give an insight into the status of the academic side of forestry in the United States and Canada, namely a census of students and alumni and their employment made by the *Yale Forest School News* and a canvass of the forest schools as to number and character of students as well as of instruction, number of instructors and their salaries and load of work, by Professor H. Winkenwerder of the College of Forestry in the University of Washington. The information collected by the *Yale Forest School News* is in print (in Volume IV, Number 1, January, 1916) and may be quoted:

There were 634 bachelors and 523 masters of forestry (or equivalent titles) graduated from the 22 schools reported, but of these 1157 technically educated men, only 803 are employed in forestry work. Details of the manner in which the schools are run are given for each school, which are highly interesting.

The information gathered by Prof. Winkenwerder is more complicated and is so far only private. We hope to have an analytical discussion of it by the collector in a future issue. Here we may, however, state that in the 19 institutions for which data are given, there seem to be around 900 students enrolled for straight forestry work, besides some 500 taking secondary work in forestry.

There were 72 instructors in these 19 institutions, 61 giving full time, ranging from one to eleven instructors in one school, three to four in the majority of cases. The greatest variety seems to exist in the load which instructors carry at different institutions. The incredible assignment of "20 hours and from 6 to 10 hours of laboratory" seems to be the heaviest; a number report 14 to 16 hours; the lowest carrying from 7 to 12 hours, excepting Directors who may have even less teaching hours.

Salaries run from $1,000 to $1800 for Instructors; $800 to $2,000 for Assistant Professors; $1600 to $2500 for Associate Professors; $1800 to $4,000 for full Professors, and Directors up to $5,000.

From the Report of the Dean of New York State College of Agriculture to the President of Cornell University we learn that the College is divided into 24 departments, with 238 separate courses for regular students; and there is a tendency of still further expansion in the number of courses. The forestry department offers a five-year course, leading to the degree of master in forestry for professional foresters, but it also provides for "students of general agriculture who wish elementary instruction in the care of woodlands and in forest planting and forest nursery work; for prospective teachers, business men, lawyers and others who desire an understanding of the place of forestry in the life of a nation; and for technical students in other lines who wish one or more technical courses, such as wood technology."

Moreover, it makes an effort to be of direct help to owners of forestlands in New York State by correspondence, publications, lectures, personal inspection of woodland or of land to be planted, and cooperative care of forestlands.

Besides, research work is in contemplation. Unfortunately, there is no large forest tract at the disposal of the department for such research work. In the enumeration of the 2773 students attending the College of Agriculture, the students taking forestry courses are not segregated.

From an academic point of view, there is of interest the proposition to divide the university year into four quarters, three of which constitute a year's work for professor or student—the Chicago scheme. Such an arrangement would be particularly advantageous to agricultural as well as forestry students, permitting summer work.

Three hundred and fifty-four students of the University of California have enrolled in the course in "Elements of Forestry" offered this year for the first time by Professor Walter Mulford. This course is designed to present a general picture of the relation of forestry to the every day life of a nation. Among the topics discussed are the influence of forests on water supply, climate, soil and public health, the life story of the tree and the forest, general principles of forestry practice, and protection from fire and insects. Nine lectures on the fish and game of the State will also be given in connection with the course, by experts in these fields. To reach a large number of students in other departments with instruction in elementary forestry is considered by the School of almost equal importance to the training of professional students.

A new forestry building, costing $40,000, has been authorized by the board of regents and will be erected on the Oregon Agricultural College campus during the coming spring and summer. It will be a brick structure, three stories high and 80 feet wide by 140 feet long. A large laboratory for logging-engineering will be located on the first floor, with smaller laboratories for the manufacture of wood products. The second and third floors will be occupied by offices, classrooms and smaller experimental laboratories. The building will be ready for occupancy at the opening of the next college year, September, 1916.

The Semet-Solvay Company of Syracuse, which owns and operates large mines in West Virginia under the direction of the Solvay Collieries Company, has recently become interested in reforestation on its holdings in West Virginia. It has asked the New York State College of Forestry at Syracuse to examine and report upon reforestation on holdings at Kingston and Marytown in Central West Virginia. Professor J. Fred Baker of the College is now in West Virginia examining these holdings and is accompanied by a party of eight Senior students who will take part in the field examination of the properties. Mr. H. J. Kaestner, State Forester of West Virginia, will join the party at Kingston and will assist in any fire protection plans which may be suggested. After the field studies are completed, the party of Seniors will visit several large lumbering operations in Central West Virginia.

Nelson C. Brown, Professor of Forest Utilization in the College of Forestry, at Syracuse University, attended the Annual Meeting of the American Wood Preservers' Association held in Chicago on January 19, 20 and 21. Following this meeting Professor Brown visited a number of large wood-using industries in and about Cadillac, Michigan. Professor Brown is securing data along the line of utilization of waste materials and visited plants at Cadillac for data to be used in a bulletin soon to be issued by the College. On February 7 a party of 30 Seniors started for the Adirondacks with Professor Brown to spend about three weeks in studying logging operations and sawmills in and around the Tupper Lake section. This month of required field work on the part of the Seniors of the College completes a year of practical experience which is required of every student in the College of Forestry before graduation.

Registration for the second semester of the College year has just closed at the New York State College of Forestry at Syracuse with 260 men and one woman registered as applicants for the degree of Bachelor of Science. No special students are accepted in the College at Syracuse. Already 22 men have signed up for the year's work in the State Ranger School at Wanakena which opens on the first Tuesday in March. Out of the 35 men who have been graduated from the State College of Forestry, 28 are in some phase of forestry work. It is not expected by the College that 80 per cent of its graduates will continue in forestry work and yet these 28 men have secured positions in forestry work during a time when it was pretty commonly stated that there were no openings.

The College of Forestry at Syracuse offers a correspondence course in Lumber and Its Uses to any person in the State of New York. This phase of its general educational work has been developed as a result of an increasing number of inquiries from every section of New York regarding the technical qualities of various American woods.

The University of Minnesota makes announcement of a correspondence course in Lumber and Its Uses, beginning in the first semester of 1916. This course is to teach technical data relative to structure and of wood as a construction material. It is given primarily for the lumber dealer, wood worker and wood user, since it is considered now that substitutes are competing with wood that more should be generally known of the particular qualities of woods which render them suitable for special purposes.

Senator Walsh of Montana has introduced a bill which has been referred to the Committee on Public Lands, providing for a grant of 100,000 acres of the public lands in Montana for the support of a school of forestry at the State University. The bill provides that the lands are to be selected by the State authorities from the surveyed, unappropriated and otherwise unreserved lands, not mineral, belonging to the United States within the National Forests of the State.

In Munich for the summer semester, 1915, there were registered 5748 students, 163 being foreigners. Out of the natives, 74 per cent, to be sure, were enlisted, leaving still about 1600 in attendance. There were inscribed 156 forestry students, 6 being foreigners, 4 from Greece, 1 Hungarian, 1 from British India; but few of the forestry students are present.

Ever since the formation in 1900 of the first Foresters' Club at the then New York State College of Forestry in Cornell University, it has become customary to establish such clubs at the educational institutions with more or less elaborate programs of lectures and entertainments. Of late, the more ambitious of these student clubs are not satisfied with the ephemeral character of club meetings, but have entered upon the publishing field. As a matter of fact, the FORESTRY QUARTERLY really started in this way as a student publication in 1902, but in the very next year, due to the collapse of the College, became a private undertaking.

Perhaps one of the first Clubs to publish a technical Annual was the Nebraska Foresters' Club, and a good one, too, begun in 1909, containing technical papers delivered before the Club.

The latest two such publications come from the Syracuse and Georgia schools. The New York State College of Forestry at

Syracuse starts what appears at first sight as intended for a periodical under the title "Empire Forester" (the frequency of appearance is somewhat enigmatic, for it starts with "Volume I, Number 1," but is to be "published annually"!), the material consisting of actual experiences which the contributing students obtained in the field. The "Georgia State Forest School Forest Club Annual," in its first volume confines itself almost entirely to extracts from speeches or from other sources elaborating the arguments for conservation of resources in general and of forests in particular. This compilation is undoubtedly useful in furnishing technical foresters with the necessary material to help propaganda along.

The two publications are made up in elegant style, showing that forestry students at least are thriving, but could be improved in literary direction.

It is said the paper shirts made in Japan are now being served out to Russian soldiers for use in the cold and wet weather. A number of these paper shirts were used by the Russians last winter and they proved to be much warmer and cheaper than ordinary shirts. The paper is made from the bark of the paper mulberry tree. Shirts of this kind have been used by the Japanese army and people for many years, their only drawback being that they cannot be washed.

The world's production of lead pencils probably amounts to nearly 2 million a year, half of which are made from American grown cedar. Owing to the growing scarcity of Red cedar and to the fact that many other trees now little used appear to be more or less valuable substitutes for that wood in pencil making, the Forest Service has carried out a series of tests which show that next to the two species heretofore used for the purpose the best trees are in order of merit, Rocky Mountain Red cedar, Redwood, Port Orford cedar, and Alligator juniper.

According to newspaper reports an Austrian engineer in Vienna, named von Dunikowski, recently applied for a patent on a tire built of wood fiber and certain binders. It is said the specifications show the new tire follows in every detail the principle of the pneumatic tire, having an inner and an outer tube. The main material used is willow and birch fiber, but the nature of the binder has not been revealed. A motor car fitted with the new tires is said to have run 437 miles under adverse conditions showing no signs of undue wear. According to reports a large Vienna bank is financing the new enterprise.

Mr. Abraham Knechtel, Forester to the Dominion Parks Branch, died at Ottawa on December 10, 1915, after a short illness, at the age of 56. He was a Canadian by birth, but became a superintendent of schools in Michigan. From this position he had the courage, when over 40 years of age and with a family, to take up the study of forestry at the New York State College of Forestry at Cornell University, and after graduation and a short employment by the U. S. Forest Service, became in 1902 one of the foresters of the New York State Forest Commission, with which he stayed until 1908, when he was called to the Dominion Forestry Branch as Inspector of Forest Reserves. In 1913, he transferred to the Dominion Parks Branch as Forester, which position he held when he died.

Both in his position with the New York Commission and the Dominion Branch he gave much time to propaganda of forestry ideas by lectures. The first large plantation undertaken by the State of New York in the Adirondacks was made under his direction.

In the June number of *The Indian Forester,* 1915, is given an interesting critical review of H. H. Chapman's *Forest Valuation.*

PERSONALITIES

1. *Northeastern United States and Eastern Canada*

Dr. B. E. Fernow has again been honored with the presidency of the Society of American Foresters.

Roy L. Marston and Miss Mary E. Emery, of Skowhegan, Me., were married on October 17, 1915.

H. Warnick Robb, Biltmore, 1911, is professor of forestry at the Independent Agricultural School at Essex County, Mass., and, incidentally, organizer and manager of the American Timberland Association, a group of consulting foresters scattered throughout the country. Robb's address is 14 Hunt Street, Danvers, Mass.

Mr. Albert Grigg, M. P. P., for Algoma, has been appointed Deputy Minister of Lands and Forests, for the Province of Ontario, succeeding the late Mr. Aubrey White.

R. G. Lewis, F. B. Robertson and D. Brophy, of the Dominion Forestry Branch, Ottawa, have enlisted.

Page S. Bunker, formerly of the Forest Service, is in charge of the municipal forest of Fitchburg, Mass.

Mr. George Chahoon, Jr., a director of the Canadian Forestry Association and Associate member of the Canadian Society of Forest Engineers, has been elected president of the Laurentide Company, Limited.

Abraham Knechtel, chief forester, Dominion Parks Branch of the Department of the Interior, died at Ottawa recently, being in his 56th year. Knechtel held the degree of Forest Engineer from Cornell University.

George H. Wirt has been appointed chief forest fire warden of Pennsylvania.

The marriage of Bessie Idella, daughter of Mr. and Mrs. Herbert F. Drew, and Harrison V. Bailey took place in Brockton, Mass., on December 23.

The continued serious illness of Eugene Bruce, which confines him closely to his home in Washington, D. C., will be learned with keen regret by his many friends.

Messrs. B. Guerin, G. H. Boisvert, and E. Menard, graduates of the Laval Forestry School and now of the Quebec Forest Service, where each holds the rank of District Inspector, have been elected to Active membership in the Canadian Society of Forest Engineers.

2. *Southern United States*

Sydney L. Moore is with the Sizer Lumber Company, but has changed his headquarters from Savannah to Jacksonville, Fla., address 43 Bay Street.

Lincoln Crowell has been transferred from Neopit, Wis., to Cherokee, N. C., where he is in charge of a reconnaissance of the extensive timberland of the Cherokee Indians.

Mr. and Mrs. Bruce J. Downey took an extended trip through South America last summer. They are living at Nashville, N. C., where Downey is connected with the Fosburgh Lumber Company.

Alfred Akerman is dean of the recently incorporated Georgia College of Forestry. The college is located in the woods, four and a half miles from

Greenboro. It has camp grounds in the woods of North and South Georgia, and the students are exercised in working out actual problems.

3. *Central United States*

E. A. Sterling is head of the Trade Extension Department of the National Lumber Manufacturers' Association, with headquarters at Chicago.

G. Harris Collingwood, for some time a ranger on the Apache National Forest, has resigned from the Forest Service and has returned to his home in Lansing, Mich. Collingwood graduated in forestry at Michigan Agricultural College and later spent a year and a half studying forestry at the University of Munich.

4. *Northern Rockies*

C. A. Lagerstrom, formerly with the C. A. Smith Timber Company at Marshfield, Ore., is conducting cruising and appraisal work for the Union Pacific Railroad at Evanston, Wyo.

5. *Southwest, Including Mexico*

John D. Guthrie has been elected Vice-President of the Arizona Yale Alumni Association.

J. D. Lamont, who graduated from Cornell as Master in Forestry in 1915, is in charge of a large timber sale to the New Mexico Lumber Company on the Jicarilla Apache Indian Reservation. His address is El Vado, New Mexico.

6. *Pacific Coast, Including Western Canada*

Walter B. Hadley has been elected Secretary-Treasurer of the Southern California Arboricultural Association.

Prof. Mason, of the University of California, plans an eastern trip for early February. He will visit the leading Eastern forest Schools.

Thornton T. Munger will give this year's course in National Forest Administration at the Yale Forest School.

H. B. Murray has been appointed District Forester at Cranbrook, B. C.

G. T. Robb, Acting District Inspector of Forest Reserves at Prince Albert, died recently during an operation for appendicitis.

7. *Hawaii, the Philippines and the Orient*

W. F. Sherfesee, Director of the Philippine Forest Service, has recently been offered the position of Co-Director of the newly organized Bureau of Forestry of China.

Pan Chen King, who received his Master's Degree in Forestry at Cornell in 1914, has been appointed forester for Anhui Province, China. His assistant in this work is D. Y. Lin, who graduated from Yale Forest School in 1914.

Theodore C. Zschokke has left his post with the Southern Pacific Company at San Francisco and accepted an appointment with the Bureau of Forestry at Manila, P. I.

Foreman T. McLean has accepted an appointment with the Philippine Bureau of Forestry, as has also Roscoe B. Weaver.

C. S. Judd, Superintendent of Forestry in the Territory of Hawaii, was appointed by Governor Pinkham, on January 6, as Chairman of the Conservation Commission of Hawaii.

8. *Europe*

Dr. Schenck is occupying an administrative position in Brussels, Belgium, where his address is Rue de la Chancellerie, 19.

Dr. Kern, who assisted Dr. Schenck in the conduct of the Biltmore School during 1911–1912, died on the battlefields of Galicia.

COMMENT

The comment in Forestry Quarterly, Number 4, of Volume XIII, on the action of the people of the State of New York in rejecting the proposed Constitution of 1915 is very interesting to a resident of the State and especially to one who followed more or less closely the development of the 1915 Constitution and its rejection by the people in November of last year. The comment by Dr. Fernow is upon the conservation phases of the 1915 Constitution only. Because this was made without developing the background of the formation of the Constitution and the relation of the Conservation Articles to the Constitution as a whole it may be a bit misleading and especially to the readers of Forestry Quarterly in States outside of New York. Therefore, certain features of the 1915 Constitution are pointed out below with a hope that they may clear up any misunderstanding as to the part the disapproval of the Conservation Articles played in the rejection of the Constitution.

At twenty-year intervals the State of New York may, and usually does, hold a Constitutional Convention. Mr. C. R. Pettis, Superintendent of State Forests of New York, discusses in the present issue very fully and clearly the action of the New York Constitutional Convention of 1893 and shows by discussion of the past land policies why the present Constitution has a clause forbidding the use of the Adirondacks and Catskills as the forester likes to see forest land used. Through the action of the Legislature and the people of the State a Constitutional Convention was called for 1915. The platform of both the older parties in the State favored such a Convention and came out clearly for the embodiment in a new Constitution of certain policies for the future development of the State. An unusually strong and representative body of men were elected to the Convention of 1915. Several of these had served in the Convention of 1893. The President of the 1915 Convention was Hon. Elihu Root. Anyone conversant with the New York of today must agree that it is seldom that a stronger and more representative body of men was brought together for action upon governmental policies.

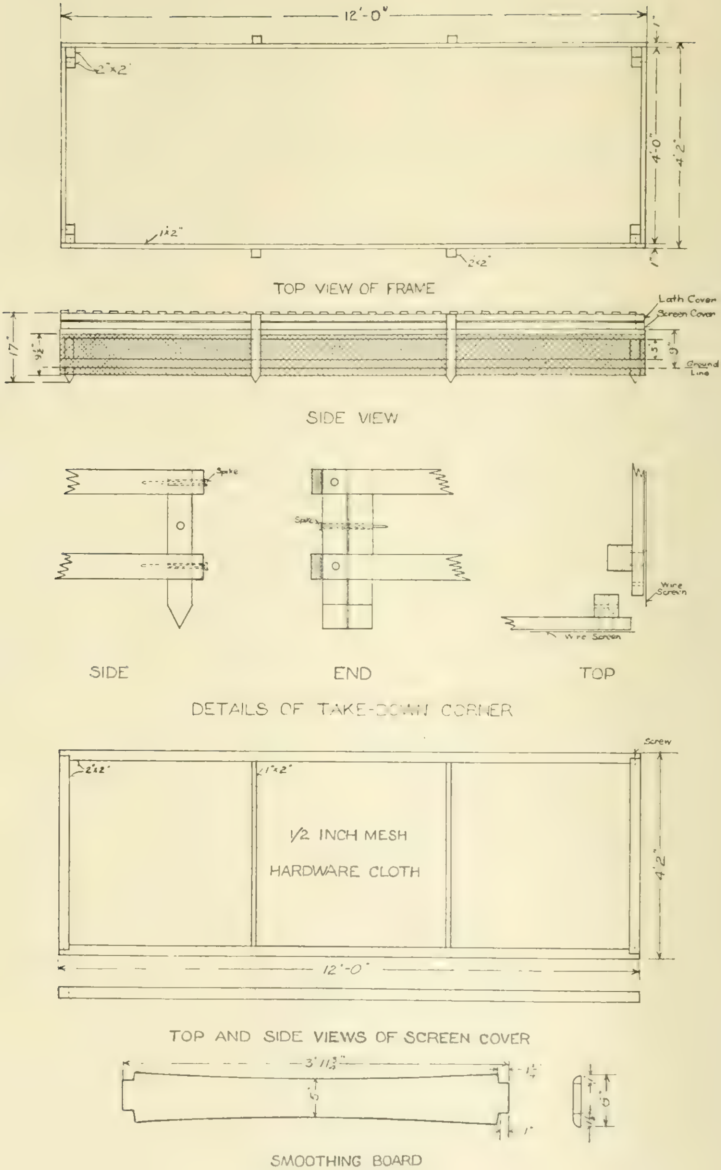
Throughout the summer of 1915 the Constitutional Convention both through committees and in a body, went over all the various phases of the present Constitution and finally evolved a Constitution which embodied, almost without exception, the requirements of the platforms of both the old parties and a Constitution which, according to former Senator Root, Hon. Henry L. Stimson, Hon. Louis Marshall and many other well known lawyers, was the strongest document ever produced by a State Constitutional Convention in this country. It would be impossible to give in a few words the many conditions and incidents which brought about the rejection of the Constitution by the people of the State in the election of November, 1915. The form of the articles dealing with conservation had comparatively little to do with the rejection of the Constitution. It was rather the result of cumulative antagonism aroused largely by misunderstandings. A bitter attack was made on the Conservation Articles and a propaganda interestingly financed was carried on throughout the State against these Articles. However, this was but an incident and alone would not have defeated the Constitution. The comment by Dr. Fernow would seem to give the impression to the outsider that the form of the Conservation Articles was largely responsible for the failure of the Constitution.

Foresters from the Conservation Commission, from the Department of Forestry in the State College of Agriculture at Ithaca and from the State College of Forestry at Syracuse appeared before the Conservation Committee of the Constitutional Convention repeatedly, and many others representing all interested in forests and forestry in New York appeared before the Committee. While the report of the Committee was not all that foresters of the State would like to have had it, yet it seemed to some to be an advance over the present Conservation Article and it seemed wisdom to accept a half loaf which meant some progress rather than no loaf at all and remain under the unusual provisions incorporated in the present Constitution in 1893. However, the people of the State refused the Constitution, and all of us in the State who are interested are going ahead with an educational campaign with a hope that eventually the people will see the wisdom of using the forests and the forest lands of the State in the right way.

Dr. Fernow comments adversely upon the provision in the 1915 Constitution that the Conservation Commission should be made up of nine members. Such a nine-head Commission which was one of the large reasons for opposition by certain organizations in the State to the Constitution, was thought by the Conservation Committee of the Convention to solve the problem of putting the forest work of the State out of politics. The State Board of Regents and the Board of Trustees of various State Educational Institutions were used as examples for the nine-headed Conservation Commission. It was felt that a Commission of public men interested in the forests of the State appointed or elected for a period of years would serve as a buffer between the technical forester selected by the Commission as Superintendent and wrong political control. It was not the idea of the Conservation Committee of the State Convention, as the writer understands, to expect the Commissioners to act as executives in any way whatever, but they were to select a technical forester as a Superintendent as the Board of Regents of the State selects a State Commissioner of Education or as the Board of Trustees of the College of Agriculture selects a Dean. The chief executive, who would be the Superintendent or the Forester, would then have a free hand in carrying out the forest work of the State backed by the united strength of the nine members of the Commission. The fact that there have been six changes in the head of the Conservation Commission of the State in the last five years would seem to indicate that something must be done to take the Conservation Commission and the forest interests of the State absolutely out of politics.

The Conservation Articles of the 1915 Constitution made provision for more extensive reforestation than can now be carried out by the State, and called for the classification of the forest lands of the State and the demarcation of boundaries. All these things are advances over what is allowed under the present Constitution and must eventually come about in the development of the Conservation policies of the State. It is possible to bring these about in the next five, ten or twenty years and it is believed that every forester in the State and every forester outside who is interested in forest policies in the country will hope that some of these advances may come in five or ten years, which is entirely possible, rather than to let the present policy toward our forests of "hands off" continue until the next Constitutional Convention which may be held in 1915.

HUGH P. BAKER.



Nursery Seed Bed Frame

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AN IMPROVED FORM OF NURSERY SEED BED FRAME

BY D. R. BREWSTER[1]

Some form of protection from mice, other rodents, and birds is necessary at most forest nurseries in order to protect the newly sown seed in the seed beds. Light frames covered with wire netting are commonly used. They vary in width from 4 to 6 feet and the length runs from 12 feet, for the portable type, to an indefinite length for the stationary form. The height varies from 6 to 24 inches and the tops are covered with removable screen covers, made in one or more sections according to the length of the bed. In the case of species which need shading, the frame also serves to support the lath shades.

At some nurseries, where burrowing animals are a serious pest, the wire on the sides is made to extend from 3 to 12 inches below the surface, entirely around the bed, and a portion of the lower edge, from 1 to 3 inches in width, is sometimes turned outward at right angles to the side of the frame to prevent the animals from going under the wire. In such cases the frames are usually set permanently in place, and the work of spading and preparing the bed is done by hand.

However, it is considered more practicable at most large nurseries to use some form of portable frame which can be removed at the end of the first year, after danger to the seed is past, and used elsewhere. This permits of using horses in preparing the ground for sowing and allows more constant utilization of the frames, thus reducing the cost of protection. These portable frames are usually 4 feet wide and 12 feet long and from 8 to 24 inches high. A frame of this type which is in common use is described by C. R. Pettis in Forest Service Bulletin No. 76, "How to Grow and Plant Conifers in the Northeastern States," page 16.

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[1]Forest Examiner in charge of Priest River Experiment Station, U. S. Forest Service, Idaho.

In several of the western nurseries, various adaptations and changes in the "Pettis" frame have been made in recent years to meet the requirements of local conditions and secure greater efficiency and economy in nursery practice. Principal among these changes has been the introduction of a "take-down" construction by the Wind River Nursery, in Washington, designed by A. R. Wilcox in November, 1912. This "take-down" feature allows of taking the frames apart and storing them in compact form in sheds in the winter, thus reducing deterioration. It also makes the frames less bulky and clumsy to move, and makes it possible for one man to do all the work of setting up and taking down alone, which means an economy of labor at small nurseries.

It has also been found desirable at many places where mice are difficult to control, and particularly at Forest Experiment Stations, where the rodent factor must be absolutely eliminated from experimental beds, to use ⅓- or ½-inch mesh galvanized hardware cloth in place of the ¾-inch mesh poultry netting specified by Pettis, since the latter will not exclude mice but only protects against birds and large rodents.

An improved type of frame which includes some original features and which has proved itself particularly well adapted for use at Forest Experiment Stations has been developed at the Priest River Experiment Station in northern Idaho. As shown in the accompanying diagram (frontispiece), the outside length is the standard 12 feet, for economy in the use of lumber, since a 16-foot stick will just make one side and one end piece. The width, however, is 4 feet, 2 inches on the outside, or exactly 4 feet inside. The lumber permits this width and by its use it is possible to use 48 square feet as the practically correct growing space in the bed, in calculating density and yield of seedlings. If the inside width were reduced to 3 feet, 10 inches by making the outside measurement an even 4 feet, there would be a net loss of 2 square feet from the area of the bed and the common practice of figuring the area of a 4 x 12 bed at 48 square feet would introduce a 4 per cent error.

The frame is made low, 5 inches being allowed between the top and the bottom side pieces, as shown in the diagram, being similar in this respect to the "Pettis" plan. This low side is particularly desirable in experimental beds, since it permits of reaching all parts of the bed easily and quickly in making germination and survival counts of seedlings. It is also of value, where beds are shaded, in bringing the shade close to the seedlings and reducing the direct light which comes in at the ends and sides.

At Priest River, burrowing rodents can be controlled by placing the wire a comparatively short distance below the surface on the sides and ends. The 1½-inch extension shown in the diagram is therefore sufficient and provides this underground protective feature without making it necesssary to leave the beds permanently in place as when the wire is placed to a greater depth. By extending the upright portions of the frame on the sides and ends 3½ inches below the lower side piece and sharpening them to a wedge-shaped point, it is possible to tack this 1½-inch extension to the uprights, thus preventing it from bending and catching in handling and making it possible to bury or lift this underground portion of the screen with practically no more time or trouble than is required in handling, if the frame is placed entirely on the surface.

The arrangement for fastening the corners together, as shown in the detail drawing, is very simple, and the fact that setting up or taking down can be done by merely pushing in or pulling out three, loose, 30-penny spikes at each corner makes it possible to do the work very easily and quickly. The use of bolts or screws, which would require considerably more time, is thus avoided. At the same time this arrangement furnishes a solid, tight, square corner as good in every way as a nailed or bolted corner. In constructing these knock-down frames it is desirable to use a templet or guide board for boring the holes for the spikes, in order that all holes will be made at the same point and all end and side sections will be interchangeable. The dove-tailed construction of the corners of the top screens, as shown in the diagram, is for the purpose of utilizing the lumber to the fullest extent and making a solid square corner.

The life of frames can be materially increased by treatment with a creosote preservative. Experiments carried on by the Wind River Experiment Station indicate that if carefully applied long enough in advance of use, so that all creosote is completely absorbed by the wood and dry, no injury to the young seedlings should result. In these experiments, both creosote and carbolineum were applied with a brush in from one to three coats. Penetration and drying were aided by having the wood warm before treatment and by stacking the treated frames in a warm room with blocks between to allow good circulation. Carbolineum, being more volatile, dried somewhat more rapidly than the creosote.

The amount and kind of material used for each frame and the approximate cost at Priest River are given below:

LUMBER	Feet B. M.	Cost
Frame		
4 pieces 1 x 2—16 feet	10⅔	
1 piece 2 x 2—10 feet	3⅓	
Screen Cover		
2 pieces 2 x 2—16 feet	10⅔	
1 piece 1 x 2—8 feet	1⅓	
Lath Cover		
2 pieces 2 x 2—16 feet	10⅔ 37′ at $20	$0.74
1 bunch lath	.05 M at $2.50	.13
HARDWARE		
½ pound 8 penny barbed box nails at 6 c.		.03
½ pound 30 penny common nails at 4c.		.02
⅕ pound 3 penny common nails at 5c.		.01
2 dozen 2-inch No. 8 wood screws at 5c.		.10
1 pound galvanized poultry netting staples.		.10
75 square feet 2 mesh, 18 gauge, galvanized hardware cloth at 2½ c.		1.87
Total cost of material per frame		$3.00
Approximate cost of labor per frame		1.00
Total cost per completed frame		$4.00

A good grade of common pine lumber should be used in the frames, and if appearance is no object it should be left rough for greater strength and durability. It has been the common practice at Priest River to use finished lumber so as to present a somewhat neater appearance and take paint better. The frames have been painted white with an inexpensive cold water paint bought in the form of a powder.

In the list of hardware, box nails are specified to prevent splitting which is apt to occur if large common nails are used. The wood screws are used at each corner of the screen cover and lath cover frames, running from the ends of the side pieces into the end pieces, and help to preserve the rigidity of the frames during the frequent lifting on and taking off incident when counts are being made in experimental work. The hardware cloth is figured on the basis of using 92½ linear feet of roll 4 feet wide for five beds. After cutting off 5 pieces 12 feet long for the covers, the remaining 32½ feet is split longitudinally into five equal strips 9.6 inches wide, which are then cut into two parts 12 feet long and two parts 4¼ feet long, the extra ¼ foot being used for the lap at the corners. If this lap shows a tendency to come open at the corners it can be stapled to the ends of the 1x2 side pieces.

The frame is so constructed as to permit of exactly regulating the depth of cover by the use of a smoothing board, shown in the diagram. Recent experiments at the Savenac Nursery have shown conclusively that it is important to regulate this depth of covering to within ⅛ of an inch in order to get the greatest and most rapid germination. The 2 x 2 uprights on the sides of the frame are placed on the outside so that the board can slide on the lower horizontal side pieces from one end of the bed to the other. It is notched at either end where it rests on the side pieces and can be made to cover the seed to any depth by making the difference between the notches on one edge and the notches on the other edge equal the desired depth. The edge with the deeper notch is used for smoothing the surface of the bed preparatory to sowing and the edge with the shallower notch is drawn across the bed to smooth and equalize the covering material. A "crown" of ½ inch is given to each edge, thus leaving the bed higher in the center than at the sides to provide for surface drainage. This board has been found very satisfactory for regulating the depth of covering seed, particularly in experimental beds.

FOREST SERVICE REVENUE AND ORGANIZATION

By T. S. Woolsey, Jr.[1]

The conclusions reached in this article do not agree in all respects with my conclusions in "Managing a National Forest from the Business Standpoint," (Proc. Soc. Am. For., Vol. III, p. 41) written in January, 1908; but it must be realized that the conditions are vastly different. In those days, the problem of publicity and of getting men to fill executive positions was foremost. As in Europe, American foresters will some day come to small one-man units when intensive business justifies such expenditures. Names of Forest Service officials whom I have quoted have been omitted so as to make the article as impersonal as possible.—The author.

Introduction

The success of any business depends chiefly on its ability to pay a satisfactory return on the capital invested. A purely commercial undertaking may be faultlessly organized as regards administrative methods, but, if the organization absorbs all the gross revenue after the preparatory and constructive period, then investors are indignant and demand a different form of management. While it is true that the Forest Service is a vast business engaged in renting and selling natural resources, it is self-evident that it is much more. It should provide a recreation ground for millions of people; it should play an important part in American national life. The conservation of forest resources, whether it pays in money returns or not, is, thanks to a few public-spirited men, permanently welded to American internal policy. Everyone realizes that no great power can afford to sacrifice its forest wealth for present speculation. In the case of some forests, it is highly improbable that they can ever become self-supporting. But who would ask that such a playground and watershed as encircles Los Angeles be abandoned simply because it does not pay in dollars and cents? The indirect value to a community is too great. Nor can "commercial timber" forests yield a net revenue until these resources can be conservatively sold. This development and sale takes time and intelligent preparation. In the meantime, this timber wealth must be protected from fire, insects and disease.

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[1]Consulting Forest Engineer, Albuquerque, N. M.

Forest Service Deficit

Under present conditions, the Forest Service costs about twice what it earns. This condition exists after eleven years of administration. The deficit is not quite so serious as might at first glance appear because part of the appropriation is spent on permanent improvements ($400,000 last year) and on investigative work of great value to the country; this scientific work benefits the National Forests as well as private companies and individuals. This constructive research is like that of the Bureau of Plant Industry, which should never be expected to return a direct revenue. Naturally, it is vital that public service should not be discarded because of a mere failure to pay expenses. Protection of valuable timber is an economy rather than an extravagance. There can be no skimping in fire protection. In the general administration of the National Forests there could be a substantial saving, but not enough to change the balance sheet; such a saving could only be effected by a careful study of administrative and executive conditions. This phase will be discussed later in this article.

When it comes to increasing the revenue, it is here that the Forest Service (or perhaps Congress) may be justly criticised. The National Forests can be and should be self-supporting, beginning with the next fiscal year. American forests are unique, of all national forests, in their deficit. Even in British India there is a handsome net revenue. It may be that the changes suggested must wait a few years before attainment, but with such a cataclysm as is now going on in Europe, economy in the United States Government is desirable. Special taxes are being levied; there is even talk of increasing the income tax and of having an increased tariff. The present administration is faced with a large deficit. Is it not logical, therefore, to have the Forest Service take the lead (rather than lag behind) in an economical policy indicated by administrative and national needs? To wipe out the present deficit in Forest Service administration is not so difficult as might be imagined by an outsider. Politics alone stand in the way. It is well known that the prices of current timber sales are based upon careful appraisals and that the aim is to secure the full commercial value of the product. Curiously enough, this policy does not hold true for grazing or for special uses. There is some justification, to be sure, for special rates in the fees of some special uses, but the writer has consistently favored higher rental rates for stores, pastures, roadhouses, resorts, as well as for all other purely commercial rentals. Today, rental prices are from 1/2 to 1/10 below the market value. The sole justification seems to be the desire of the Forest Service to curry favor with the small man.

This certainly is not necessary in carrying out such a policy as regards grazing. Is not the large man favored also? Is this fair, considering the timber-sale policy of appraising at the full market value? The present grazing fees are the strongest illustration of the variance of the commercial policy of the Forest Service.

Another reason for the deficit is the amount of free use. There is said to be some danger of creating permanent rights and servitudes such as arose in the Middle Ages in Europe from the free use of wood for fuel. There the conditions were different. There was a peasant and servitor class, dependent upon the feudal lords for gratuities. The hardy western settler can hardly be thus classed. He is independent and resourceful. So, perhaps, the best solution is to abolish free grazing and free timber, although the real danger of servitude may be largely theoretical. Congress has already provided for the sale of timber at cost to agriculturists. Grazing fees are already low, and even if increased (as they should be) it is believed the settler can afford to pay them. If, however, it is desired to assist the small grazer, why not give the large man the same privilege? Still another alternative (if free use is abolished) might be to base the grazing fees for the small local resident (say up to 50 head of cattle or its equivalent) on the cost of grazing administration (as is granted the wood-user for timber at cost by congressional law). At all events, the policy ought to be made uniform for the disposal of all resources.

The small man, at present, is favored by Regulation G-5, which reads, in part:

"Milch or work animals not exceeding a total of ten head, owned and in use by bona fide settlers residing in or near a National Forest, require no permit . . ."

This is obviously contrary to the policy underlying the federal income tax, and does not treat all citizens of the Republic equally. It favors the small man. This is, in theory, beneficial to the Forest Service, since it makes friends for the administration among the small settlers throughout the West. If such a regulation followed the policy incorporated in the federal income tax, *this ten head would be exempt for all owners, rich and poor alike.* This, to my mind, would be preferable. The grazing administrative regulations and instructions are admirable. They excel, in the detail of range regulation, anything that has been put in force by any power in the world. Yet, in the big factor of grazing fees, the grazing administration is lamentably weak. The grazing business of the West, notwithstanding figures published by the Forest Service, is mainly in the hands (judged on the basis of number of stock grazed) of the big men. In Arizona, on the Coconino Forest, probably 65 to 75 per cent of the grazing business is directly or indirectly in the hands of three families. Those who know the West, know that this statement is practically true for most of the big grazing centers. *Since the "big business" controls the grazing of the West, why should not commercial rates be charged?* Private owners charge much higher rates than the Forest Service, and even the Indian Service charges about five times as much as on the National Forests. For example, on the Apache Indian Reservation, the 1916 year-long rates for cattle were $2.50 and 50 cents for sheep. These rates were the result of competitive bid. Forest Service timber sale rates are in theory at least also fixed by competitive bid. On the Sitgreaves National Forest, which joins the Apache Indian Reservation, the year-long rate for cattle is 48 cents, and for sheep 12 cents. The main business difference is that, on the Indian land the range may be fenced. Is there any reason why the Forest Service should forfeit two or three million dollars a year simply to prevent regulated fencing? The main reason for not allowing fencing on the National Forests is the desire to keep grazing for the small man. The Forester wishes to prevent the big man from outbidding the small man and putting him out of business, so does not use a complete system of bids in fixing grazing fees. These arguments, to my mind, are not sound. They are political catch-words; *politics, and politics alone, prevent the Forest Ser-*

vice from charging fair rates. The writer believes unreservedly in the policy of an immediate and considerable increase in the fees. The cattle, horse, sheep, and goat business has never been more prosperous. Now is the time for an increase. A considerable increase, at once, to my mind, is preferable to a large number of small increases. Anyone familiar with the stock business knows that owners could well afford higher rates. To argue otherwise is merely playing politics. Does the Forest Service have to submit to political domination? It is believed that to allow fencing would be popular with the permittees and regulations could be drafted to prevent unfair monopoly. Community fences, making suitable provision for water, would take care of the settler. With fencing, the number of cattle upon which fees are paid would be increased.

The writer does not venture to quote the exact rates which should be charged, but, generally speaking, about double to four times the present rates would be fairer than those now in force. At the same time it would, to my mind, be preferable to change the last paragraph in Regulation G-5, to correspond with the exemption clause of the federal income tax:

"All permittees may graze, free of charge, not exceeding a total of 10 head of cattle (or their equivalent) upon National Forests. *This stock can, however, only be admitted after permit has been issued.*"

This would be treating all owners alike, whether millionaires or poor homesteaders, and would be more democratic than the present unequal class exemption. The Forest Service has made a name by its administrative efficiency. How can it afford to permit such a glaring error in its grazing administration to go unnoticed? To base the decision as to partial grazing fees purely on politics and on the question whether the Wilson administration can afford to make political enemies of the stock men of the West is a poor sort of argument. The stock men know the truth of the statement that the grazing fees are not in accordance with commercial usage. They would, undoubtedly, bring tremendous pressure to bear against an increase, but, deep down in their hearts, they would recognize the fairness of the measure and respect the Forest Service all the more. *With desirable fencing privileges, they might even prefer the higher rates.* They realize the inherent justice of giving the preference range right to the small local resident. They must realize that even if the rates were largely increased the small owner would still be able to make an equitable return on his investment; the smaller the outfit, the larger the proportion of his stock would be grazed free (if Regulation G-5 were modified). Under the modified G-5 regulation proposed, a man running 30 head of stock would pay on 2/3; the man running 1,000 head would pay on 99/100. Its fairness is obvious. As already explained, there are the alternatives of abolishing all free grazing, or, if preferred, the small settler could be allowed a few head of stock at rates based on the cost of administration. The point argued by the writer is that the present system exemplified by Regulation G-5 is unsatisfactory.

How far would increases in special use and grazing fees go toward making the National Forests self-supporting?

According to the Forester's Report for the fiscal year ending June 30, 1915:

"Approximately $5,281,000 was expended for the protection, utilization, and improvement of the National Forests, including all overhead administrative costs."

The cash receipts were $2,481,469.35—a deficit of $2,799,530.65. The special use returns were $176,000, and for grazing $1,130,000. By doubling the special use fees $176,000 would be saved and by tripling the grazing $2,260,000—enough to wipe out the deficit when coupled with administrative economy, and when it is realized that last year the expenses were "beyond the normal" because of an extraordinarily severe fire season, and that $400,000 was spent on improvements. Even if the grazing fees were merely doubled it is likely that, with a better demand for timber, coupled with the abolishment of all free use of timber and grazing, the deficit would be wiped out by 1918. Some saving could be made administratively by perfecting the present organization. An analysis of this phase of the problem is of such interest professionally that it will be discussed in some detail under the following heads: Forest Reserves under the Land Office; Forest Service Inspection Districts; Western Administrative Districts; Centralized Supervisor Organization; Arguments Favoring Consolidations; Organization Development; Possible Organization Reform; Conclusions.

Forest Reserves under the Land Office

When Professor Fernow left the employment of the Department of Agriculture in 1898, there was no administrative organization for the existing reservations. In his own words:

"There was no organization at all, but the forest reservations were under the General Land Office like all other public timber lands. In 1898, legislation was passed handing over the survey of forest reservations to the Geological Survey and a rider was hung onto the bill to charge the General Land Office with the administration of these forest reservations . . . Later . . . Professor Roth was called into the General Land Office to organize this service."

The writer secured from Professor Roth a great deal of data in connection with the early Land Office administration, both historically and professionally of wide interest. Professor Roth took charge of Division R in the General Land Office in 1901. When he took charge, the Secretary of the Interior approved grazing permits and all sales of timber, no matter how small, and made all appointments. The Commissioner of the General Land Office signed every letter, and other correspondence was forbidden. The Chief of Division R merely initialed all letters and directed the office and field force from Washington. The field work was in charge of a general inspector who was supposed to be the eye of the Commissioner of the General Land Office. The General Inspector at that time was closely allied to Binger Hermann (then Commissioner of the General Land Office) and kept him informed politically, but did not engage in professional forestry. There were in addition, superintendents of forest reserves. Originally, it was intended to have one for each state, but, of course, the number of forest reserves organized at that time, did not justify this number: California had two, Oregon, Washington, Idaho, and Montana, one each. There was but one superintendent for Wyoming and South Dakota, for Colorado and Utah, and for New Mexico and Arizona. These superintendents acted as inspectors, and since they had no real administrative powers, papers had to be forwarded to Washington, thus causing much delay. When Professor Roth took charge, he curtailed the powers of inspectors to that of mere inspection. These inspectors were originally political appointees, had little or no power for good, and while they had an office they were not supplied with clerical help. The supervisors, who often had charge of more than one "reserve," had no real power for good, but were almost all political appointees, often incompetent. Unfortunately, they had a great deal of power for evil, since they could hinder, prevent and neglect everything that they wanted to. They were usually appointed by local Congressmen and were considered his men. Naturally they hired as rangers men the Congressman recommended. Nominally, they did practically everything that rangers do now, but they had uniform pay with no office worth the term, and no clerical help. The ranger was ordinarily a temporary man, employed for a few months, recommended by the supervisor and appointed by the Secretary. According to Professor Roth, their pay at that time was actually but $60 per month flat, and even continued bad weather might lead to their removal from the rolls; on paper the pay was $60, $75 and $90! Of course, there were some good men, as well as very bad ones, but few were really competent. Professor Roth feels that:

"With competent men this outfit could have done good work and kept a small organization largely for field use. As it was, the whole affair was no good. We got things changed some, but the right opinion and point of view was lacking from top to bottom. One strong point in favor of the old regime was the fact that it had the politicians with it."

A forest official (whose name I do not care to give) wrote in regard to Division R:

"Any organization which tended to close field supervision was theoretically good, especially in those days, but our experience was that the average Forest Superintendent was appointed for political reasons; that there was no way by which they could be checked up and that as a class they were not worth their salt. . . . Professor Roth did his best to dispense with them . . ., but the Commissioner of the General Land Office—presumably for political reasons—did not follow out his wishes . . . The main trouble was the lack of field supervision, there being but two inspectors, and as I recall it, Binger Hermann was not very anxious to have them do much inspection work."

Fred S. Breen, of Flagstaff, Arizona, who proved an efficient administrator (1905-1908) under the Forest Service regime, commented on the early organization in these words:

"The Forest Superintendent at that time for this district was at Santa Fe and had Arizona and New Mexico under his jurisdiction . . .

"The system as run then was mighty cumbersome. A free use of timber permit or application was made out by the Forest Supervisor, sent to the Superintendent, then to Commissioner G. L. O. and was finally approved by the Secretary of the Interior; no matter how small the amount. There were no blanks printed at that time for a supervisor and we made a weekly report on blanks used by the special agents of the Land Office. Rangers made the same weekly report. I started for Prescott, where I had been assigned a reserve of one township, but was met at Lamy Junction by the Superintendent, who advised me that the San Francisco Mountain Reserve had been created and that the people were holding mass meetings and condemning the whole business. And in good truth there was a hostile atmosphere when we arrived. Few men wanted the job as ranger (at $60 a month and keep his own horse) because of the feeling against the whole outfit, but I succeeded in getting five men, all I was allowed, to cover the 3 million-acre patch of trees.

"From 1898 to the summer of 1905 there was a steady drought with high winds and you can imagine about how the fires whipped us to death.

"I think the superintendent scheme was mainly a failure because he had no authority and I think they were afraid to turn any loose in Washington."

The letter of instructions which Mr. Breen received on August 6, 1898, is interesting as showing what a supervisor was supposed to do. It is, therefore, quoted in full. Naturally it has some historic value, signed, as it was, by Binger Hermann:

August 6, 1898.

MR. FRED S. BREEN,
Forest Supervisor,
Manteno, Illinois.

SIR:

Having been appointed a Forest Supervisor, you are hereby placed under the supervision and direction of Forest Superintendent J. D. Benedict, located at Santa Fe, New Mexico, who will direct your work and through whom you will submit your reports to this office. You will, in turn, have under your immediate direction various Forest Rangers.

You are assigned to duty in, and will have charge of the Prescott Forest Reserve, with headquarters at Prescott, Arizona. Report yourself by mail to Superintendent Benedict.

You will carefully study the Circular of June 30, 1897, and amendments thereto, prescribing rules and regulations governing forest reserves, and become thoroughly familiar with the subject, as it will be your principal duty to see to the enforcement of the regulations. Copies of said Circular will be sent you for distribution to persons desiring information on the subject.

You will familiarize yourself with the conditions existing in the reserve under your charge for the purpose of preventing, as far as possible, forest fires and violations of the forest reserve regulations.

It is of the first importance to protect the forest from fire, and, to this end, it is desired that you call the attention of those likely to start fires, such as campers, sheep-herders, hunters and prospectors, to the Act of February 24, 1897, "to prevent forest fires on the public domain," set forth in the Circular of March 13, 1897 (compilation of Public Timber Laws, etc., page 144), and embodied in the forest reserve regulations. Copies of said Circular of March 13, 1897, will be sent you for distribution; and a supply of the forest fire poster, printed on cloth, will be sent you for posting in conspicuous places in the Reserve.

Should prompt action on your part be required at any time to extinguish or prevent the spread of a forest fire, and your force of rangers, is not available, or is inadequate, you are authorized, in such emergency, to employ assistance, under your personal supervision, to beat out the fire or get it under control. You must exercise great caution in employing such assistance, being careful in incurring expenses, which must be kept at the lowest possible figure. Whenever practicable consult by mail or telegraph with the Superintendent before incurring such expenditure.

All reliably obtained evidence against persons violating the provisions of the forest fire law, you will report to the proper United States Attorney, and render any assistance that may be necessary in the prosecution of the parties.

Superintendent Benedict will give you additional instructions in regard to sheep-grazing, illegal appropriation of public lands, timber trespasses, the free use of timber, elimination of lands from reserves, and other kindred subjects in connection with forest reservations.

You will establish correspondence at numerous points with persons residing in or near the Reserve under your care, who will keep you advised of forest fires and depredations on the same or public lands near by, in order that you may have prompt notice of such matters and that they may receive your immediate attention.

You will make weekly reports to this office showing in detail, the *daily* services rendered by you, and a summary of the work done each week by Forest Rangers under your charge; which reports you will forward through the Forest Superintendent in charge of your field of duty. You will also require the Forest Rangers in your charge to submit, through you, weekly reports to this office, showing in detail the daily service rendered by them, which reports you will forward direct to this office.

It is further desired that you will submit *monthly* reports to this office, through said Superintendent, covering all matters of importance coming to your attention respecting forest reservations; especially in regard to the matters of sheep-grazing and forest fires, being careful to make the several matters the subject of *separate* communications.

In regard to fires you will state the dates and numbers of the same, the names and addresses of the parties responsible for their starting or spread, the origin thereof, the locality burned over, the probable area of same, in acres, the extent of the damage done (that is, whether under-growth only was burned, or there was partial or complete destruction of the standing timber), and an estimate of the value of the timber destroyed—stumpage and probable market values; also state the effect upon the forest cover and water supply; and all other information of value relating to the subject. It will also be well for you to report the names and addresses of campers and tourists and the degree of care exercised by them to prevent forest fires.

You will direct the Forest Rangers under your charge to observe closely the operation of the Forest Reserve regulations, and ask them to express their opinions respecting the same, and to make any suggestions in relation thereto that may seem to them to be of advantage in change or modification; all of which you will submit with your monthly reports, with any comments or recommendations you may deem it advisable to make.

In addition to submitting monthly reports, you will keep this office currently advised of all action of importance, taken by you, forwarding your reports through said Superintendent.

You will have under your direction a force of Forest Rangers to patrol the entire district in your charge, and you will assign to each a specified territory, which it will be his duty to patrol under your orders. Your district should be, as far as practicable, equally distributed among the force assigned to you. Each Ranger will be required to make his headquarters in the territory assigned him, at some elevated central point, to be selected by you, overlooking the surrounding country.

The duties of these rangers are set forth in a circular addressed to them, copy of which is enclosed herewith; and you will see to it that they carry out the instructions given therein.

A supply of circulars, posters, stationery, etc., will be forwarded to you, from which it is desired that you will supply the rangers in your charge.

Very respectfully,

(Signed) BINGER HERMANN,

Commissioner.

The Forest Reserve Manual, published in 1902 by the General Land Office, is of interest, and occasionally one sees expressions which have even been handed down and incorporated in the Forest Service Use Book and official instructions. For example (p. 29), "a fire which can not be controlled by twenty to forty men will run away from a hundred or even more men . . . " This certainly sounds familiar. Another example of progressive work (on paper no doubt) was: "plans for the coming month. Brief statement as to what work will be carried on . . ." (p. 57).

The official description in this Manual regarding the organization (p. 85 and following), showed that the inspector of Forest Reserves "is superior officer in the field"; that superintendents "act as local inspectors" and "he assists by suggestion and advice the central office, as well as the local officers, and consults with the supervisors and helps plan the work on the reserves." According to the Manual, the supervisors were men "well grounded and experienced in forest survey, timber estimating and timber business . . . " The head rangers "will act as technical assistants to the forest supervisors . . . and will direct the marking, cutting . . . and will inspect cutting and attend to other Reserve work; . . .; they will act as superiors to the ordinary rangers . . . ." Nominally, the forest rangers were divided into three classes; class one, $90; class two, $75; class three, $60. But all men connected with this organization had already learned that *there was too much authority centralized in Washington.* As already emphasized, the Secretary of the Interior went so far as to grant the right to repair local roads and trails. He granted permits for hotels, stores, etc. He granted grazing permits, but curiously enough, according to the Manual, no grazing permits were issued unless it could be shown that no damage would be done to the Reserve and the burden of proof was placed upon the permittee. According to the Manual (p. 9), "the grazing of sheep, goats and horses in herds *is generally prohibited* . . .," but "cattle are generally allowed to graze in all Reserves." How could such a mixture of rules, with the centralized power in Washington, hope to be popular in the West? It is true that a Grazing Association allotted the range, subject to the recommendation of the superior who transmitted the permits for issuance by the Secretary of the Interior; if there was no local association, then the application was made to the supervisor direct, who could also issue free use permits for wood up to twenty dollars in value. In the sale of timber, the preference was for local use and export could be denied. The timber was advertised, as is now the case, if the value was over $100. The duties of the general force were chiefly to protect the forests, to prevent fire and trespass, supervise special grazing improvements (if there were any) and other general administrative duties. Some detail has been given so as to leave a fairly exact idea of the conditions at that time.

Forest Service Inspection Districts

The "Forest Reserves" were placed under the Forest Service, February 1, 1905.

Until the spring of 1907, this Land Office type of organization was nominally continued by the Forest Service with some changes; such as the addition of timber sale inspectors and the granting of additional authority to supervisors. In 1907, Chief Inspectors were appointed, but were superseded in 1908 by the forest administrative districts.

The main reason why the inspection system of 1907-08 was not a success as a permanent organization was because supervisors had too little authority and were inexperienced. The top notch supervisor of today is better acquainted with policy and methods than the chief inspector of 1907. Another drawback was the necessity of chief inspectors taking up all reports with Washington and the fact that the office was saddled with June 11[1] field work which occupied at least half the time. But even today, the district forester must "recommend" rather than make important decisions. Then, too, the inspection form of organization was not thoroughly tried out. It was in operation scarcely a year. Who can say it would not have worked, if, after being given a thorough trial, it had been modified to meet Western requirements?

Western Administrative Districts

In 1908, six administrative districts were established at convenient centers in the West, and, in 1913, a seventh district was added for the Appalachian areas, Arkansas, Florida, and Oklahoma. The establishment of this seventh district unquestionably

[1] Forest Homestead Act of June 11, 1906.

indicates that the Forest Service believes thoroughly in the district organization, since its headquarters are in Washington, in the same building occupied by the Forester. The scheme of this three-fold organization is clearly, (1) to have the broad policies and procedures developed in Washington, (2) to have the seven districts administrative, executive, and inspection offices together with some pure routine (such as accounts), and (3) to have the supervisor more and more purely an executive officer. This form of organization has been maintained since 1908, with few modifications. Ordinarily, the administrative offices in Washington inspect only their own work. One General Inspector is provided for a close study of important problems (chiefly personnel), but no corps of special inspectors is maintained.

Within the districts the organization has varied considerably. When the position of associate district forester was abolished in 1912, in some districts the different chiefs of office (assistant district foresters) alternated with the district forester during his absence; in other districts, the chief of operation always alternated and, in effect was made an associate district forester, although this was not expressed in increased salary. In one district, the district forester felt that all of his office chiefs should be general men; that, simply because one happened to be chief of silviculture was no reason why in the field he should not undertake general inspection. Another district forester rather leaned towards specialists; he felt that the repetition of travel which this necessitated would be more than paid for through increased efficiency gained by having specialists undertake only the work with which they were most familiar. There is still a good deal of variation in the district organizations. In District 3, for example, the plan formerly adopted was to have general inspections made of all the forests in the district at least once every year or so. These general inspections were carried on by the different office chiefs and apparently gave them excellent training; supervisors believed in it. In 1913 and 1914, in District 3, all strictly general inspection was limited to operation and the District Forester.

The writer has always argued for more general inspection for the district office and for the participation of all assistant district foresters in the general administration as acting district foresters. In March, 1916, such a policy was officially promulgated in District 3 by the District Forester after a study in part of the organization perfected by Major Hine for the Southern Pacific and Union Pacific Lines. Such a change is gratifying, since it is believed necessary for efficiency to have all assistant district foresters undertake general inspection and continue familiar with the conditions in other lines of district activity. It is safe to say that intelligent general inspection is cordially welcomed by most forest supervisors.

The idea underlying this change is that the acting district forester is chief of staff. One reason why, in past years, this scheme did not succeed as well as it might have, was because the acting district forester was supposed to be responsible for routine in his own office as well as for the routine going over the district forester's desk. According to the latest scheme, the assistant district forester, while acting district forester, will not only sign all correspondence from his own office, but will have routed over his desk (while acting district forester) for information and review all letters from all offices. It is very welcome to see that the plan calls for the rotation of all assistant district foresters as acting in charge of the district. The officer temporarily in charge of the office whose assistant district forester is acting as chief of the district will handle the work just as if this officer were actually absent.

Another variance in organization has been the relative size of the units under one supervisor in the various districts. Usually there are administrative reasons for placing a large or small area under one man. In the words of a Western officer:

"The difference in the size of the Forest Units in the various Districts is not so pronounced at the present time, with the exception, perhaps, of District 2, where the tendency has always been toward relatively small units. District 4, with an average Forest Unit area of 960,000 acres, probably occupies a middle-ground. The chief justification for the system or organization prevailing in District 4 is found in the intensity of the grazing use, and *the large volume of free use business* and small timber sales. Upon the——Forest over 2600 grazing permits are issued annually, or a greater number than the total number issued in at least one or two of the other National Forest Districts. There are several other Forests where the number of grazing permits is considerably over 1,000. The population is relatively dense surrounding the Forests in Utah, the San Pete and Castledale valleys, which lie east and west of the Manti, containing, for example, about 27,000 people, all engaged in agricultural pursuits and all interested to a greater or less degree in the use and administration of the Forest."

The following table shows approximately the size of the units for the six western districts.

District	*Number of Administrative Units*	*Gross Area (1,000 Acres)*	*Average Area (1,000 Acres)*
1	26	26,934	1,036
2	32	22,904	716
3	16	21,521	1,345
4	31	29,761	960
5	19	26,148	1,376
6	26	27,319	1,051
	150	154,587	1,030

The above figures are approximate and are subject to corrections caused by the redistricting which is continually taking place.

The table indicates that the average number of units per district is 25; the minimum of 16 for District 3 and the maximum of 31 for District 4. The average unit is slightly over 1,000,000 acres, but varies from 715,740 acres in District 2 to a maximum of 1,376,208 in District 5, with District 3 a close second to the maximum with 1,345,078 acres. Surely such difference in the acreage between units in District 2 and District 3 must signify a fundamental difference in organization. This is all the more significant, when it is realized that District 3 has advocated a further increase in the size of its units. The details of this plan will be analyzed later. Fundamentally, the variance seems to be due to two forms of administration; one, where the supervisor is assisted by specialists, and where he himself devotes little time to details, and the other, where the supervisor is an all-round administrator and is personally familiar with the detail of all lines of work. The local conditions in District 2 and District 3 are very similar (but District 2 includes Michigan), so that one system must be wrong, and the other right. Which is correct and what changes in organization are demanded? This will be discussed later.

Forest Organization in Other Countries

The present Forest Service organization is quite similar to that of Austria, where, however, the districts are in part dictated by the political and racial differences. In Austria,[1] the head of the

[1] Proc. Soc. Am. For., Vol. 9, No. 1, pp. 7-37.

Forest Service is concerned with judicial, legislative, and administrative problems, including technical management, forest experiments and examinations. Under his direction, subordinate officials at the central bureau examine and approve district budgets, prices of forest products, technical studies, free use, wages, promotions, appointments, and organization regulations. There are 7 districts (Vienna, Gmunden, Salzburg, Innsbruck, Görz, Lemburg, and Czernowitz), each in charge of a director or district forester that directs and supervises the "forests." He is an executive who recommends and carries out schemes approved by the central administration at Vienna. He maintains the property of the State and funds lands, and plans increases in revenue; supervises free use, building operations, shooting and fishing, working plans, annual and current reports, finances, allotments, and appointments within their districts. Important district problems, however, are not decided within the district, but only after consultation with the chief officials of the other districts. Judging from the large number of forests (196), and bearing in mind that the total area administered is less than 4,000,000 acres, it is clear that the supervisors in charge of forests are all-round men who personally supervise all field work done by their subordinates, besides being responsible for office work. There is clearly no room for a supervisor staff with administrative districts.

In France, there are no districts in the sense that districts are maintained in Austria. There is a central bureau at Paris having much the same functions as the Vienna bureau, but instead of seven districts there are thirty-two "conservations," not including three in Algeria, and one in Tunisia. The French "conservation" is, therefore, practically identical (but far less important) than the proposed staff supervisor organization, proposed by District 3. In France, the conservator makes personal trips to superintend important work on the various units within his conservation, holds the more important timber auctions (which are oral), and generally represents the district in the local department; is the personal representative of the Waters and Forests Service in dealing with the Prefect or local governor. Under the conservator, are comparatively small forest units, usually in charge of an inspector or assistant inspector who personally supervises important marking and other field work and "management" (working plans). "Reboisement" are projects separate from the regular "inspections" or forests in certain districts where there is specially important work. In Algeria, there is some variation from the organization of France proper. Here, there are three conservators, one of them acting as chief conservator, working directly under the Governor-General of Algeria. Each conservator has, as an associate, a so-called "controleur" who is really a general inspector working in co-operation with the conservator. This position was formed in order to give employment to an additional number of high officials so as to prevent stagnation in promotion which was current in 1903. Moreover, there are no "inspections" under a "supervisor," as in France; instead, there are "chefferies," or small forest divisions, usually under forest assistants, examiners, or assistant inspectors. This gives men a chance at slightly higher pay and increased responsibility, without having to wait for their regular promotion. The French rangers in Algeria have, as assistants, native guards who really act as couriers, guides and protectors against lawless acts by the native Arabs.

In India, there is still another form of organization. An inspector general, under whom there is a superintendent of working plans, reports directly to the Viceroy. He supervises the policy of the local conservators, but these conservators work directly, in real matters of routine, under the local governments. The Indian organization is very much as if there were state foresters in every state of the union reporting directly to the local governors, subject to the approval of a central federal bureau as to working plans and certain forest policies of importance to the whole of the United States. Much the same plan is now in force where the Forest Service is charged with the allotment and supervision of federal fire protection money given to States when they qualify for allotments by passing satisfactory forest fire laws. The Indian organization is really a compromise between the organization proposed by the states rights men in the United States and the "Federalists."

On the continent the army type of organization is followed. Ordinary promotions follow naturally certain terms of service, unless a man is disqualified by inefficient work. In India, the method of promotion is more nearly that of the United States, except that Anglo-Indians and natives are not given the same advancement as is the pure English Stock. In all of these countries there are pensions on a fairly liberal scale. As is natural, the salaries on the Continent are less than those in the United States, while the salaries in India are considerably more; they vary with the cost of living. Every important forest service has an annual budget (except the United States), followed by formal annual reports. The rangers are generally housed, and, except in France proper, the executive and administrative staff is provided with houses.

The forest schools in all these countries are maintained by the state, and, in India, local ranger schools are being maintained in order to give the *local* ranger a *local* training to fit him directly for the field work which he must undertake. In France, there is a ranger school at Barres and a staff school at Nancy. The directors of practically all schools are also in charge of local forests; this enables them to keep their hand in and to be administrators as well as professors. The school forests are always used as demonstration grounds for the students and are often model forests.

The table which follows shows (with some exceptions) the equivalent titles and salaries for the American, French, Austrian, British Indian, and German (Prussian) forest services. A glance at the titles used in other countries, it seems to me, indicates that our own titles are unsatisfactory. Titles which seem preferable are: Chief Forester and Assistant Forester to correspond with the title of Forester and Associate Forester of today. The title, Chief Forester, seems better than that of Director, Director General, Inspector General, or any such un-American name. Since the Associate Forester is really a sort of advanced Assistant Forester or branch Chief, there is no reason for having a separate title beyond the fact that the statutory roll now carries one. Assistant Forester and Inspector should remain as at present. The term Administrator for Assistant Forester has been suggested, and the term Executive Assistant instead of Inspector, but they are unnecessary. In Washington, under the proposed new organization there should certainly be one Chief Inspector, with an inspector as assistant, and if the present district organization were replaced by inspectors there should certainly be a district inspector in charge, also assisted by inspectors. On the forest, the title should

Comparative Table of Main Titles and Salaries

United States Equivalent	*Salary ($ ±)*	*France*	*Salary ($ ±)*	*Austria*	*Salary ($ ±)*	*British India*	*Salary ($ ±)*	*Germany (Prussia)*	*Salary ($ ±)*
Forester.........	5000	Directeur Général*	2400–3,000	Ministerialrat	2842 up	Inspector General	10,500	Oberlandforstmeister	3333–4048
Assistant Forester	3000–3500	Administrators*.	2200–2600	Höfrat	2030–2842	1 Assistant Inspector General	rank + 800	Landforstmeister	1600–2738
Inspector........	2700–3200	Inspecteur* Chiefs of Service	1400–2200	Höfrat, Oberforstrat, Forstrat	......	....	....	Oberforstmeister	1,000
District Forester	3000–3200	Conservateur*...	1600–2400	Oberforstrat and Forstdirector	1299–1786	Chief Conservator	8600	(See above)	......
						Conservator.....	6,000–7600	....	......
Assistant District Forester	2700 ±	Inspecteur (Controleur in Algeria)	according to service	Forstrat......	974–1299	....	....	Regierungs and Forstrat	1714
Forest Supervisor	1800–2400	Inspecteur	1030–1350	Forstmeister..	731–974	Deputy Conservator	2300 +	Forstmeister Oberförster	714–1714
Forest Examiner or Deputy Supervisor	1400–1800	Inspecteur-adjoint	750–950	Oberförster Forstverwalter	568–731	Assistant Conservator	1520–2800	Forstassessor or Forstreferendar	......
Forest Assistant..	1200–1400	Garde Général..	570–660	Forst assistenten	447–568	....	....	Forstheflissener	......
Forest Ranger....	1200–1500	Brigidier.......	270–310	Förster.......	267–365	Ranger.........	natives	Förster.........	333–600
Assistant Forest Ranger	1100+	Garde..........	220–260	Forstgehilfe...	203–251	Assistant Ranger	natives	Forstaufseher (Hilfsjäger)	239–321

* Note: These salaries are not exact, since changes have been made in some cases since the data was secured.

be supervisor and assistant forest supervisor rather than deputy. The word deputy is a county term which should be dropped. "Forester" has been suggested instead of Forest Supervisor, but the latter seems preferable. Forest Assistant and Forest Examiner could be retained for lack of a better term. The names Forest Ranger and Assistant Forest Ranger are good. It has been suggested that the word Forest in front of Supervisor is superfluous, but there are so many kinds of supervisors in this country (as for example, supervisors of poor farms, supervisors of counties, etc.), that the prefix Forest is absolutely necessary. These titles proposed are in accordance with usage in the States; for instance, we have accepted State Forester and Assistant State Forester as standard. Why can't we get away from the abnormal and complex titles which have crept into the Forest Service organization; there are something like 72 different titles at present! One of the chief reasons for these seems to be that whenever a special man is required to do special work the Civil Service Commission must have an examination for a position governed by some new title. This does not seem reasonable. Mr. Ringland favors a scheme of graduated advancement based upon service, inspection, and examination for promotion. It is something like that of the Public Health Service. Chief Forester, Senior Forester, Junion Forester, Forester—anything is better than the present titles.

Centralized Supervisor Organization

This idea of an even more centralized supervisor administration has been considered officially in District 3 (Arizona and New Mexico), but, so far as is known, the Forester at Washington has not decided to make any drastic changes. According to a letter received from the District Forester on January 4:

"The moving reason for my recommendations is this: Mindful of the millions needed for military defense and the loss in revenue due to economic disturbances, the Forest Service can look for no increase in its appropriations for sometime to come. Therefore, the problem is wholly one of adapting our organization to secure the greatest efficiency with money now available. In my judgment, the present organization does not accomplish this. Therefore, I have given a great deal of study to ascertain in what way the organization can be bettered. It is not claimed that there will be a decrease in costs but rather there will be a decided increase in efficiency for the same money. Some day, of course, we shall need small forest units intensively administered. We must wait, though, for business to justify this. Obviously, if I make my ideas of forest administration stick, there should be changes in the District office organization. In brief, the changes I have in mind would be the elimination of much of the Forest work now of necessity carried on in this office. The Supervisors with their staffs should be able to handle practically all such executive work as we are now handling. The effect would be a small staff in here engaged in inspection of the work as executed in the field and in the development and shaping of administrative policies."

This consolidation if applied to District 3 means the elimination of six units by contracting sixteen administrative units into ten.

Let us consider one of these consolidations (Santa Fe-Carson) in detail[1]; on paper it seems logical and progressive.

The total gross area of these forests will amount after the consolidation to 2,126,670 acres, with an unusually long boundary of 1,005 miles, due chiefly to the indentations of private land grants within forest areas, yet the units are homogeneous and, notwithstanding the high mountains, the travel by valley routes is usually practicable. There is an eight months field season. A field telephone system is practically completed and the Carson can be connected to the proposed headquarters at Santa Fe by the construction of a few miles additional telephone. The lookout points will be conveniently located with respect to Santa Fe and the shipping and travel will be as easy or better than from Taos, the present headquarters of the Carson. The population is conveniently located with respect to Santa Fe, which is the capital of the State.

Extensive land classification is well along, but very restricted grazing reconnaissance has been undertaken. The boundaries of the various divisions are well established and suitable. Other routine work is pretty well lined out. Extensive timber reconnaissance has been collected for all forests, except the Taos division of the Carson.

The salary roll at present for the Carson and Santa Fe, administered separately, totals $41,745. After the combination, the total expenditures are estimated at $39,565. This second figure

[1]Based on data compiled by A. C. Ringland and D. P. Johnson; presented to the Soc. Am. For., Albuquerque Branch.

provides for the salary of two $2,000 men, who would be transferred from the District Office to the Supervisor's Office. One of them would specialize in timber sales, the other in engineering. Apparently, there are no obstacles to such a consolidation under the head of geography, topography, climate, communication or transportation. While the volume of business would be large, it can, for the most part, be systematized so as to be reduced to mere routine work. If the consolidation were made, the work would be divided into three heads—silviculture, grazing, lands and engineering, which would include both permanent improvements and fire protection. Silviculture and lands and engineering would each be in charge of a specialist, while the supervisor would probably specialize in grazing. It is significant that, when the Forest Service first took over the then-called Forest Reserves, the Jemez, Pecos, and Taos Reserves were administered by three supervisors, all located in Santa Fe, but, at that time, there was no organized office machinery to speak of, practically no telephone conveniences, Forest Service policies were poorly defined, map and status data were meagre, the rangers were inferior, and the supervisors had no staff. Under present conditions all this has been changed.

In the words of a local officer, the specialist idea as applied to the Santa Fe-Carson is exemplified as follows:

"In the first place, it is not the idea to relieve the ranger of his present duties, or in other words to depend upon a lower class of rangers. They already have more than they can do properly and the specialist idea would not relieve them materially. An engineer, for instance, would be busy for two years in adjusting boundary disputes with grants. Important trails should be surveyed and instructions given,—even in a lesser important trail construction; as a matter of fact, there is no end of engineering questions which would come up to a good specialist. It was the idea that fire protection, all sorts of improvements, and survey work which the district rangers have not time to handle, even if they are qualified, would be handled by the engineer. A lands specialist would be nothing new—we have had two of them for the past two years, and with the occupancy permit work staring us in the face, we will have more work than one land specialist can handle of that class of work alone in the future. The grazing man would not count cattle, nor would he be an office man. With 500 grazing permits, it may easily be seen that there is enough administrative work in connection with these permits and the attending complications to keep one man from the

Supervisor's office busy on handling complaints. In addition to this, we simply must have more information on the carrying capacity of our ranges. We know little enough to enable us to take decisive action on the applications we receive, to say nothing of properly utilizing what is apparently a present surplus on some units which in reality resolves itself into a fire menace.

"The timber sale specialist would not handle the timber sales, but he would be required to do the work which the Supervisor should do if he had time, viz., mark the timber, make frequent check scales; or in other words, in addition to marking the timber, be able to give frequent inspections. In my opinion, there is less need for a timber sale specialist than for the other three named, for the simple reason that our timber sales ar limited and so far, the Supervisor and Deputy have been able to handle the inspections. However, we have not personally handled the marking, as I know we should have done."

Arguments Favoring Consolidations

The arguments in favor of larger units with a staff[1] organization are summarized from a paper Mr. Ringland read before the Albuquerque Section of the Society of American Foresters on December 11. As he pointed out, geography alone may preclude certain consolidations which, otherwise, might be desirable, "for example, geography alone precludes the Wichita National Forest in Oklahoma from consideration with any other National Forest area—it is then the governing factor." Geography, in its narrower sense, will become less and less an obstacle to efficient communication with the increasing use of motorcycles and automobiles. "Topography is a factor commonest . . . in high and rough mountain regions. . . . Topography determines intensiveness of administration."

Communication, whether by travel, telephone, or telegraph, naturally must be considered.

"The most important factor determining the size of a Forest Unit is the intensity of business. The Datil Forest, referred to, is a striking example of a Forest where because there is as yet little development, the geography and topography and communication permit the supervision of a very large area. On the other hand, it was business needs alone that dictated the present ad-

[1]It is important that the word "staff" be clearly understood. According to Major Hine: "The staff officer is the playwright, the line officer the actor; one designs, the other executes." In Mr. Ringland's paper he referred to the supervisor's staff personnel as composed of *executives*, "line officers."

ministration of the Coconino and Tusayan Forests as separate areas, for the communication facilities are excellent, and geography and topography are not influencing factors."

The denser the population, the smaller the area that can be administered. In any reorganization it is naturally advisable to consider, somewhat less seriously to be sure, the homogeneity of the climate as affecting work, the progress of the early development activity on each unit and the relative expense. It is argued that where factors permit, it is a mistake to place too small an area under one man because of the danger of having to fill the position with a mediocre man having the pay *small* and the forest allotments *meagre*. Such an officer must concern himself with petty details since the area under administration cannot afford a regular clerical staff. On the other hand, the writer wishes to call attention to the danger of overadministration. The goal should not be the highest possible efficiency, but rather a reasonable efficiency coupled with a moderate and reasonable expense. Moreover, it is well to consider what a forest unit should constitute:

"Under existing conditions, financial and other, and expected conditions, a National Forest administrative unit is to be considered *all* that tract of National Forest land, so situated as to geography, topography, climate, means of transportation and communication and population, amount and character of forest business (including forest protection), and public sentiment, that the Forest Supervisor with adequate executive and clerical assistance can keep in actual, close, personal, field supervisory touch with his field officers, and in close field and office supervisory touch with all activities, business, improvements and constructive policies of the Forest of which he is in charge as administrative head, and for the welfare of which he is responsible."

It is well to remember that in railroad reorganization, whenever you can replace a specialist with an all-round man your business is the gainer.

"Unnecessarily small forest units cause the ineffective expenditures of large sums of money—in rent, salaries, travel and the handling of the business with the District Office."

The District proposes two classes of National Forest units. One is defined by Don P. Johnson, as a unit

"which produces enough administrative, protective and constructive work to warrant a specialized supervisor's staff of at least four men, specializing in Silviculture, Grazing, Lands and Engineering. A second-class unit is one which, on account of geography, topography, communication, or population factors, does not produce enough of each of the four broad activities to warrant the full specialized staff."

Naturally, the volume of business as well as its character may vary from time to time and, consequently, will impose modifications in the staff organization. The plan as outlined is simply to carry a modified form of district organization to very important forest units which are to be formed with the special object of giving a large enough area under one man to justify a rather expensive staff.

This staff naturally divides itself into three divisions: (1) administrative; (2) executive; (3) clerical.

The administrative includes a supervisor and deputy forest supervisor who alternate in office. The executive includes the specialists whose duty it will be to perform much of the special field work now undertaken by rangers.

The clerical division will include a chief clerk, and suitable assistants to take care of the clerical routine of accounts, property, letter-writing, filing, etc.

With such an organization, it is obvious, as Mr. Ringland points out, that a change must occur in the duties and organization of the ranger force.

"Major executive work involving unusual mental effort is taken away from the ranger. To him is left minor executive duties—very small sales, free use, and the like."

He will put more time on fire protection, and in bossing per-diem guards "engaged in physical effort." This is, in theory; in actual practice, it is not always true.

The ranger force will be reduced, provided the ranger can be given a district.

"Topographically possible to cover adequately. While it is with hesitation that a definite area is suggested, yet 333,000 acres may be assumed as the standard."

The rangers will oversee forest guards and the work of forest protection, and perform minor executive duties more economically handled by them than by the staff executive. Most significant of all, they will be expected "to assist the staff executives in the performance of their major activities." Rangers of unusual ability will graduate to the staff. Applying this theory to District 3, Mr. Ringland argues that "using funds now available . . . this will mean . . . a personnel of ten supervisors, ten deputy supervisors, twenty executive staff assistants and twenty clerks, a staff of sixty, supervising sixty rangers and one hundred ninety forest guards, or a full staff of two hundred fifty. The forest guards will work at round-ups, count stock, do improvement work, burn brush, police, haul supplies, and cultivate and harvest forage crops."

They will be recruited for eight months a year at $60 a month from the local population. In addition, there will be fire patrolmen serving not over four months.

In conclusion, Ringland argues:

"That here is an organization, systematically distributed, . . . made up of individuals selected for the work at hand. It is a simple organization susceptible of expansion or contraction—it is flexible. Can we not then meet our needs more independently? Can we not then make it possible to recognize the work of the individual and attempt to pay him accordingly?"

These recommendations appear theoretically sound, except for one weakness—a most important one—,his failure to comment more adequately[1] on the future of the district office. To my mind, a competent supervisor's staff means the end of the district staff in its present form. There are, to be sure, almost insurmountable objections to the Supervisor staff organization, especially forceful *unless* the district office is abolished. Then, too, how will it affect public sentiment? Having a local supervisor in a town, often makes that town exceedingly loyal to the Forest Service, on account of the personal intercourse between the supervisor and the more prominent citizens. With the staff organization, there will probably be less real intimacy on the part of the supervisor, even if he were enabled to make systematic public sentiment tours, giving lectures at convenient points—something that is sadly lacking at present. There will be a greatly increased travel expense, since it might readily happen that, in rotation, you would find on one forest district the grazing specialist, the improvement specialist, the timber sale specialist, and the land specialist—each of them perhaps accompanied by the respective chiefs from the district and

[1] Since this was written, it is understood that Mr. Ringland planned a study of the District organization as a corollary to his other organization studies.

from the central bureau. It is possible that one all-round man could handle these problems with sufficient efficiency without the necessity of this duplication of travel. As the Service grows older and the forest efficiency increases, cannot good all-round men be secured to obviate the necessity of so much travel in duplicate? Moreover, there can be such a thing as too much efficiency. In any business there is a certain theoretical limit when it pays to be less efficient and more economical. Has not paper efficiency often been put at too high a premium? When one compares the highest efficiency with work that is somewhat less efficient but much cheaper, often the less efficient work should be our ideal. It is similar to the case of the company that hired a tool custodian at $75 per month to prevent an annual tool loss of $100. There was greater efficiency in looking after tools but the net loss was $800 a year.

Another point is that, although the ranger is obviously becoming more and more effective and although recruited from a higher class of men (many of them with technical forest education), he is to be given under the new plan (unmodified) less important work than the frontiersman was given in the past. The new organization might mean more frequent changes of residence on account of the varying volume of business necessitating reductions or increases in the staff. On paper, it looks as though we would be maintaining at needless public expense two district organizations. *Why can't the present district organization be abolished if we adopt the supervisor staff organization?* If this change were made one of the main objections would be the fear of tremendously increased traveling expenses between Washington and the West, yet, if the trips are properly systematized, this travel would be more than paid for by the saving in the large rental cost of the present district offices. Another objection to the abolishment of the district office is its beneficial effect on local public sentiment, but this could probably be handled quite as efficiently by a general inspector free from onerous routine duties. There would probably be slightly decreased efficiency if the District were abolished; this would be more than counterbalanced by economy and uniformity. Perhaps, $100,000 to $300,000 a year could be saved and the present District policy would be welded together. The application will be discussed later on.

It is significant, when considering expense, to remember how large the district office forces are, but one must remember that many of the men spend much of their time in doing forest work that would otherwise have to be done by the supervisor. In February, 1916, one of the District Offices (typical of other District Offices) numbered 72 officials. Of this number, there were in the office of operation alone, 1 assistant District Forester in charge, 2 men on fire protection, 1 on improvement, 1 on telephone, 1 on roads, several stenographers or clerks. The district overhead amounts to 8 per cent and the Washington overhead to roughly 19 per cent, making a total of 27 per cent for overhead supervision.

One of the other Districts favors a moderate unit for these logical reasons, which present a strong argument:

"The division into Forests is based primarily on *topography* and *communication.* As the methods of communication increase, it might be possible to increase the size of units, but this I rather doubt, since I believe it extremely important from the standpoint of *protection* to keep the units small enough to prevent the organization becoming unwieldy. An example of increased efficiency due to a smaller unit of organization is well borne out in the case of the ——— Forest. This Forest is composed of what were formerly parts of the ——— and ——— Forests. Before its organization on its present basis the number of Class C fires doing considerable damage in this territory was very high. Since that time, however, the damage has dropped much lower, and the same is the case on the two adjoining Forests. This indicates that considerable efficiency in fire protection is often gained by smaller subdivisions. Aside from topography and communication, the deciding factor is one of *business.* Here, again, the factor of supervision on the part of the supervising officers is met with. I feel that any saving from reducing the number of supervisors below those we now have would seriously decrease the efficiency of the individual and of the organization as a whole; neither do I believe that the work of the Forest Service, at least in this District, is such as to lend itself to any considerable amount of specialization. The work of the ranger varies greatly, and any attempt to secure administration through specialists in a different line would lead to endless duplication and greatly decrease the efficiency of the organization as a whole, and greatly increase costs. The time may come when an organization of the kind suggested will be practical, but until it does, the District organization with its corps of specialists available to render assistance to the supervisors along special lines is, in my opinion, indispensable.

"The advantage of the District organization, as distinguished from a centralized authority in Washington, aside from the direct increased efficiency in the conduct of the affairs of the organization, which is, of course, its chief function, lies in bringing closer to the community the direction of local affairs. This is a very real advantage, and in my opinion, a most important one."

Organization Development

The organization charts which follow show the development of the forest, district, and Washington organization for the years, 1904, 1907, 1909, 1915, and as proposed.

The Forest organization changed as follows:

CHART 1

1904
Supervisor
Chief Ranger
Rangers (class 1, 2, 3)

1907
Forest Supervisor
Forest Assistant
Rangers (on districts) — Rangers (on projects, as large sales)
Guards

1909
Forest Supervisor
Deputy Forest Supervisor (on Forests)
Forest Assistants
Rangers (on districts) — Rangers (on projects)
Guards

1915
Forest Supervisor
Deputy Forest Supervisor (on Forests)
Forest Examiner
(Chief Clerk)
Rangers (on districts) — Rangers (on projects)
Special Assistants
Fire Lookouts or Patrols.

Proposed:
Forest Supervisor
Deputy Forest Supervisor
Forest Examiners
[on large units: staff]
[on small units: no staff]
(Chief Clerk)

Rangers (on districts) — Fire Control — Rangers (on projects)

Under the forest district organization of 1904 (Chart 1), it is evident that few changes have taken place between 1907 and 1915 The only really fundamental change is an elaboration in order to take care of more complicated work; even as far back as the fall of 1905 there were project men in charge of timber sales as well as rangers on districts. A recent elaboration is in fire protection, where the fire chief controls the fire lookouts. No change in the

CHART 2

The development of district organization shows the following:

1904 *District Offices* (7)

- Superintendent
  - Supervisors (on Forest Reserves)

1907 *District Inspection Offices* (6)

- Chief Inspector
  - 3–5 Inspectors
  - Land Examiners (Act, June 11)
  - Forest Supervisors (on National Forests)

1909 *District Offices* (6)

- District Forester
  - District Law Officer
  - Associate District Forester
    - Operation
      - Organization
      - Occupancy
      - Engineering
      - Accounts
      - Maintenance
    - Grazing
    - Products
    - Silviculture
      - Timber Sales
      - Planting
      - Silvics
  - Forest Supervisors (145 National Forests)

1915 *District Offices* (7)

- District Forester
  - Law Officer
    - Accounts
    - Operation
      - Highway Engineer
      - Maintenance
      - Special Studies
  - Engineer
    - Silviculture
      - Subsections as required
      - Experiment Stations (Specialists)
      - Special Studies
    - Lands
      - Inspection
      - Entry
      - Survey
    - Grazing
      - Studies
  - Forest Supervisors (153 National Forests)

Proposed: *Inspection Districts* (8)

- District Inspector
  - Law Officer | Inspectors
  - Forest Supervisors (100–120 National Forest Units)

The Central organization at Washington developed as follows:

CHART 3

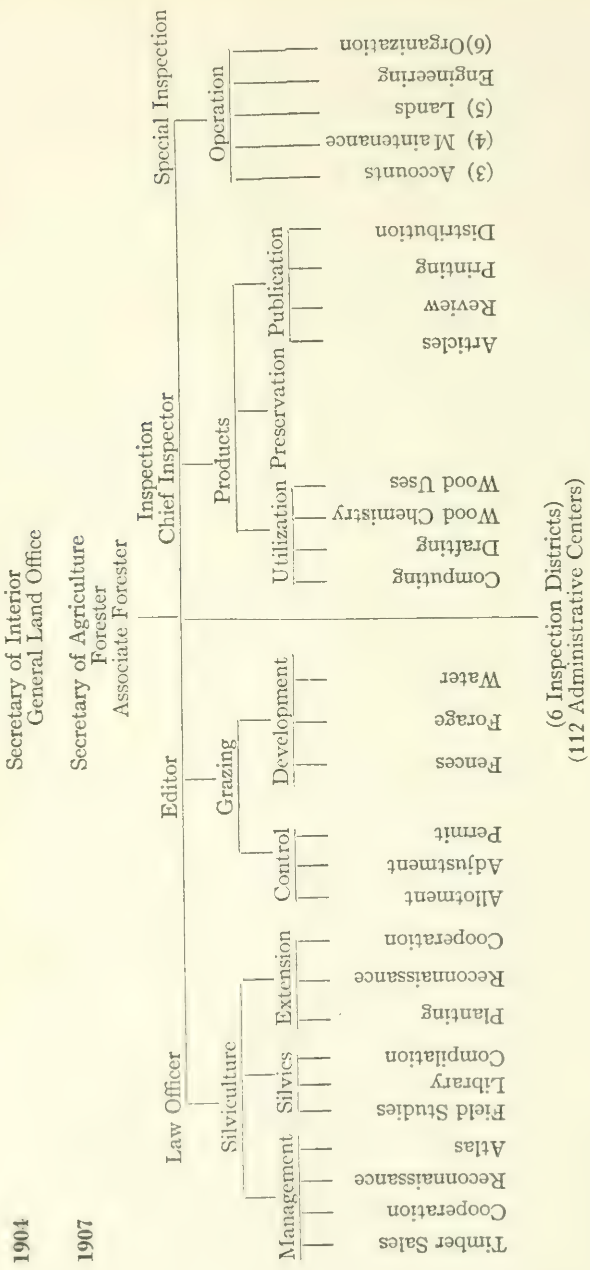
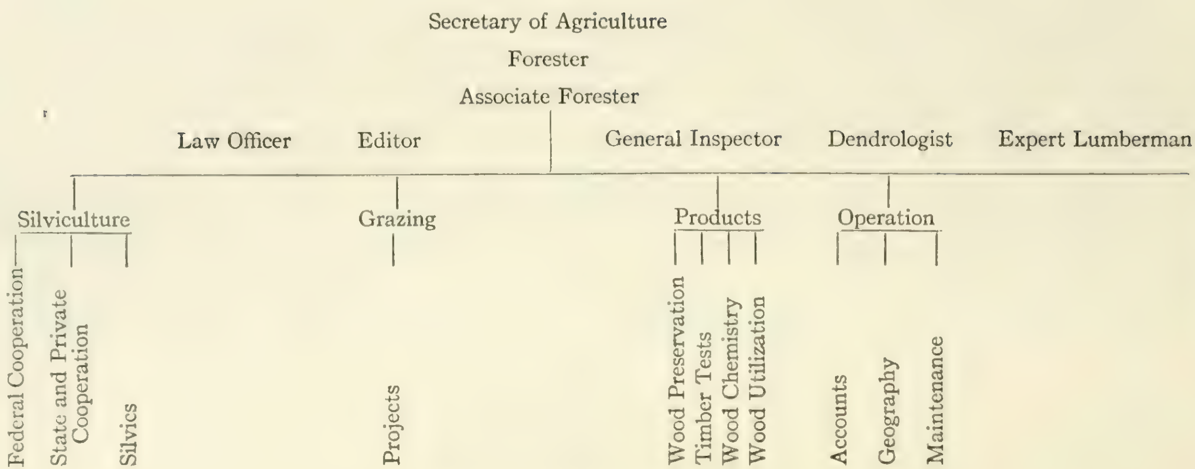


CHART 3 (*Continued*)

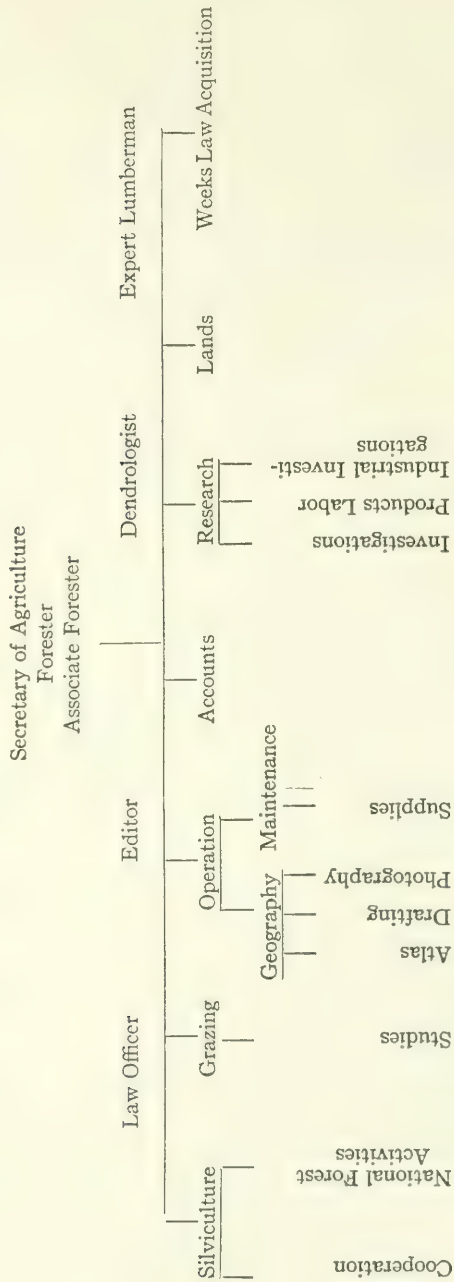
1909



(6 Administrative Districts)
(133 Administrative Centers)

CHART 3 (*Continued*)

1915

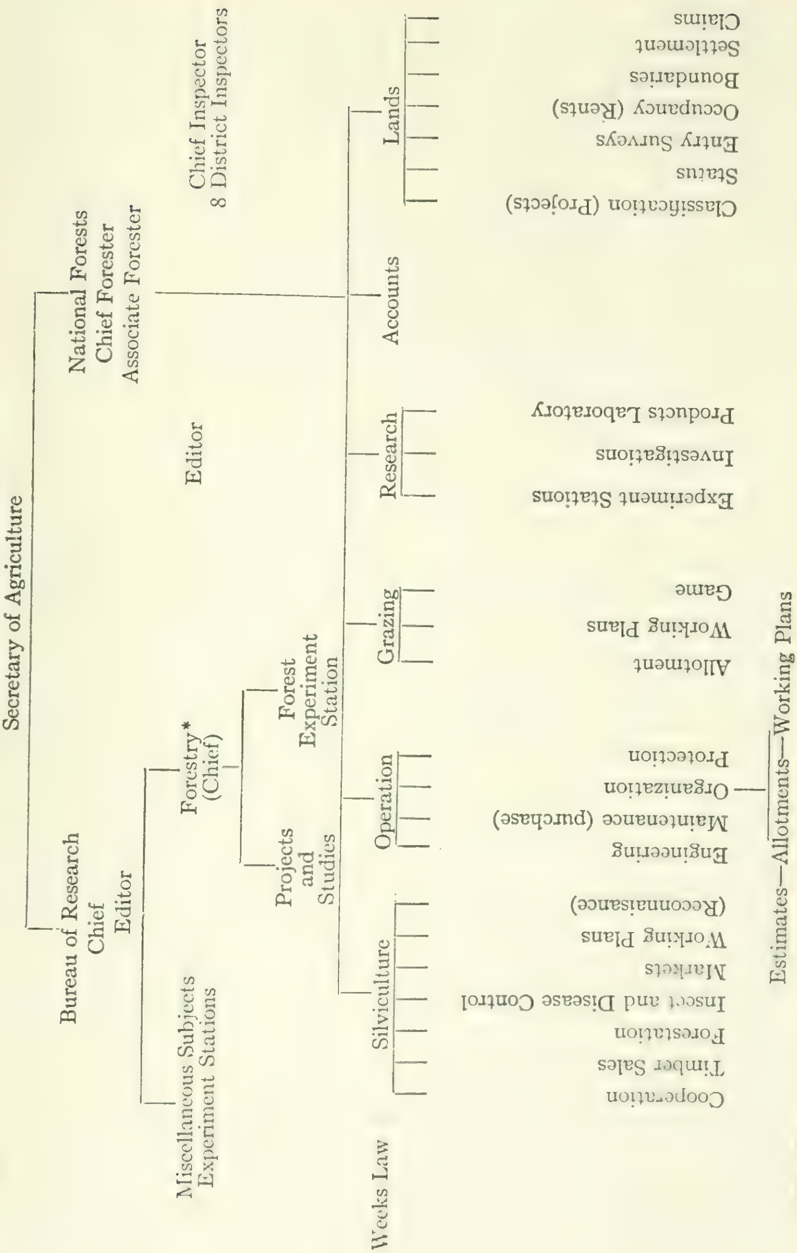


present organization is proposed, although on very large units, it may be desirable to adopt the District 3 scheme of a staff organization; but this staff is more elaborate than appears necessary. Instead of having grazing, timber sales, engineering and lands specialists, probably two specialists could handle the four activities (Chart 2). The changes in the district organization outlined above do not require explanation.

The intensiveness of organization in 1907 is interesting (Chart 3). Take the branch of operation for example. It was divided into accounts, maintenance, lands, engineering and organization. This, it should be remembered, was when the administration was centralized in Washington. What brought this organization into disrepute was the fact that it was over-organized. Accounts was divided into: (1) disbursements, (2) bookkeeping, and (3) receipts, each with a chief; maintenance was divided into (1) purchase, (2) record, (3) supplies, and (4) photography; lands, into (1) special uses, (2) claims, (3) agricultural, (4) settlements, (5) status, and (6) boundaries; organization, under a chief and assistant chief, was divided into six districts corresponding with the inspection districts, each under a forest assistant or supervisor, detailed for routine work. Of course, this early district organization was designed to train the supervisors. Probably the mere routine under "organization" done by these six men could be readily handled today by one or two competent officials with perhaps the assistance of a chief clerk. The organization proposed is, to be sure, somewhat similar to that of 1907, but there is a vast difference. It has been simplified; most important of all we have trained men in the office to handle the routine economically and simply. Even more significant is the fact of the increased authority supervisors enjoy, so that the argument that since the organization did not work in 1907, it will not work today, can by no means hold true.

If the Forest Service is ever to be upon a self-sustaining basis, it is absolutely essential, to my mind, that research be separated from administration. Therefore, in the chart of the proposed organization (p. 223), a United States Department of Agriculture Bureau of Research is indicated under a chief who would be assisted by an editor and perhaps by a technical expert in an advisory capacity. The bureau would be divided according to

CHART 4. PROPOSED REORGANIZATION



*See Text.

subjects, such as Forestry, Plant Industry, etc., absorbing the real research work from each of the present divisions of the Department of Agriculture. The Forest Research office would then be subdivided by projects and studies and would, of course, include the Madison Laboratory. The Forest Experiment Stations would be under a separate chief. Until this very radical reorganization is possible, research, of course, should remain as a separate branch under the Forester. The Experiment Station research should, however, be absolutely divorced from Western administrative control; confer and work in co-operation, but keep the research organization absolutely separate from administration. This is fundamental with the research organizations of other countries and there is no reason for departing from the precedent in the United States.

Possible Organization Reform

While it is unquestionably true that the districts have been extremely useful from 1908 to 1915, the time is fast approaching when better results can be secured by distributing the experienced assistant district foresters as chiefs of more important units. While it is true that a densely forested region, such as the Northern Pacific coast, cannot be organized on as large a scale as some of the open, easily traversed forests of the Southwest, yet it would be possible to re-align and re-organize forests of the same class in different parts of the country. Obviously, it would always be impossible to have one man administer as large an area in New Hampshire, or in the southern Appalachians as could be done in New Mexico. The problems are altogether different. Therefore, the local forest organization must vary considerably. The scheme of staff organization advocated by District 3 seems practicable, if, simultaneously, steps are taken to dispense with the District Office. Otherwise, the forest staff organization does not seem advisable, except possibly as a test case. It seems to me, fundamentally, however, that the first improvement in our forest administration must commence at the bottom rather than at the top, and that the best way to accomplish this is to get the very best men possible for the position of Supervisor. That is where the men are most needed. The next logical step is to make the forest important enough to hold men permanently. No matter how efficient the inspection, no matter how faultlessly thought out are the circular letters, policies, and Manual instructions, they cannot succeed unless strong men have charge on the ground. No one can dispute this.

In the words of a supervisor of long experience: Reform should

"begin at the bottom—too much attention and too much money has been devoted to overhead organization . . . . . the Service is top-heavy . . . . . full of men in swivel chairs originating bright and new ideas for the man at the end of the line to carry out, when this same end man is not keeping up with the fundamentals of forest administration and protection because of these new schemes, interesting but valueless."

This picture is, perhaps, somewhat over-drawn, but it is at least significant of the feeling of 10 to 20 per cent of the supervisor force—the important men on the ground—as stated in the following opinion:

"The Service must adopt without any qualification the organization theory that the supervisor's office is the executive unit. . . . Everything and everybody must sooner or later deal with the supervisor—so why not accept it? . . . Under present conditions in the Service, the District Office is superfluous in the organization scheme, but has the means of supplying the needs of the supervisor by gradually eliminating the District Office in its present form—and adding the men and the funds made available, to the Forest . . . . . I favor as large supervisor units as possible with this proviso: that overhead supervision charges must be kept within bounds. Over-administration is worse than under-administration."

As already explained, one of the chief theoretical criticisms of the present organization of the Forest Service is because inspectors usually inspect their own work. One of the best organized businesses in the United States, the Fred Harvey system, is working along this line. The head official wrote me on January 11:

"The inspection feature is one to which we have been giving some consideration along the lines of your inquiry, and we are disposed to think there is merit in having the inspection separate and distinct from the administration."

It is certain that the Forest Service has not enough money at present to justify maintaining a separate inspection system so long as the districts are maintained.

As a supervisor put it:

"Supervisors' offices are becoming better equipped and organized and men have become better trained and more experienced and are somewhat more seasoned by virtue of increased age. I believe it will be found that a good Supervisor who has been fortunate enough to have the help he needs, is handling routine matters with good satisfaction. We have probably gotten to the point where there is too much duplication in connection with routine matters which, of course, absorbs valuable time which should be expended in connection with matters really worth while. We really have no organized inspection system as I interpret the term. For instance, I go out and inspect a ranger who has been instructed by me to do certain things. Naturally, the points which I inspect first are the ones to which I have given greatest time and care. They may be hobbies and carried to too great a degree of precision as compared with other lines of work. Members of the District Office inspect their special lines and only occasionally branch out to other lines which should be inspected simultaneously with the one in which he happens to be most interested. And so it goes *ad infinitum.* A separate inspection office would be a tremendous expense and should not be considered unless a proportionate saving in expense could be made in other branches."

One of the strongest Forest Service District officials in the West thus summarized the District administration and inspection phase:

"If it is to be conceded that uniform interpretations of laws and regulations, and uniform administrative practices are desirable so far as local conditions will permit, then there is obviously need for some central organization, which will act as a check or balance upon the pronounced tendency of Supervisors to diverge from a prescribed course of action. It would be quite possible to discontinue the District Offices, whenever it becomes practicable to man each Forest Unit with a Supervisor who is not only always subject to discipline and anxious to conform to the stated policies of his superiors, but who, in addition, has unusual breadth of vision and power of understanding, who is thoroughly in sympathy with the aims and ideals of the people with whom he has to deal, who can reconcile the conflicting demands of different interests, and who, finally, has executive or administrative ability, tact and good judgment to a very marked degree. If each of our Supervisors was of this class, probably there would be no need for the District office organization, since the Supervisors would assume most of the duties now performed by the District office, and the important and constructive features of the Service work could be handled from a central office, since immediate action would not be essential.

"The foregoing is all pure theory or speculation, since ten years of Service work has as yet failed to develop the ideal type of Supervisor, who can administer his Forest perfectly without a closer degree of supervision and instruction than could be afforded by the Washington office. The present Supervisors have been drawn from a number of different sources, and represent almost every conceivable feature of practical experience and technical training. The truth of the matter is, perhaps, that the burden imposed upon the average Supervisor is one which no normal man could satisfactorily carry without assistance readily available from a superior office, which, in itself, is thoroughly in touch with conditions and thoroughly understands all of the problems which influence the administration of the Forests. Another factor which must be considered is the tendency of the American people, especially of the West, to refuse to abide by the decision of a single official. Probably this tendency will diminish as the work of the Service becomes more settled and the precedents are better understood, but while the order is changing, as it is now, no single man, or group of men, can possibly perform all the duties which require performance upon the average Forest.

"A Supervisor furnished with a staff of specialists might largely meet the administrative requirements of a given Forest, but I am not at all certain that he would be able to do this to so much greater advantage as to justify the added expense which would result from such a form of organization. Specialists are not of much value unless they really are masters of their specialty, and men who are recognized as authorities in a given line of work usually must be paid salaries commensurate with their abilities. Staffs of specialists composed of men drawing Rangers' salaries who would be specialists simply because they were placed in charge of one particular activity, do not appeal to me as a solution of our problem."

Then, too, there seems to be but little doubt that with small one-man units, the officer in charge cannot average up to the same caliber that he would if there were a half or a third the number of units to muster. The smaller the units, the more the need for a motherly district office; with large units under a capable supervisor assisted by a deputy and a specialist or two, the need for a district office is reduced in the ratio of the higher forest efficiency. The ideal supervisor is certainly a man who understands the field work on a forest; unfortunately, the larger the unit the less can be the personal contact of the supervisor with field problems unless he maintains a chief of staff to handle much of his routine. Such an organization might be top-heavy and costly. In commenting upon the present inspection system, Dr. Fernow stated:

"As regards inspection, there seems to be little doubt that it should be carried on by separate system and not by the assistant district forester. In inspection there are two principles to follow: either to have an inspector who is familiar with the locality, which is an advantage in a way, or to have some one from the outside come in, which prevents personal bias to some extent."

Under the organization proposed, it is evident that two kinds of inspection are proposed, one local inspection, really the most important, *but by a man not connected with administrative work;* second, administrative specialists' inspection, by experts from Washington who would not have local prejudices.

Professor Roth thinks the present organization of the Forest Service is good. He feared that the establishment of the district offices had some elements of danger, such as mere duplication. There was danger, too, of the organization being top-heavy and being turned into red tape factories, but he feels that the men have worked out of it and that perhaps more districts would be a help. He is not sure. He says:

"In any case, you follow the general principle and as you have done so far,—central office, district offices, supervisors' offices, protective districts and inspection. You are drifting and of necessity. As markets give you a chance to practise more and more extensive forestry, you need more help to care for business and there is need of detail knowledge for the man doing it. Various combinations are possible, and advisable, even on the same forest. One ranger district may call for a competent 'forester' and thus become a 'revier' regardless of any plan or policy. Another part of the same forest may go for twenty years merely as a group of protective units. In the end it all comes to this: (1) Head office which is responsible, directive and helpful in gathering and disbursing knowledge; (2) inspection as the eye and mouth of No. 1; Supervisor who is the unit of all administration."

In regard to the specific question as to whether assistant district foresters should inspect their own work, Professor Roth states:

"Fundamentally, no man is qualified to play inspector for his own doings. The Assistant District Forester may do the work of several 'foresters' . . . ., but even then it will need independent, separate men to inspect and see things without bias and report without paint. Success in modern work seems to depend on the whole organization being (1) responsive, so that when you press the button something happens, (2) responsible, that the blame will never fall on the wrong man; (3) inspected, where everything is fully known and frankly stated. The really competent man loves all three and wants all three. An incompetent abhors all three and fights against their instruction."

It seems to me that this is an added argument for the eventual abolishment of the districts. Naturally, such an inherent criticism of the Service organization, such as my suggestion of abolishing the districts, can have but little weight, particularly as extremely strong pressure would be brought in favor of continuing the district organization by those whose personal interests would be directly affected. Perhaps the best plan would be to assign the whole organization of the Service as a definite project for careful study. The results of such a scrutiny would assist the Forester, the branch chiefs, and the district foresters to form a logical conclusion. The form of organization which I personally feel is best adapted to give sufficient efficiency and yet to clearly reduce the present costs, is as follows:

To have a very much simplified "staff organization" on forests where it is necessary and where, for some local reason, it is not practicable to continue the present form of forest organization. To have in each district one general inspector and, perhaps, one or two assistant inspectors to advise the central bureau on particular matters of regional policy, personnel cases, and such other specific problems as the central bureau required advice upon. One inspector could act as fire chief where regional conflagrations were likely. The district office would be abolished. The chief clerk in each supervisor's office would be a special disbursing agent who would report directly to Accounts in Washington; or Accounts could be in the inspection town or at Washington. A district law officer could maintain his headquarters with the general inspector and would advise the local supervisors on legal matters. If desired to centralize law work, I see no inherent objection to having law problems decided in Washington and the local Land Office special agents handle, upon advice from the Forest Service, land cases before the land courts. The Experiment Station would be the district investigative center and silvical study headquarters. Supervisors would secure equipment from Ogden as heretofore and would correspond directly with Washington regarding routine personnel matters, but would be free to consult the general inspectors, at their option. They would correspond directly with Washington in regard to lands, timber sales, operation routine, and grazing. They should be given more authority, so that many matters of detail need not be taken up with the central bureau, but could be decided locally. An excellent example of needless red tape is the reference of 220 acre pasture permits to the district office for approval; they are often perfunctorily approved there by a "chief clerk." This would necessarily mean an increase of the present organization in Washington by the addition of enough specialists to handle this additional routine. By this form of organization a great deal of the present routine duplication would be obviated. Probably the present district system would be somewhat more efficient than that proposed, but the modified organization *would be much less expensive and efficient enough for all practical purposes.* The main objection to the change would be the necessity for a certain amount of travel between Washington and the West. Possibly in the past this travel on the part of administrative officers has been greater than is necessary. Half the reasons for this travel in past years has been to educate those inspecting and to familiarize them with the local conditions in the various portions of the West. For example, an officer who took an expensive auto trip to the Verde, in Arizona, said in explanation of his trip: "I wanted to see what a watershed looks like." This sort of thing is a luxury.

This form of organization would certainly be more efficient for District 7, which already has its "district" headquarters in the same building as the central bureau. Before this District 7 organization was perfected, the branches were bothered a great deal with routine details which came in from the various forests in the district. If they had had routine specialists under their supervision, the detail would be cared for as it would be in the new organization, and a tremendous benefit would result in that the really important decisions would be made, so to speak, by the routine district office, and the Washington office, after verbal conferences. There would be uniformity in policy and the present lack of co-ordination between the districts would be done away with.

What then would be the effect of this re-organization on a district such as Arizona and New Mexico? The district forester would be replaced by a district inspector. The supervisors would be assisted when needed by a hydro-electric engineer, working under the Washington office, probably with local headquarters at Denver. Game protection would be handled by the supervisors as a distinct side issue. The assistant to the solicitor could remain in the district town as heretofore. Accounts would be forwarded to Washington for audit, or the chief clerks in the supervisor's office could be made disbursing agents. The personnel would be handled by the District inspector and the organization routine by a central bureau in Washington; the fire organization would be handled by an inspector only in times of stress (namely, when more than one forest was threatened) according to a prearranged scheme of special fire organization. Road surveys would be under the highway engineer who would be in charge of the project. Telephone construction and general improvements would be handled by a traveling expert under the direction of Washington, probably two or three experts for the seven districts would be sufficient. Property maintenance would be taken care of from Ogden as at present. The work now under Silviculture would be handled from Washington with the technical-scientific work under the field direction of the director of the Experiment Station. Station studies would be continued as investigative projects and administered from Washington. The consulting pathologist would be stationed at the Experiment Station, working in close co-operation with the various supervisors. The assembly of maps would be at Washington. Grazing would be handled from Washington, except that important local studies would be made projects under the Director of the Experiment Station. The routine of lands would be handled entirely from Washington with classification a project in the hands of a traveling examiner. Entry surveys should be legislated under the General Land Office (where they properly belong) instead of under the Forest Service as at present. Is there anything about this change that is impracticable? Unquestionably, it would mean the saving of from $100,000 to $300,000 without undue diminution of efficiency.

To my mind, if there were arrangements made to take care of the routine in Washington, a *simplified form of supervisor staff organization* would unquestionably be best in, (1) New Hampshire, (2) Arkansas, (3) the Southern Appalachians, (4) parts of New Mexico and Arizona, and (5) Southern California. Men more familiar with other regions could speak more authoritatively of how the problem would be worked out elsewhere.

The problem of Forest Service organization may be finally solved in a number of ways. The organization may be continued virtually as at present, with such improvements as may be possible from time to time as the result of normal development. To the federal officials this is naturally the most obvious and practicable solution. If, however, the present organization is not considered satisfactory, it might be best to increase the importance of the districts by giving the district foresters more authority and, in this way, gradually reduce the Washington office to an inspection bureau which shall stand between the districts and Congress and the Secretary of Agriculture.

In the words of a consulting forester:

"Speaking broadly, I feel that the Washington office should be cut down to almost nothing. Disregarding altogether those forces which Congress may impose upon the Washington office, the staff there should be simply the Forester and, say, a dozen inspectors. These inspectors should be the pick of the whole Service, should spend most of their time in the field, and should act as the Forester's personal representatives. The Forester should have a much more intimate knowledge of the field than he now has, or ever can get by himself alone. The Washington office, in other words, should be essentially an inspection office rather than administrative in character."

Still another plan would be to continue the district organization but to follow the French and British Indian system of having very small districts. This would mean the establishment of perhaps 30 districts in the West instead of 7 as at present. The possibilities are cited to show the complexity of the problem.

In deciding on any change, it seems to me that the fundamental aim should be to spend as much of the appropriation as possible on the Forests with just enough administrative inspection to insure the proper efficiency. Any form of organization that is finally decided upon must really aim at increasing the efficiency of the actual forest administration. The present organization is somewhat top-heavy.

Conclusions

My conclusions are:

1) The 1915-1916 organization of the Forest Service is unnecessarily along luxurious lines. The present District Office might be abolished, or simplified if the pure routine were concentrated.

2) A larger proportion of the appropriations should be spent on the Forests; in other words, overhead charges are too high.

3) Routine which cannot be performed in the Forest Supervisor's office might be centralized in Washington; the Supervisor is the true executive. Under present conditions much executive work is performed by the Districts.

4) Scientific forest investigations should be more completely divorced from administration.

5) General inspection on Forests is necessary and should not be made solely by administrative officers. An independent inspection system is advisable if the District Offices can be largely cut down or abolished.

6) Too high a standard of efficiency in the methods of routine administration is often maintained. By having a less top-heavy organization, the routine would be handled a shade less efficiently and with loss of speed; but the resulting efficiency would be ample and perhaps \$100,000 or more could be saved annually.

7) A committee might be appointed to study the administrative re-organization of the Forest Service and to recommend definite changes.

8) To make the Forest Service self-supporting, the fees charged for grazing and for commercial rentals should be largely increased. With this increase and a simplified organization, the Forest Service would be self-supporting within a year.

All these conclusions are tentative and subject to modification after further study.

But any reorganization must perforce depend on practicability and expediency. Particularly in the United States, where each bureau must look to a committee of Congress for its appropriations, it is often considered ill-advised and dangerous to recommend any reductions in estimates. This contention cannot be granted. The bureau that is recognized for its sincerity will fare better than if it has a reputation for bluff; overestimates, based on the prediction of a cut in these estimates, are misleading. But unquestionably in any reorganization the minutiae of statutory roll changes will be a very considerable bugbear; it is usually far easier to drift along. One frequently hears this policy expressed by members of the central bureau: "Keep the men out in the Districts; there's too many men in here already—if rafts of men come in we'll be top-heavy." But if the total routine and administration work can be done with three quarters the force by concentrating, why not do it even if a large force must be in one town?

It looks very much as if the Forest Service had gone after the minute economies indicated by efficiency studies as applied to the ranger and overlooked the broadest phase of its own organization; more money and better men are needed on the Forest—*not* in the District Office.

But often an organization gets into a rut; in judging an innovation, men have perchance personal axes to grind. It is for this reason that an independent is in a better position to form his professional judgment without bias. If a friendly investigation of the Forest Service organization were attempted, perhaps it could be best accomplished by a board of three foresters in the employ of the Service under the direction of the Forester. A state forester, a consulting forester with administrative experience, and a representative of the Service. When the final report of this committee had been prepared, a larger advisory committee could visé the detailed recommendations, before the problem was finally decided upon by the Forester and Secretary. There is precedent for such an impartial investigation in the Cleveland Commission appointed by President Taft. It is always easier for an outsider to look impartially at any organization than for those serving in it.

It is only fair to state that the writer has not been connected with the Forest Service since April 1, 1915, and that he has seen no National Forests beyond those in Arizona, New Mexico, Arkansas, Florida, Oklahoma, and Southern California. On the other hand, he has seen and studied forest administration in British India, Germany, France, Australia, North Africa, Corsica, and Switzerland.

These data are not presented as a criticism of the present administration; they should be read in the light of friendly suggestions coming from a friend and well-wisher of the present federal forest organization. Such radical changes as are suggested must depend on a great many internal factors which, naturally, the writer is not in a position to weigh with as much accuracy as can those in the organization itself.

The writer does not wish to come out clearly in favor of any particular form of organization unreservedly without far more study and investigation. It must be clear, however, from the conflicting data that have been presented, that there is much that can be done to make the present organization cheaper and more logical.

OPERATIONS AND COSTS ON PENNSYLVANIA STATE FORESTS

N. R. McNaughton[1]

The following is a summary to date of work done on Pennsylvania State Forests. Costs given include maintenance in every case, for periods of from two to seven years. To a certain extent, this destroys the value of the costs for comparison, but the complicated system of bookkeeping formerly in use makes it difficult to separate maintenance costs from extension costs for operations which were started several years ago.

It will be noted that in the summary no mention is made of nursery work or tree planting. Exact figures on these operations are not yet available, but for the convenience of those who may wish to use these figures for reference, it is safe to say that at least 16,000,000 seedlings have been planted to date on an area of not less than 8,000 acres. The total nursery stock for 1916 is about 20,000,000, of which number about 7,000,000 are available for planting this spring.

	Miles	*Cost*	*Average Cost Per Mile*
Township roads on Forests when purchased	456.9		
Woods roads on Forests when purchased	2,063.5		
Above roads improved by Department	1,265.7	$51,520.00	$40.70
New roads built by Department	316.2	60,947.00	192.72
Trails opened	528.5	10,249.00	19.40
Boundary lines opened	1,056.5	12,431.00	11.79
Fire lanes opened:			
4–8 feet wide	61.4	2,088.99	34.02
9–12 " "	194.0	4,575.93	23.58
13–18 " "	287.6	8,297.89	28.68
19–25 " "	150.7	6,699.96	44.46
26–32 " "	26.0	1,817.96	69.90
33–40 " "	5.0	299.57	59.91
41–50 " "	1.0	150.00	150.00
Over 50 " "	1.0	117.71	117.71
Total Fire Lanes	(726.7)	(24,048.01)	(32.95)
Total roads, trails, boundary lines, fire lanes opened to date	3,893.75	159,195.01	
Boundary line surveyed, but not opened	1,636.6		
Compartment line opened	182.5		
Telephone lines built:			
Metallic	220.95	12,031.80	54.91
Ground	33.25	1,217.00	36.60
Total	(254.20)	(13,248.80)	(52.12)

[1]Forester, in charge Karthaus State Forest, Pennsylvania.

	Number	Cost	Average Cost
Telephones connected	86		
Fire towers erected:			
Wood	27	$1,074.00	$39.78
Steel[1]	7	1,821.00	260.14
Trees	67	232.76	3.48
Total	(101)	(3,127.76)	
Buildings erected	122	60,154.00	
Springs cleaned, walled, or made accessible	1,168		
Fires extinguished on State Forests only	802	28,442.93	
Fish planted	829,130		
Handboards posted	6,565		
Acres from which chestnut blight removed[2]	41,464		

Income from State Forests[3]

Saw timber	$81,466.96
Shingles	403.70
Lath	2,351.50
Mine and trolly ties	245.70
Posts	1,064.42
Bark	1,381.20
Pulpwood	72.63
Acid wood	310.33
Cordwood	6,281.83
Mine props	4,295.53
Railroad ties	3,952.81
Telephone poles	1,720.45
Stone	13,650.48
Pasture	100.00
Fines	64.80
Rents and leases	3,381.54
Miscellaneous	5,998.22
Total income to date	$126,742.10

[1] Several cheap windmills included.
[2] Twenty-eight foresters report blight spreading; 8 report it apparently stationary; 14 report no blight or do not report, and 1 reports it receding.
[3] Total income turned over to the State School Fund.

THE COST OF FOREST IMPROVEMENT SYSTEMS

P. S. LOVEJOY[1]

The forest tract of which the forester takes charge is seldom a virgin wilderness. As a rule, forestry is undertaken only after the region has been more or less developed. Nearly always, lumbering, at least, will have preceded forestry. So long as there is any occupation or utilization of the region by men, there will be found some manner of permanent improvement. For each kind of use and occupancy, the improvements constructed will vary. A country opened for grazing will, as a rule, have a few miles of poor roads and trails, a few poor cabins and fences, and a few camp sites; for trapping, a few small cabins and a few strings of blazes are enough; the placer miner requires at least pack-trails and the lode miner must have wagon roads; the lumberman requires a considerable mileage of temporary roads, many of them passable only in the winter, and all of them to be deserted as the cutting is completed. Where ranchers in the valleys go into the timber for fuel and building supplies, a few roads into the foothills satisfy their needs. Where agricultural lands within the forest are developed, good roads, many trails, and the varied construction necessary in home building will be provided.

The normal situation, when the forester takes charge of a large tract, will have developed out of a variety of old uses and occupancies and the development of improvements will not have been wise or logical from the forester's point of view. The early development of a region is nearly always predicated on the assumption on the part of the newcomer, that he is there only for "a stake," and that he will have no permanent interest in the long future of the region. As a result, the improvements will be laid out with a view to some specific utility and seldom with any idea of future reticulation.

The first "opening" of a country is usually done by the big game animals, especially the deer and elk. The Indians, in time, opened trails for their own purposes, usually with the sole idea of getting "a way through" with a minimum of labor. Some-

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times the Indians located and used lookout points. They also found and used a few good camp sites.

Following the Indian's trails, came the trappers. Their improvements were usually very scant—a few poor trails, ending blindly at little cabins, and a few blazed snow-shoe trails, the discovery of the streams open for canoe travel. Through the North and West, the prospector followed the trapper. First, the placer miner and later, the lode miner. The placer miner left little behind him save a few trails and tumble-down shacks. The lode miner built many miles of good roads. He knew himself to be a fixture in the country, and that transportation was of as much importance to him as good ore. He had visions of stamp-mills with heavy machinery, needs for roads to haul ore and concentrates out to the smelter, railroads. Success for him involved great expenditures in improvements. From the prospector and miner the forester usually inherits many miles of good and poor roads and trails, some deserted cabins, and a criss-cross of blazed lines. These blazes are always confusing and, where they mark "live" prospects or patented lands, always involve much work.

As the mineral resources are developed, agricultural and grazing resources are also developed. New roads and trails and new lines of blazes go into the timber. At about this stage, it is likely that the Public Land Survey comes in. This is a permanent improvement of great value to the forester, but, usually, it brings with it a train of characteristic troubles. Where the Survey was utilized to permit the "homesteading" of heavy timber, the semblance of residence and development often produced a network of short roads and trails which, even though poor, did open up the country as never before. With the coming of patents to the land and the following concentration in ownership, wholesale desertion of the country often followed, with the consequent rapid closing of roads and trails.

Where the Survey has been followed by patents and later by lumbering operations, the country fills with slash; slash-fires largely destroy the survey lines and monuments; roads and camps put in principally to facilitate logging, are deserted; scattering settlements develop here and there, maintaining a feeble connection with the "outside" and put to it to maintain themselves until they grow in acreage of tilled land enough to warrant new efforts at improvements. Frequently enough, the settlements gradually starve out and the improvements are largely lost.

With the first "boom" development, the Counties will have been organized and the County Commissioners will at once be swamped with the demands for improvement work. The funds available through taxation will uniformly be inadequate, and decision as to where the small funds shall be spent will depend as largely on the political complexion of the improvement as upon its immediate need or general desirability. Shortage in funds and in engineering ability will lead to the building of roads where the location is later seen to have been very faulty or ill-considered. As the County develops the location of the improvements required will change and there will be constant temptation upon the Commissioners to declare old roads closed, rather than to attempt to keep them in shape.

Where the majority of the County is timbered, and the usual concentration in ownership has taken place, the timber will be the most obvious source of revenue and it may be expected that the tax rate will go up. The vicious cycle, common to most of out-timbered regions, is now begun. Agricultural development lags decades behind logging. But with the slow increase in settlement and the impoverished condition of backwoods farms, something other than the new farms, must build the roads and maintain the schools and County machinery. So the timber taxes go up, but the timber owner seldom secures new roads or new protection from fire. Finally, taxes reach a point where they begin to be confiscatory. The owner cuts in order to get from under. The faster the timber is cut out, the less taxable property remains and the higher the taxes go.

If the timber is taxed to the limit, it is the appointed time for the County to bond itself for roads. The State is called upon, especially in case it happens to have retained lands for a "Forest Reserve." Where National Forests exist, the County draws a percentage of the gross Forest income, in lieu of taxes. If the income happens to be low, on account of poor market facilities for the National Forest timber, Congress is urged to loan funds for immediate road building, later to be reimbursed from the income which is expected. The Counties are hard put to it for their essential improvements. The forest must help. But there is not enough income for both and the funds are expended outside the forests.

When the forester takes charge, he is more than likely to find a small mileage of good roads and trails and a large mileage of poor or deserted ones. One of his first interests will be the inspection and mapping of all existing improvements and the recording of their history, condition, present utility, and probable future utility in a real system of improvements for his forest. He is likely to find that a very large portion of the roads and trails actually in use are most miserably located for permanent use and development. This naturally follows from the way in which they have come into being. Trapper *A* once followed up a ridge with a blazed trap line. Prospector *B*, with his pack horse, found the blazes and followed them, leaving horse tracks and chopping behind him. Prospector *C* follows *B*, also doing a little chopping and clearing. Traffic follows the blazed line without respect to grade, footing or anything but objective points. Continual piecemeal work, occasional cut-offs which have become obvious, the patching of swamp holes, the development of residences and camps and all manner of projects, all with relation to the existing trail, finally lead to road construction closely following the old accidental trail location. This is logical enough since the abandonment of the old way and the location and construction of a new one would generally be prohibitive in cost. The investment required for new and satisfactory improvements looks prohibitive and the old improvements are patched up again. While such a situation is logical enough for the early settler and prospector, the results are unfortunate for the forester, who operates on a radically different basis.

It may often happen that the first competent forester in charge of a forest has been preceded by others who have had no competent notion of improvement systems as against improvement projects. In such cases it is likely that there will have been individual projects undertaken or completed so as to tie into the existing old system but so as to prove of little or no advantage in an adequately conceived plan for the entire tract. The temptation to postpone the introduction of the final improvement plan or to patch up the existing system, is then increased, especially if available appropriations are inadequate.

In placing a forest under administration, of course, the first important job is the forest inventory, the making of a record as to stock and plant on hand. An important and readily completed portion of the general inventory will cover the improvements. For each item of construction now in place, a map and written record should be prepared. These records will include, besides improvements proper, practically all of the forms of uses and occupancy existing on the forest, since nearly all uses and occupancies involve improvements of some kind. Among the principal items to be investigated and recorded will be: Ranger stations and suitable station sites, with the improvements on each and the possibilities of agricultural and other development, roads, trails, telephone lines, bridges, cabins and other buildings, camps and camp sites, navigable streams and known fords, lookout points and their equipment and points of supply. The connection of all interior routes of transportation and communication with those outside the forest area should be investigated and recorded.

Where construction, such as telephone and telegraph lines, flumes, irrigation ditches, stores and other buildings, etc., is found to be present, the procedure will properly be the prompt determination of the rights and equities under which they may be present on the forest land and the taking of immediate steps to terminate or validate the occupancy, by removal, trespass action or permit. Great care is necessary here to insure that presumptive rights are not allowed to grow up and that the rights of the forest owner are fully acknowledged by the users. Special care should be taken in the cases involving rights of way and other easements in order to prevent the monopoly of important road or trail sites and the possibility of their being closed to traffic.

When this early work is caught up, the forester will begin the consideration of the data available with a view to the preparation of his Improvement Plan, which will probably be one of the first sections of the Working Plan to be completed. Before he can progress far with the formal Plan, it will be necessary for him to secure a great amount of detailed and dependable information not to be had from the mere occasional traveling of the forest roads and trails. As a matter of fact, a good Improvement Plan can hardly be completed until the complete inventory of forest resources is available. A good tentative plan, however, can be drawn after a dependable reconnaissance (in the proper sense of the term). It will be necessary to know the topography and much as to the prevailing climatic conditions, when streams flood, whether they carry much driftwood, where snow drifts and where it blows off, for what periods each year roads and trails will be clear at given elevations, what rainfall is to be expected and the time of year at which it comes, the prevalence and character of windfall in timber and in old burns, etc. The accumulation of such information is usually slow and only to be acquired by continuous first-hand effort, supplemented generously by second-hand information from the regular forest officers and the local public. It is a rather difficult and unhappy job to attempt the writing out of such information and its formal filing in such manner as to make it readily available to others, and especially to possible successors. So far, it has seldom been done. As a result, the foresters who later have charge must begin all over again and the accumulated data of their predecessors is permanently lost. We should be able to devise a better method for recording such information but probably much of it must always be left to be carried in the heads of the local men. (Change in personnel must always be costly.)

By the time there is available enough information to approximate something in the way of a preliminary plan, the essentials of the whole system will doubtless be rather evident. It will be apparent, for instance, whether the road and trail system is to approximate a quadrilateral reticulation or whether it will be of cob-web pattern, following up the radiating streams or ridges and interconnected by stretches across the valleys or divides. The practicable routes are usually obvious as soon as the topography is known.

Next, will come the determination of the relative urgency of the many urgent projects and the more detailed investigation and estimating of the costs and relative benefits of each. Usually there will result a schedule assigning given construction to each year for the next five or more years—the Preliminary

Improvement Plan. Tentative plans will be made on a more comprehensive basis, so that the total of probable construction may be under consideration for many years in advance. On the basis of the earlier work and its costs and values, the revision of the Plan proceeds from year to year, properly being recorded by maps and written reports, so as to insure that full record of the information available, and the notions of the forester currently in charge, may be available at all subsequent times.

On many of our American forests which have been under administration for some time, especially the better administered of the National Forests, this status of affairs has been reached, and as a rule, the individual improvement projects undertaken and completed have been well conceived and executed. In many cases, however, specific construction has been done without any adequate data and without the intelligent formulation of anything resembling an idea as to what the final system will be like. It is to be expected that there will be a generous number of poorly conceived and poorly constructed projects until the body of technical improvement information available to foresters, is much greater than it is at present. Probably the most common error is failure to foresee improvement needs far enough in advance. Permanently beneficial projects have been too often subordinated to current and petty administrative conveniences, as in the case of too-good Ranger station buildings built on short-life timber sales.

What will the improvement system on an average American forest be like in twenty-five, fifty, a hundred years? What will it have cost? What will it be worth? How shall the forester budget his improvement expenses between protection, utilization and administration? What will the ratio between first cost and maintenance charges be? On what calculations shall the forester proceed to justify large initial improvement investments before the forest is on a fully self-supporting basis? Questions such as these must shortly be considered, rather than such questions as: Had we better tackle the Bearskull cut-off before we equip the Moletree lookout? Did Thompson get the minimum possible grade on that location? Would it be better to build the Hasty station with three rooms or two, and shall it have a well or can we pipe the water down from that seep?

It is probably true that the first improvement construction is done in answer to current administrative demands, a little later with a principal view to protection problems, and last on account of utilization necessities. The three, of course, are mingled more or less constantly. While it is rather fruitless to attempt to segregate them, protection needs doubtless are the most urgent for the present and are likely to remain so for at least a number of years. What improvements will be required in order to permit the operation of a satisfactorily effective fire protective organization?

Such a question will be variously answered according to two principal factors: (1) the inherent difficulties of transport and communication due to the topography and cover, (2) the intensity of work justified by the value of the timber to be protected and its danger from fire. In much of the Western Yellow pine region, for instance, where a wagon or automobile can be rapidly taken across country without specific roads, the problem is radically different from the very broken and densely tangled forests of the Couer d'Alene or Puget Sound regions. An open and scrubby growth near timberline may be subject to frequent lightning fires, but would not warrant the investment in improvements which would be warranted by a comparatively small acreage of replanted old burn, or accessible and merchantable timber.

In any case the approximate improvement needs for protection can be arrived at by specifying the minimum time to be allowed between the start of a fire at any point on the forest and the arrival at the fire of an adequate crew properly equipped. For the forest of low value this period will be longer than for the high-value forest. Where the difficulties of travel across country are great, rapidity of transport along the main travel routes must compensate for the slowness of cross-country travel. For our well-run forests, we shall shortly have figures to indicate, for given forest and stand, the average area burned over per hour of unrestricted spread. If a certain figure is adopted to indicate the maximum annual acreage of burn which can be tolerated, and if the average number of fires per year can be statistically anticipated, it would be possible to determine the theoretical distance between roads and trails necessary to permit the degree of protection desired. The same thing might better be expressed in terms of mileage of roads, trails, etc., per unit of forest area. For such purposes probably the township is the most convenient unit.

At least five variables can be identified: (1) Average number of fires per township to be expected and provided for, (2) total acres of permissible burn per 1,000 acres and township, (3) average rate of spread of fire per hour, in acres, or say, for first 5 hours, second 5 hours, etc., (4) rate of practicable travel by fire-fighting crew over roads, trails, across country, (5) average distance to be traveled by fire crews between their headquarters and the fire. Reasonably accurate figures can usually be interpolated for any given forest or township. A hypothetical case for a specific township would work out as follows: (1) Number of expected fires, 3, (2) allowable burn 1 : 1,000, equals 23 acres per township, (3) rate of spread, first five hours covers 5 acres, (4) rate of practicable travel—by motor vehicle on roads, 15 miles per hour, by pack train on trail, 3 miles, across country, 2 miles per hour, (5) average distance for crew to travel, 15 miles. This works out: average area of burn at time crew finishes work, 7+ acres. (Allow for spread after work commences, 2+ acres.) Permissible area of fire when crew arrives, 5 acres. To maintain this record, the crew has a maximum of five hours to make its trip, without allowance for margin of safety. (It is assumed that the fire is promptly detected, accurately reported by telephone from a lookout, and that the crew is ready to start at once with complete equipment.)

If there is no hitch, with an all trail route to the fire, the crew will arrive in just five hours. If there is an automobile road (and an automobile), the crew can be set down in one hour. If there is 5 miles of good road and 10 miles of cross-country travel, the crew will arrive in 5 hours and 20 minutes. With 9 miles of trail and 6 miles across country, the crew gets in 6 hours after the fire is reported—an hour too late.

Working with such a formula, it is possible to approximate the results to be expected with any given degree or quality of improvements. It is possible to reach the same end by determining the greatest distance from road or trail or telephone line which can be reached within reasonable time after fire is reported.

Most foresters will today admit that their forest is poorly protected if it requires as much as five hours to reach any spot desired after leaving the nearest point on trail or road. Assuming a travel rate of 2 miles an hour, on foot, across country, 5 hours travel defines an approximate rectangle bounded by trails 20 miles apart. This is very obviously very inadequate improvement. If 2 hours travel from a trail is the maximum to be allowed, an approximate rectangle of trails having 8 miles to the side is defined. Were a township bounded by trail, and of uniform topography and stand, it would take about 1.5 hours travel to reach the SE corner of Section 16. If the township were bounded by road and bisected in both directions by trail, a crew could be brought from a distance of over 20 miles so as to reach the SE corner of Section 16 in about two hours, or Sections 8, 11, 26 or 29 in still less time. That is, a crew could leave some road or trail at a number of points, and reach any interior point in the township without traveling over a mile and a half. Such a condition would involve about twelve miles each of road and trail per township and would certainly be considered as very intensive development, as compared with average conditions obtaining in our forests today.

With such an improvement system, the problems of fire protection would be vastly simplified and the losses could certainly be made negligible. But could such an intensive system be justified? Certainly it would run into money very fast. Good graveled roads can be constructed through most of our forests for a cost of $3,000 a mile, or less, including bridges. With 12 miles of road per township the first cost would be $36,000. The average good trail will cost about $75 per mile. Twelve miles of trail per township then cost $900. Total for roads and trails $36,900.

Other protective improvements to support the roads and trails will be necessary. Carrying out the improvement scheme in the same degree of intensity, allow a well developed Ranger station to every four townships. A well equipped station should be such a place as will permit men to live in comfort and content. (There are only a few of them in America today.) For the station, allow residence $1,500, bunk-house $500, barn and vehicle sheds, etc., $1,000, tool and work-shop with equipment $500, water supply system $200, fences and corrals $300, clearing and breaking ground for hay, garden, orchard, etc., $1,000, equipment and miscellaneous items $500--say a total of $5,000. This pro-rated comes to $1250 per township for Ranger Stations.

Telephone lines are required. With so low a mileage of roads and trails it would be desirable to parallel each with a telephone line. Allowing a cost of $50 per mile, the 24 miles will cost $1200, or with extra instruments set at the intersections of roads and trails, special construction required, etc., a total for telephone equipment of $1500 per township.

Lookout facilities will be needed in most forests. Allow one fully equipped lookout station to four townships. Each is likely to require its individual trail, telephone line, building and equipment. For this allow, say, $1,000 per lookout. Pro-rating this comes to $250 per township.

Fire tools and tool caches will be needed. Along the main trails where the Ranger Stations happen to be far apart, and in back districts where housing for patrolmen and transients should be provided, small cabins should be available. These will also serve as caches for larger quantities of tools and equipment than the regular fire-tool boxes will accommodate. Allow about ten fire-boxes at $5, tools and equipment for each $20, total for boxes equipped, $150. For the construction of the way-cabins, $200, equipment with stove, bedding, food supplies, patent tool grinder, etc., $100. Total for fire-tools and equipment $450 per township.

Each District Ranger, on this scale, should have his automobile at $1,000 and, say, three saddle and pack horses with their gear, say, $400. Transportation facilities pro-rated then, total $350 per township.

Other items, such as permanent fire lines, doubtless should be included, but no American forester is likely to feel that the township improved as suggested is under-developed. The items listed sum $50,700, representing the first cost of the improvements for one township; without the road item, $14,700; with the mileage of roads replaced by trails $15,600. About 60 per cent of the total cost, as suggested, goes to road construction. This ratio of road cost will prove low.

If the average township has a stand of 10 M feet b. m. per acre, worth $2 per M, the sale value is $20 per acre, or $460,800 for the township. If the improvement system has cost $50,700, something over 10 per cent of the sale value of the forest will have been invested in improvements. If the average stand runs 20 M feet b. m. per acre at the same stumpage value, or if it runs 10 M feet b. m., as before, but is worth $4 stumpage, the cost of improvements drops to 5 per cent of the sale value of the forest. But such figuring is misleading. The mere fact that the forest improvements guarantee great accessibility and nominal fire losses, automatically increases the value of the stumpage. Who would doubt but that the stumpage on such a township, especially for a long time investment, would bring over 10 per cent more than an identical township which was not so improved? Where is the merchantable forest which has not increased in sale value more than 10 per cent during the last ten years? Who will doubt but that the average forest will double its stumpage value within twenty years? If so, that is at the compounding rate of about 4 per cent per year; which is to say that a very modest estimate of the rate at which our forests are increasing in value will amortize the construction costs of an improvement system indefinitely more elaborate than any yet attempted, or given serious consideration in this country, and within a maximum period of about three years.

It is hardly fair to load the protection costs with the entire improvement bill. With the exception of the lookout stations and part of the tools, all the other improvements will be used for purposes of general administration and many of them will be essential to the utilization of the forest resources. For proper bookkeeping, the improvement costs should be charged off to the different lines of forest activity in the degree in which they are essential to it. For the whole forest business, however, the results would be as indicated.

It would seem quite obvious, from a business point of view, that all the improvements which can be utilized or desired, can be justified for the permanent forest. But comparison with other lines of business makes the case still more convincing.

A township of agricultural land will support about 70 miles of section-line roads, costing at least $1,000 a mile if the average value of the land, with other improvements, is as low as $50 per acre. If the average value per acre is $100 practically all the roads will be graveled, well drained and kept up, and will have a replacement cost of at least $2,000 a mile, not including the sale value of the right of way for agricultural purposes, for which it would be worth $100 an acre, or $800 per mile. At $2,000 a mile the township's road cost equals some $120,000; adding the value of the rights of way, $176,000. (There is little or no soil waste in forest roads, since the tree roots go under the road and the crowns meet over it). The sale value of all the farms in the township, at $100 an acre, will be about $2,300,000, on which the road value amounts to about 7.5 per cent.

But there is a large additional mileage of farm roads on the interior of the Sections. Then, to carry out the parallel, there should be added the value of the fences, houses, barns and sheds, machinery, vehicles and work stock, the farm waterworks, telephone connection, etc. This could hardly be as low as $25,000 per Section; for the township, $900,000. The total for roads and other improvements then reaches about $1,076,000, which represents nearly 50 per cent of the sale value of the whole township. If it be objected that the farm is a more profitable business than the forest, it should be noted that the census returns indicate that the average farm in the United States does not net 4 per cent on the capital investment.

With all construction there are two costs, first cost and that of maintenance. Foresters seem, as a rule, to have disregarded this second item with a good deal of freedom. The time is already here when it must be taken into consideration very carefully. Even the Forest Service has, as yet, no dependable figures for maintenance costs and no adequate method of checking up on them. If the matter is of the importance it would appear to be, there should be detailed forms and regular procedure in recording such costs for each class of improvements. On one National Forest careful check on the details of telephone repair was kept. The returns promptly indicated that a certain stretch of line through an old burn was costing more in repair than would the felling of the old snags. Maintenance records on a certain trail showed that the original swamping had not been wide enough and this was remedied on later trail work. Aside from such utilities as these, of course, with a rapidly extending improvement system, it will be necessary to budget the annual improvement funds to take care of the normal depreciation due to wear, washing, settling, breakage, windfall, land slips, new growth, etc. The percentage of first cost required for annual maintenance will vary somewhat with each class of improvements and in a given class or project, with the period during which it has been in use. A new building should require but little expense for some years. Later, new shingles, new floors, repainting, etc., are required, the expense of maintenance tending to increase with time until the entire building is so in need of repair that it is cheaper to wreck it and build anew. With such improvements as trails and telephones, it is usually better to have the first construction stop short of full completion so that use may indicate the exact location and degree of additional work to be done. Such work is, then, usually done during the first two or three years after the project is in operation. This work is perhaps more properly charged to first cost than repair. But later, real repair work will be required and the necessity tends to decrease from year to year, at least for a number of years. This is because the timber likely to fall has been felled, the regular patrons anticipate trouble and prevent it by a minimum of timely work, the line wire is adjusted so as to give it the required slack or tightness, bad ties or joints are found and repaired so as to maintain themselves indefinitely. With trails the tread is firmed and the roots which are exposed by packing and scuffling, are removed, side-hill washes are cured by water-breaks, soft spots are filled and bad rock is taken out; save for the regular minor yearly repair and the removal of occasional windfalls, the trail stays in shape. With roads the maintenance costs will depend largely on a number of factors, varying with region, individual location, method and quality of original construction, and traffic. A well-made dirt road used only when it is dry, will stand up indefinitely, where a few days of heavy traffic when the road is soft may require immediate and expensive repair. Puncheon and corduroy require constant attention and periodic renewal. Gravel roads, properly crowned and drained, if dragged in proportion to the traffic over them, stand up for many years but in time require resurfacing. Wooden culverts and cribs become unsafe or useless and have to be replaced. Still better quality roads, of macadam or concrete, have their own peculiarities but agree in requiring attention in proportion to the quality of first construction and the amount of traffic over them. Concerning roads and road engineering and costs we are rapidly building up a fund of information, even for forested conditions. The forester may expect much expert assistance from the engineers in his road problems. For the other classes of improvements he will probably have to work out his own salvation.

In general, it is probably safe to figure that a depreciation of 10 per cent a year takes place in the whole improvement system and that the forester in charge may as well begin to organize his affairs so as to take care of his maintenance work.

Where the improvement funds are limited to fixed sums having no relation whatever to needs or values, as in the appropriations made for the National Forests, the situation is serious. The Service received, for its approximate 160 million acres, in 1907 and 1908, $500,000, in 1909 and 1910, $600,000, in 1911, $275,000, in 1912, $500,000, and in 1913 and 1914, $400,000, with an additional sum since 1912, available for roads and trails, amounting to 10 per cent of the gross income from the National Forests. This amounted, in 1914, to about $235,000, giving a total annual fund currently available for improvements, of about $500,000 to $600,000 a year. The expenditure of this fund is limited in various ways, as in pro-rating the 10 per cent item to the States in accordance with the income from the National Forests within the States and in confining it to roads and trails. The amount to be expended in the construction of a Ranger Station house is fixed at $600. The direct appropriation is distributed to the different Districts in the discretion of the Forester, and to the different Forests in the discretion of the District Foresters. The individual Forest, therefore, is unable to anticipate within more than very vague limits, what its improvement fund for the next, or succeeding years, will be. This is hardly a fault in the Service organization, but rather an inherent difficulty in the situation. But the individual Supervisor is, as a result, unable to develop a plan with much success. The sadly inadequate total fund available is of course the great difficulty. The Forester's Reports show this to have varied between 0.055 and 0.310 cent per acre per year. The actual total should probably be a small fraction higher so as to absorb the improvements put in with emergency money in connection with fire-fighting and the work done by the regular salaried officers at odd times between other duties. The total has certainly never reached as much as 0.5 cent per acre per year (equivalent to about $115 per township per year).

A great amount of the improvements now present on the National Forests were put in at private expense in years past but must now be maintained by the Service, since they have been deserted by their owners. From year to year the amount of new construction increases. The total value of the National Forest improvements, figured on replacement cost, was estimated in 1914 at $3,553,000. Ten per cent of this sum will probably approximate the current annual depreciation. This amounts to $355,300, leaving for new construction on about 160 million acres of Forest, about $194,700 a year, or about 0.12 cent per acre (equivalent to about $28 per township). At this rate it will be about ten years before the sum total of the annual appropriations is wholly required to maintain existing improvements, at which time the improvements will have a replacement value of about $5,500,000. With some 6900 townships in the National Forests, the improvement investment, at this time, will total about $797 per township, and really less than that, since many improvements must be constructed outside the boundaries of the Forests. As compared with the cost of the system on the well improved township previously hypothecated, this amounts to 1.6 per cent. As compared with the township well improved, but with trails instead of roads, it amounts to about 5.3 per cent.

Such figuring is of use in showing the ridiculous insufficiency of the present appropriations and of the Improvement Plans necessarily based upon them. This is still more evident if attempt is made to compare the cost of the finished improvement system possible under current appropriations with the present or future value of the Forests. The result is a practically disappearing decimal.

The same situation, or worse, is to be found with our State Forests and with the Private Protective Associations. The situation is only slightly better on most of our privately owned forest estates and parks. Adequate appropriations cannot be hoped for until practising foresters fully appreciate what improvements their forests are entitled to and until they demonstrate that their Forests can amply afford all the improvements which can be desired. When foresters are able to do this, and when they develop a public understanding of the situation, they will be able to put an automobile road where an automobile road is required; until they do it, they will continue to wonder where to find a brush to paint the Joke Creek Ranger Station door.

BUSINESS RATE OF INTEREST AND RATE MADE BY THE FOREST

By Filibert Roth[1]

With more extended application of forest valuation in the United States, there comes more and more the desirability, if not necessity, for a decision and agreement concerning the management rate or demanded business rate of interest (*Wirtschaftszinsfuss* of the German authors). This is *not* a current rate, but one that is chosen by the business manager as suitable to the character of the particular business, a rate with which the business manager is satisfied, and which he demands or at least attempts to secure from the business, with which he calculates his business results.

That such an assumed rate of interest is necessary, not only in forestry, but also in farming, railroading or any other business, is evident. Whenever the question is asked: "Does the farm pay?" there follows the second question: "What is the measure of pay?" or at what per cent must it pay to deserve being called a paying farm. That this per cent is set arbitrarily is clear, and yet there are limitations. If a rate of 20 per cent were used in the studies of farm economics now being made by the Department of Agriculture and by some of our Agricultural Experiment Stations, it is evident that all farming would appear in a very "blue" light. Since good farms in Indiana, Iowa and Illinois pay about 3 per cent on their sale value, the price of even the best farmlands would seem unreasonable, and the whole business a poor, losing affair. This would have no effect on the corn, but it would have a bad psychological effect on the people, and it also would make all the calculations seem more or less absurd, for after all, everybody knows that farming is a good and necessary business and supports a large part of our people. There is evidence that even today with the usual rates of 5 or 6 per cent on money capital, and the growing demand that every business should pay, there is some of this psychological effect at work, and a part of it finds expression in the migration to the city.

It is usually argued that this demanded business rate should be at least the "current" rate, and much debating on this point is still going on, both here and abroad. But this current rate,

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[1]Professor of Forestry, University of Michigan.

according to Dr. Thompson of the United States Department of Agriculture (*see* article on *Rural Credit,* in *Saturday Evening Post,* April 15, 1916), is from 10 to 15 per cent on personal securities, and from 8 to 10 per cent on mortgages over a large part of the United States.[1] Setting this current rate then, would make farming appear as a losing business, and in place of an actual profit the farm produces a loss of 200 per cent of the actual net income. It is evident that the money lender does, or must, take an interest entirely out of proportion to what the farms make. And to use the money lenders' rate as a measure of successful farming simply misleads and can have no real value.

In forest valuation, the business rate, the *assumed p* of all the formulae, meets us at every step. If the value of a 20-year-old stand of pine is to be determined, and if it cost $10 per acre to plant, then this $10 has been out at interest for 20 years, and none of this interest has been paid by the stand. At what rate should it be figured? Should this rate be 3, 5 or 10 per cent; should a uniform rate be adopted for all these calculations, and for all parts of the country? These questions are not new; they have been debated a great deal abroad; and even today Dr. Frey accuses Endres and others of using a "rate to suit the forest" (*waldfreundlich*), and incidentally one which suits their pet notions on forest statics.

That the management rate for any business, whether farming or forestry, can serve as a useful *measure*—and that is its chief function—only when it truthfully represents such business, would seem to follow from what was said concerning the effect of current rates on the farm business. If a well managed forest, satisfactorily regulated and with most of its stands in satisfactory condition of stocking and thrift, i.e., a fairly normal forest, if this forest makes a growth of only 3 per cent on the actual sale value of growing stock and land, then it is evident that 3 per cent is all that we should expect, and that any well stocked forest making 3 per cent must be considered as well taken care of. In this case, then, the 3 per cent rate becomes a fair and useful measure, and any forest making less may need investigation and a change of forester or plans.

But what does the forest actually make? The following fig-

[1]This seems an extravagant statement, as those owning or owing mortgages in the Eastern half of the Continent will testify.—Ed.

ures, taken from the normal yield tables of Schwappach, may help to answer this question. The following premises should be kept in mind:

1. The forest is normal, both as to age classes and conditions of stands; it is not the best, but the average of fully stocked forest.

2. The prices are actual current prices for Central Europe, and are stumpage prices.

3. The value of the growing stock, yields and thinnings are the actual sale value, so that young stands, not yet marketable, are ignored entirely.

4. The value of land is assumed by the writer as follows, for site II:

for oak,	$80	per	acre;
beech,	$60	"	"
spruce,	$50	"	"
pine,	$40	"	"

which is believed to represent fairly the present day conditions and values in Germany.

5. The expenses for: Reproduction (Planting), *c*, $10 per acre; Administration, protection, taxes, etc., *e*, $1 per acre.

6. The value of the normal growing stock for any rotation is the sum of the values of the main stands (G_n), as given in the tables for each decade up to and inclusive of the year of rotation multiplied by 10.[1] Thus, for the 80-year rootation in spruce, the values of the main stands from 30 (the youngest salable material) to 80 years are added and multiplied by 10.

The following tables give some of the results:

SPRUCE, SITE II, AFTER SCHWAPPACH

Age	*Main Stand* Y_r Per Acre	*Sum of Thinnings* ΣT_q Per Acre	*Yearly Cut Capitalized* $\frac{(Y_r+\Sigma T_q)100}{G_n+rS_c}$ Per Cent	*Net Income Capitalized* $P_f=\frac{(Y_r+\Sigma T_q-c-re)100}{G_n+rS_c}$ Per Cent
30	$56	$2	...	...
40	172	15	4.2	3.1
50	366	48	4.8	4.1
60	541	114	4.5	4.1
70	803	218	4.4	4.1
80	972	348	4.0	3.7
90	1092	496	3.6	3.3
100	1183	662	3.3	3.0
110	1260	829	3.0	2.8
120	1305	983	2.7	2.6

[1] To make this mathematically correct, the last number of the series should be divided by 2.—Ed.

The above shows that:

a) With a reasonable technical rotation (90 years and over) the interest actually made by the growth of a normal forest of spruce on good land is 3.3 per cent or less;

b) With a rotation of 120 years the influence of planting costs and current expenses becomes almost trivial.

Interesting, in this connection, are the following figures:

INTEREST RATE MADE BY THE NORMAL FOREST OF DIFFERENT SPECIES, ON SITES I-IV REGULATED TO A ROTATION OF 120 YEARS

$$P_f = \frac{(Y_r + \Sigma T_q - c - re)100}{G_n + rS_c}$$

Site	*Pine Per Cent*	*Spruce Per Cent*	*Oak Per Cent*	*Beech Per Cent*	*Oak 160-year Rotation Per Cent*
I	2.2	2.5	3.6	2.9	2.2
II	2.1	2.6	3.0	2.9	2.1
III	2.0	2.6	3.3	3.1	2.1
IV	2.0	2.7	...	3.0	...

These figures indicate that the sites do not materially affect the per cent made.

Summing up:

1) The normal forest of Central Europe, in ordinary rotations, makes between 2 and 3 per cent on the sale of the forest;

2) The rate made by the forest is quite independent of site;

3) Beech and oak exceed pine and spruce in the rate made in a 120-year rotation, not by a better income, but by a smaller value of the growing stock in young stands and consequently less value of G_n, the important part of the capital;

4) The rate made by a forest varies within narrow limits for all reasonable rotations, and is little affected by current expenses;

5) The rate does not vary materially with changes in price of timber, since such changes affect capital and income alike;

6) Extensive forestry, with small expenses and small incomes, will produce as good a percent (for ordinary lands and rotations of 100 years and over) as intensive forestry, but the income and capital are both smaller, and such a forest does not fully perform its public duties;

7) In farming a reduction in the sale value of the land (farm) radically affects the per cent made by the farm. In forestry the usual values of the land are, with ordinary rotations, of little

consequence, since the principal portion of the capital, 75 to 90 per cent, consists of the growing stock itself;

8) The rate which the yearly growth in value makes on the sale value of the growing stock of a regulated forest is the *unattainable goal* in forestry, and since this, on site I for spruce, stays below 4 per cent, with a rotation of 100 years, it is evident that any business rate or measure of 4 or more per cent does not correctly represent the forest business.

It may be argued, as has been done and will be done, that if men can not make 6 per cent in forestry, they will certainly not go into this business.

To this, we may say: Probably not one per cent of our citizens make 5 per cent or over on their money; even the organized money lenders lose sufficiently to reduce this current per cent very materially.

The pawnshop man expects at least 100 per cent per year on his investment. He would sneer at 3 per cent in farming. But that is of no consequence to the people or to farming. A nation must either farm or import food; only Great Britain has enough of commerce and manufacture to import food on a large scale, and England farms her lands more efficiently and more successfully than probably any other nation in the world. The same reasoning applies to forestry.

A PRACTICAL APPLICATION OF PRESSLER'S FORMULA

By A. B. Recknagel[1]

The purpose of this paper is to show how Pressler's well-known formula[2] may be used in a practical way to determine the current annual increment in mixed, selection forest and, from this, to work out the regulation of the cut. The data used were obtained in connection with work done by Cornell University students in the Catskills and Adirondacks during 1914 and 1915. Criticisms of the methods used and the results secured are invited in order that the method, if at all meritorious, may be perfected.

Probably no stands present greater difficulties in determining the current annual increment than do those of the hardwood type in the Northwoods. Aside from the conifers, at least three chief hardwood species are involved—beech, birch and maple. The stands are uneven-aged and markedly irregular in composition. The condition of the stand encountered in the Catskills is well illustrated by the stand and stock tables (tables 4, 5, 6 and 7) printed Bulletin 11 of the New York State Conservation Commission.[3]

To get some idea of the growth in this heterogeneous forest, stump analyses were made on 132 beech, 123 Yellow birch, 71 Hard maples and 8 White ash trees in nearby cuttings. Increment borings were made on 109 hemlock and 167 balsam trees. The customary diameter-age curves were prepared for the hardwoods; the data for the conifers were also averaged and curved. In this way, the year required to grow one inch in d.b.h. were obtained, and from this, by the use of Pressler's formula, the current annual increment per cent. The results are as follows:

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[1]Professor of Forestry, Cornell University.

[2]See Graves' *Forest Mensuration,* John Wiley & Sons, New York, 1906, pp. 304-9.

[3]Bulletin 11, *Forest Survey of a Parcel of State Land,* Albany, N. Y., 1915.

TABLE 1.—*Current Annual Increment Per Cent of Six Species by Pressler's Formula*— $\frac{V-v}{V+v} \times \frac{200^*}{n}$ *Ulster County, N. Y.*, 1915

All Slope Type except Balsam *Read from Curves*

Basis 610 *Trees*

	Hemlock		*Beech*		*Birch*		*Maple*		*Ash*		*Balsam*	
D.B.H. Inches	*Years to Grow 1" in D. B. H.*	*Current Annual Increment Per Cent*	*Years to Grow 1" in D. B. H.*	*Current Annual Increment Per Cent*	*Years to Grow 1" in D. B. H.*	*Current Annual Increment Per Cent*	*Years to Grow 1" in D. B. H.*	*Current Annual Increment Per Cent*	*Years to Grow 1" in D. B. H.*	*Current Annual Increment Per Cent*	*Years to Grow 1" in D. B. H.*	*Current Annual Increment Per Cent*
	Basis 109 *Trees*		*Basis* 132 *Trees*		*Basis* 123 *Trees*		*Basis* 71 *Trees*		*Basis* 8 *Trees*		*Basis* 167 *Trees*	
6	6	....	12	....	10	....	12	....	....	....	8	....
7	7	7.19	10	....	10	....	10	....	....	....	9	5.88
8	8	4.30	11	....	10	....	10	....	....	....	10	3.55
9	8.50	4.00	11	....	10	....	10	....	....	....	10.5	2.94
10	9	2.69	11	....	9	....	10	....	....	....	11.25	2.54
11	9.75	2.68	12	....	10	....	10	....	....	....	12	2.14
12	10	2.26	12	....	9	....	8	....	....	....	12.50	1.62
13	10.50	2.08	17	1.90	10	4.68	8	4.75	2.0	13.57	12.75	1.30
14	11	1.75	17	1.24	9	3.03	8	2.18	2.4	9.96	13.0	1.17
15	11.25	1.55	21	.77	8	1.94	8	1.64	2.7	7.66	13.25	1.00
16	11.50	1.69	23	.54	9	1.22	8	1.59	3.0	6.09	13.50	.87
17	12	1.48	26	.40	9	1.46	8	1.47	3.3	5.85	....	....
18	12.25	1.24	27	.48	7	2.19	6	1.46	3.5	5.42	....	....
19	12.50	1.10	....	....	9	1.60	7	1.35	3.8	3.93	....	....
20	12.75	.97	....	....	7	2.45	7	1.49	4.0	3.91	....	....
21	13	.89	....	....	8	1.35	6	1.99	4.3	3.43	....	....
22	....	....	....	....	8	1.15	6	1.73	4.5	2.86	....	....

Hardwood volume tables begin at 13 inches, hemlock and balsam at 7 inches d. b. h. The volume tables used are listed on pp. 6 and 7 of Bulletin 11, New York State Conservation Commission.

* V = Volume at certain diameter in inches; v = Volume at next smallest diameter in inches; n = Number of years to grow this inch in diameter.

TABLE 2.—*Current Annual Increment Per Cent of Six Species, St. Lawrence County, N. Y., 1915, by Pressler's Formula*

	Red Spruce		*Balsam Fir*		*Hemlock*		*Beech*		*Yellow Birch*		*Hard Maple*	
D.B.H. *Inches* (1)	*Years to Grow 1" in* D. B. H. (2)	*Current Annual Incre-ment Per Cent* (3)	*Years to Grow 1" in* D. B. H. (4)	*Current Annual Incre-ment Per Cent* (5)	*Years to Grow 1" in* D. B. H. (6)	*Current Annual Incre-ment Per Cent* (7)	*Years to Grow 1" in* D. B. H. (8)	*Current Annual Incre-ment Per Cent* (9)	*Years to Grow 1" in* D. B. H. (10)	*Current Annual Incre-ment Per Cent* (11)	*Years to Grow 1" in* D. B. H. (12)	*Current Annual Incre-ment Per Cent* (13)
5	11	....	7	....	Basis	....	....	....				
6	10	....	8	....	borings	....	....	....				
7	9	....	10	....	on 200	....	....	....				
8	8	....	13	3.7	trees	....	....	....				
9	7	....	15	2.6	curved	....	....	....				
10	7	4.4	15	2.3	10.4	4.81	10	2.2	27		9	2.6
11	7	4.1	17	1.8	10.6	3.59	12	2.6	22	1.7	10	3.2
12	6	3.9	17	1.9	10.8	2.96	11	1.9	18	1.2	7	4.4
13	6	3.3			11.0	2.18	11	2.1	15	1.4	7	2.9
14	6	3.7			11.2	2.14	10	1.7	13	1.6	6	4.8
15	6	2.6			11.4	1.65	10	1.7	13	1.4	5	3.4
16	5	3.8			11.6	1.72	10	1.6	9	1.7	5	3.7
17					11.8	1.59	9	1.4	8	1.7	5	2.7
18					12.0	1.83	8	1.8	8	1.7	5	2.9
19					12.3	1.30	8	2.0	8	1.4	4	3.0
20					12.5	1.44	7	2.4	7	1.8	4	3.1
21					12.7	1.10	6	4.1	5	2.0	3	4.1
22					12.9	1.08			5	2.1	3	3.6
23					13.2	.97			4	2.3	4	2.3
24									4	2.3	4	2.7
25												

Data: Column (2) Growth after cutting, Santa Clara, N. Y., U. S. F. S. Bull. 26, Table p. 43, top, column No. 6.
(3) Volumes based on U. S. F. S. Bull. 26, Table II, p. 81.
(4) Growth on hardwood slope (nearer local growth conditions), U. S. Dept. Agr. Bull. 55 (N. S.), Table 14.
(5) Volumes on hardwood slope (nearer local conditions), U. S. Dept. Agr. Bull. 55 (N. S.), Table 41.
(6) Columns (8), (9), (10), (11), (12) and (13), based on data gathered locally.
(7) Volumes based on U. S. Dept. Agr. Bull. 152 (N. S.), Table 12.

The Adirondack data were obtained on typical hardwood land in St. Lawrence County, New York. Stump analyses were made of 162 beech, 47 Yellow birch and 142 Hard maple trees. Increment borings were made on 200 hemlocks. The customary diameter-age curves were prepared for the hardwoods; the data for the hemlocks were also averaged and curved. Existing growth tables for Red spruce and Balsam fir were used. It should be noted that the Adirondack figures are for a forest from which the soft woods were culled 17 years ago to a diameter of 8 inches at point of cutting. This explains why, at present, the beech constitutes 34 per cent of the stand (34% of volume), the birch 18 per cent of the stand (28% of the volume), the maple 15 per cent of the stand (28% of the volume), the hemlock 11 per cent of the stand (5% of the volume), the spruce 19 per cent of the stand (3% of the volume), and the Balsam fir ¾ per cent of the stand (¼% of the volume). The Catskill data were based on virgin stands as far as the hardwoods are concerned.

The results are given in Table 2.

The current annual increment per cent must be translated into terms of board feet in order to be useable. For example, in the case of the hemlock in the Catskill data, the current annual increment in board feet per acre would be figured as follows:

TABLE 3

D. B. H. Inches	*Current Annual Increment Per Cent (Pressler)*	*Volume on Average Acre (Stock Table) Board Feet*		*Current Annual Increment Per Acre Board Feet*	
7	7.19	6.80	X	.488	Xi
8	4.30	6.41		.276	
9	4.00	12.18		.487	
10	2.69	17.98		.484	
11	2.68	24.08		.645	
12	2.26	28.83		.652	
13	2.08	26.68	Y	.555	Yi
14	1.75	21.45		.376	
15	1.55	15.48		.240	
16	1.69	18.36		.310	
17	1.48	22.23		.329	
18	1.24	20.51		.254	
19	1.10	13.60		.150	
20	.97	7.78	Z	.076	Zi
21	.89	17.56		.156	
		continued in stock table*		5.478	

* Table 5, Bull. 11, N. Y. State Conservation Commission.

The same thing should usually be done for each species and, of course, separately for each type.

The next step is how to use these data to determine the allowable cut. The increment may be used directly, as described by Hufnagl, that is the simple summation of the current annual increment per acre which, in the case of hemlock, adds up to 5.478 board feet per acre, but a better method, which we may call the "Swiss Method" is described in an anonymous article on selection forest management in the Swiss Forestry Periodical for 1913, briefed in FORESTRY QUARTERLY, vol. XIII, pp. 260-2, as follows:

"Divide the volume of the oldest size classes by the annual increment of the entire stand. This will give the number of years during which the volume of the oldest size class must last. If this be 45 years, then the cut for the next decade would be from one fifth to one quarter of the volume of the largest size classes."

Expressed mathematically:

Let $X =$ the volume of the size classes below the diameter limit

" $Xi =$ the current annual increment thereon

" $Y =$ the volume of the size classes above the diameter limit but within a current annual increment of, say, 1 per cent

" $Yi =$ the current annual increment thereon

" $Z =$ the volume of the size classes beyond a current annual increment of, say, 1 per cent—that is overmature timber—surplus growing stock

" $Zi =$ the current annual increment thereon

" $CC =$ the cutting cycle

Then $CC = \frac{Y+Z}{xi+yi+zi}$

And annual cut $= \frac{Y+Z}{CC}$

This is the strict interpretation of the method as described, but since Z is surplus growing stock, it should play no part in determining CC; nor should the increment thereon (Zi).

Then $CC = \frac{Y}{xi+yi}$

And annual cut $= \frac{y+z}{CC}$

Using the data given above (Table 3) and a 12-inch d.b.h. limit, the cut for hemlock figured by this method would be as follows:

$$CC = \frac{Y+Z}{xi+yi+zi}$$

$$Y = 138.31 \text{ board feet}$$

$$Z = \frac{168.48}{306.79} \quad " \quad "$$

$$Xi = 3.032 \quad " \quad "$$

$$Yi = 2.214 \quad " \quad "$$

$$Zi = \frac{.232}{5.478} \quad " \quad "$$

Substituting, $CC = \dfrac{306.79}{5.478} = 56$ years.

Annual cut $= \dfrac{Y+Z}{CC} = \dfrac{306.79}{56} = 5.478$ board feet or, for the 1730 acres in the slope type $= 9{,}477$ board feet of hemlock.

Eliminating Z and Zi in figuring CC:

$$CC = \frac{Y}{Xi+Yi} = \frac{138.31}{3.032+2.214} = \frac{138.31}{5.246} = 26 \text{ years.}$$

Annual cut $= \dfrac{Y+Z}{CC} = \dfrac{306.79}{26} = 11.797$ board feet, or, for the 1730 acres on the slope type, $= 20{,}409$ board feet of hemlock.

For the other species in the Catskills, the cut, to a diameter limit of 16″ b. h., figures out as follows:

Beech:	10.878	bd.	ft.	per	acre;	18,819	bd.	ft.	for	1730	acres.
Birch:	29.183	"	"	"	";	50,487	"	"	"	"	"
Maple:	17.345	"	"	"	";	30,007	"	"	"	"	"
Others:	14.610	"	"	"	";	25,275	"	"	"	"	"

These volumes must, however, be reduced 15 per cent for local defect in the timber. For example, the hemlock is reduced from 9477 board feet to 8055 for the 1730 acres. The corrected values for the Catskills, together with the probable rotation and a comparison of the cut as figured by von Mantel's method, follow:

TABLE 4

Regulation of Cut—1730 Acres of Slope Type. Catskill Mts.

Species	*Rotation* Years	Corresponding D. B. H. Inches	*Allowed Annual Cut, Board Feet* Swiss Method	von Mantel's Method
Hemlock	160[1]	12[1]	8,055	7,411
Beech	200	16	15,996	14,646
Birch	140	16	42,913	40,715
Maple	160	16	25,506	16,573
Other hardwoods	...	(16)	(21,484)	.....
Total of first four species	...	..	92,470	79,345
Total all species	...	..	113,954	.....

In the case of the Adirondacks, the same data were worked up. The Swiss method was then applied, not separately by species, but for all the species in the given type.[2] The diameter limits, b. h., and corresponding ages were: spruce 12″, 100 years (Graves' *Principles of Handling Woodlands,* p. 12); hemlock 14″, 160 years (U. S. Dept. Agr. Bull. 152 [N. S.]); Balsam fir 10″, 128 years (U. S. Dept. Agr. Bull. 55 [N. S.]); beech 14″, 184 years; Yellow birch 14″, 147 years; Hard maple 14″, 167 years.[3] The other species were considered as being similar to the Hard maple. "X" in the Swiss Method = all below the named diameter limits; Y = all between the named diameter limits and including 24″ d.b.h.; Z = everything 25″ d.b.h. and over.

In tabular form the data are as follows:

TABLE 5

Current Annual Increment Per Acre in Feet Board Measure

Type	*Beech*	*Birch*	*Maple*	*Soft Maple*	*Spruce*	*Balsam*	*Hemlock*	*Black Ash*	*Miscellaneous*	*Total*
Swamp	.....	12.92	1.49	10.24	8.78	9.44	6.54	3.64	3.66	56.71
Spruce flat	12.74	20.40	13.32	17.12	16.86	7.79	18.84	......	.47	96.54
Hardwood	47.69	24.09	55.55	5.61	5.66	0.33	7.30	......	.05	146.28

Applying the Swiss Method, $CC = \frac{Y}{Xi+Yi}$ and Cut $= \frac{Y+Z}{CC}$ the results are as follows:

[1] U. S. Dept. Agr. Bull. 152 (N. S.), Table 10. With a cutting cycle of 56 years there would be about 3 cuttings in a rotation; with a cutting cycle of 26 years there would be about 6 cuttings in a rotation.

[2] If this had been done in the case of the Catskill data, the result would have been 112,493 as against 113,954 board feet, from which it is evident that the total cut is practically identical in either case. However, the figuring by species is, undoubtedly, the more accurate.

[3] This compares closely with Table 7, U. S. Dept. Agr. Bull. 285 (N. S.), which gives for 14″, beech 180 years, Yellow birch 155 years, Hard maple 171 years.

Type	*CC Years*	*Annual Cut Per Acre Board Feet*
Swamp	44.3	60.52
Spruce flat	41.8	109.77
Hardwood	36.9	194.91
Average	41.0	......

In order to compare these results with other methods, the rotations used being: spruce, 100 years; hemlock, 160 years; Balsam fir, 120 years; beech, 180 years; Yellow birch, 140 years; Hard maple, 160 years; other hardwoods, 160 years; the annual cut was figured by von Mantel's, Heyer's and Hufnagl's methods, as follows; the cutting cycle for the Swiss Method being taken as an even 40 years:

TABLE 6

Type	*Allowed Annual Cut Per Acre, Board Feet*				
	von Mantel II	*Heyer IX*	*Hufnagl XII Var. 2*	*Swiss CC=40 Years*	*Average*
Swamp	39	...	...	67	48
Spruce flat	77	210	...	115	134
Hardwood	105	324	305	180	228.5

Note: The Roman numerals refer to the numbers of the methods in *Forest Working Plans*, John Wiley & Sons, New York, 1913.

From this it would appear that the cut as figured by the Swiss method is amply conservative. It would seem to be a very common sense method of finding the allowed annual cut in a selection forest. It should be checked, however, by other methods, such as those illustrated above and by the area check. The basic data should be revised at least once every decade. If the growing stock then shows an unintentional and undesirable diminution, the cut was set at too high a figure; if conversely, the growing stock at the time of revision, shows an unintentional and undesirable increase, the cut was set too low.

FIRE RISK IN MASSACHUSETTS

By H. O. Cook[1]

We have so long emphasized the forest fire risk in this country that I believe we have blinded ourselves to certain facts concerning the danger to forest property, and under some circumstances unduly exaggerated it. It has seemed to me that the principal fire risks in our more densely-populated commonwealths are limited to certain sections and that there is a great difference in the average fire risk as between sections of the states. I have held the theory that in a State like Massachusetts the principal fire risks were confined to a belt of land about one eighth mile wide on either side of the railroad right of way for reasons that are obvious, and to the vicinity of manufacturing communities where there is a more or less irresponsible population which on Sundays and holidays spreads out into the surrounding woodlands and carelessly sets many fires. Acting upon this hypothesis, I have taken our forest fire data for 1914 in an endeavor to see whether my theory is correct, although in order to make a really satisfactory test of this matter one should take the data for a series of years. I am free to confess that, although the results of this investigation bear out my theory, it does not do so to such an emphatic degree as I expected.

We have in Massachusetts 253 cities and towns with a total area of 5,321,000 acres. I have picked out 73 communities, including 21 cities, which have a distinctly manufacturing population. Fourteen cities were left out because they have no forest land and consequently no forest fires. I do not mean to imply that none of the remaining 280 communities have no manufacturing industries, but that their industrial population is not a large factor in the town. In comparing these two groups of communities we have used the non-railroad fires only, assuming, as we have a right to, that a great part of these are due to the direct carelessness of the population itself. We find that 73 industrial communities (20% of the towns), having 25 per cent of the total area, had 33 per cent of the fires of the year 1914 both in area and number, while 80 per cent of the towns, largely rural or residential, had but two thirds of the fires. My original idea was that the disproportion should be

[1]Assistant State Forester, Massachusetts.

greater. Possibly if I had gone a step further and had joined to the industrial towns the adjoining communities, I might obtain more pronounced results, because an industrial community on Sundays and holidays spreads beyond its own political boundaries.

Coming to the matter of railroad fires, and taking a strip one eighth mile wide on either side of the track as the danger zone for twenty-five hundred miles of railroad, we find that there are 400,000 acres in this zone. I understand that many railroad fires spread more than one eighth mile from the track, but when we see that the average fire only covers six acres it is evident that the majority of the fires extend but a short distance. On 400,000 acres of railroad zone, or 8 per cent of the State, we have 830, or 26 per cent of all the fires. The relative fire risks may be summarized as follows: Railroad zone as 3 is to 1; industrial zone as 3 to 2; all other as 2 to 3.

Classified Causes of Fires—1914

	Number of Fires	*Per Cent*
Unknown	1,174	37
Railroad	830	26
Burning brush	196	6.2
Hunters	520	16.4
Steam mills	3	1
Children	140	4.4
Miscellaneous	318	9.9
	3,181	

Distribution of Fires—1914

Number Towns	*Total Acreage*	*Per Cent Total*	*Number Fires*	*Per Cent Total*	*Acres Burned*	*Per Cent Total*	*Average Fire Acres*
			Manufacturing Towns				
73 (20 %)	1,262,460	25	786[1]	33[1]	11,860	33[1]	15
			All Other Towns				
280 (80 %)	4,058,540	75	1564[1]	66[1]	22,340	66[1]	14
			Railroad Belt				
	400,000	8	830	26[2]	4,800	12[2]	6

[1] Non-railroad fires only.
[2] Per cent of all fires.

REMOVING GROWTH FROM FIRE LANES

By N. R. McNaughton[1]

In Forestry Quarterly, Volume XII, there appeared on page 472 a note on the use of a shrub called *Mille pertuis* as a non-inflammable cover for the fire lanes in France. The note was called to the attention of the writer, who was then conducting experiments with the same end in view on the Karthaus State Forest, Clearfield County, Pennsylvania.

Inquiry about this shrub was made at several of the large seed houses, but replies were received from but two. Neither recognized it as *Mille pertuis*. One replied that it is known as *Hypericum elegans* in America, and that a small supply of seed was available at $2 per ounce, but that it was doubtful if the stock could be increased or the price lowered until after the war. Under the circumstances, and in consideration of the small amount of money available for experiment, none of the seed was used.

Other experiments, however, no less interesting, have been carried on on the Karthaus Forest, and although sufficient time has not elapsed to make possible definite statements as to results, it may not be amiss to give a rough outline of methods and material used.

The first experiments on this Forest were made with the idea of finding some evergreen cover for fire lanes, similar to *Mille pertuis*. To this end, in the early spring of 1914, six measured strips of plowed fire lanes were thoroughly raked and sown to white clover, red clover, crimson clover, buckwheat, timothy, and pulverized rock salt. The idea in using buckwheat was to so loosen and modify the soil that an evergreen could be successfully introduced the following year.

In every case, except where rock salt was used, the experiment was a total failure. This is not to be wondered at, and was rather expected, since the lanes were exposed to glaring sunlight all the time, absolutely no tree cover being present, and the soil contained a large percentage of sand. Under these conditions, probably the only preliminary treatment which will make pos-

[1]Forester in charge, Karthaus State Forest, Pennsylvania.

sible the introduction of one of the evergreen covers is a liberal application of lime.

All growth on the rock salt plot was killed within a week, and to this day—almost two years—not a wisp of anything green can be found there. Forty pounds of the crushed salt were applied to an area of about 300 square feet. The experiments should be continued until the minimum amount of salt which will produce these results is found.

In 1915, the experiments were continued, but were modified, in that the result striven for was the complete removal of all growth present. For this purpose a spot was chosen on which was found the greatest diversity of species which it is desirable to remove from fire lanes, such as bracken, sweet fern, huckleberry bushes, grass, weeds, and hardwood and scrub oak sprouts. All brush was cut to the ground, and the areas treated were mowed as closely as possible and raked, so that solutions might penetrate to the roots.

The following materials were applied to the plots thus prepared on the morning of July 6, a cool, clear, windy day, immediately following a rainy period of several days.

14	oz. sodium hydroxide in 1 gal. water	to	50 sq. ft.
14	" " " " 2 " "	"	100 " "
3	qts. granular salt in 3 gals. water	"	72 " "
3	" sulphuric acid in 3 qts. water	"	45 " "
3	" " " " 6 " "	"	72 " "
2	" " " " 6 " "	"	80 " "
1	gal. kerosene	"	60 " "
1	" gasoline	"	60 " "
1	" "Mount Vernon Weed Killer" in 25 gals. water	"	375 " "

All growth was killed in less than a week on every plot except the one treated with kerosene. Every plot, however, was again covered with a growth of bracken, sweet fern, and grass before the growing season was over, except the one treated with weed killer. On this plot all growth is dead now, but it is suspected that new growth will appear this spring.

Numerous cases are on record of damage done to crops by the oil from burst mains escaping over fields. In at least one case, damages were awarded on the basis that *the fertility of the soil was permanently destroyed.* If this be true, crude oil will solve the problem, and should be given a fair trial. Also, there are several by-products of the distillation of petroleum which may do the work as well, and which are much cheaper than crude oil.

Chief among these is a comparatively light, oily by-product which goes by the trade name of "Pennsylvania distillate."

Insufficient funds make it impossible for the Pennsylvania Department of Forestry to experiment with these materials in any large way now, but it is hoped that in the near future the experiments will be continued until some definite result is obtained. Any method will be of value which, at a reasonable cost, will either remove growth from fire lanes and keep it off, or else replace the present growth with some non-inflammable, evergreen material.

SEED TESTING WITH THE JACOBSEN GERMINATING APPARATUS AT THE DANISH SEED CONTROL STATION

Translation by J. A. Larsen[1]

The Danish Seed Control Station at Copenhagen is now the oldest institution of its kind in the world. It was organized as a private enterprise by E. Möller Holst in 1871 and taken over by the Danish Government in 1891. The committee of five by which it is governed is representative and comprises one member of the legislature, one farmer, one seed merchant, and two others having expert knowledge in matters pertaining to seed. Its main object is to provide the farmers, seed breeders and seed merchants with information as to the quality of seeds which they have to use or sell.

The work is done in a special building at No. 15 Bülöws vei, Copenhagen V, under Director Herr. K. Dorph-Petersen, three chief assistants, six assistants and up to twenty temporary assistants as the work demands. That this is at times considerable may be gathered from the fact that the Station has tested an average of over 4,000 samples per annum since 1891.

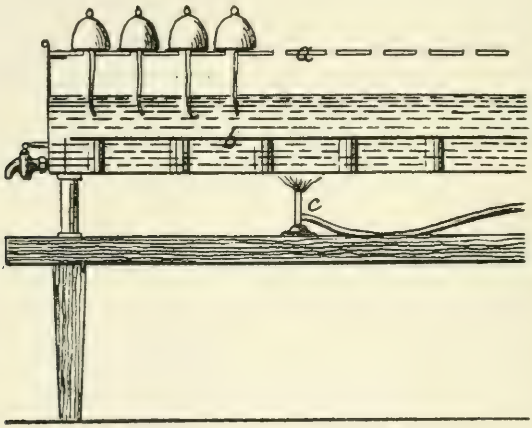
A complete analysis of the seed embraces a determination of the genuineness, purity per cent, weight, vitality and germinative power. Genuineness is usually determined by comparison with standard samples, or in doubtful cases by measurements, microscopic examination or raising plants. Purity per cent is obtained by mixing the sample well, spreading it out upon a flat surface by shaking so that every seed touches the plane, and then removing at will two or more sectors which are weighed and hand picked, whereupon the amount of clean seed and the various kinds of extraneous material such as pieces of plants, earth, gravel, broken seeds, weed seeds, etc., are separately determined. By clean seed is meant all uninjured seeds of the species in question whether large or small.

Three separate samples of 200 seeds each are counted from the carefully mixed sample, weighed separately and their mean multiplied by five to obtain the weight of 1,000. In case any of the

[1]Forest Examiner, Priest River Experiment Station, Idaho.

three samples vary more than 5 per cent from their mean the process is repeated. Usually a 5 per cent variation from the mean weight is allowed for seeds making 1,000 or more to the 5 grams, and a 10 per cent allowance for larger seeds. The dry weight, number per hectoliter, and other customary measures are listed for agricultural seeds.

The three samples of 200 seeds previously counted and weighed may be used for the germination test, which is made in triplicate,



THE JACOBSEN APPARATUS.

a. Glass strips.
b. Metal plate.
c. Bunsen burner.

their mean result being used as the figure representing the true germination per cent. However, should the result of one of the tests vary more than 10 per cent from the mean of the three, this figure must be disregarded, and if the results show more than 6 per cent variation between the different parallel tests the whole test must be repeated.

Practically all tests are made in the Jacobsen germination apparatus, which consists of a square metal tank about five inches high within which narrow strips of glass rest upon an inside rim a short distance below the upper edge. The glass strips are put close together so as to allow the wick attached to the 8 centimeter woolen disc placed on the glass to run down into the water. Above the woolen disc, which is made from all wool blanketing, is placed a coarsely knitted disc made out of loose yarn, and above this again is a circular filter paper upon which the seed to be germinated rests. The three different discs and the seed are then covered by a glass bell jar provided with a hole near the apex to allow entrance of air. For the same reason the filter paper, knitted disc and woolen cloth have a hole near the center. The water in the tank which is heated by means of a Bunsen gas burner is made to circulate by placing a metal plate resting upon metal supports about two inches above the tank bottom. The temperature of the water is allowed to vary from 15 to 25 degrees centigrade. This apparatus is easy to operate, occupies relatively small space for the number of tests and insures uniform results of high standard.

Though the main work of the Seed Control Station centers around seed used in agricultural practice, the later years have witnessed a steady increase in the number of forest seeds submitted for testing. The work in this field extends over a much shorter period so that the desired standards for all species have not in all cases been perfected, but most of the tests are run from 21 to 28 days, though in one instance the seed of one species of Rhus germinated only one seed in one year, while the remaining seeds were in perfect condition.

The articles published by the Station staff, principally by the Director, are very numerous and cover the field well in respect to peculiarities of different kinds of seed and the methods of overcoming them, the difficulties experienced in testing, identifying the seed, and the regulation of the seed market. Some of the articles which may prove of interest to investigators are listed below:

REFERENCES

Tests of Forest Seed, 1902-1907, Dansk Tidsskrift for Skovväsen, Volume XX; *Danish Seed Control Station*, 1896-1907, by K. Dorph-Petersen, published by J. Jörgensen and Company, Copenhagen; *Analysis of Forest Seed for 25 years*,[1] (not for

[1]Reviewed in F. Q., volume XIII, p. 527.

sale) by Johannes Rafn, Dansk Skovfrökontor; *Work of the Danish Seed Control Station, 1913-14,* by K. Dorph-Petersen, published by Nielsen and Lydicke, Copenhagen; *Work of the Danish Seed Control Station, 1871-96,* by O. Rostrup, published by Det Nordiske Forlag, Copenhagen.

(All above publications are printed in Danish, but *Analysis of Forest Seed for 25 Years* is to be had in English.)

In addition to these the Agricultural Journal, Landbrugets Planteavl, Volumes 4 to 14, contain numerous articles dealing with seed and seed testing. The nature of the matter treated may be judged by the following articles:

Germination under Different Colored Light, Vol. 4; *Relation between the Amount of Water Loss under Heating and the Number of Rebellious Seed,* Vol. 4; *Examples of Decreasing Germinative Power,* Vol. 5; *Influence of Carbon Dioxide Gas on Rebellious Seeds,* Vol. 5; *Decreasing Germinative Power from Spring to Fall,* Vol. 7.

A DAY IN AN IRRIGATED PLANTATION, CHUNGA MUNGA, PUNJAB, INDIA

By H. R. MacMillan[1]

A few days in Lahore, the capital of the Punjab and the headquarters of the important Government railway system of India, afforded the opportunity of visiting a most interesting and successful forest plantation.

The plains of the Indus and its tributaries, the five rivers of the Punjab, in which Lahore is situated, constitute, naturally, in spite of the dense population and great scarcity of wood, a most unfavorable location for the production of timber. Although the soil is a rich alluvial clay, the climate with its combination of heat and aridity has prevented the formation of any growth exceeding scrub. The precipitation varies from 5 to 20 inches a year, averaging about 15. The cold weather (there is no winter) does not go below a shade temperature of 68° F. in the day and 26° F. at night, and the hot weather brings hot blasting winds and a temperature which reaches 188° F. in the shade and averages at times, day and night, over 100° F.

The land in the natural state lay a level desert, bare except for scattered shrubs and trees a few feet high. The first British work after establishing peace was to provide for the pressure of population by constructing the great irrigation schemes for which the broad level plain traversed by five large mountain-fed rivers was so well adapted.

The area brought under irrigation for agricultural purposes in the Punjab is now 8,300,00 acres, producing crops valued at about $88,000,000 annually. Areas of land suitable for cultivation still remain unirrigated owing to the lack of water available for either the winter crops which require water in February and March or the summer crops which demand water in August and September. It is this land, suitable for agriculture in every way except that water is not available for it in the season in which it is demanded by agricultural crops, that is being used for forest planting. Fortunately there is sufficient water, unneeded for

[1]Timber Trade Commissioner, Dominion of Canada, and Chief Forester, British Columbia.

other purposes during the months of May, June and July, when the forest plantations require irrigation.

The plantations on the plains around Lahore were started in 1866 for the purpose of growing railway fuel for the government railways. At that time coal had not been discovered in India, the railways were burning wood, and with the rapid exhaustion of the accessible wood supply, feared the necessity of bringing coal from Great Britain.

The earliest plantations consisted both of species native to the dry plains, the chief of which were acacia, Arabica, *Dalbergia sissoo,* a native of the flooded river banks and silt islands, and mulberry. The most successful species were the Shisham (*D. sissoo*) and mulberry, which were originally only tried on a small scale. The acacia, though a native of the region, was killed out by frost in the irrigated plantations.

Great difficulty was experienced in starting the plantation. The first attempt, seeding broadcast in the cultivated plain, followed by flooding, was unsuccessful. It was believed the soil was too hard. Trenches were then dug, filled in with loose earth and seed sown along the filled trenches. This, too, was unsuccessful. Finally, a trial was accidentally made which proved most successful, of digging the trenches, sowing the seed in the edge of the bank of earth beside the trench and flooding the trenches to within about four inches of the level of the seed. The trenches are dug one foot deep, one foot wide and 10 feet apart. The seed is sown in March or April and the trenches flooded. The seedlings come up about two feet apart in the trenches and are 6 to 8 feet high in the first year.

The first years of the plantations saw numerous failures after the seedlings were started, due to failure to supply water at the right time. The system adopted now is to flood the plantations two feet or more in depth during May, June and July. The plantation is traversed by a large canal from which leads run through every block and compartment. The blocks are surrounded by embankments to protect the roads.

The system of irrigating is simple. Channels lead across each block and at right angles to the channels are the trenches dug when the area is planted and reopened after felling is completed. The general slope of the plantation is two feet in the mile. The water is turned into each block for a depth of two feet for about two days. The remainder of the year the trees go without water except for the limited rainfall. Naturally it is difficult to find species capable of thriving under such conditions.

Where patches of alkali soil occur, the blocks are trenched and irrigated several years before planting. The flooding removes the alkali and renders the soil fit for planting.

The rotation first fixed for the plantation was 15 years, sufficient to furnish fuelwood 5 to 6 inches in diameter. When the railways ceased taking wood for fuel, the rotation was raised to 20 years in order that a larger proportion of workwood might be secured.

The system now followed is coppice under standards. From 8 to 15 Shisham standards are left when the coppice is cut at 20 years and are allowed to stand over through another rotation for the production of logs. At 40 years the standards are 18 to 26 inches d.b.h. and 50 to 60 feet high, producing each one good log 12 to 17 feet long and a quantity of smaller timber.

Nearly all the plantation was originally pure Shisham. Birds have distributed mulberry throughout the whole area, and its superior coppicing ability, more rapid growth and constant reseeding have enabled it in two rotations or less to almost completely oust the Shisham. A root fungus, not known to seriously affect the Shisham in its natural habitat, the flooded river lands of the region, has developed throughout the flooded plantation, and is hastening the disappearance of the species. Mulberry forms 80 per cent of the outturn from the compartments now being cut. It is already becoming difficult to find sufficient Shisham standards for the next rotation, and those standards being left over will largely disappear because of root fungus before the next cutting period.

A question has already arisen concerning the species to be used for standards. Mulberry will not do, as it reaches the limit of its profitable development in 20 years. It will be probably necessary to plant for standards.

Limited experiments have been made with eucalypts. Ordinarily, this species cannot be planted in the Punjab because of white ants which devour the young trees. White ants have been driven out of the existing plantations by half a century of yearly flooding and the trees are safe there. The most satisfactory eucalypts for growth have been *Rostra* and *Tereticomis*. Specimens of these species on irrigated land have reached about two feet in diameter and 120 feet in height in 40 years. Neither of these trees produce satisfactory saleable timber here because of their certainty of splitting. The species which though slower growing produce the best timber in this district are *Paniculata* and *Crebra*.

The working plan calls for final cutting on an area of 450 acres per year. This has never been done, the highest area cut over in the last 5 years being 350 acres. As a result, final cuttings are over 1,000 acres behind, a condition which seriously affects the profit from the plantation.

Thinnings have never been tried in the plantation until this year, even though the condition of the stand, largely made up of such a ragged species as mulberry coming up so close together, urgently requires such treatment. The failure to have tried thinnings is more unaccountable, when it is taken into consideration, what must have been fairly obvious, that the first trial thinnings in mulberry at six years of age produced 1,000 cubic feet of stacked wood per acre, and in addition to greatly improving the condition of the stand resulted in a net profit of $1 to $20 per acre.

The working plan is now being revised and it may be expected that the new plan will provide for overtaking the arrears in felling and for thinnings throughout two or three times in the rotation.

The outturn per acre is fairly high. The 20-year-old coppice, exclusive of standards, produces 4,000 cubic feet of stacked wood per acre. The utilization is very close, the stumps are cut level with the ground, all dead wood is taken and everything used down to a minimum diameter of one inch.

The plantation is well supplied with good roads, each of the 10-acre blocks being surrounded by a road. The railroad runs along one side of the plantation and the Forest Service has built a 10-inch gauge tram with steel trucks operated by bullock power, over which all timber is taken out.

The whole of the work is done departmentally under contract. The cutting of the timber is done under contract at 2 cents per cubic foot for logs averaging 10 cubic feet or more, 1½ cents per cubic foot for smaller logs, $3 to $52 per 1,000 stacked cubic feet for fuel and workwood over two inches in diameter at the small end, and $3 to $20 per 1,000 stacked cubic feet for smaller stuff. These prices include felling the trees, cutting the timber, excepting the logs, into 5½ feet lengths, carrying it to the road and stacking it. Another contractor takes the timber to the depot at the railroad, using the government tram and trucks at 16 cents per 1,000 cubic feet per mile. The average haul is 2½ miles. A further 32 cents is paid for handling.

The total cost for logs at the depot averages five cents per cubic foot and for fuel 42 cents per 100 cubic feet.

The Divisional Forest Officer holds monthly auctions at the depot of the produce of the plantation. The purchasers are native merchants, who ship the wood by rail to the neighboring cities of Lahore and Amritsar (the seat of the manufacture of Persian, Turkish and Kashmir carpets for American purchasers). The logs of Shisham are used for furniture, carts, beds, beams in houses. The mulberry is used for vehicles, furniture and sporting goods; large quantities of it are manufactured into the hockey sticks, tennis rackets and cricket bats used by the thousand, both by British regiments in India and in native schools. The wood is carefully picked over, everything that patience and ingenuity can turn to an industrial purpose is so used and the remainder is sold for firewood.

The prices realized are good. The best Shisham logs sell at the depot for 44 cents a cubic foot quarter girth measure. The average realized for the Shisham logs is about 36 cents per cubic foot. The mulberry logs sell for an average price of 18 cents per cubic foot. Quantities of billets 5½ feet long and 3 to 10 inches in diameter are sold mixed with firewood which are afterwards sorted out and industrially used. Including these billets, firewood over two inches in diameter sells for $3 to $50 per cord. The smaller firewood, less than two inches in diameter, sells for $1 to $17 per cord.

The land is valued at $3 to $30 per acre. Irrigation costs $6,000 per year for the whole plantation for the water used. The cost of digging the trenches and establishing the plantation on new ground is $4 to $16 per acre. Supervision and care is very little. The staff consists of one ranger, one deputy ranger and four of a subordinate grade, known as foresters, together with about 70 coolies—all natives. The total cost of this establishment, together with a proportion of the Divisional Forest Office charges amount to about $1700 per year.

The total cost of the plantation up to 1909, allowing interest compounded annually at 4 per cent was $224,000. Even though there were extensive early failures, though thinnings have not been practised, and the possibility of the plantation each year has not been realized through failure to cut over sufficient area each year, the surplus each year over actual expenditure now realizes 4.67 per cent on the invested capital represented at 1909.

Under more intensive management, with such cheap labor, rapid timber production and an excellent market, the profit would undoubtedly be much greater. The failure to obtain better results in the past appears to have been due in large measure to the fact that the plantation has been under the supervision of native district forest officers, who although trained as foresters, as a rule neither exhibit the initiative nor exercise the care necessary to make the most of an irrigated plantation. The failure to have experimented with thinnings is probably due to this cause.

The Punjab Government is preparing to embark extensively on plantations, partly as a means of investing each year the surplus of Government revenue above expenditure and partly to meet the pressing demand for fuel and workwood. An area of 60,000 acres of irrigated plantations is contemplated, on the greater part of which a start has now been made.

NEWS NOTES FROM DISTRICT 1, FOREST SERVICE

By J. F. Preston

During the past winter a Ranger Conference was held at the Priest River Experiment Station. Twelve rangers were selected and assigned to the station for the purpose of giving them some additional training. Members of the District Office gave special lectures and in addition the rangers were required to do sufficient improvement work to justify the expenses of their assignment. The need for better trained rangers is very urgent and this is one method the District has adopted in order to raise the general standard of the ranger personnel. This conference at Government expense is in addition to the short courses for rangers given at the various Forest Schools and is not intended to interfere with these courses in any way. In fact, the purpose of the conference is accomplished if the men who attend will have an added desire to take a more pretentious course of training. The conference this year was very successful.

District Forester Silcox is developing what he calls an administrative plan for a Ranger District. This plan outlines in a simple way qualitative and quantitative standards of work and shows graphically the location of the work in the District with respect to the ranger's headquarters. This is along the line of scientific management and is another step in the effort to raise the general standard of ranger personnel. When it is remembered that 80 per cent of the Forest Service appropriation is spent for salaries, the importance of such efforts cannot be over-estimated.

The office of Operation has inaugurated a rather comprehensive scheme for employing forestry students for short-term work during the summer, such as guards, surveyors, reconnaissance men, etc. The office is following in a general way the principles outlined by Mrs. Katherine Blackford. The form of application which is required is rather formidable in appearance, but the results so far attained amply justify the methods. The big objection to forestry students in the past has been the number of rather low quality men which have been obtained, not so much due to the men themselves as to the fact that they have not been fitted to the particular job for which they are best suited. The results of this system, as shown by the accomplishments last year, are very gratifying. It will mean evidently a very much larger percentage of the temporary force secured from Forest Schools, to the mutual advantage of the students and the Forest Service.

There is in District 1 an urgent need for rangers of a higher type than the ranger examination of the past has produced. The ranger's position has grown in importance, the living conditions have improved, and along with it, the standard for the man to occupy the position has been raised. As a matter of fact, the ranger position is the best possible training for Forest Assistants. If they are not able to handle a Ranger job, they should not be retained in the service. If they can handle it successfully, there is just as much opportunity, and perhaps more, for advancement to higher positions as there is through the old way of entrance by the Forest Assistant examination. There is some Civil Service difficulty yet to be overcome.

The University of Montana Forest School has this year obtained students from all over the United States and from some foreign countries. The District Forester of New South Wales, Australia, is in attendance, studying forestry methods in this country, as well as securing technical training.

There have been some recent developments in fire protection which are worthy of note. The Adams portable telephone has been developed during the past year and will be used for the first time this season. This telephone was developed by R. B. Adams, Telephone Engineer in this District. The instrument weighs about two pounds and, with a "howler" attachment to the ordinary phone, this light, portable instrument does all of the work required of any telephone instrument. The lightest phone formerly available weighed ten pounds.

Kitchen and mess equipment for fire fighting has been standardized for 2, 5, 10 and 50 men outfits. All the cooking vessels are made to nest one within the other so as to secure the lightest weight and the smallest volume.

For smoke chasers' outfits, a combination axe and mattock has been made, which, together with a shovel with a detachable handle, forms the smoke chaser's fire-fighting tools. The whole outfit weighs about 8 pounds, which is considerably lighter than any serviceable tools for this purpose ever before used.

The problem of rations for smoke chasers is now receiving considerable study. It seems to be impossible to outline any rations which will enable the men to do hard work, with a less weight than three pounds per day per man.

The three District warehouses built last year—one at Missoula, one at Kalispell, and one at Spokane—have been about 50 per cent stocked. They have been proved to be amply worth while and every effort is now being made to stock them to full capacity. The equipment maintained will be for third line of defense only. The equipment for first and second line defense will be maintained in the Forest. By way of explanation, I might say that first line of defense is the smoke chaser's force, consisting of one and two men in a place. The second line of defense is the settlers, administrative officers and others locally available. The third line of defense is the floating labor force available at the larger towns.

CURRENT LITERATURE

Forest Valuation. By Filibert Roth. Volume II of Michigan Manual of Forestry. Published by the Author. Ann Arbor, Mich. 1916. Pp. 171.

Forest Valuation. By H. H. Chapman. John Wiley & Sons, New York. 1915. Pp. 310.

It is most interesting to note these two volumes, which have appeared within half a year of each other, together, for it would hardly seem possible to treat the same subject in so absolutely different manner. The treatment in both is original, and in no way resembles that of previous authors, mostly German. Both books are written with American needs in view; yet by merely looking at the table of contents one notices differences at least of arrangement, and in reading one is at once made aware of a difference as one of opposite poles. Professor Roth, as is his wont, approaches each problem in the simplest manner from the concrete case, such as is apt to occur in practice, and leads one by an interesting train of thought and with a persuasive common sense to recognize the propriety of the abstract deductions and theoretical methods. Professor Chapman, on the contrary, prepares first with the heavy artillery of theory and scientific apparatus the way for attacking each problem, but he also continues relentlessly the use of the same arm.

While, if anything, Roth's presentation appears almost too elementary and simple, and for a textbook, for which the volume is clearly designed, rather deficient in theoretical discussion, Chapman's volume errs in the other direction by neglecting concrete example and at times the "pedantry of erudition" hampers lucidity of statement and makes the reading difficult and laborious, especially since irrelevant detail appears without differentiation together with the essentials.

Work such as these two volumes represent should, however, be judged leniently for it is breaking new roads, to bring the subject of forest finance to fit American conditions and attitudes. If, therefore, we appear to criticize sharply, it is done not in the spirit of fault finding, but for the purpose of assisting in smoothing the road.

Both authors have chosen the more confined title of "forest valuation," yet to some extent they introduce discussion on general financial and statical problems which would suggest as more appropriate the broader title of "forest finance." Discussions of the relation of capital and income, of a financial rotation, of a comparison of use of land in agriculture and forestry, as Roth has them—these are statical inquiries. Both authors have, however, to the reviewer's mind an erroneous conception of the meaning of forest statics and its position in the larger subject of forest finance, of which forest valuation and statics are the two broad chapters.

Although Chapman cites the proper and clear definition of Schlich and repeats it in the preface, thereby supposedly making it his own, his chapter under the title *Forest Statics* is concerned merely with the methods of balancing accounts and figuring profits. There is nothing of "weighing the comparative merits of different methods of treatment to which forests may be subjected," as Schlich's definition would require, and as was the conception of the inventor of the term forest statics, Hundeshagen. Only one of the static problems, that of the comparison of agricultural and forest values, is treated in a chapter of 14 pages.

The balancing of income and outgo is, to be sure, in a manner a statical comparison, but the operation of mere book balancing needs hardly the dignity of a special term: statics connotes rather a balancing of such balances, the application of forest valuations to test the financial effect of different methods of management.

The entire absence in Chapman's volume of attention to the most important statical inquiry, that of the financial rotation, is a serious omission. Even in a book on valuation pure and simple one can hardly afford to omit this subject, for expectancy values are based on rotation.

Roth also defines statics as weighing "advantages and disadvantages of both lines," *i. e.*, "whether to change from farm crop to forest crop pays better," but eventually the balancing of costs and incomes seems to him statics and not alone the comparison of valuations, the comparison of methods of treatment or methods of capital employment in which costs and incomes have already been balanced. Incidentally, Judeich, whom Roth correctly cites as exponent of forest finance, was not, as is stated, at any time head of the Saxon forest department, only director of the forest school at Tharandt.

While we are on the subject of definitions, we may refer to some others which appear to us deficient.

Roth is sparing with definitions, taking for granted that capital, interest, etc., are well understood terms, while Chapman goes to unusual lengths in clearing the way by definitions of elemental economic concepts.

We are inclined to quarrel with the definition of capital by Chapman as "wealth available for future use," that "all wealth is capital," and that classification into wealth intended for consumption and that used for the production of other wealth "leads to confusion." On the contrary, much clearness in financial conceptions is secured by recognizing capital as differing from product, and going still further into classification of current, fixed and specialized capital, which helps in the discussion of interest rates, making us realize why different classes of capital produce interest at different rates.

In subsequent passages, indeed, the difference is tacitly understood, and under costs in forest production not only capital account and current expense account, but, with much less need, crop expenses are separately grouped.

In neither book appears a clear distinction between subjective and objective cost values, that is between the actual investment value, which represents the actual (subjective) expenditure of whatever nature actually paid out in the acquirement of a property, or the cost (subjective) which was actually involved in creating it, as contrasted with the possibly very different expenditure (objective) which would be necessary to reproduce it. This lack of distinction as we will see later, leads to peculiar attitudes.

It would also be better usage to reserve *cost* value for value represented by cost of production, and distinguish it from *investment* value (see Roth, pp. 29 and 89).

In both books, the discussion on interest rates, which is perhaps the most troublesome subject in the whole field of forest finance, receives but scanty and unsatisfying attention. For instance, although Roth's section on *Interest* contains over four pages, it confines the discussion to actual usages in various lands and various business, but fails to analyze the reasons which produce the different interest rates, and then arbitrarily (on p. 55) proposes the adoption of 3 per cent for calculatory use because this rate is "used extensively in European works." The reasoning is not convincing. In discussing the interest actually made in European forest management he very properly calls attention to the fact, which we have repeatedly pointed out, that in the usual finance calculations of State administration the returns are not related to any original investment value, but are based upon a sale value not at any past time but the present. We disgree in thinking that "this high value is not a fictitious one, but a very real thing, and that these properties could readily be sold at these high prices." We believe, on the contrary, that the values are merely calculated, fictitious ones, and while the exploitable timber part could perhaps be sold, there would never be a ready market for the large areas of the young age classes: the prices are figured, but there is no market.

As Chapman correctly points out (p. 109), the method of recalculating the investment with a standardized interest rate also clouds the question of profitableness of the investment.

Chapman gives a much fuller and comprehensive discussion of the factors which influence interest rates, in a chapter of 13 pages. He leaves out, however, the practical considerations, applicable under American conditions particularly, of increment on stumpage price, which is a most potent influence on the interest rate. There are good reasons why wood prices should still rise in Europe, and still stronger reasons why they should rise with us, and by so much as they rise we can be satisfied with a lower interest rate on our investment, since the value of the investment is sure to increase without our effort and make up for the low rate. That the item of interest on borrowed capital is not paid from gross income and is "entirely a personal matter between the owner and his creditors" is a novel way of looking at banking business and misleading, for such loans are made on some sort of mortgage and not on personal notes.

That such important fundamental conceptions of forest finance as the soil rent and forest rent should, in Chapman's book, receive only incidental notice in the chapters on *Appraisal of Damages* and *Taxation*, is, to say the least, an unsatisfactory arrangement.

Better logical arrangement of matter is also in other respects to be wished. It is, indeed, dangerous to make any statement regarding matter in the book that might not in another part be modified. One would, for instance, in a chapter headed *Values,* expect to find the various values determined from different points of view at least cited, but we find in this chapter only sale value in juxtaposition to appraised value (as if sale value were not also an appraised value!).

Nor is Roth's volume quite free from faults in logical coordination. The chapter *Application of Valuation, e. g.,* starts with three subjects of general import which are not application but basic, namely, nature and value of the timber crop, risks in forestry, and a discussion on the interest rate, which with other basic matter should have been placed into a separate chapter. There is no good reason why discussion on stumpage values on pages 43 and 44 should be separated from the chapter on *Value of Stumpage* on page 89.

In Chapman's book, we feel constrained to point out some peculiar conceptions. In the discussion of the soil expectancy value, it is stated (pp. 94, 95) that this value "represents the value of all future income dating from a point just subsequent to the complete removal of a crop of timber. *It is the value of all future crops exclusive of the one occupying the ground.*" And farther on, it is intimated that this value is good only for one year.

This is an entirely novel way of looking at the soil expectancy value as a variable quantity deduced from an accidentally present crop; instead of being based on best possible crops—the ability of the soil to produce. The *condition* of a crop may be due to fire, insects, or any other extraneous cause, but that has no bearing on the soil value. The soil value is, however, properly variable according to the *kind* of crop, as for instance, the species used will give one soil value which another species could not produce.

Again, the unwillingness to accept the soil rent as a cost in bringing the timber crop to maturity "unless a different person owns the soil and rents it to the one who grows the trees" (p. 124), is a strange misconception of the whole basic fabric of finance calculation, which requires that every capital be charged with its appropriate interest. The soil may be considered worth nothing by the owner and, therefore, in his proprietary account he may leave out the charge, but this is not strict financial accounting and in appraisal of damage the other party will surely and properly insist on having made account of it.

The mere consideration that the owner of the soil could have used it for other purposes makes it clear that the soil rent is a cost against the timber. The trouble lies in mixing theory and practice, in failing to distinguish between financial methods and practical procedures. A financial method fits every contingency, but under practical conditions we may modify it, consciously deviating from its correct reasoning.

Whether the Government or anyone else is the owner makes no difference, there is a soil value and a soil rent, but under circumstances the one or the other party may waive consideration of this value.

The proposition to throw all objective values overboard and relying entirely on subjective ones, utilizing only actual costs and sale value, may lead in many damage cases to utter injustice, when, for instance, at present unsaleable properties are involved. The absurdity of this position appears, indeed, on page 127, when for the Government at least, it is suggested, recovery of damage is precluded because it did not pay anything for the land and was to no expense in producing the stand of trees.

This may be practical politics, but it is not finance.

A curious inconsistency might be pointed out in the discussion on taxation, when, on page 141, it is stated "such investments of capital (taxes) add nothing to the value of the property," and on page 144, by taxes "the entire level of values is raised." We take it "value" means something different in the two statements.

The main trouble in Chapman's book, which seems at the bottom of such misconceptions and the involved diction, is its original idea of reducing financial accounting to the bookkeeper's accounting. In no business is this customary or practical, and especially not in a business in which the time element is so prominent as in forestry, in which compound interest calculation is unavoidable, in which much of the product is unsaleable and becomes saleable only in time. The time sacrifice is a value or investment which the bookkeeper cannot take care of directly. All the way through there is an attempt to subordinate finance calculation to bookkeeping instead of the reverse.

Regarding the chapters on forest taxation in the two volumes a correspondent makes the following pertinent remarks in which we agree:

"The ignoring of the influence of the financial rotation has led to all kinds of wild confiscation paragraphs which prove nothing as to the fairness or unfairness of the annual property tax for forests as compared with other forms of property. It is easy to show that any property (not only forests) will be confiscated if it for any reason no longer furnishes a satisfactory income to meet taxes, *i. e.,* has passed the 'financial rotation' . . . The Loblolly pine in Chapman's example (p. 147) shows 40 years as the financial rotation, when it earns less than 5 per cent, so that the 2 per cent tax on sale value becomes confiscatory (absorbs more than 2/5 of net income). This tax confiscation becomes more pronounced as one gets farther beyond the financial rotation. This is no discrimination against forest investment, as a tax on any capital earning little or no income always becomes confiscatory and drives the owner to some effort to make it earn properly. . . .

"Roth states his problem even more unfairly (p. 113) . . .

"Forestry either does pay the current business rate of interest or it does not. If it does, it can pay the same annual tax as other property without any confiscation whatever. I favor the final tax on grounds of *expediency* not of *justice*. If forestry does not pay an acceptable interest rate to the private owner, but we still desire forests, then it is a matter for Government activity."

There are quite a number of other minor points on which discussion might be profitable, but it would extend this review too far. Both books are worth close study; both of them if used as textbooks, leave, however, ample scope to the teacher to enlarge and to explain; indeed, if the two were merged in one and the good points in either taken and the deficiencies corrected we would have an ideal volume.

Roth's volume brings incidentally a large amount of useful information regarding forest production, both in Europe and America. In the appendix there are several interesting helps to be found, namely, money yield tables for the German species, which are highly suggestive, and volume yield tables in curves to which in a novel way height and diameter curves are added so as to have the whole increment story in smallest compass handy for use in determining rotations and other problems.

Only one interest table, namely, for extension, is given, up to 10 per cent. Whether it is worth while to give this in decimals is open to question. The same space might have been more usefully employed to introduce the usual discount, capitalization and rent tables.

Chapman's book in this respect is better and also adds extensive logarithmic tables.

In the use of the formulæ, Roth gives the advice (p. 13, footnote) to write *1.op-1,* in order to recall the derivation of the expression. This seems gratuitous for it is just as easy and less cumbersome to see the derivation of $\frac{a}{.op} = C$, from $C : a = 100 : p$.

The index to the 55 formulæ developed by Chapman is useful, but we believe that there is much unnecessary formula work gone through in the volume.

Finally, we should mention approvingly the very desirable teaching apparatus furnished by Roth in the 37 problems for practice work. The execution of one or the other of these problems would render the book fit for self-study.

B. E. F.

Forest Legislation in America Prior to March 4, 1789. By J. P. Kinney. Bulletin 370, Agricultural Experiment Station, Cornell University. Ithaca, N. Y. 1916. Pp. 359-405.

This interesting study, compiled as a thesis for the degree of Master in Forestry, has, to be sure, only historical value. It tries to show that even before the formation of the Union attention was directed to "Conservation." The study is based on original sources, which are cited by titles filling three pages. The gist of the legislation is given under the name of each colony, and is divided into four sections, namely, legislation regarding forest fires; regarding conservation and the prevention of trespass; regarding control of forest industries; and regarding special developments, such as control of sand dunes, control of river driving, and cooperative forestry.

Most of the legislation one would hardly refer to as being inspired by the modern conservative thought, but it is rather dictated by property interests, although conservation ideas were not absent, as *e. g.,* when in the Plymouth colony, as early as 1626, no man was allowed to sell or transport any timber out of the colony without approval of governor and council, the inconvenience from lack of timber being given as a reason.

Later legislation regarding wood exports, except of manufactured materials might, however, be construed as merely a result of economic policy. Similarly, the Massachusetts law forbidding the cutting of White pine trees above 24 inch diameter was based on property considerations, such mast trees being reserved for the royal navy. But the restriction of a lowest diameter for fuelwood to six inches in the Albany market may perhaps have been true conservation policy.

The most interesting developments mentioned are the control of the Cape Cod sand dunes, which began as early as 1709 and continued to be an object of legislation by many successive acts until 1797, and the encouragement of cooperative forestry. The wisdom which lay behind the legislation of Massachusetts (1744) of permitting a number of woodlot owners to cooperate in managing their forest properties calls for re-enactment in our times. Also the re-establishment of communal or municipal forests, which were common in those early times, recommends itself.

We congratulate Mr. Kinney on having made such a good start for a history of forestry in the United States based on a systematic study of original sources.

B. E. F.

The Red Rot of Conifers. By F. H. Abbott. Bulletin No. 191, Vermont Agricultural Experiment Station. 1915. Pp. 20.

Trametes pini, the cause of red rot, a decay characterized by a darkening of the wood and the formation in it of white spots or "pockets," is one of the most destructive of the parasitic and wood-destroying fungi, and from this standpoint has been the subject of numerous investigations. Few conifers are immune to its depredations; of our eastern species tamarack is most susceptible, though closely followed by pine, hemlock, spruce and balsam. Its greatest ravages are in unthinned stands, especially pure stands of White pine, and infection occurs mainly through broken branches. The annual losses to timber owners in Vermont alone were estimated to be a quarter of a million dollars, so that the losses throughout America each year probably run into many millions. Prevention is best effected by proper thinnings, removing diseased trees and destroying the punks or fruiting bodies; though the practicability of the methods remains to be put to the test in forest areas in America. The lumber from diseased trunks is of very inferior quality, but is usable to some extent in box-making, cooperage, etc.

J. H. F.

Larch Mistletoe: Some Economic Considerations of Its Injurious Effects. By J. R. Weir. Bulletin No. 317, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 25.

Many of the conifers of North America are subject to attack from one or other of several species of dwarf mistletoes, slender, leafless, yellowish or brownish flowering plants, one to three inches in length, growing in small clumps on the stems and branches of their hosts. In the East the spruces not infrequently fall a prey to one of these pests; in the West, Lodgepole pine, Yellow pine, Jack pine, Western larch, Douglas fir, hemlock and other species suffer. In this bulletin, Dr. Weir presents the first of a series of economic studies on these parasites—*Arceuthobium laricis* on Western larch.

Infection is most abundant in thin, open, uneven, exposed stands, in some cases involving 80 to 90 per cent of the larch, and trees of all ages are susceptible. The effects produced are witches' brooms, burls, open wounds, through which destructive fungi may gain entrance, stunted growth, and often death. Lumber from diseased trees is inferior in amount and quality. Mistletoe may be controlled by inserting in all timber-sale contracts a clause requiring the cutting on the sales' area of all larches infected with mistletoe, whether merchantable or unmerchantable.

J. H. F.

The Development of the Vegetation of New York State. By Dr. William Bray. Technical Publication No. 3, the New York State College of Forestry at Syracuse University. Syracuse, N. Y. November, 1915. Pp. 186.

The object of the publication of the above title is to present the vegetation of the State of New York from the standpoint of its origin and development, and to set forth the factors, general and particular, which have differentiated it into its present aspects. The dynamics of plant life is the major motif of the bulletin. The present vegetation is used only to illustrate the adjustments to climatic conditions and the various stages in the developmental sequence. After devoting some twenty pages to an explanation of what vegetation is and how it works, the author passes to a consideration of its geological history from the Carboniferous period to the present, naturally stressing the profound influence of glaciation. This discussion covers about twenty pages. The consideration of the present zonal relationships of the present flora occupies around forty pages of the bulletin. Thus, about one-half of the bulletin is devoted to giving the reader an insight into causes, mostly climatic, which have fashioned the vegetation of the State in its present mould. Most of the remaining portion of the publication is concerned with filling in the details of the mosaic, that is, with the succession of vegetation, due to local factors, in the various habitats. This is included under two general headings: *The developmental sequence of vegetation upon a substratum having an excess of water, and the development of vegetation upon a substratum subject to prevailing water deficit.* The mean of these conditions, the prevailing one in the State, receives only about ten pages of generalized discussion. This disproportionate presentation is intentional on the part of the author, in order to emphasize the developmental nature of vegetation, and he clearly shows that succession in the two general habitats mentioned above leads to the establishment of mesophytic vegetation. One fears, however, that this method of presentation will leave the general reader with the impression that succession and developmental relations of vegetation come to a complete standstill in the climax type. As a matter of fact, vegetation is never stable. The dynamics in the climax type varies only in degree from that in the types lower down in the developmental scale.

All through the bulletin one is impressed with the importance of vegetation in increasing the water content of the dry situations and in ultimately decreasing the water content of wet situations, and in both, of increasing the fertility of the soil. The significance of this is brought to a head under the caption: *The status of New York vegetation under cultural conditions.* When one considers how large a percentage of the soil of the State is not at present producing anything of value, or at least a reasonable interest return, or worse, not in a position even to become really productive, he is impressed by the fact that the plant-producing capacity of the land has been grievously abused by the advance of man's dominion over it. The great problem in the State of New York, as in most other regions occupied by highly developed industrial peoples is to rectify this condition, or perhaps better, to educate public opinion so it will appreciate the economic losses which such a condition of affairs entails. Although the author does not mention it, the magnitude of the problem in this particular State is indicated by the fact that the people have several times exhibited their determination to let rot on the ground the interest accrued by the annual growth of the forest in the State forest reservation.

Several illustrations may be given to show the author's method of treatment of his subject. For example, under the topic: *Zonal relations of the New York flora,* he makes the following subdivisions: *Zone of Willow oak, Sweet gum and Persimmon,* in which the indicator species, besides those mentioned, are Shortleaf pine, Black-Jack oak, Laurel magnolia and Hop-tree. The growing period is from 190 to 200 days. This zone is confined to Staten Island, the southern portion of Long Island, and along the Sound contiguous to the Connecticut coast. *Zone of Dominance of Oaks, Hickories, Chestnut and Tulip tree,* in which there are eleven species of oak and six species of hickory, besides Black walnut, Butternut, Hackberry, Kentucky Coffee-tree, Honey locust, Sassafras, Red-bud and Flowering dogwood. The growing season is from 160 to 180 days. This zone occupies the Hudson valley and its adjacent highlands nearly as far north as Lake George, a belt along the southern shore of Lake Ontario, the Finger Lake valleys and the valleys of most of the southward draining streams. *Zone of Dominance of Sugar maple, Beech, Yellow birch, Hemlock and White pine,* a mixed forest, in which the frostless period is from 130 to 150 days. This is the climax type of the State, and it occupies the greater part of the area. The under vegetation of the forest also reaches its climax here. *Canadian-Transition Zone.* In general, the dominance is the same as in the zone above, but there is a tendency, especially at the higher elevations, towards the dominance of Red spruce, balsam, Paper birch and Mountain ash. It is further characterized by the usual absence of oak, hickory, elm, tulip and chestnut. The herbaceous forms of the Appalachian region begin to drop out and more northerly ranging species to come in. The growing period is from 100 to 130 days. The zone is found in the Catskills from about 2,000 feet to 3700 feet in elevation and in the Adirondacks up to 3500 feet, more or less. *Canadian Zone,* characterized by the dominance of Red spruce, balsam and Paper birch, and it is found in the Adirondacks between 3500 feet and tree line. *Arctic Flora of the Adirondack Peaks.* The distribution of these zones is displayed on a map of the State.

While this bulletin apparently belongs to a series of technical publications, from his conversational style, the elaborateness of his explanations and the reiteration of his point of view, it is evident that the author has a "popular" audience mostly in mind. As an educational medium one feels that the bulletin would have better served its purpose to have been issued in at least three distinct parts. It contains too much meat for the non-technical reader to digest and assimilate at one meal. Even in its present condition its educational value would have been enhanced by a conspicuous display of a summary of its contents. To the botanist and ecologist, however, the enthusiasm of the author is contagious and the bulletin is an inspiration.

C. D. H.

Timber Conditions in the Smoky River Valley and the Grand-Prairie Country. By J. A. Doucet. Bulletin 53, Dominion Forestry Branch. Ottawa, Canada. 1915. Pp. 55.

The area covered by this report lies mostly in the drainage basin of the Smoky River and its tributaries, whose waters flow into the Peace River in Alberta. The author's exploration extended over seven months and some 9500 square miles of territory were examined. About 8,000 square miles were found to be forest land and 1500 square miles prairie land, the latter being a southeastward extension of the Peace River prairie country in British Columbia. It appears that only about one third of the forest land is covered with forest. About 2.6 million acres, or more than half of the forest land, have been burned, most of it several times, in the past 30 years. Approximately, one third of the burned area is restocking in potentially commercial quantities. The rest of it is probably destroyed forever, from the standpoint of commercial forests, unless it is artificially restocked.

Virgin forest occupies a little more than one quarter of the actually forested area and about one twelfth of forest soil of the region. What there is of it, however, is in good condition, since it is estimated to contain approximately three billion feet of saw timber, around 7,000 feet per acre, besides three million cords of firewood. The forest is composed of spruce to the extent of 70 per cent of the stand, the remaining portion being pine and poplar. Stands from 50 to 100 years old occupy 28 per cent of the forested area. They are estimated to contain about three quarters of a billion feet of saw material and four and a quarter million cords of firewood. These stands are about one half pine and one third spruce. Pole-timber forest less than 50 years old occupies 735,000 acres, or 46 per cent of the forested area. In these stands poplar leads with 42 per cent, pine follows with 38 per cent, and spruce contributes only 10 per cent to the composition. This area is estimated to yield about 3.5 million cords of firewood.

This forest of the younger age classes probably had its origin from the results of burning, leaving only that classed as virgin, above 100 years old (8% of the area), as having escaped the ravages of fire in the past 100 years. The author estimates that on the tract examined 16,000 million feet of merchantable spruce and pine timber have been destroyed by fire in the past 30 years. The author says: "The results of repeated fires have been appalling. However, the comparative figures, and other considerations given under this title, are as nothing compared with the impression the eye-witness receives." The author recommends the placing of practically the entire area under forest reservation and he discusses plans for its protection from fire.

C. D. H.

Forest Protection in Canada, 1913-1914. By Clyde Leavitt. Commission of Conservation. Ottawa, Canada. 1915. Pp. 317.

In a very attractively prepared and well illustrated volume, the second report of the Forester for the Commission of Conservation has been issued, covering the years 1913 and 1914. This report, which is partly the work of Dr. C. D. Howe and Mr. J. H. White, and to which several others have contributed, is divided into six parts.

Part I deals with the work of administering General Order Number 107, of the Board of Railway Commissioners for Canada. This Order places upon the railways under the jurisdiction of the Board—about 85 per cent of the railway mileage of Canada—the responsibility for safeguarding lands adjacent to their rights of way from fire damage caused by railway operation, the manner of safeguarding being left to the Chief Fire Inspector, who is at the same time Forester of the Commission, to prescribe. This work was first organized in the Western Provinces in 1912, and the present report deals with the continuation of the work as first organized, the improvements that have been made as a result of experience, and the extension of the work to the Eastern Provinces. In the East, arrangements were perfected for handling the inspection of patrols in Ontario, Quebec and New Brunswick. All inspection for the Board is by officials of the Dominion or the Provincial Government Departments interested, acting as cooperators with the Board of Railway Commissioners at their own expense. The fire protection work itself is done entirely by the railway companies, with their own staffs and at their own expense, and the report points out that its efficiency is directly dependent upon the efficiency and sufficiency of the inspection staff provided by the railways and on the development by them of a special organization to handle protection work. Through such a policy the Canadian Northern

Railway and the Canadian Pacific Railway have been much more successful and worked much more harmoniously with the representatives of the Board than have some of the other lines.

Interesting features of this portion of the report are a sample letter of instructions in full to a large railway corporation specifying the patrols that are to be established, their equipment, etc., and a discussion of the velocipede versus the power speeder as a means of track patrol.

The summary of fires reported in 1913 shows 709, of which 365 were known to be caused by the trains and 131 reported as cause unknown. The rest were due to miscellaneous causes or the cause is not reported. Total damage outside the 600-foot strip is placed at $40,587. In 1914, 1346 fires occurred; 904 caused by railways; 227 cause unknown; the rest due to miscellaneous causes classified in the report. The damage outside the protection strip is placed at $433,442.

Part II contains the reports of the Committee on Forests of the Commission of Conservation for 1913 and 1914. These outline the progress of the investigative work undertaken by the Commission, the most important of which is the inventory of Canadian forest resources which the Commission has undertaken to make. Both reports repeat the recommendation made previously, that the officers of the Dominion Forestry Branch be placed under the Civil Service Commission.

Part III is devoted to a discussion of brush disposal. It is entirely made up of reports on the status of brush disposal in the various provinces by forest officials and by extracts from State Foresters reports, or special articles on the situation in various states near the international boundary. On the whole, brush disposal has not progressed far in Canada. The Dominion Forestry Branch leads in its work on some of the Forest Reserves, but here the natural and economic conditions are unusually favorable. British Columbia has done some good work along this line under adverse conditions. In the rest of Canada, practically nothing is done to remove this menace.

Parts IV and V are by Dr. C. D. Howe. The first is a discussion of The Effect of Repeated Forest Fires upon the Reproduction of Commercial Species in Peterborough County, Ontario. It is a record of a detailed examination made on some

85,000 acres in a typical section of old logged-over lands in Ontario, where through lack of any kind of protective measures, fires have been allowed to run practically at will for years. The investigator finds that the number of fires in the area has increased 300 per cent in eight years. The entire cut-over area of pine lands, amounting to 70,000 acres of the 85,000 acres in the tract, has been severely burned at least once since lumbering, and some portions as many as eight times. The result naturally is the practical elimination of the valuable species and in some cases the creation of useless rock barrens bare of all trees. Some 12 per cent of the area is in this latter condition. It is interesting to recall, as giving point to the author's contentions, that between the first examination in 1912 of a larger area, the Trent Watershed, of which this smaller area forms a part, and the survey made by the author in 1913, some 20 per cent of the larger area was fire swept. If, as there is every reason to think, the area examined by the author is typical of the logged-off lands of the Province, the conditions revealed contain little to encourage any hope of future yields of timber from the second growth forests of Ontario. The total disregard, or rather the blank ignorance, of responsible officials who should be fully seized of the conditions existing on the cut-over forest lands of the Province, constitutes a most serious situation in a province so largely composed of lands fit only for timber production.

The second report by Dr. Howe concerns the national reproduction of Douglas fir in British Columbia. The author concludes that adequate natural reproduction can be assured by regulated broadcast burning of logging slash.

Part VI is by Mr. J. H. White. It is a general survey of the status of "Forestry on Dominion Lands in the Four Western Provinces." The forest conditions in the various provinces are discussed, together with the fire protection, methods of administering timberlands and disposing of timber. In doing this, the author has necessarily explained the origin and relationship of the three forest administering agencies of the Department of the Interior, a relationship which is—perhaps, with reason—often a source of confusion to those not familiar with the situation.

There is one suggestion we would make in regard to this report. There are three principal phases to the fire protection situation in Canada. These are railway fire protection, of which we have a great deal; brush disposal, of which we have not very much, and forest protection, for which we spend well over $1,000,000 per annum without knowing whether we get anything or not. We think that a report of this magnitude entitled "Forest Protection in Canada," should tell us something about this important phase of the subject.

W. N. M.

Report of the Director of Forestry for the Fiscal Year Ending March 31, 1915. By R. H. Campbell. Part VI of the Annual Report of the Department of the Interior. Ottawa, Canada. 1915. Pp. 102.

This annual report is now available as a separate, reprinted from the Departmental report. It follows the same general lines as previous ones, being made up of a general survey of conditions during the year by the Director, with separate reports by each of the officers in charge of the four inspection districts, the Chief of the Tree Planting Division and the Superintendent of the Forest Products Laboratories. No additions to the forest reserve area are reported, although large areas of land in the northern Forest Belt have been examined and those found unfit for agricultural development have been temporarily reserved. Attention is directed to the enormous areas in this region that have been fire swept in comparatively recent years and to the minute proportion of the region that now bears merchantable timber. The report emphasizes the extreme danger of complete and almost irremediable denudation that will result from the burning of these young stands of reproduction which have mostly not yet reached seed-bearing age. It rightly considers this one of the most important problems in forest protection before the Forestry Branch.

The fire situation during 1914 was extremely dangerous, especially in Alberta and British Columbia. In all, 1986 fires were reported, of which 408 were on the Forest Reserves and 1578 outside the Reserves. The area burned over was 691,000 acres and the timber destroyed amounted to 508 million feet b.m. As this shows an average stand of only 730 feet per acre, it is some indication of the lightness of the stands in these forests, since it is known that fires in the region generally cause the death of all the timber within the area covered by them. The Forestry Branch on the Reserves probably receives the most complete and detailed reports of the actual fire situation each year secured by any agency in Canada, and their reports of present conditions on protected areas, considered in connection with the facts as to past destruction revealed by its forest surveys, should be carefully studied by those interested in securing efficient protection of Canada's remaining timber resources. One disquieting feature of these reports is the large percentage of fires that attain a considerable size. Nearly 50 per cent of the fires on the Reserves attained a large size, indicating that the fire protection has not been developed to a state of efficiency that is essential. The inspectors who comment on this rather obvious situation attribute it to lack of permanent improvements, and in some cases, to faulty personnel and lack of training.

The distribution of trees for prairie planting shows a slight increase. The total for the year was over 3,800,000 trees distributed. A new nursery was established near Saskatoon, to take care of the distribution to the more northern sections.

The Forest Products Laboratories reports considerable progress in organization and also in the starting of several important investigations. Much of the year was taken up in getting together the necessary equipment and staff, especially in the pulp and paper division. As in other divisions of the Forestry Branch, the war has affected the work of the Laboratories through reductions in staff. This influence has been especially important in the clerical and technical staff of the Laboratories and in many instances has greatly handicapped the prosecution of established lines of work and prevented the undertaking of new work almost entirely. W. N. M.

Report of the Forest Branch of the Department of Lands, Province of British Columbia, for the Year Ending December 31, 1915. Victoria, B. C. 1916. Pp. 56.

This report is divided into eight sections: Market Extension, Lumber Industry, Forest Records, Land Classification, Forest Reconnaissance, Forest Branch Organization, Forest Protection, Permanent Improvements.

The first section refers to the activity of the Forest Branch in extending the use of British Columbia wood products, to which we shall refer under *Comment*. It contains brief references to the experiences of the Chief Forester in his mission in search of markets. He found in London that the United States' timber brokers controlled entirely the Pacific Coast lumber trade, but succeeded in arousing patriotic interest to send at once orders for several cargoes worth over $200,000, through the Forest Branch to British Columbia. He expresses expectation that after the war Holland will handle much of the European import market of Douglas fir in competition with Longleaf pine. Similar competition is suggested for South Africa, if regular means of transportation can be established. Some 20 wood exhibits were established at as many industrial centers in various parts of the world.

This work shows a considerable amount of initiative and is to be highly recommended.

Statements as to lumber and other wood production places the total output for 1914 at 1152 million feet b.m., a total slightly more than Ontario and Quebec data. Elaborate tables, by districts and species, are given for the production of 1915, which totals 1018 million feet b.m., 42 per cent of which is Douglas fir and 35 per cent Red cedar, the balance divided among 10 other species. An estimate of the value of the output for 1915 places it at $29,150,000. On timber sales, in which less than 100,000 M feet were involved, the stumpage price of the two leading species were 95 cents and $1.05 respectively. Almost the entire cut must be exported as no large wood-working industries are developed.

Under Forest Records, the financial statements are included, which show that the war has a considerable influence on collection of dues, the $1,923,000 revenue being $120,000 below the previous year and more than one million dollars below 1913. The expenditures for the Forest Branch were almost $500,000, of which $166,000 for protection and $207,000 for general administrative expenditure. The outlay for protection, toward which the licensees contribute, was for 1914-15 $403,200, for 1915-16 fire season only, $182,000.

Absolute forest land or land bearing the statutory amount of timber, i.e. 5,000 feet per acre east of the Cascade Mountains, and 8,000 feet west, is being reserved from disposal. In the past two years, 1,628,541 acres have been so reserved. In this connection, a land classification is carried on, which during 1914 could be done at 4.5 cents per acre, or 1 cent per M feet b.m.

The Forest Branch is engaged in cooperation with the Commission of Conservation in making a survey of the forest resources of the Province, and in this connection carries on forest reconnaissances. From these, it has already become evident that previous estimates have been too low, albeit many large bodies of good timber found are for a long time going to be inaccessible. A classification into timber of varying degree of stocking, scrub timber, barrens, burn not yet restocking, burn with good reproduction, undrainable swamps, muskeg, mountains above timberline, areas suitable for grazing, etc., is made.

The staff of the Branch during 1915 was very considerably reduced, from 558 to 378, largely through enlistment, and mostly from the temporary force, which was reduced from 391 to 218; there were, however, 10 technical men among the enlisted, which undoubtedly crippled the force considerably, representing about one third of this staff.

The largest amount of space, 16 pages, is devoted to the discussion of Forest Protection. It starts with an account of weather conditions. A fire season of unprecedented severity was experienced on the Lower Coast and Vancouver Island, due to lack of rainfall (half the normal) and high temperatures, fortunately with absence of winds. (It has been noticed that with temperature under 70° fires are generally not dangerous, unless accompanied by high winds.) Nevertheless, a smaller area than the previous year was burned, 244,000 against 355,000 acres, but the damage was greater, being estimated at 187,900,000 feet and $108,873, as against 118,600,000 feet and $72,000 the previous year.

Cooperation with the United States Forest Service is organized at the boundary, also cooperation with the Board of Railway

Commissioners, with the Dominion Forestry Branch, and with a number of lumber companies and timber limit holders. All the usual means, including moving picture shows, are used to educate the public. It seems that campers' and travellers' fires are now the most frequent cause, with 30 per cent, next to it brush-burning, with 26 per cent, while railway fires are reduced to less than 10 per cent, a similar per cent being credited to lightning. Less than half the expenditure of the previous year was made, namely $176,881, of which $19,449 for fire fighting, reducing the cost per fire to $61 as against $219 the previous year; but a larger percentage of fires was left to take care of itself. A gratifying statement is to the effect, that "notwithstanding adverse financial conditions, considerable areas of logging slash were disposed of by logging operators on their own initiative." No damage resulted from these burnings, and operators are so well satisfied that each year will see more of it. Unfortunately, no statements of cost are made.

The whole report from beginning to end breathes a business air which is a credit to the Forest Branch.

B. E. F.

Meddelanden från Statens Skogsförsöksanstalt. Haeftet 12, 1915. Stockholm. 1916. Pp. 161 + xxviii.

As usual, this volume is full of interest from the organization point of view, being a report on the activities of the Swedish Experiment Station for the period 1912-14, and containing the working plan for the following triennial period, the custom of a working period of three years being continued.

In gratifying manner, most of the longer discussions are briefed in German, and, now, in addition, some are briefed in English at the end of the volume.

The Station is divided in two sections, the natural history section and the forestry section, Dr. Hesselman being chief of the former, Gunnar Schotte of the latter. Considering that the whole establishment is allotted less than $12,000, its product is certainly admirable in quantity and quality.

The forestry section studies the increment of different forest types on (by the end of 1914) 42 sample areas; it conducted thinning experiments on 211 plots; experiments with exotics on 65 areas; cultivation of heath soils on 62 areas; seed investigations on 550 areas; natural regeneration studies on 34; plantings of different spacing on 42; sowings at different dates on 18; cultivation of drained peat soils on 25; and methods of culture on 12; altogether 1061 experimental areas are involved in these investigations.

The natural history section concerned itself with studying the influence of thinnings on soil flora; the factors influencing natural regeneration; the influence of light burning and clear cutting on the soil; the change to swampy conditions in various localities; the muskeg, peat soil and heather problems, and soil studies generally; the influences of races of forest trees; diseases; biology of seed germination; etc.

For the following period, 1915-17, entomological studies are to be added, an article on enemies of pine and spruce, by Ivar Trägårdh, being briefed in English. Special accentuation is placed on the program as regards regeneration methods for the northern forest areas (Norrland), where both government and private owners desire more extensive utilization, but are also willing to spend more for regeneration.

The question whether the old trees of the virgin forest furnish satisfactory seed is the first to be attacked; also the value of influence of draining; the relative efficiency of various soil work; different planting methods; the seed from other localities; these are problems proposed to be solved during a period of 15 years at a cost estimated at $65,000 distributed over that period.

B. E. F.

By-products of the Lumber Industry. By H. K. Benson. Special Agents Series 110, U. S. Bureau of Foreign and Domestic Commerce. Department of Commerce. Washington, D. C. 1916. Pp. 68.

This report comprises a brief survey of utilization of forest by-products in the United States preliminary to a more extensive investigation. The meaning of the term "by-product" is restricted to "such products as require the use of technical and more or less highly developed manufacturing processes for their production." The scope of the investigation was accordingly limited to a survey of the industries engaged in the distillation of wood, the manufacture of tannin extract, wood pulp, ethyl alcohol, producer gas, and various minor wood products. The report includes diagrams of apparatus, production costs and yields, statistics of production, future prospects of the industry, and in some instances names and addresses of principal manufacturers. It contains little that is new and bears earmarks of being more of a compilation than a report based upon first-hand information collected by the writer.

S. J. R.

Structural Timber in the United States. By H. S. Betts and W. B. Greeley. Paper Presented at the Meeting of the International Engineering Congress in San Francisco, Cal., Sept. 20-25, 1915. Pp. 50.

This paper gives a survey of the timber resources of the United States with special reference to structural uses. The important species are discussed from the engineer's standpoint, and a summary is given of the data obtained by the U. S. Forest Service on their mechanical properties and factors affecting them, and the methods of timber testing employed at the Madison Laboratory. Attention is also directed to grading rules and commercial specifications and suggestions made for their improvement. In an appendix are tables giving the number of sawmills and amount of lumber sawed annually, the amount of wood consumed by the principal wood-using industries, average strength values of various structural timbers, and nomenclature and characteristics of the Southern pines.

S. J. R.

Eighth Report of the State Forester of Connecticut for the Year 1915. By W. O. Filley. Part III Annual Report of the Connecticut Agricultural Experiment Station. New Haven, Conn. 1916. Pp. 193-232.

The bulk of this report is devoted to "A Forest Survey of

Connecticut," by Albert E. Moss, Assistant Forester. U. S. Geological Survey maps were used as a base, and by means of an automobile every road was traversed and the boundaries of the woodland sketched in. An odometer was used to check distances between points on the road map, while distances to the woodland boundaries were estimated by eye. In this manner every woodland tract was completely circled and the boundaries noted. These areas were then colored on the map, the two types distinguished being hardwoods and conifers.

It was computed from the map that 1,482,700 acres or 46.4 per cent of the land area of the State is wooded. The largest areas of woodland are in the northwest corner, the northeast quarter, and along the Connecticut River near its mouth, extending some distance to the west.

The following table summarizes the forest areas by counties, with the water area eliminated. The forest areas include not only land which is growing merchantable wood and timber, but also pasture land and old fields with sufficient growth to indicate that it is reverting to forest.

County	*Total Area Acres*	*Forest Area Acres*	*Per Cent Forest*
Fairfield	417,118	127,600	31
Hartford	472,154	192,750	41
Litchfield	611,184	308,550	50
Middlesex	249,377	132,300	53
New Haven	389,853	178,000	46
New London	451,676	217,700	48
Tolland	272,577	152,850	56
Windham	330,506	173,550	53
	3,194,445	1,483,300	47.2

S. J. R.

The Black Poplars. By A. Henry. Reprint from the Transactions of the Royal Scottish Arboricultural Society, Volume 30, Part I. Edinburgh. January, 1916. Pp. 14.

No group of trees is more obscure than the cultivated species of Populus; besides the natural species and varieties there are many sports and hybrids. In the present article Prof. Henry deals with the many forms of the European *Populus nigra* and the North American *P. deltoidea.*

The glabrous form of the European Black poplar (*P. nigra* var. *typica*) is confined to southern and southeastern Europe and is rarely cultivated in Great Britain. Its fastigiate form, the Lombardy poplar, (var. *italica*) is a well known tree, and is probably of sport origin. As is known, most Lombardy poplars are staminate, but Henry instances a pistillate tree at Kew. He considers the pistillate trees reported in Germany to be of hybrid origin.

The other variety, *P. nigra* var. *betulifolia,* differs from the typical form in the presence of dense short pubescence on the twigs. It is native to France and southern England, and has been slightly introduced on this continent. The corresponding fastigiate form of the pubescent variety is known as var. *plantierensis.*

The North American Black poplar differs from the European in the shape of its leaf, its ciliated margin and the presence of glands on the base of the blade in front, as well as by floral characters. Henry distinguishes three geographical varieties—var. *monilifera* of the northeast, var. *occidentalis* of the western plains, and var. *missouriensis* of the southeast.

The Black poplars cultivated for timber in England, France and Belgium are almost invariably of hybrid origin between the above American and European forms. These are chosen largely on account of their exceptional vigor. Eight of the principal hybrids are discussed, with distinguishing botanical characters, elucidation of their origin, and very interesting figures of size and rate of growth. He instances one 150 feet in height and over 8 feet d.b.h. at 81 years.

Until lately all the hybrids in cultivation had originated as chance seedlings. But the artificial production of fast-growing hybrids is now receiving attention. We have already noted Prof. Henry's own experiments in this direction in FORESTRY QUARTERLY, vol. XIII, p. 97.

The article concludes with a key to the above mentioned poplars reproduced from *The Trees of Great Britain and Ireland,* with two plates. This is very useful, as this expensive set is not widely available.

J. H. W.

OTHER CURRENT LITERATURE

The Spruce and Balsam Fir Trees of the Rocky Mountain Region. By G. B. Sudworth. Bulletin 327, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 43. Maps 10.

Fire Protection in District 1. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1915. Pp. 117.

National Forest Areas, January 1, 1916. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 7.

Tree Distribution under the Kinkaid Act, 1911. 1st Revision. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 13.

The Wood-Using Industries of Indiana. Compiled by J. C. Nellis. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 37.

Forest Conservation for States in the Southern Pine Region. By J. G. Peters. Bulletin 364, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 14.

Termites, or "White Ants," in the United States: Their Damage and Methods of Prevention. By T. E. Snyder. Bulletin 333, U. S. Department of Agriculture. Contribution from the Bureau of Entomology. Washington, D. C. 1916. Pp. 32.

Pecan Culture: With Special Reference to Propagation and Varieties. By C. A. Reed. Farmers' Bulletin 700, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 32.

The Leopard Moth: A Dangerous Imported Insect Enemy of Shade Trees. By L. O. Howard and F. H. Chittenden. Farmers' Bulletin 708, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 12.

The Care and Improvement of the Wood Lot. By C. R. Tillotson. Farmers' Bulletin 711, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 24.

Oviposition of Megastigmus Spermotrophus in the Seed of Douglas Fir. By J. M. Miller. Reprint from Journal of Agricultural Research. U. S. Department of Agriculture. Washington, D. C. April 10, 1916. Pp. 65-8.

Laws, Decisions, and Opinions Applicable to the National Forest. Revised and Compiled by R. F. Feagans. U. S. Department of Agriculture. Office of the Solicitor. Washington, D. C. 1916. Pp. 151.

Australasian Markets for American Lumber. By F. H. Smith. Special Agents Series 109, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce. Washington, D. C. 1915. Pp. 48.

Ground Water in the Waterbury Area, Connecticut. By A. J. Ellis. Water-Supply Paper 397, U. S. Geological Survey. Washington, D. C. 1916. Pp. 71.

Glimpses of Our National Parks. U. S. Department of the Interior. Washington, D. C. 1916. Pp. 37.

New or Noteworthy Plants from Colombia and Central America. By H. Pittier. Contributions from the United States National Herbarium, Volume 18, Part 4. Washington, D. C. 1916. Pp. 143-71.

Proceedings of the National Park Conference, . . . 1915. Washington, D. C. 1915. Pp. 166.

Chelan National Forest, Washington; Ozark National Forest, Arkansas; Bandelier National Monument, New Mexico; Natural Bridges National Monument, Utah. Proclamations by the President of the United States. Washington, D. C. 1916. Pp. 2, .., .., 1 leaf and diagram.

Proceedings of the Society of American Foresters. Volume XI, No. 1. Washington, D. C. January, 1916. Pp. 1-170.

Contains: Forest Service Silviculture Plans, by T. S. Woolsey, Jr.; The Utilization of a Tropical Forest, by G. P. Ahern; Notes on Forest Cover and Snow Retention on the East Slope of the Front Range in Colorado, by N. deW. Betts; Chemistry as an Aid in the Identification of Species, by A. W. Schorger; Foresters Have a Vital Interest in the White Pine Blister Rust, by P. Spaulding; The American Forester: His Opportunities, by C. DuBois; Professional Ethics, by B. E. Fernow; The American Forester: What the Society Has Done and Can Do for Him, by D. T. Mason; The Forester's Duty toward Lumbering, by G. M. Cornwall; The Place of Logging Engineering in Forestry, by J. F. Clark; The Lumberman's Duty Toward Forestry, by F. E. Olmsted; Scientific Notes and Comments; Reviews.

Fourth Annual Report of the Kennebec Valley Protective Association. Bingham, Me. 1916.

A Manual for the Use of Lumbermen, Woodsmen and Sportsmen. Published by the Kennebec Valley Protective Association. Bingham, Me. 1916. Pp. 32.

Seventh Annual Report of the State Forester of Vermont, 1915. St. Albans, Vt. Pp. 55.

First Annual Report of Vermont Timberland Owners' Association. Bloomfield, Vt. 1915. Pp. 6.

Twelfth Annual Report of the State Forester of Massachusetts, 1915. Boston, Mass. 1916. Pp. 130.

Eighteenth Annual Report of the Massachusetts Forestry Association. Bulletin 117. Boston, Mass. 1915. Pp. 41.

Tenth Annual Report of the Commissioner of Forestry of the State of Rhode Island, 1915. By J. B. Mowry. Providence, R. I. 1916. Pp. 18.

Forest Planting. By J. B. Mowry. Leaflet 2, State of Rhode Island. Providence, R. I. 1916. Pp. 4.

Fifteenth Report of the State Entomologist of Connecticut for the Year 1915. By W. E. Britton. Part II of the Annual Report of the Connecticut Agricultural Experiment Station. New Haven, Conn. 1916. Pp. 81-192.

Woodlot Conditions in Dutchess County, New York. By F. B. Moody and J. Bentley, Jr. Bulletin 368, Cornell Agricultural Experiment Station. Ithaca, N. Y. 1915. Pp. 302.

State Forest Camp in the Adirondacks. Bulletin of the New York State College of Forestry at Syracuse University. Vol. XV, No. 8. Syracuse, N. Y. March, 1915. Pp. 16.

I. A New Species of Pityogenes. By J. M. Swaine. *II. Observations on the Life History and Habits of Pityogenes hopkinsi Swaine.* By M. W. Blackman. Technical Publications No. 2 of the New York State College of Forestry at Syracuse University. Syracuse, N. Y. Volume XVI, No. 1. November, 1915. Pp. 66.

Logging to a Fixed Diameter Limit in the Adirondack Forests. By H. P. Baker. Address before The Empire State Forest Products Association at Its Annual Meeting in December, 1915. Separate. Pp. 16.

Lidgerwood "1913" Overhead Skidder. Bulletin 54, Lidgerwood Manufacturing Company. New York, N. Y. Pp. 9.

Lidgerwood Portable High Spar Skidders for Overhead Skidding. Bulletin 55, Lidgerwood Manufacturing Company. New York, N. Y. 1915. Pp. 15.

American-Hill Steam Niggers, Kickers, Log Stops and Other Log Deck Machinery. Bulletin H-1, American Sawmill Machinery Company. Hackettstown, N. J. Pp. 16.

Report of the Maryland State Board of Forestry for 1914 and 1915. Baltimore, Md. 1916. Pp. 77.

Qualities and Uses of the Woods of Ohio. By W. R. Lazenby. Bulletin 6 (Volume II, No. 2), Ohio Biological Survey. The Ohio State University. Columbus, Ohio. 1916. Pp. 75-111.

Fifteenth Annual Report of the State Board of Forestry of Indiana. Indianapolis, Inda. 1915. Pp. 168.

Indiana Centennial Patriotic Arbor and Bird Day Manual. Indiana State Board of Forestry. Indianapolis, Inda. 1916. Pp. 52.

Timber Preserving Machinery. Bulletin 1439-A, Allis-Chalmers Manufacturing Company. Milwaukee, Wis. 1915.

Manual for Timber Reconnaissance, 1914. U. S. Forest District 1, F. A. Silcox, District Forester. Missoula, Mont. 1915. Pp. 63.

Tenth Annual Report of the Coeur d'Alene Timber Protective Association, 1915. Coeur d'Alene, Idaho. 1916. Pp. 16.

Annual Report of the Potlatch Timber Protective Association, 1915. Potlatch, Idaho. 1916. Pp. 20.

Walnut Culture in Arizona. By J. J. Thornber. Bulletin 76, Agricultural Experiment Station, University of Arizona. Tucson, Ariz.

The Cost of Growing Timber in the Pacific Northwest, as Related to the Interest Rates Available to Various Forest Owners. By B. P. Kirkland. Reprint from the Forest Club Annual, University of Washington. Seattle, Wash. 1915. Pp. 23.

California Redwood. California Redwood Association. San Francisco, Cal. 1916. Pp. 30.

Alabama Bird Day Book, 1916. Alabama Department of Game and Fish. Montgomery, Ala. 1916. Pp. 96.

Report of Committee on Forestry, 1914-15. Hawaiian Sugar Planters' Association. Honolulu, Hawaii. 1915. Pp. 22.

Report of the Commissioner of Dominion Parks for the Fiscal Year Ending March 31, 1915. Part V of the Annual Report of the Department of the Interior. Ottawa, Canada. 1915. Pp. 70.

Forest Products of Canada, 1914: Lumber, Lath and Shingles. Compiled by R. G. Lewis, assisted by W. G. H. Boyce. Bulletin 56, Dominion Forestry Branch. Ottawa, Canada. 1916. Pp. 62.

British Columbia Douglas Fir Dimension. Timber Series, Forest Branch. Victoria, B. C. 1916. Pp. 15.

British Columbia Western Larch. Bulletin 16, Timber Series, Forest Branch. Victoria, B. C. 1916. Pp. 16.

British Columbia Western Soft Pine. Bulletin 17, Timber Series. Forest Branch. Victoria, B. C. 1916. Pp. 15.

British Columbia Red Cedar Shingles. Bulletin 18, Timber Series. Forest Branch. Victoria, B. C. 1916. Pp. 3.

Proceedings of the British Columbia Forest Club, 1915. Victoria, B. C. 1915. Pp. 74.

Report of the Department of Forestry, New South Wales, for the Year Ended 30 June, 1915. Sydney, N.S.W. 1916. Pp. 12.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Volume III, Part 4 (Part XXIV of the Complete Work). Published by the Government of the State of New South Wales. Sydney, N.S.W. 1915. Pp. 63-79; pls. 100-3.

Report on the Forest Administration in Burma for the Year 1914-15. Rangoon, Burma. 1916. Pp. 109.

Annual Administration Report of the Forest Department of the Madras Presidency for the Year 1914-15. Government Press. Madras, India. 1915.

Rubber Manuring Experiments at the Experiment Station, Peradeniya. By M. K. Bamber. Bulletin 18, Ceylon Department of Agriculture. Colombo, Ceylon. 1915. Pp. 12.

Physiological Effects Produced on Hevea braziliensis by Various Tapping Systems. By L. E. Campbell. Bulletin 19, Ceylon Department of Agriculture. Colombo, Ceylon. 1915. Pp. 27.

Henaratgoda Experiments: The Effect of Different Intervals between Successive Tappings of Hevea brasiliensis. By T. Petch. Bulletin 20, Ceylon Department of Agriculture. Colombo, Ceylon. 1915. Pp. 26.

Moornutzung und Torfverwertung. Von Paul Hoering. Julius Springer. Berlin. 1913. Pp. 683. Mk. 12.

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PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

Timber of Russia

M. Tkatchenko, of the Russian Forest Department, had a paper under this title before the International Engineering Congress in San Francisco. In FORESTRY QUARTERLY, vol. xiii, p. 402, we had briefed the last official statement regarding Russia's forest resources quite fully, and will note here only such additions as appear in the advance copy of the above mentioned paper (24 pages).

The statistics do not always gibe, which may often be due to differences in translating measures and to the uncertainty of all Russian statistics.

As to area, the present author's statements are slightly (16 million acres) lower than the official ones. The forest per cent over the whole European and Asiatic territory is 37, and 8 acres per capita. In Finland, the forest per cent is 45. The distribution is very uneven, from 50 to 82 per cent in the northern, falling to 1-1.5 per cent in the Steppe country.

Ownership statistics also vary considerably. In Asiatic Russia, the national forests in the official statement are given as 253 million acres, or 75 per cent, in Tkatchenko's statement 772 million, or 90 per cent.

The description of forest conditions is divided into four sections, namely the forests of the northern country, those of other provinces of European Russia, those of the Caucasus, and those of Asiatic Russia. Under each heading, the distribution of species, mechanical properties and commercial uses, methods of lumbering, and management and yield are touched upon.

The best yields in the North country of the two principal species are stated as follows for best soils:

	Age	*Height Feet*	*Diameter Inches*	*Volume per Acre Cubic Feet*
Scotch pine........................	100	88	12	7075
Spruce...........................	100	90	12	7650

In the northern forests spruce at 200 years, commonly with 14 inch diameter, cuts 5300 feet, while the largest trees reach 121 feet in height and 38 inch diameter. Larch-pine-spruce forest on clay soil in 160 years cuts 6500 cubic feet per acre.

In addition to the above species, *Pinus cembra* and *Abies sibirica* are discussed.

The logging is done mostly for logs alone, in selection fashion, the standard log being 23⅓ feet in length and 8¾ inches in diameter at top. Lately, the strip method has been employed and pulpwood secured as well. Stumpage prices for Scotch pine is from 2 to 5 cents, for spruce from 1 to 3½ cents per cubic foot (say from $1.25 to $6 per M feet b.m.). River driving and rafting is the usual means of transportation. In 1912, the allowable cut in the northern national forests was set at 942,480,000 cubic feet, the actual cut was only 40 per cent of this.

Since the pine and spruce grows naturally in even-aged stands, the diameter limit cutting leads to devastation and the supposition that after the first selection, a rotation of 60 to 80 years would suffice has not been realized; 140 to 160 years is stated as proper rotation.

In the other provinces of European Russia to the south of a line from Petrograd to Ufa, conifers still predominate, but broadleaf trees are admixed or occur in pure stands. Oak, in 220 years, with a diameter of 30 inch and height of 120 feet, often yields 6500 cubic feet per acre. Fraxinus and Tilia also abound. Yield statements for this region are unfortunately omitted.

Stumpage prices in this region vary much from province to province, the lowest prices even for oak and pine being 1 cent per cubic foot, and for spruce even ¾ cent; on the other hand the highest prices are 11 cents for spruce, 13 cents for pine and 24 cents for oak; these prices for coniferous wood resemble our own White pine stumpage prices.

In these forests, more intensive management is possible; rotations usually are 120 years for pine, 100 years for spruce, 160 years for oak and 60 years for oak coppice. In most national forests a strip clear-cutting system for all three species is followed, the width of the strip being 140 to 210 feet; for other hardwoods than oak 350 feet; sometimes for pine 10 seed trees are left on the strip; or for spruce and oak, under favorable economic conditions, planting is taken recourse to.

Here about 81 per cent of the permissible cut was actually realized in 1912.

The forests of the Caucasus are rich in species (*see* F. Q., viii, p. 494, and xii, p. 100). Among the 100 real timber species, six conifers appear, coniferous forest occupying one quarter of the forest area. Among the hardwoods, Black walnut, beech, chestnut and 11 species of maple are enumerated. Spruce and pine, of which latter there are six species, grow up to 7,000 and 8,000 foot elevation. The Black Sea coast forest is said to resemble in luxuriance of development the Pacific Coast forest. Similar luxuriance is found on the west coast of the Caspian Sea, where *Buxus sempervirens, Parrotia persica, Quercus castanifolia* are holding sway. Sixty per cent of the forest is, however, made up of beech, oak, and hornbeam.

The production varies with species from 5,000 cubic feet (oak at 120 years) to 8,000 feet (pine at 120 and beech at 200 years), 12,000 feet for spruce and 16,000 feet per acre for fir, the latter two in 250 years rotation when d.b.h. are from 5 to 7 feet and heights 170 to 180 feet.

Stumpage prices vary here from 1 to 5, and for conifers to 8 cents per foot. In 1912, only one fifth of the permitted cut was realized; lack of transportation being the drawback.

The forests of Asiatic Russia are as diversified over the enormous area as the climate, from the north country, as for instance around Yakutsk, where the quicksilver freezes in the thermometer, to the dry, hot mountains of Turkestan.

The forests of the west slope of the Ural Mountains remind one of those of the European northeast districts, a mixture ("black taiga") of *Picea obovata, Abies sibirica, Pinus cembra* and *Larix sibirica.* White birch and aspen come in after fire ("white taiga"), and to a limited extent oak and elm appear. Pure pine forest is found "along sandy borders on the elevated *right-hand banks of the rivers,*" hence the more rivers the more pine forest. The farther east one goes from the foot of the mountains, limestone out-croppings increasing are productive of growing frequency of larch, two species, *L. sibirica* and *dahurica,* the most widespread species, especially on northern slopes to the very north, together with *Populus suaveolens* and Siberian pine. The southern slopes are usually occupied by Scotch pine, *Pinus cembra* forming there the timberline tree. A new flora is found in Kamchatka, *Abies glacialis* and *Betula ermani* being associated with *Larix dahurica*. To the southeast of the Jablon ridge, the milder climate gives rise to broadleaf forest with Mongolian oak, *Betula dahurica* and *Ulmus campestris*. In the Ussur and Amur countries, Japanese and Chinese flora appear, with a great variety of broadleaf and coniferous species. Toward the south of the great Siberian forest there is a gradual change to the forest-steppe zone, where birch and aspen give tone to the forest.

On the mountains of Turkestan, especially their northern slopes, *Picea schrenkiana* appears, together with *Abies sibirica, Betula alba* and *Populus laurifolia,* towards timberline replaced by *Juniperus excelsa*.

In the central Turkestan mountains, such species as *Juglans regia, Pistacia vera, Morus alba, Platanus orientalis, Acer laetum, Celtis australis,* and in the river bottoms *Populus euphratica, Eleagnus hortensis* and *Fraxinus potomorphia* give an entirely new aspect to the forest. A table of growth data apparently exceeds the rates of our northern forest, 1 inch in 7 or 8 years seeming to be general.

Stumpage prices for Scotch pine and Siberian larch range from ½ to 5½ cents, for Siberian fir ½ to 2 cents, and for other species remain below 2½ cents, say $3 per M feet b.m. It is suggested that the Pacific Coast United States could import at such low prices.

Selection cutting is the practice, not however, the largest, but the most convenient sizes are mostly taken. In Siberia, not over 20 inch trees are taken.

In 1912, of the permissible cut only 11 per cent were taken. Fires are the greatest bane. Taking the whole government forest area of around 500 million acres, for which 3.5 billion cubic feet are permitted to be cut (7 cubic feet per acre), only about one half is sold and given for free use. The present income, which has increased in the last 20 years fourfold, amounts to only $45 million with an expenditure of $14 million. There are 4500 persons permanently employed, of whom 1500 inspectors and supervisors and 800 technical assistants, besides some 32,000 guards. There are two higher forest schools and 43 lower with a two-year course, supported entirely at government expense.

In 1912, Russia exported $124 million (?) worth of timber, 40 per cent of which was sawlogs at very low rates.

Private forests are under government control (law of 1888) when of protective character; in such, selection method only is permitted; at the same time taxes are remitted. Again, in forest at headwaters, clearing is restricted. In other private forests—on paper at least—working plans are prescribed and wasteful practices forbidden.

BOTANY AND ZOOLOGY

Variation in Fir

The fir, *Abies pectinata,* different from spruce, has very little tendency toward variableness, nevertheless, Klein in his Forest Botany gives 8 different sports or freaks, which are cited as so many lusus. He makes reference to only two specimens of branchless firs (*Lusus irramosa*) in two localities. Burger has found a locality in Switzerland where branchless firs occur in numbers; an illustration is given. They are found in the midst of a dense regeneration of 15 year average, in which height growth shoots of 20 to 32 inch are not rare.

The details of 14 specimens are given, varying from 16 to 27 years in age, and from 16 to 66 inches in height (the latter not 1 inch in diameter); some without any branches at all, some with 1 to 3 side branches, not at all or little branched, and one (19 years old and 48 inches high), with no stem at all, except the base, each shoot showing the characteristics of a side branch with the combed position of the foliage. This latter specimen has at the end of each shoot 1 to 2 buds, and at one shoot only the normal 3 buds.

Unfortunately no mother tree to which this generation might belong was found. The author looks, however, to seed variation as a cause of the freaks.

Of the other cited lusus, that called *flabellata,* the fan fir, is quite frequent, in which all side branches lie in one plane with the stem, so that the whole tree looks like a branch. Such usually show near the base a curvature or thickening of the stem, which leads to the suspicion that at that place an original end shoot was killed, and it is really an erected side branch we have to deal with. By and by this character is lost and a regular tree developed. The author, therefore, thinks this should not be considered as a lusus, but a growth form. He advises careful watching of the lusus, protecting the species by freeing from overgrowing neighbors.

Spielarten der Tanne. Schweizerische Zeitschrift für Forstwesen, January-February, 1916, pp. 13–9.

Japanese Conifers

Dr. H. Shirasawa, of the Japanese Experiment Station, reports five new coniferous species from Japan, namely, *Picea koyamai,* new species, a dwarf mountain tree of 30 feet height; *Picea bicolor* Mayr var. *acicularis* Shirasawa et Koyama, also a dwarf mountain tree of the same height; *Picea bicolor* Mayr var. *reflexa* Shirasawa et Koyama, a tree of the valley; *Picea maximowiczii* Regel, lately discovered to occur in Japan, a large tree resembling *P. polita,* but very rare. *Abies veitchii* Lindl. var. *olivacea* Shirasawa, with glossy olive-yellow cones.

Neue und wenig bekannte Picea- und Abies-Arten in Japan. Mitteilungen der Deutschen Dendrologischen Gesellschaft, 1914, pp. 254-6.

Douglas Fir Leaves and Chinook Winds

Munger has been observing the effect of dry winds upon the leaves of Douglas fir in the vicinity of Portland, Oregon. In March and April, when the Chinooks come down the Columbia Canyon, the leaves of the fir on easterly exposures turn brown. The injury is sometimes so striking as to give the impression that all the timber is dying. The year-old twigs are often killed, but as a whole the affected trees recover during the growing season. The coast form of the tree is more susceptible to the injury than the Rocky Mountain form, which the fir east of the Cascades resembles, so the effect of the injury is less noticeable eastward and is not apparent east of the crest of the Cascades. The author suggests "parch blight" as an expressive and distinguishing name for this injury.

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Parch Blight on Douglas Fir in the Pacific Northwest. The Plant World, February, 1916, pp. 46-7.

How Trees Grow in Size

Curiously enough, the explanations of the commonplace phenomenon of diameter growth are still quite fragmentary and usually the formation of the annual ring is merely declared an "inherited characteristic." Dr. Jaccard discusses the matter in detail under three headings, namely, the change in anatomical composition of wood during the season; the periodic formation of annual rings under influence of exterior factors; the form acquired as a result of annual ring formation and their varying width.

The formation of the early or spring wood zone, with many vessels of large lumen, is ascribed to the need of increased transportation of water and nutrients upon the formation of foliage. The flattening of the later woodcells is not so easily explained. De Vries could produce flat cells in spring wood by applying a rigid bandage around the bark, and spring wood in the summer by properly located incisions in the bark, from which he deduced the change of spring and summer wood to bark pressure, which growing in the summer is by the splitting of the bark released in winter.

This Sachs-de Vries theory, however, does not explain the suddenness of change from spring to summer wood. Russow adduced change of osmotic pressure in the cambium cells at different seasons, but Wieler's attempts to measure these pressures did not substantiate the theory. The author suggests that Wieler's series was too small to permit generalization, and Krabbe has shown that this pressure does not vary very much through the year; the bark expands with formation of the ring, hence does not explain the phenomenon. The reduction in lumen of summer wood cells is often accompanied with thickening of the cell walls:

this, however, is not at all as frequent as is usually supposed, and more apparent, an ocular delusion, than actual. In desert plants, and in others with small root system and hence reduced transpiration, spring wood cells are thick-walled. According to Wieler, this can be artificially produced by regulating water supply. The same phenomenon was shown by the author in scrubby pines and spruces from acid moor soils, which he explains as due to deficiency of water reducing turgescence of tissues accompanied by large amount of concentrated nutritive sap (osmotic pressure!), which is used in thickening the walls.

The phenomenon of double rings due to defoliation and of change from spring to summer wood, and prevention of the variation due to regulation of supply of water and of food, enabling King and Kühns, Jost and Wieler to produce any desired formation, leaves no doubt that the anatomical variations in structure of the wood accompany variations of water supply.

As to the periodicity of growth phenomena and annual ring formation, the usual explanation of hereditary habit is demolished by the citation of most interesting observations of behavior in tropical regions and experiments which show that exterior conditions influence the periodicity and that some species have the ability under given favorable conditions to grow uninterruptedly.

Trees from the temperate zone, where periodicity of growth coincides with periodicity of season, transplanted into tropical conditions (Buitenzorg) show still periodicity, but vary this not only from species to species, but from individual to individual.

Nurserymen have learned to overcome the natural periodicity by the application of ether vapor, warm water baths, water injections below the buds, concentrated food supply, electric current and intense light. Klebs' most interesting experiment with a beech plant is cited, in which a beech still in foliage by September 11 was exposed to 200 candlepower light. After 10 days the dormant buds began to lengthen and by September 25 a complete new foliage was formed. After keeping it during October to December in a hothouse, growing, by December 25 it was exposed to a second illumination by 1,000 candlepower, and by January 27 a third foliage was formed, complete by the middle of February, the old leaves dropping. By the middle of March a fourth foliage began to form naturally.

This experiment proves conclusively the influence of exterior conditions on growth.

Was wissen wir vom Wachstum der Bäume. Schweizerische Zeitschrift für Forstwesen, January-February, 1916, pp. 1–12.

SOIL, WATER AND CLIMATE

Importance of Colloids in Forestry

The importance of the chemistry of colloids with reference to soil conditions and the use of soils in forestry and agriculture is brought out by Prof. Dr. Rohland in the following manner:

Clay and clayey soils, according to the author, as well as the humus and peat soils, owe their characteristics to the colloid materials contained in them; these soils owe also their fertility to the colloids. Sandy, crystalloid soils are free from colloids and, therefore, possess less water capacity than the former and less absorption of water vapor.

One may conceive the colloids as a tissue of fine mesh in which the water can adhere as in a sponge. In this water the nutritive salts are found in solution, as well as the crystalloids, and owing to this sponge action are not as readily leached out as in a sandy soil. There are also certain chemical exchange processes taking place in the colloid soils according to the laws of equivalency, *e. g.*, calcium may be displaced by a corresponding amount of potassium, which is much more valuable in the nutrition of plants. Similarly, the magnesium salts, important in the formation of chlorophyll, can displace the calcium salts. Hence the application of gypsum is effective only when such soluble salts are present, which they are in colloid soils; and so other fertilizers, such as superphosphates, plaster, marl, depend in their effectiveness on the presence of exchangeable salts.

Alkali and alkaline earths applied to clay soils effect flocculation of their colloid contents with concomitant volume increase; the clayey constituents experience a colloid-chemical change of constitution with consequent loosening of the soil.

If, however, clay and clayey or humus soils are dried, they give up the colloid-chemically absorbed water, and they lose somewhat the capacity of taking up water; and, if repeatedly dried, finally if artificially dried, they lose almost entirely their water-absorbing quality.

The time element, then, must be taken into consideration. But since in nature constantly additions of water by rain and humidity are replenished, so that new colloids can be formed, they never attain this condition.

It is proved that raw humus reacts acid and that moss-turf contains acid which, however, do not form salts; also that humus material react partly neutral, partly alkaline, partly acid, but lack some characteristics of acids, hence true acids are probably not present, but presumably colloids. According to colloid contents, soils are more or less stable, the soils deficient in colloids having the tendency to slide.

The presence and quantity of colloids can be tested by the ease of absorption and aniline colors, so that it is easy to determine for practical purposes the value of the soil.

The author, then, refers the low water stages in German rivers to lack of colloids. The widespread change of broadleaf by coniferous woods has the consequence of reducing the humus cover, and hence the capacity for absorption of water and vapor has been reduced.

Especially with regard to waste lands this lack of colloids is important and must be supplied by adding clayey or humus material.

In connection with the discussion on the colloids of peat, the interesting statement is made, that during the war there has been developed a method of substituting peat for cork. Peat of moss, heather, roots of alder and willow can be compressed into plates of varying thickness and hardness and serve satisfactorily as protection against heat and cold in hospitals and barracks.

Die Bedeutung der Bodenkolloide für die Forst- und Landwirthschaft. Forstwissenschaftliches Centralblatt, 1915, pp. 257–63, 455–60.

Food of Earthworms

Since earthworms are supposed to be useful in comminuting the soil, it is of interest to note that, according to von Aichberger's careful studies, the earthworm feeds mainly on the edaphon, *i. e.*, minute animals of the lowest orders, of which 1 cubic millimeter may contain as many as 29. The earthworm also, but not necessarily, feeds on dead vegetable matter, but never on live plants. As regards the comminuting of the soil, the significance of the earthworm has been overestimated; in this respect, the edaphon has much more significance, and forms an intervening link between the mechanical action of the earthworm and the chemical of the soil bacteria.

Untersuchungen über die Ernährung des Regenwurms. Forstwissenschaftliches Centralblatt, November, 1915, pp. 523–4.

SILVICULTURE, PROTECTION AND EXTENSION

Interlucation and Increment

Upon the basis of 20 tree sections (fir and beech), several of which are pictured, Forstmeister Roth, of the Hungarian Experiment Station, discusses the influence of severest thinning (*Lichtung,* for which we propose the new term *interlucation*) on increment.

The response to sudden access of light, as is well known, is, as a rule, not immediate, at least not in height growth: an adaptation of the foliage to the new light conditions is first necessary; indeed, a retardation of growth is usually noticed. As regards diameter, the response appears in the width of the annual ring almost sudden. On a section of fir which for 105 years showed hardly .7 *mm* average width of ring, the first ring after interlucation showed no influence, the following rings showed a width of 2 to 4, 5, 8, 10, 10 *mm*; in 5 years an increment ten times as large as in the preceding periods.

Another section of 134 years age, for 55 years made hardly .4 *mm* rings, then for 8 to 10 years in opener position made up to 2 *mm* width, then for another 55 years under suppression the width fell to .6 *mm* on the average, altogether in 126 years the diameter was only 135 *mm*; then suddenly set free, the first ring showed no influence, but the next year's ring was 2 *mm,* and then followed rings of 4, 7, 7, 7, 8.5, 7, 7 *mm,* in other words, the light produced 14 times greater increment.

A third section, at 84 years old, showed only an average of .7 *mm*; after interlucation no response for first year, then 2, 4, 6, 6.5, 7.5, 8, 8, 6 *mm,* or ten times the former increment.

The same conditions were observed in beech sections, showing from 10 to 13 times the increment after interlucation, with one or two years non-response between. By looking over stumps, it was found that the response continued at least for 15 and 16 years on 80- to 100-year trees, and appearances promised a longer continuance of such response. This response was also shown in the upper sections, although the width of the annual rings in the upper sections was relatively smaller than those of lower sections (increased taper!).

The greater reaction at the base, the author explains as due to reaction to wind.

As to the undesirable quality of this uneven-grained wood, the author states, that these examples are extremes showing the reaction of suppressed trees, chosen to bring out the fact of the reaction strikingly, but that, if normally developed trees were taken, the quality defect would be lessened or would vanish altogether.

Beiträge zur Lichtungsfrage. Forstwissenschaftliches Centralblatt, January, 1916, pp. 43–48.

Practical Application of Regeneration Methods

Dr. Martin, in continuation of his discussion on Swiss conditions, elaborates on the practical considerations in the application of silvicultural methods of natural regeneration, and especially the direction of the progress of fellings, the importance of which Wagner, with his strip-selection method, has lately so much accentuated.

In Switzerland, rules in this and other respects are often noticeable by their absence, and success is secured in spite of their neglect, as *e. g.*, in the forests of Winterthur, where excellent regeneration is secured with a progress of fellings from southeast to northwest, while Meister in Zurich regenerates one half his forest from north to south, the other from south to north with equal success. The direction of valleys and aspect of slopes, to be sure, influence the direction of fellings, and these in Switzerland being very varied, general rules cannot be given; moreover, climatic conditions are so favorable that almost any method succeeds.

For pure stands under a clearing method with planting, in which fellings are located by definite lines, considerations for a strict felling series are of more importance than with natural regeneration which adapts the outlines of fellings to topography. The dangers from wind and sun dictate the directions in which fellings are to progress. Where drouth is to be feared, as in most German conditions, the progress from north to south is indicated, but in Switzerland with ample precipitation, this consideration in most cases does not have any importance. On the contrary, it is often desirable to open towards the south in order to warm the soil, especially in high alpine situations.

To avoid wind danger, progress from northeast to southwest is now considered the most satisfactory, or where direction of winds differs a position of the front of fellings turned by 45° from the direction of the most dangerous winds. Dealing with natural regeneration, wind resistance of the seed trees is to be secured by timely thinnings, which method is lately much advocated in Switzerland, when a greater freedom as to location of fellings may also be granted and regard can be paid to the needs of the reproduction for protection against frost, heat and weeds by even distribution of the nursetrees.

For mixed stands, Martin advocates specially Gayer's group method, opening the crown cover by small holes not only over volunteer growth, but in closed stands in more or less regular distribution, and gauging the opening so as to give advantage to one or the other species. Such procedure produces the desirable uneven conditions for development. It is however, to be realized that only the first openings, say of the diameter of tree height, in their center, have favorable conditions for regeneration, the margin and subsequent openings introduce difficulties from insolation and competition of the old timber and weeds; snow-breakage, too, is increased.

Since in pure stands, there is no call for creating uneven conditions of regeneration, or favoring one part of the stand against another, the group method is not applicable here. But to preserve and advance a species, which without assistance of the manager would lag behind the other or be crowded out, openings made in such a manner as to secure earlier regeneration of the species to be favored than the other are an excellent means of keeping the mixture. Only for this purpose is the group method applicable. Species in need of light require larger openings than the tolerant, larger than the height of the timber. For such species (oak and pine) the enlargement of the group makes, however, conditions less and less favorable, and it is safer to resort to underplanting. But for tolerant mixtures, as, *e. g.*, fir, spruce and beech, the group method is to be recommended and is favored in Switzerland.

A further discussion of the location of fellings brings out additional considerations, all of which show the impossibility in the mountains to stick to rules. "Neither a uniform nor an irregular position in the regeneration fellings, neither the Saxon felling series, nor Wagner's strip selection can serve as rule."

The totality of the factors of production and the aim of the management, not a circumscribed principle or method, must direct judgment in the location of fellings. Age, completeness of stocking and healthy condition, as well as topography, influences regeneration and location and progress of felling areas. The most important requirement for success in regeneration consists in correctly recognizing and appreciating the given conditions in their single factors which are active in securing regeneration, and in their total combined effect.

Die wichtigsten Verhältnisse und Maasnahmen in der Schweiz, etc. Tharandter Jahrbuch, 1915, pp. 432–49.

Douglas Fir Seed

Busse has made germinating tests of Douglas fir, grown in Germany, which show a remarkably low germination per cent. The trees were only 25 to 30 years old; cones were easily opened by room temperature at 25° *C* in 12 hours; cleaning of wings, however, was found difficult on account of exuded resin; the yield was .36 kg. per 1 hl. A knife test gave only 9 per cent germination; three regular tests averaged 7 per cent, while in the trade 70 to 75 per cent is guaranteed. The reason for this low per cent is sought either in the age of the tree or in the climate.

Another test from another locality and from 30-year-old trees showed for the green variety a similarly unfavorable per cent, namely, 6 per cent, while for the blue variety the per cent was 37.5.

Zum Anbau der Douglasie. Forstwissenschaftliches Centralblatt, June, 1915, pp. 284–6.

Seed Control

A long article by Dr. Schwappach gives a detailed account of the arrangements and work in the seed control station at Eberswalde. He points out that in the method of seed testing there are practical requirements, especially on the part of seed dealers, that must not be overlooked; the first is that the test should be rapid, and the second that it should bring out a possible high germination per cent.

As regards samples, it is often overlooked that the test gives answer only as to the sample which can be applied to quantity only if the sample properly represents it, and the number of samples must be in proportion to the quantity of seed for which they are to be representative. As an example, three samples of larch seed from top, middle and bottom of bag varied in purity between 19.2 and 26.3, in germination between 67.7 and 75 per cent. A special instrument, Nobbe's sampler, is recommended for taking samples. Proper packing for shipment is also of moment.

All samples, besides being properly identified, are examined for purity and germination. For purity test, an average sample of varying amount is used, for birch 2 *g.*, for Chamaecyparis and Thuya 10 *g.*, for small spruce seed 15 *g.*, for most other conifers 20 *g.*, for White pine, Black pine and similar large seed 25 *g.*, for Abies 30 *g.* For larger broadleaf species, the entire sent-in sample is used. In segregating the admixtures broken and unusually small seed, surely not germinative, are included, which may lead to disagreement of results. For many species, which, owing to slow germination or to dormancy, make the germination test impracticable, the knife test is applied. This is done with Abies, Acer, Carya, Fagus, Fraxinus, Juglans, Quercus.

Two examples of Abies showed 61 and 73 per cent germinative power by the knife test; while the one in 140 days had germinated only 20 per cent, the other in 120 days, 21 per cent; similarly, two oak samples giving 67 and 95 per cent by knife test, had in 63 days, in moist sand, germinated only 8 and 27 per cent, respectively.

Besides temperature (25° *C*) and humidity, and even lighting is desirable in germinating apparatus. This is secured by 32 candlepower electric light at 2 *m* average distance through 8 hours daily, which is found sufficient. The tests are carried on usually for 20 days in various apparatus, on blotting paper (Jacobsen), clay plates (Cieslar), and wet sand. Clay dishes are specially recommended for Douglas fir (40 days), White pine (60 days), Chamaecyparis, Thuya, Betula; blotting paper for spruce, Scotch pine and larch.

To expedite germination of White pine, the seed is kept for 30 days in a cold room near freezing point or colder, when germination in a Cieslar plate begins promptly, and in 30 days is finished. Incidentally, an experiment with fall sowing of White pine produced considerably better results than spring sowing.

Robinia, the application of boiling water, left for three minutes, when after two days 50 per cent will be germinated and after 30 days 80 per cent. Since in practice only the rapidly germinating grains are of value, the determination of the germinative energy, *i. e.*, the number of seeds germinating in 8 to 10 days, is of significance. The better the seed, the greater the energy as shown by a series of tests.

The average values secured during six years testing, for species in which we might be interested or which might find equivalents with our species, are given as follows:

	Per Cent Average	*Per Cent Highest*	*Per Cent Lowest*
Abies pectinata	50	67	19
Larix europaea	45	88	11
Picea sitchensis	70	83	40
P. excelsa	83	98	11
Pinus divaricata	77	95	37
P. silvestris	83	100	39
P. strobus	60	100	19
Pseudotsuga	65	83	43
Acer platanoides	89	90	88
Betula alba	18	19	17
Fraxinus excelsior	90	94	87
Robinia	65	80	55

Variations from year to year run for spruce from 74.6 to 92.3, for Scotch pine from 79.2 to 88.7. The high per cent of the latter over former statements is ascribed to better practice in seed extraction and storing.

The combination of per cent of purity multiplied by per cent of germination divided by 100 has been considered to give the use value: a seed of 95 per cent purity and 90 per cent germination gives a use-value of 85.5 per cent. But, it is argued, purity and germinative power are not of equal value, an impure seed of high germination per cent has a higher practical value, than a seed with low germination.

In the regulations for the control station given verbatim in an appendix a formula is given by which the true use-value is expressed, namely:

$$x = \frac{(R \pm r)(K \pm k)a}{Rg.Kg}$$

in which Rg and Kg the guaranteed, R and K the actual purity and germination, r and k the permissible variation in purity and germination, a the contracted sale price, x the proper price. The permissible variations are for purity 1 per cent in seeds of 97 per cent and over, 2 per cent for seeds from 90-96 per cent, 3 per cent for seeds under 90 per cent purity. For germination 2 per cent for seeds over 90 per cent, 3 per cent for 80 to 90 per cent, 4 per cent for those below 80 per cent germination.

The error per cent in tests also is discussed at length. For seeds whose germination lies near 50 per cent, the regulation permits variations of 15 per cent; but Schwappach thinks even for these a variation of 10 per cent sufficient and for others 5 per cent.

Die Waldsamenprüfungsanstalt Eberswalde. Zeitschrift für Forst- und Jagdwesen, November, 1915, pp. 631–51.

Classification of Thinnings in India

"A Classification of Thinnings and Increment Fellings," by Howard, is given in considerable detail.

To start with, he divides thinnings into (1) ordinary thinnings, (2) crown thinnings, (3) increment felling. The ordinary thinnings are divided into three groups: (*a*) light thinnings, (*b*) moderate thinnings, (*c*) heavy thinnings. Crown thinnings are divided into (*a*) light and (*b*) heavy, as are also increment fellings. The data is based, frankly, upon European practice, but the modifications suggested for British India will be interesting to silviculturists. T. S. W., Jr.

The Indian Forester, February, 1916, p. 66-71.

Thinnings and Yield

Emile Mer gives some interesting figures on the yield in cubic metres of spruce stands after thinning. His conclusions are that, in the regular spruce stands of the Hautes-Vosges, the thinning should not only be begun early (25 years or thereabouts), but should be quite heavy, not only from the point of view of yield, but also for the sake of the production per cent. His conclusions are clear cut and decisive, notwithstanding a previously admitted theory that the young spruce stands should be kept dense.

T. S. W., Jr.

Revue des Eaux et Forêts, February 1, 1916, pp. 45-53.

Rodent Damage

V. Boutilly, Inspector of the French Waters and Forests Service at Algiers, reports lack of success in reducing rodent damage by the use of "minium" or sulphate of copper in solution.

Boutilly, who has charge of the forestation around Algiers, found that the only method of reducing rodent damage was to thoroughly brush out and clear the land to be sown instead of being content simply to brush out seed spots or strips. With complete clearing "the rodents have no clumps to hide in and almost all leave the area, and the damage is reduced accordingly. Moreover, I have noticed that the young cork oak plants which are quite tender during youth . . . , especially at the end of summer, resist the heat better if they are uncovered than they do if they are growing in the midst of brush. I think that this phenomenon is due to the freshness caused by proper aeration."

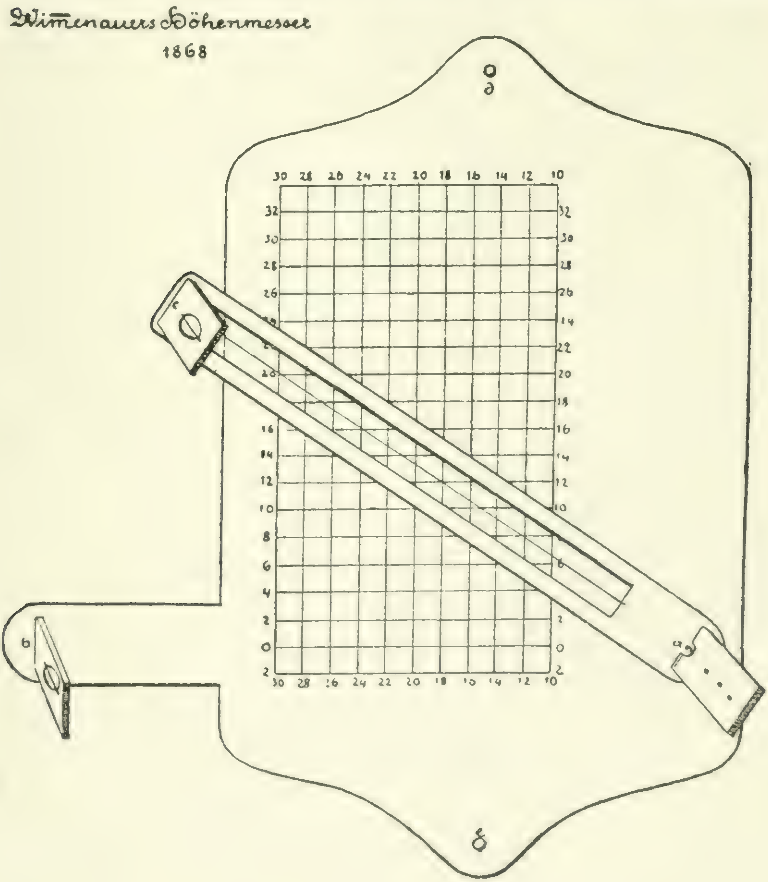
The air circulates better and the plants survive when, otherwise, they would succumb to the heat.

Bulletin de la Station de Recherches Forestières du Nord de l'Afrique, December 30, 1915, pp. 113-4.

MENSURATION, FINANCE AND MANAGEMENT

Precision Hypsometer

Dr. Hemman describes a hypsometer, constructed by Dr. Wimmenauer in 1868, and reports on a series of tests in which Christen's, Wimmenauer's old, and the same inventor's sextant hypsometer were used. Christen's hypsometer is generally the most favored, and is in most cases satis-



factory enough, but where precision is required, as, for instance, in height increment studies, also in sales on the stump, etc., it does not satisfy; the sextant, with mirror, satisfies the requirement of precision, but it works slowly, and neither of these instruments is as good in stands with underbrush (cover of base!) as the old Wimmenauer, which for all these years existed only in one exemplar in the tool collection at Giessen, but can now be had from Spörhase Giessen for 27 mk.

The instrument consists of a zinc or brass plate with a graduation as in the figure. Around point *a* a straight-edge turns, with a rectangular section cut out, in which a fine wire is stretched. At *a*, *b*, *c* sights are fixed. At *d* and *e* there are two holes through which by screws to attach the instrument to a staff.

In measuring, position is taken between 30 to 100 feet from the tree and the staff placed vertically by means of a plumb bob, when the straight-edge lies horizontal. An assistant holds a rod with two targets which are 2 meters apart, placed so high that the horizontal sight line strikes either the higher or lower target. Then sight *c* is sighted on the second disk when the length of the stand line can be read off from the horizontal graduation, where the wire *ac* cuts the zero line. Next, *c* is sighted on the top and the height above the horizontal is read off on the vertical graduation on the abscissa corresponding to the stand line. If, e. g., the latter were 16 *m*, the reading might be, as in the figure, 10.5 *m*. This is the height above the horizontal; the lacking part is measured directly by the assistant.

The small squares being of 5 *mm* side, corresponding to 1 *m* height or length of stand line, fifths and even tenths can be estimated. The distance between the sights being about 22 *cm*, an accurate sighting and reading is possible.

The author considers this the all-round best instrument, easily worked and accurate, more so than the Christen.

Zwei Wimmenauer'sche Höhenmesser. Allgemeine Forst- und Jagd-Zeitung, October-November, 1915, 234–9.

Helps in Estimating

Fischer bemoans the fact that estimating contents of trees, logs, etc., has in Germany become a lost art, the mechanical use of tables having destroyed the ability, and therewith the interest, to the detriment of original thinking. One reason for this inability he finds in the metric measure as a unit, being too large to keep in one's eye, and, in cubic meters, requiring the handling of fractions which the mind does not grasp readily. Nevertheless, by using the decimeter for lineal measurement and square decimeter and liter for basal area and volume, and the are for sample area expression, this difficulty may be reduced.

He then develops aids for rapid mental calculations which form part of the art of estimating. These are naturally given for meter measure, but similar short cuts could be devised for our own measures. We give some of the rules.

1. Avoid multiplications except by 10 and its multiples and the small numbers 2, 3 and 4. Substitute rather division and addition and subtraction.

E. g., instead of $17 \times 25 = 17 \times \frac{100}{4}$

" " $5.7 \times .7854 \left(=\frac{\pi}{4}\right) = \frac{5.7}{1.28\left(=\frac{\pi}{4}\right)} = 5.7 - 10 \times 2\% = 4.56$

" " $73 \times 1.25 (=\sqrt[3]{2}) = 73 \times \frac{73}{4} = 91.25$

" " $26 \times .57$ (form factor) $= 26 \times \frac{1}{2} + 7 \times 2\% = 14.82$

This is the secret of rapid mental calculation.

2. To check a calculation mentally do not repeat the same calculation, but make a different kind of calculation, or at least follow a different sequence of calculation, when also any errors in the factors (height, form factor, etc.) reveal themselves more readily.

3. Since exponential expressions are needed so frequently, it is worth while to memorize second and third potencies; or in cubing, the memory may be assisted by the rule

$$(10+a)^3 = 2a^3 + (10-a)^3 + 600a$$

E. g., $14^3 = 2 \times 4^3 + 6^3 + 600 \times 4 = 2744$

Or squaring larger numbers:

$$(10a \pm b)^2 = 10a(10a \pm 2b) + b^2$$

E. g., $54^2 = 50 \times (50 + 2 \times 4) + 4^2 = 2916$

If a is properly chosen, b^2 needs rarely to be more than 25 and can mostly be neglected.

This method can still be used advantageously with halves and quarters and reducing the squaring of tens to squaring of units.

E. g., $15^2 = 10 \times 20 + 25 = 1 \times 2$ and 25 hung on $= 225$
$35^2 = 30 \times 40 + 25 = 3 \times 4 = 12$ and 25 hung on $= 1225$
$7.5^2 = 10 \times 5 + 6.25 = 7 \times 8 + .25 = 56.25$
$4.75^2 = 5 \times 4.5 + .0625 = 22.5625$

The author then develops a number of approximation formulae, which give a sure judgment as to limits and average values of contents of trees of a given diameter.

1. The volume of a mature tree approximates in metric measure: $v = 100d^2$, because in such trees $\frac{\pi}{4}h.f.$ is frequently $= 100$.

[With our foot measure, $v = r^2$, with the same reasoning, mathematically correct when $h = 91.6$, and $f = .50$. For different heights add or subtract 10 per cent for every 10 feet.]

For young trees and meter measure, two approximation formulae and their derivation are given with extensive explanations as to their application.

$$(2) \qquad v = 40 \times d^3 \text{ or}$$

$$(3) \qquad v = \left(\frac{10d}{3}\right)^3$$

2. To secure an estimate of the participation of the clear bole in the total volume, the following consideration is given:

If the clear bole (h_c) reaches to p per cent of the total height, h, the volume of the clear bole v_c is approximately $\frac{p}{10}\left(20 - \frac{p}{10}\right)$ per cent of the total volume (really a little larger), hence the formula

$$(4) \qquad v_c = \frac{\frac{p}{10}\left(20 - \frac{p}{10}\right)}{100} v, \text{ if } h_c = \frac{p}{100} h$$

hence for $h_c = 10$ per cent of h, $v_c = 1(20-1) = 19\%$ of v
$= 20$ " " " " " $= 2(20-2) = 39\%$ " "
$= 30$ " " " " " $= 3(20-3) = 51\%$ " "
$= 80$ " " " " " $= 8(20-8) = 96\%$ " "

The proof for the approximate correctness of the formula is given.

A number of approximation formulae for giving contents of logs are elaborated.

To these mathematical considerations is added a discussion on "*Anschauung*," "conception," or the ability of securing a mental picture of the meaning of measurements; for instance if a larch is given as containing 15 cubic feet, can we picture it and have an idea of its linear dimensions. Having been accustomed to go to tables, this ability remains undeveloped, a condition which is medieval as compared with other sciences; progress in mensuration can be expected only from methodical cultivation of "*Anschauung*."

To develop this ability, it is necessary first to have conceptions of the unit measures and their relations. Starting with a Christmas tree of 20 *dm* (80 inch) height, we may realize that it represents a cube of 1 liter (=cubic decimeter=61 cubic inches). This conception can be extended to stouter and higher trees and gradually by practice an eye is developed. Finally, however, there is a limit even for the practised eye, beyond which the conception, on account of the many liter, is not any more clear, when the approximate calculation must help out. Then, we can secure a conception that the tree assumes the form of a cylinder with the diameter at breasthigh and the form height. One can, then, mentally calculate the basal area with that height and get a conception of the size of the tree. Or we can apply formula (2) and come to the conception that it is possible to change the normal tree body into 40 cubes of the side of d. b. h. The eye learns not only that normally (when $\frac{h}{d}=100$, $f=5$) these 40 cubes represent actually the tree volume, but also that when there is a deviation from these normal conditions, a complement is necessary. By the conceived change of the tree body into elementary unit bodies the estimate becomes surer.

Again formula (3) tells that normally the tree volume represents a cube of $\frac{10d}{3}$ side. This side of the cube would exceed the d. b. h. $2^1/_3$ times or $1^1/_6 d$ on each end; to secure a conception in comparison with the tree, we would have to move out this side so that there develops a cube which on all sides symmetrically encloses the tree like a cuff. The practised eye also recognizes at once that, for instance, a long spruce pole can be represented by a body, the base of which is $\frac{10d}{3}$ but whose height must be more than $\frac{10d}{3}$, perhaps $4^1/_2d$. This forces one to investigate whether really the height in this case is greater than $100d$ (the normal condition of the formula), or whether f is unusually large. The relation $\frac{h}{d} = 100$ is easily impressed upon the eye and helps greatly in discovering divergence.

By securing in this way a conception of the forms, ocular estimating is aided and developed.

Similarly, a special conception of the increment can be developed. This is done by using Breyman's increment per cent formula.

The difficulty of estimating form factors, the author suggests, might be overcome by photographic representation of sample trees with various form factors, on which the eye could practise. Such photographic "estimating pictures" could also be used to practise the eye in other directions.

In conclusion, the author once more accentuates the necessity of developing the ability to estimate correctly, which he calls the "art" in mensuration. Especially in forest organization it is needed, for the tables are after all only average or limit values and in a given case can be said "to be always wrong." They require adaptation to the peculiarity of the stand in hand, which no table, no measurement, no rule can fully represent. This individualizing between limits set by theory and investigations laid down in yield tables is the function of the estimator, who, to be sure, must be an expert.

Zur Schätzung des Festgehalts von Bäumen und Rundhölzern. Allgemeine Forst-und Jagd-Zeitung, October–November, 1915, pp. 225–234.

Forest Valuation and Organization

Oberforstrat Frey inveighs against the soil rent theorists and their expectancy values, which, according to him, have no practical and only doubtfully theoretical significance, for they assume that wood prices and interest rates remain the same forever, which is contrary to experience. The arbitrary choice of interest rate leads to calculations which are difficult to gibe with the results of an organized forest management in an actual, existing forest. He sneers at the advice of these calculators not to accept and manage according to their calculations, but to modify according to silvicultural, technical and economic considerations. Forest valuation and organization must in their results, and in the deductions from these results, be in full accord, if they are based on theoretically correct basis and are to lead to practically attainable results. Just because the expectancy calculations do not lead to results which can be realized in practice without arbitrary modifications, these calculations must be based on false theory and should be abandoned.

The author then contends that calculations should be made only with present sale values. Moreover, he denies that the value of the soil is a measure for arriving at the best method of management or organization; the value of the stock alone is determinative, for with the value of the growing stock rises and falls the value of the increment, the annual forest rent, or net yield. "The amount of the average annual income which different management, especially different rotations, can produce, gives the only judgment as to which, under given *present* conditions, is most advantageous to the owner." Thus, for a forest near a city, on account of higher wood prices and of a market for small material, a relatively low rotation may show itself advantageous, while for a forest more distant from market, the opposite may be found advantageous. A certain definite basis for organization can thus be established. Stock and increment alone determine what kind of management is admissible and advisable.

The author continue his iconoclastic invective by declaring all the methods of regulation, allotment methods, management classes (working sections), predetermined rotation, etc., as having only historical or theoretical value. Away with the straight-jacket; freedom for the manager! [We note that later on, he uses these regulators nevertheless!]

If for a given forest, the mean annual total increment has been determined by estimate on the basis of yield tables, and it has been shown that this increment can be secured in "ripe" stands continuously without diminishing the growing stock, regeneration being provided, the problem of organization is solved. The "age of ripeness," the author, when first bringing forward this "method of exchange values" in 1889, defined as the age at which the value of a stand per acre coincides with the value of the normal stock per acre. The author in his earlier publication proved that if then the annual increment (volume or value) is used, the stock remains unchanged, and the age classes establish themselves (Heyer's method?).

If the question were to be discussed, what changes in existing condition or management of a given forest might be immediately (not in future) desirable in order to secure a larger and more valuable increment, it must not be overlooked that the owner is rarely in position practically to undertake anything affecting present conditions to radically change the stock. Every owner must organize his forest under the given stock conditions, and with present market conditions in view: speculations for the future will bring mostly disappointments.

An ordinary yield table, giving contents of main and side stand and the mean periodic increment, furnishes all necessary basis for regulating a forest. From this, for various rotations, the annual yields for the working block and the corresponding normal stock are figured, and finally the age of economic maturity as defined above ascertained. If x is the chosen rotation, I_x the corresponding total increment per acre, and S_n the normal stock per acre, then the equation $S_n = \frac{I_x x}{2}$ holds, and any stand, the yield of which shows this amount, has attained maturity. All older stands of a working section to which the rotation x is to apply are also to be considered ready for the axe, since their yield exceeds the minimum; all younger stands remaining below the minimum $\frac{I_x x}{2}$ are immature. These stands are also not to be placed in calculation with their present yield, but with the product of the mean annual total increment of the ripe stand into their age (Heyer's method?).

If instead of the mean annual total increment, the mean felling age increment is used, the age of maturity coincides with the age of half the rotation, while with the mean annual total increment, the age of maturity lies mostly 10 and more years above half the rotation.

The above regulation may, of course, be based on volumes or values.

[We leave to our readers to discover the flaws in the radical position taken by the author.—Rev.]

Uber die Beziehungen zwischen Waldwertrechnung und Waldertragsregelung. Zeitschrift für Forst-und Jagdwesen, December 1915, pp. 756-62.

Value Production of Spruce and Fir

Schüpfer, pointing out that the German spruce is the best money producer, while fir beats it in volume production, makes a comparative calculation for the two species on the basis of sample areas, to find out whether the tendency to favor the spruce against the fir is justified.

In a 130-year-old spruce stand, with trees 8 to 32 inch diameter, the average sample tree had 19 inches with 109 feet height. From volume tables for spruce and fir the contents of the group of trees for the latter species showed 9.2 per cent greater volume. The form quotient for the sample tree of spruce was .68, for fir .71 (more full bodied). A subdivision into assortments made the first-class logs for fir nearly 4 per cent more. Loss in logging (over volume table contents) for spruce 11.4 per cent, for fir 12.7 per cent (larger bark per cent); in practice, these figures might increase to 13 and 14 per cent respectively. Taking log prices for spruce of various grades and averaging, the quality figure is 21.77 mk; with the same prices, the fir would work out 21.78 mk, but on the whole harvest the quality figure for fir could be 6 per cent lower in order, multiplied with the volume, to yield the same as spruce.

Considering, however, that the fir being the most tolerant species can support a stand denser, produces a larger basal area, and during the period of regeneration, acquires a considerable increment on the nurse trees, has less enemies, regenerates readily, it may be assumed that it can compensate for a 10 per cent reduction in volume-value difference on sites that are suitable.

Zur Massen- und Wertserzeugung von Fichte und Tanne. Forstwissenschaftliches Centralblatt, December, 1915, pp. 537–42.

Working Plans in Burma

Watson reviews at some length the inaccuracies of past working plans. The main trouble has been that too small a percentage of the growing stock was measured and then only trees of the more important species above a certain size. The result was too much theorizing based on highly inadequate data. He states:

"The later tendency to more sketchy field work and the substitution of linear values for fixed sample areas has, in my opinion, greatly reduced the value of the later working plans. One of the chief causes of inaccuracy in the past was faulty classification of sound and unsound trees."

Another fault in the early working plans was that they did not consider the relative accessibility and condition of the reproduction and too frequently the richest compartments were cut over first, even if no reproduction had started; the girdling of inferior species was not based upon the benefits to be derived. Often the recommendations were impracticable and the prescriptions for cutting species other than teak were vague or of little value. After analyzing the faults of past working plans, Watson gives in considerable detail recommendations regarding future plans which are well worth study. T. S. W., Jr.

The Indian Forester, January, 1916, pp. 4-17.

UTILIZATION, MARKET AND TECHNOLOGY

Utilization of Waste from Hardwoods

A Wisconsin hardwood lumbering company had been cutting its birch to 8 inches "clear surface" and its maple to 10 inches. The stumpage value had gone up over $5 per M feet, and the company thought it might lower its log specifications to 7 inches for birch and 8 inches for maple. This was tried and the lowered specifications increased the cost of logging, per M feet, by $1 to $2, log scale. The smaller and rougher logs decreased the mill output by about 20 per cent with a consequent increase in the cost of milling of the same amount. The lowered average grade of lumber lowered the mill-run value so that the net result was to increase the cost of production by about $5 per M, "and, if we had any means of determining the cost of manufacturing the poorer logs due to lumber, it would probably amount to four or five times the value of the product obtained." The old diameter limits were therefore accepted as "the limits of economy."

But these log specifications remove only about 65 to 70 per cent of the weight of standing timber, the balance being left as economically worthless. In addition there is the mill waste in kerf and slab (20% with circular and 8% with band saws). This mill waste, when reduced to its economic limit by rehandling slabs for lath, square, crate and box lumber, etc., still leaves over a cord of mill waste per M of manufactured lumber. Of this cord, about ⅔ is used for fuel and hog-feed and ⅓ is available for other uses. Altogether there is about 50 per cent of the log goes into lumber, 30 per cent into fuel, and 20 per cent is available for other uses. On the basis of these figures, only about 15 per cent of the weight of the standing hardwood forest can be made into lumber under the most modern practice.

Where logs have to be hauled some distance, the freight charges act to increase the quality of the poorest log which can be profitably handled. Efforts to dispose of the mill waste as city fuel usually fail, or the results are unprofitable on account of freight or cost of handling. Efforts made to utilize the mill waste in small "novelties" such as tent pins, broom handles, billiard cues, etc., failed because the best of logs and not refuse are required. The only practicable method of salvage so far discovered, except for mills with exceptionally favorable location, is the distillation plant. Such a plant was erected.

The plant erected has six retorts, each of 8 cords daily capacity. The plant, wood yard, track equipment, etc., cost about $200,000 and an additional $25,000 for working capital is required. At the prices charged by the woods to the plant for its wood, a profit of about $1 per cord is realized as stumpage. Allowing for depreciation, the plant has been earning 6 to 8 per cent on the investment. Since the values of products have been high, the profits have also been more than was expected through a long term of years. The Company will be satisfied, however, if it can realize an average profit of 50 cents per cord as stumpage on its wood.

The requirements for chemical wood are exacting. All wood must be seasoned for a year, maximum cross section must be under 6 by 12 inches, the minimum size allowable permits only the heaviest slabs and edgings to be used. The wood must be practically all sound, etc. To make up the cordwood into wood proved unsatisfactory since labor was often scarce or unskilled at the work, constant inspection was necessary, the first risk while seasoning in the woods was great, the labor cost for handling and hauling the wood amounted to as much for chopping and piling, and the spur tracks had to be left in a year after logging was finished, thus doubling the steel required.

For these reasons the present practice is to log clean, taking everything out in log lengths, and leaving only saplings under five inches in diameter, tops and very defective trees and logs. Good and poor logs go to the mill where they are sorted, those too poor for the saw going to the wood-mill, where they are sawed into 50 inch lengths and run through split-saws to reduce the cross section to the required specifications. Slabs and edgings from the sawmill are mixed with the product of the wood-mill loaded on cars, and taken to the wood-yard for seasoning.

The retort plant requires only a few highly skilled men, but must be very carefully operated. The labor required aggregates 90 men.

Products of the plant run about as follows: per cord of wood 50 bushels of charcoal, 11 gallons of 82 per cent crude alcohol, 160 pounds of acetate of lime. Under usual conditions there is a ready sale of alcohol and acetate. Charcoal, on account of its bulk, low value, and tendency to spontaneous combustion, is difficult to transport over long distances. Its principal use in wholesale quantities is in special iron furnaces, which are not often available near the chemical plant. The cost of the distilling operation is about $8.50 per cord. The value of the products has recently fluctuated between $6 and $11 per cord. The use of the chemical wood has just about doubled the total amount of merchantable wood which can be economically removed from the forest.

The essentials for a successful chemical plant are: (1) sawmill located near the forest and having hardwood supply adequate for 20 years at the rate of ten million feet per year, (2) a large supply of running water, and (3) proximity to a charcoal iron furnace. P. S. L.

Canadian Lumberman and Woodworker, June, 1913.

Grading of Southern Pine

The Southern Pine Association has adopted and published a set of grading rules somewhat different from any heretofore used. In this new classification all the southern pines are thrown into one group which is separated into two grades. Species distinctions are entirely ignored. The grades are based upon the number of rings per inch, the percentage of summer wood, and the sharpness of the color contrast between the summer and the spring wood. There are other points of interest, all of which are brought out in the coypriglited standards of the American Society for Testing Materials, Philadelphia, reprinted in the *Lumber World Review,* December 25, 1915. O. L. S.

Future Walnut Supply

Circassian walnut, *Juglans regia,* to the extent of 1,745,000 feet is consumed annually in the United States. Most of it is used as veneer for furniture, interior finish and musical instruments. The supply comes wholly from old orchards in the northeastern part of Asiatic Turkey, where they were planted originally for the nuts (English walnuts). After bearing a hundred years or more they are cut for the wood. In the United States there are 1,720,000 trees planted in orchards producing more than 20,000,000 pounds of English walnuts annually in California alone, where almost half the total number of trees are located. Texas and Oregon also have a large number of these trees. Thirty-five States in all have bearing trees. Whether the wood from these trees will develop the fine figures and colors is not yet known; that grown in Europe has never come up to the native stock.

The Black walnut, *Juglans nigra,* is planted for the nuts in nearly every State; Iowa leads in Black walnut orchards, Kansas, Missouri, Nebraska and Pennsylvania follow in the order named. At present the reports show 1,060,000 trees planted with three fourths of them bearing, and the nut crop of 15,630,000 pounds worth $245,000 annually. O. S. L.

Hardwood Record, December 25, 1915.

Fire Resistance of Wood

Tests made in Seattle, Washington, at which quite careful records were made, show that a three-inch wall of wood is more resistant to an exterior fire than an inch thickness of wood covered with sheet iron. A small structure 4 by 6 by 8 feet was built with one wall of ⅞ inch shiplap lined on the inside with sheets of galvanized iron; the other three walls were of

3-inch tongue and grooved stuff painted with two coats of white lead and oil. Openings were arranged for draft and a fire was built inside. The progress of destruction is shown in the records following:

Time in Minutes	*Temperature Degrees F*	*3-inch Wood Wall*	*1-inch Wood Wall with Galvanized Iron*
7	800	Paint started to burn	....
10	1300	....	Dense smoke through cracks in shiplap
19	2050	....	Shiplap begins to flame outside
25	2125	Outside still cold	....
30	2225	....	Four top boards burned through
40	2175	Red coals appear near bottom	....
43	....	Fire extinguished with water	

O. L. S.

The Lumber World Review, December, 1915.

Shoemakers' Wood Use

The use of wood for shoe-making seems to be increasing, although no records are available to show at just what rate. The wooden heel is at present gaining ground on account of the high-heeled style in women's shoes. More than a dozen factories in Massachusetts manufacture them, and many turn out 500 dozen pairs per day. One firm has made wooden shoe heels continuously for 20 years. Sugar maple, Paper birch and beech are used. Shoe shanks that fit under the arch of the foot are made from wood for many shoes. Veneer of Paper birch and Sugar maple is used almost exclusively. Shoe pegs and "peg ribbons" are made from Paper birch. The "ribbons" are long strips as wide as the peg is long, peeled from the log. They are fed into a machine which splits off a peg and drives it as the shoe passes along through its process of manufacture. Wooden soles are used around furnaces and where workers are on hot floors. Cottonwood, basswood, willow, maple, birch and beech are all used. There are small factories in the United States that make one-piece, all-wood shoes. Cottonwood is preferred, but basswood, maple and birch are also used.

O. L. S.

Hardwood Record, December, 1915.

Powder from Woodpulp

An extract from the Indian Trade Journal shows that there is not the least difficulty in making as good propelling powder from wood pulp as from cotton. "The best woods for this manufacture are those free from resin, but resinous woods can be purified without difficulty and the Germans have an ample supply of both varieties."

T. S. W., Jr.

The Indian Forester, January, 1916, p. 41.

STATISTICS AND HISTORY

New French Statistics

Dr. Endres abstracts from the newest (1912) official work of the French government "Statistique et Atlas des Forêts de France," par M. Lucien Daubrée, Directeur général des Eaux et Forêts, in two handsome volumes of 726 pages.

Each department is treated by itself, the text being accompanied by a map, "the most perfect that has so far appeared in this line." The text goes into the minutest detail of forest conditions, stands, yields, ownership, etc. A summary at the end mechanically repeats the statements for each department alphabetically without attempt at regional compilation. The statistics are for the year 1908.

The forest area comprises 24,420,000 acres, or 18.7 per cent, and .62 acre per capita; but 5.1 per cent of this is unproductive waste. The mountainous departments have the largest forest areas with over 30 per cent, except that the Landes, Var and Gironde exceed all others with 55.4, 49.5 and 46.2 per cent. The smallest per cent is found in the coast departments, where they vary between 3 to 6 per cent.

The 12.1 per cent of State forest and 19.7 per cent of communal forest (31.8%) 3 are under the régime forestier, 2.7 per cent of communal forest and the 65.5 per cent of private forest, mostly in small areas, are without State control except the limiting of clearing in protective areas.

The largest private ownership is found in the planted forests of Landes and Gironde, the largest State ownership in the Pyrenees, Vosges and Alps.

Two thirds of the total forest area is occupied by coppice and composite forest, only one third is in timber. Only 20 per cent is coniferous, and most of the timber forest, 58.9 per cent of its possessions, is in the hands of the State. Besides 9.3 per cent of the State property is in process of conversion from coppice to timber.

The production is poor, only 35.7 cubic feet per acre, of which only 28.6 per cent is workwood (as against 50+ cubic feet and 40.6 per cent for Germany). The production in the State forests is only slightly higher than the average, namely 38 cubic feet, with, however, a higher workwood per cent, namely 36.2. Per capita, the workwood production is only 6 cubic feet, less than half that of Germany. Yet the importation is not large and very variable from year to year, between $20 and $50 million; in 1911, 70 million cubic feet were imported, which brings the total workwood consumption to around 8 cubic feet, as compared with around 20 cubic feet in Germany, which imports (without wooden ware) around $80 to $90 million.

The reviewer, then, gives details regarding the forest areas in the departments at present occupied by the German army, and in another section those of the more important other forest territories. The occupied territory comprises over 5 million acres in 9 departments. These detail descriptions are of interest only by the incidental information on forest conditions and productivity, which, however, in the form given do not lend themselves to generalization.

The most densely forested departments of the occupied territory are the Ardennes, Meuse (Argonnes), Meurthe-et-Moselle, and Vosges; the latter with 37 per cent. The Pyrenees, Alps and Jura are the forestally important districts outside the war country. Corsica is also briefly described.

Die neue Forststatistik Frankreichs. Forstwissenschaftliches Centralblatt, January, February, 1916, pp. 18–26, 84–98.

Saxon Forest Finance

The usual tabulation of the financial results of the Saxon State Forest administration, given in great detail for every revier and district, for the year 1913, exhibits the following totals:

Wood growing forest area		426,312 acres
Planned fellings		29,624,000 cubic feet
of which workwood		82 per cent
Actual fellings, all sold (66 cubic feet per acre)		28,355,566 cubic feet
of which workwood		85.7 per cent
Receipts		$4,169,000
Expenditures:		
Administration	$493,800	
Improvements	375,700	
Woodchoppers	517,885	
General	66,915	
Total		$1,454,300
Net income		$2,715,700
Per acre	$6.33	
Per cubic foot	9.5 cents	
Forest capital		$103,250,000
Forest per cent		2.63 per cent

The large amount of expenditure on improvement (capital account?) is particularly noticeable. On the whole, this showing differs but little from the preceding year (briefed in F. Q., xiii, p. 406), the net income being slightly less. The lowest forest per cent for a single revier figures out .12, the highest 4.15. This time only six reviers remain below 1 per cent as against 10 in the previous year, but also only two bring over 4 per cent as against 7 in the previous year.

The fact that not the actual capital investment, but a present sale value is the basis for finance calculation renders it impossible to figure the real profitableness of the business.

Compared with 10 years ago, the net income, with nearly the same cut, has increased over 40 per cent, the expenditures only 12 per cent, and the expenditures for improvement have increased over 50 per cent.

Die Reinertragsübersichten der Kgl. Sächs. Staatsforsten für das Jahr 1913. Tharandter Forstliches Jahrbuch, 1915, pp. 419–31.

Bavarian Statistics

From a very comprehensive discussion of forest conditions in Bavaria by Dr. Endres, we quote a few interesting figures comparing conditions in 1900 with those of 1913 for the total Kingdom.

The age class distribution is given for the different species. It shows decidedly an excess in old stands for the age class over 120 years, which a few years ago was charged against the State administration as irrational; 20 per cent of the spruce area is over 100 years and 40 per cent of the fir area. The age classes show that since 1833 to 1852 no progress had been made to propagate pine, while for spruce and fir an increase in the youngest age classes of 29 per cent has taken place.

The wood yield in the 14 years has increased 16.7 per cent, the increase being specially noticeable in workwood, the workwood per cent having increased from 53 to 57.4 per cent. The stoutwood product in 1913 having come to 55 cubic feet per acre for the whole State, the State forests produced 74 cubic feet. The greatest increase in production (34.5%) is recorded for the State forests, while in private forests the increase was only 2.4 per cent. Bavaria is the one State in Germany which exports surplus, almost half its cut, to other parts of Germany, which imports altogether in the neighborhood of 500,000,000 cubic feet. There has been an increase of forest area for all Germany of 1.63 per cent since 1900, for Bavaria 1.13 per cent (Saxony and Alsace-Lorraine alone experiencing a reduction).

Die forstwissenschaftliche Bodenbenutzung Bayerns in Jahre 1913. Forstwissenschaftliches Centralblatt, November, 1915, pp. 499–519.

Forest Labor

A close canvass of labor conditions in the Bavarian Forest Department is of interest on account of the completeness of the inquiry. The first thing that will strike the American reader is that of the around 75,000 laborers 42 per cent are women and boys. These latter are, of course, used mainly in planting and other light labor in spring and summer, while winter work falls to men. Counted by days of labor, however, $^4/_5$ of the work is done by men. Only 22 per cent of the 43,107 men are forest laborers by "profession," and if 200 days in the year are counted as full work the number of men doing full year's work is reduced to less than 10 per cent, or 4151. About $^9/_{10}$ of all persons occupied in forest labor give less than half a year's time, and in the average hardly 2½ months. Altogether, the labor days represent 15,119 full 300-day years. The requirement per 100 acres is given as 224 labor days, less than 1 man per year. There is, however, from district to district a variation from 150 to 370 labor days per 100 acres noted.

Logging labor consumes 59 per cent, of which, however, 88 per cent is done by contract or by the piece; road building requires 11 per cent; cultures, 24 per cent; other work, 6 per cent.

Of all the work, 54 per cent is done under contract. The length of day for day labor varies from 8 to 10 hours, according to season.

The pay varies very considerably from district to district. Men get from 40 cents to 87 cents, or 56 cents on the average, but in logging by the piece the earnings may rise to as high as $1.75, averaging 75 cents in winter and 95 cents in summer. The contract price for most districts is about 60 to 70 cents per 100 cubic feet logs of hardwoods and 10 per cent less for softwood logs; cordwood is cut for 70 to 90 cents. Woodchoppers' wages have risen since 1900 more than wood prices.

Women's wages average only a little over 40 cents, 73 per cent of men's wages; boys' and girls' not over 36 cents.

The wages are mostly paid bi-weekly, the foreman collecting and disbursing them for a 2 per cent commission.

In the high mountains, the administration furnishes shelter, straw and blankets, and elsewhere at least shelter.

Of course, all the general insurance and aid for the sick applies to forest laborers. For the full year (1908), the care of sick, given entirely free of cost, amounted to nearly $2 per head for 26 weeks. Invalid insurance, paid half by the State, amounts to $1.60; accident insurance, to $3.34; altogether "social care" requires $10.96 per laborer for full time.

In concluding the review in the Swiss journal, the writer expresses the expectation of a wholesale emigration after the war.

Die Forstarbeiter. Schweizerische Zeitschrift für Forstwesen. January-February, 1916, pp. 23–30.

German Forest Problems

Dr. Borgman discusses interestingly forest political conditions and post-bellum problems for Germany. Germany's import of workwood has in the last 10 years risen from about 350 million to not less than 500 million cubic feet, equivalent to 40 per cent of the consumption, the home product satisfying hardly more than 60 per cent of the consumption. Shortage, especially of mine timbers has been felt since the war, and increase of home production will become necessary even after the war by reduction of unprofitably high forest rent rotations, increased thinning practice, and reduction of superfluous growing stock, as well as by supplanting poorly growing old timber by vigorous young stands. All of these measures will also improve the financial result through improved value increment, both absolute and relative.

The forest reserve fund question is also discussed in this connection and the use of these funds for purchase and reforestation of waste areas.

Even for Saxony, the author asserts that the forest administration could be made more profitable by using accumulated excess forest capital. On the other hand, the author cautions against confounding capital and rent, and if the war leads to over-cutting, the forest should be credited with its contribution to the general industrial reestablishment and a return to sustained yield management made possible.

After the war, tariff politics, development of transportation, wood trade, and new commercial treaties are expected to occupy attention, and especially new relations in this respect with Austria. Extension of forest area and assistance to forest owners, reorganization of forest departments, education and association problems are touched upon, and the article closes with confidence in ultimate victory.

Forstliche Tagesfragen. Tharandter Forstliches Jahrbuch, 1915, pp. 456–71·

Effect of War on French Forests

Perhaps the most authoritative statement that has yet been published is given by C. de Lesseux, summarizing the class and amount of material used for specific military purposes and the damage resulting from actual fighting. According to this authority, the average trench requires about one stacked cubic meter of wood per ten meters of trench. This is used for barricades, benches, elbow rests, etc. The shelters of various types require 5 to 20 stacked cubic meters per shelter, while the artillery screens average 40 to 50 meters. This means an expense for wood of about 6,000 francs for a complete battery, including munition shelters. These figures, however, are often exceeded since the shelter for some single guns has cost from 2500 to 2700 francs each. Aeroplane covers, to protect guns against observation by aeroplanes, usually consume about 35 meters. An ordinary block house consumes 2500 to 2700 francs worth of wood.

At the commencement of the war, before the heavy artillery was brought into action, the damage was usually localized and, for the most part, small. At some of the passes, small areas were completely destroyed because of intensive operations. After the heavy artillery got into action, the damage became more complete. At such places as Hartmannsvillerkopf, the forest was completely destroyed by bombardments. This destruction was often very rapid. For example, on July 23, 1915, on the north slope of Schratzmannele, opposite the French positions, a very dense pole wood was ¾ destroyed in less than a day. By the middle of September, there was nothing left of this particular forest. In spite of the numerous bombardments, however, there has been very little fire. Only one fire of any size is recorded, namely, on July 25, 1915, in the attack on Linge, the forest was lighted by French artillery on a north slope and resulted in heavy damage to the German defense, since it made visible their trenches, barricades, and barb wire entanglements. In addition to actual destruction by fighting or for use in fighting, considerable forest areas were denuded to facilitate artillery. The construction and heating of temporary camps has also consumed a great deal of wood.

Lesseux concludes that the French forests have paid a large tribute to the war.

T. S. W., Jr.

Revue des Eaux et Forêts, April 1, 1916, pp. 110-6.

NEWS AND NOTES

With the beginning of the year, the first Chinese Forest Service has been inaugurated under the Department of Agriculture and Commerce. The Minister of Agriculture, Mr. Chow-tsz-chi, is credited with the initiative and with a genuine desire to make this Service effective, taking a very active detailed interest in its organization. The Vice-Minister, Mr. Ching, is ex-officio Director-General of the Service, and Mr. Forsythe Sherfesee, for six years employed in and lately Director of the Philippine Forestry Bureau, on leave of absence for a year, has been called to act as Adviser and Co-Director, another Co-Director being Mr. Ngan Han, who studied forestry in Cornell and Michigan several years ago, published an elementary forestry book in Chinese, and secured experience in Manchuria regulating the operations in government timber concessions. There is also on the staff one other foreigner, Mr. William Purdom, coming from Kew Gardens, who acts as botanist and collector of the most necessary data, at present entirely lacking.

It is proposed to organize the Service in six divisions, Investigation, Reforestation, Education, Propaganda, Provincial, and Clerical.

The first difficulty will, of course, be the finding of men capable to carry on the work in the absence of native foresters until they can be educated. In the present temper of the people, it might be difficult to employ any more foreigners. We are not informed whether the forest school founded at Mukden a few years ago is still running.

While all this is interesting news, it would be strange if the rule of "ups and downs" which has beset the development of forestry practice in other parts of the world should fail in China. Indeed, we expect no clear sailing, especially in these revolutionary times. The developments which come from political changes may displace the forest-friendly head of the Department and substitute a less favorable one; besides, there are peculiarities and complexities in carrying on government, and obstacles which we in the West do not need to consider. If we were correctly informed, a first attempt at a Department of Agriculture and

Forestry was made three years ago under the leadership of C. S. Chan; two years ago the Chinese National Conservation Bureau discussed the matter of reforesting at the headwaters of the Yellow River. The Germans, too, at Tsingtau and Kiaustschou had started plantations which were so successful as to encourage private imitation with plant material furnished by the Germans.

In this connection, we can refer those readers who are interested to an article by Rosenbluth, published in FORESTRY QUARTERLY, vol. X, p. 647, on "Forest Conditions in China," and another article by P. C. King, a Chinese forestry student at Cornell, suggesting details of an organization for China, in FORESTRY QUARTERLY, vol. XII, p. 578.

To not only extend, but wisely direct the use of wood materials has become a special function of the National Lumber Manufacturers Association in its Trade Extension Department. This is of interest to foresters especially because this powerful Association has seen fit to entrust this work to trained foresters. Mr. E. A. Sterling starts with an Introductory Publication entitled, "Structural Timber" (January, 1916), in which he explains the object of this work and pleads for a rational use of wood in construction, analyzing the many engineering phases connected with the use of structural timber. The reference to the fire hazard of wood structures is cleverly handled, the fallacy of drawing conclusions from a comparison with European experience being disclosed. "To say that the annual fire loss in the United States is $2.50 per capita against 58 cents in Europe is to ignore a necessary measure of value. The fact that the United States has about three and one half times the number of fires and also very nearly three times the number of buildings leads to the simple conclusion that Europe has fewer fires because it has fewer (wooden) buildings." Foresters will find much useful reading in these "Engineering Bulletins," which we understand can be secured free of charge from the Association.

Mr. R. H. Campbell, Director of the Dominion Forestry Branch, discussing in the *Canadian Engineer* the question, "How Long Will Our Timber Last?" very properly considers it futile to estimate the probable date of exhaustion. Even if the data of supply were on hand, which they are not, the data of consumption are most variable. "We can hope to postpone exhaustion of supply indefinitely" by proper forms of conservation, such as the use of inferior material. That this is being done now the writer demonstrates from price movements. In the last five years the average price of lumber has increased slightly compared to the increase in value of the best grades. In 1900, "White pine good sidings in Ottawa was from $33 to $38; in 1914, $58 to $65, an increase of $2 per year. The average price for White pine lumber in 1908 was $20.03, in 1913, $20.79, an increase of only 15 cents a year.

On May 4, a National Conservation Congress was held at Washington, D. C., the result of which has been a serious setback to the Conservation movement. As at the last Conservation Congress in 1913, the question of how to handle the national water powers was the principal problem to be discussed, and this time the advocates of handing over the water powers to private exploitation had the upper hand over the advocates of adequate national control. Two measures, the Shields bill and the Myers bill before the U. S. Senate, were endorsed by an overwhelming majority, which bills provide only a nominal control and conditional recovery of the granted privileges after 50 years.

There can be an honest difference of opinion as to what in detail is the best policy for developing the national water powers under federal control, but a close analysis of the two mentioned bills will leave little doubt that they were drafted by and for grabbers of natural resources rather than by patriotic citizens, and that the introduction of the clauses of perfunctory control was to serve only as a sop and to blind the innocent conservationists as to the real purpose.

A committee on forestry headed by Professor J. W. Toumey, presented a resolution advocating extension of National, State and communal forests, which seems also to have been lost. Mr. Zon, as Secretary of the Committee, was responsible for a report to which we expect to return when in print.

A committee of five members was appointed to represent the Society of American Foresters.

Prof. Richard T. Ely, Professor of Political Economy at the University of Wisconsin, has in preparation a volume on Conservation, which he anticipates by a paper submitted to the February meeting of the American Institute of Mining Engineers, entitled *Conservation and Economic Theory*, and which is printed in Bulletin No. 109 of the Institute and also appears in reprint. Prof. Ely was one of the first among the economists who occupied himself with this subject, before the name had become familiar and while it was still mainly forest conservation. He recognizes the fact that the foundation for the conservation movement was laid by the pioneers in the forestry movement. In discussing some economic principles of conservation, he makes the statement, "the higher the price of land, the better the farming in the absolute sense," and denies that the high products from the land is the cause of intensive farming. In forestry, this would probably not hold: the higher price of the product makes forestry principles practicable. Another interesting statement is that "the conservation of human resources limits the conservation of natural resources," having reference to a reduction in labor cost as conducive to improvement in farming, accentuating that in the final analysis conservation problems depend in their solution upon individual social philosophy. "We need a keener social consciousness and a new state-sense if we are ever to solve the problems of conservation, and the solution can be put in force only by conservation commissions."

To arrest the ravages of the White pine blister rust, which has now gained a foothold in six eastern States and is suspected in the Ohio Valley, the United States Department of Agriculture, through the Federal Horticultural Board, has sent to all eastern nurserymen an urgent request not to ship White pines, currants and gooseberries west of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and Texas. At a conservative estimate, the value of the Government and private holdings in these forests is $240,000,000.

At the same time, the Department has issued a warning to the States within the range of the Western White pines, of the danger of allowing nursery stock of these three kinds, from eastern nurseries, to enter their territory.

The forest fire statistics of Pennsylvania show that in 1915 the losses total up to $850,000. Some 42,000 acres of State forest and 295,000 acres of private forest were burned over, and $32,000 was spent in extinguishing fires. Railroads are still the largest single cause—an almost entirely avoidable cause, as is being demonstrated in Canada.

The average fire covered 300 acres, did damage estimated at $775, and cost $30 to finally extinguish. It is found that 77 of the 1,101 fires burned over 1,000 acres each, or about 60 per cent of the total burned area, showing that these larger fires need particular attention of the protective service, which has by the last legislature been created into a Bureau of Forest Protection with an appropriation, to be sure, of only $45,000. The total number of wardens charged with fire protection is now 1800; but the appropriation is too small to use this force effectually, and is only just about one fortieth of the loss for 1915 in timber alone. But as a newspaper editorial points out, the indirect loss caused by keeping unproductive 5,000,000 acres of forest, every acre of which is burned over once in ten years; the loss of floods, water famines and impure water supply; the loss of taxes due to depreciation amounting to about $300,000, and other such losses may aggregate 15 to 25 million dollars.

A striking tribute to the efficiency of the fire protection work of the State Forest Service is conveyed in the reduction of the insurance rate for Northern Minnesota by the State Insurance Commissioner to that prevailing for Southern Minnesota. The aggregate of the reductions far exceeds the total appropriation for the whole forest service.

The forestry work of New Jersey, which was first carried on by the Geological Survey, then by a forest commission, has grown into wider scope in 1915 under the Department of Conservation and Development, Alfred Gaskill Director, which is charged by law with the "full control and direction of all State conservation and development projects and of all work in any way relating thereto, except such work as is conferred on other boards." This Department works under a Governing Board of eight appointees with two Divisions, namely that of Geology and that of Forestry and Parks. A pamphlet lately issued describes very briefly the features of the State as basis for such development.

For elegance of appearance in paper, print and illustration, *The Empire Forester* (should be Empire State Forester), the annual publication of the students of the New York State College of Forestry at Syracuse, takes first rank. The contents of the hundred odd pages are very varied and besides contributions of students, contain short articles by several professors and outsiders. By an unfortunate lapse on the part of the proofreader, Mr. Fernow, giving a brief statement regarding the formation of the first New York State Forestry Association in 1885, is made to say that Mr. Roosevelt at the organization meeting over which he presided "perhaps for the first time had the subject of forestry, of conservation, brought to his closer attention," and then is made to continue, "This was a misfortune, for the gentleman, however good with his pen, had not the art to make himself agreeable to man." This in the light of the future doings of this "gentleman," would astonish anybody, even a proofreader. The blunder consisted in leaving out a paragraph which referred to a reverend gentleman who was elected secretary, and to whose door may be laid the failure of the Association.

The Canadian Forestry Association, during the last year, since Mr. Robson Black became its Secretary, has launched a remarkably diversified propaganda to arrest public interest. The newspapers have been plied by articles and cartoons as never before, the Journal of the Association has set a new standard of propaganda, the Boy Scouts have been enlisted with booklets, prizes, etc. The latest is an edition of 25,000 booklets entitled "A Matter of Opinion," giving in commonplace conversational language expression to the attitude of the past and appreciation of the modern situation by various classes of citizens, the settler, the camper, the banker, the railway man, the power engineer, the fire ranger, the taxpayer. If democracy means the prevailing of public opinion, this flood of sane, informative literature should do much to waken up the democratic spirit and lead to results.

The Minnesota Forestry Association has effected combination with the Game Protective League in making the little, neat publication, *The North Woods,* the official organ of both Associations, under the title, *The North Woods and Wild Life.*

During a Southern Logging Association meeting two hundred and twenty-three questions concerning pine operations were submitted to the logging superintendents present. These questions, with a summary of the answers, are given in the *Southern Lumberman,* of October, 1913. They include many phases of the logging business, varying from costs of different operations to kinds of animals used for skidding, food value of different grains, kinds and sizes of different parts of equipment, camp board, amusement, home life of men, wages, durability of equipment, and many other items. The answers are illuminating, in spite of the small number answering each question.

Yale Forest School is about to institute "research and instruction in tropical forestry" and has appropriated $5,000 for two years for this purpose, to start the new enterprise the next academic year.

The New York State College of Forestry at Syracuse University, announces University Extension work in forestry, in charge of Shirley W. Allen. In the circular, it is announced that four technical foresters give their entire time to this State-wide educational work. The College offers a regular reading course in Lumber and Its Uses, for which a charge of $5 is made. A traveling forestry library is also one of the methods employed.

An interesting development in the education of the general public to secure a proper attitude towards forestry is the summer camp in the Adirondacks instituted by the New York State College of Forestry three years ago, which is designed especially for high school boys. The camp for 1916 will open on August 2, at Raquette Lake Station, under supervision of W. A. McDonald, who will give instruction in elementary forestry and woodcraft through the month. Lectures on plant relationships, on common animals and insects, and on beneficial and injurious fungi, will be given by specialists.

A very complete outline for Study of Lumber Operations by Students has been prepared by Mr. H. H. Tryon, of the New York State College of Forestry at Syracuse University, as Bulletin No. 7, Vol. XVI of the University publications.

A readable account of the work of the Mont Alto Forest School is to be found in *Forest Leaves*, April, 1916. It appears that the school has so far graduated 78, of whom 60 are employed in the State Forest Service, 8 in other forestry work, and only 7 in other callings, 3 having died. Much stress is laid on the location of the school in the forest, which, by the way, is said to be in first-class condition and already paying one third of its cost of maintenance. The advantage of such location is, however, in part offset by the loss of the advantages which come from the contact with other interests at a University. The old controversy between the advocates of University and Academy for forest education will never be settled for the advantages and disadvantages of either location are compensatory; hence we need both to develop different classes of men.

From exhibitors at the Panama-Pacific International Exposition, the University of California has received a large amount of demonstration material for forestry, including the very complete collection of Japanese lumber presented by the Japanese government, and representative samples of the principal woods of China, Honduras, and Guatemala. Sweden gave an exhibit showing by-products obtained through distillation of wood. The C. A. Smith Lumber Company presented its entire exhibit of different woods, cut on its holdings in the Coos Bay region. The Louisiana State Commission gave samples of eastern lumber, a tapped Longleaf pine tree trunk, and products obtained by the naval stores industry. A large amount of other demonstration material has been donated by lumber and manufacturing establishments.

Mr. Shoitsu Hotta, Assistant Professor of Forestry at the Tokyo Imperial University, has entered the Yale School of Forestry as a candidate for the degree Master of Forestry. Mr. Hotta will be in the United States for a period of two years.

The forest academy at Eisenach, which had been founded in 1830 and had produced many noted foresters, among whom Koenig and Stoetzer, has been abolished, partly due to financial difficulties due to the war. In the last semester before the war, of the 78 students 30 were foreigners, mostly Russians.

H. R. MacMillan, Chief Forester of British Columbia, now under temporary appointment as Dominion Trade Commissioner, is expected to return to Canada in September, from his tour of the world in the interest of the wider use of Canadian timber.

The work of the British Columbia Forest Branch is being seriously hampered through enlistments for service at the front. In all, 81 members of the staff have enlisted, of whom 9 are forest school graduates and 8 are forestry students.

P. Z. Caverhill, Provincial Forester for New Brunswick, has made plans for the beginning of field work, in connection with the survey of Crown lands. He will be assisted by G. H. Prince and H. C. Belyea, both graduates of the Forestry Department of the University of New Brunswick. Prince recently resigned his position as District Forester in the British Columbia Forest Branch to take up this work. Belyea is now completing a graduate course at the Yale Forest School. In addition to the work of the survey parties, Prof. R. B. Miller, with some of his students, will this summer make some volume and growth studies.

The Boy Scouts' Association of Canada has made provision for the issuance of a Forestry Badge, to members passing the prescribed test. This is a material expansion of the previous provision for a Woodman's Badge.

It is expected that the reports on the forest resources of British Columbia and Saskatchewan will be completed in July. Data for these reports have been in process of collection by the Commission of Conservation during the past two to three years. Dr. H. N. Whitford and R. D. Craig have been in charge of the work in British Columbia, and J. C. Blumer in Saskatchewan. Close cooperation has been afforded by the British Columbia Forest Branch and the Dominion Forestry Branch, as well as by a large number of limit-holders and private owners.

The Dominion Forestry Branch has lost 37 of its regular staff through enlistment. Of these, 10 are forest school graduates, 8 are technical men (not foresters) from the Forest Products Laboratories at Montreal, and 19 are non-technical men. In addition, about 20 men have enlisted who were regularly employed for the summer season only, on such work as fire-ranging, etc. One of the men from the Forest Products Laboratories was killed in the Battle of Langemarck.

In his recent botanical exploration of Panama, Mr. Henry Pittier discovered a tree known to the natives as *alcornoque*, and to which he has given the name of *Dimorphandra megistosperma*. The species name has reference to the enormous seeds borne by the tree, exceeding in size those of any other known dicotyledonous plant. Mr. Pittier collected some of these seeds over 7 inches long by 4.7 inches broad, growing in pods nearly 10 inches long. The tree is allied to the *mora* of Guiana, and grows to heights exceeding 100 feet. Its wood is said to be better than any other for structures kept permanently under sea water.

A "meeting for those interested in the formation of a Great Plains Forestry Association" had been called for December 31, 1915, at Columbus, Ohio, in conection with the meeting of the American Association for the Advancement of Science.

A program was announced in which E. H. Clapp, of the U. S. Forest Service, F. Dunlap, of Missouri, C. A. Scott, of Kansas, Dorr Skeels, of Montana, J. H. Foster, of Texas, took part. Besides questions of organization, tree planting problems in the different States represented by these men were discussed.

The meeting was not very well attended, but a society was formed under the title, "The Midwest Forestry Association," with Dr. F. Dunlap, of Columbia, Missouri, President. Another meeting was to be called for May 20, at Kansas City, to formulate more definitely the problems of the new society. There seems still an open question whether this is to be a propagandist association or made up of practising foresters.

A Southern Forestry Congress is to meet in Asheville, N. C., July 11 to 15, with a view to discussing the particular needs of the

Southern States as regards forestry. The call is issued by Joseph Hyde Pratt, State Geologist of North Carolina, as president, and J. S. Holmes, State Forester of the same State, as secretary. A number of associations, forestry and manufacturers, are invited to be represented, and it is proposed to form an Association of Southern Foresters. Excursions to the Biltmore Estate and to the Pisgah National Forest are planned. Mr. W. L. Hall is appointed representative of the Society of American Foresters and it is contemplated to hold an open meeting of the Society at the same time.

Mr. Roy L. Campbell, B. A. and B. Sc. F., 1914, of the Faculty of Forestry, University of Toronto, has been appointed Secretary of the Dominion Trade Commission, who will travel about three months in England, France and Italy, with the object of finding means for the extension of Canada's foreign trade. The Commission sailed from New York in the fore part of May.

A committee to design a badge for the Society of American Foresters was appointed last year, with Mr. C. R. Pettis as chairman, who reports that a pin in the shape of a shield has been selected, of size and weight like that of the Society of Civil Engineers, green enamel with letters and border in gold. The price is $3.25. Orders for pins should be sent to the Secretary, Mr. C. R. Tillotson, accompanied with the price.

PERSONALITIES

1. *Northeastern United States and Eastern Canada*

Horace W. Chittenden has severed his connections with the Lehigh Valley Coal Sales Company, and is now with John M. Nelson, Jr., in the wholesale lumber business, with an office at 115 Broadway, N. Y.

James L. Grimes is forester for the towns of Pitts, Knoxville, and Carrick near Pittsburgh, Pa.

Nelson C. Brown has been elected chairman of the forestry committee of the Empire State Forest Products Association.

Nelson C. Brown, Professor of Forest Utilization in the State College of Forestry has been in New York completing field investigations of the wood distillation industry. While in New York City, Professor Brown was able to get in touch with the industries which have developed from the bringing in of tannin extracts from South America. The information which Professor Brown has secured will be used in a bulletin on this phase of the wood-using industries of the State.

F. F. Moon, Professor of Forest Engineering in the New York State College of Forestry, spent a week this spring in Central New Hampshire. While there he visited the holdings of the Yale Forest School at Keene and several other large plantations in the same section.

Richard H. Goode is engaged in the timber brokerage business at 88 Broad Street, Boston, under the firm name of the Imperial Lumber Company.

The wedding of Miss Elsie V. Myers and Bernard R. Levy took place in New York on February 29. Levy is with the International Paper Company of Bangor, Me.

Edward R. Linn, of the Brown Corporation, Taschereau Beauce, Que., was married on February 12 to Georgene W. Greenwood at Columbus, Ohio.

John F. Heck and Miss Eva F. Wilson, of Watertown, S. D., were married on December 28. Heck is connected with the Berlin Mills Company, N. H.

Stanley B. Hall, formerly with the Forest Service, has opened an office at 101 Milk Street, Boston, for the special practice of law as it affects timberlands, lumber concerns, and their interests. Hall retains his connection with Miles and Hall, Consulting Foresters, at the same address.

William D. Hayes is now connected with the Langtown Lumber Company of Redington, Me.

R. R. Bradley, Forester for the New Brunswick Railway Company, was married on April 19, at Ottawa, Ont., to Miss Elizabeth Blackburn Bryson.

A. C. Volkmar, formerly of the U. S. Forest Service, is forester for the Riordan Pulp and Paper Company, at St. Jovite, Que.

W. J. Boyd, B. Sc. F., University of Toronto, 1916, was married on May 2 to Miss Cleda Sara Singleton, at Kingston, Ont. Mr Boyd has enlisted for Overseas Service and holds a Lieutenancy Commission with the Fifty-third Battery.

C. H. Morse, B. Sc. F. and B. A., University of Toronto, 1915, has enlisted for Overseas Service with the 224th Battalion, the Foresters' Battalion.

2. *Southern United States*

The marriage of Miss Marian F. Sturtevant of Washington, D. C., and William B. Barrows occurred on January 22. Barrows has for several years had charge of the Division of Forest Measurements in the Washington office of the Forest Service.

Arthur Dubois is connected with the Florida Plantations Company with headquarters at 37 Wall Street, New York.

Mrs. John H. Mitchell has announced the marriage of her daughter, Dorothy McGuire to Walter G. Schwab on February 22 at Washington, D. C. Schwab is connected with the State Forestry Department, Baltimore, Md.

William J. Mills, formerly Vice-President of the Case-Fowler Lumber Company, at Macon, Ga., is President of the newly formed Boxer-Mills Company with offices in the American National Bank Building, Asheville, N. C.

3. *Central United States*

Carl Crawford has been elected President of the American Wood Preservers Association.

Walter M. Gleason has sold his interests in Wyman's School of the Woods and expects to enter the field of lumbering in the near future.

R. F. Fenska is teaching at Wyman's School of the Woods, Munising, Mich., as is also R. J. Guyer.

G. Harris Collingwood is taking graduate work in Economics at the University of Michigan.

4. *Northern Rockies*

Joseph H. Potts was killed on January 4 by the overturning of his automobile. Potts was graduated from the Biltmore Forest School in 1909 and was an ex-Forest Examiner in the Forest Service; at the time of his death he was Secretary and General Manager of the Wyoming Tie and Lumber Company.

R. M. MacMurray, Yale Forest School, 1907, died on August 1, 1915. MacMurray was formerly in the employ of the Forest Service and of the State of Montana.

Clinton G. Smith is now Chief of Silviculture in District 4 of the Forest Service, headquarters at Ogden, Utah.

Solomon E. Perlman was married in New York on January 23 to Miss Goldstein. The Perlmans are located at Thompson Falls, Montana.

W. E. Jackson, of the Forest Service, and Miss Nancy Robb, of Nicholasville, Ky., were married on November 24, 1915.

5. *Southwest, including Mexico*

It is reported that Paul Redington has been appointed District Forester at Albuquerque, New Mexico, in place of Arthur C. Ringland who held the position since the inception of the District in December, 1908.

Milton K. Lockwood is superintendent of logging for the Laguna Corporation holdings, at Matamoros Camp, near Campeche, Mex.

6. *Pacific Coast, including Western Canada*

M. A. Benedict has been transferred from the California to the Sierra National Forest to replace Redington, and J. D. Coffman from the Trinity to the California, vice Benedict.

The marriage of Thornton T. Munger, of the Portland office of the Forest Service, and Miss Mary E. Heilman, of Evansville, Ind., took place on May 18.

Henry B. Steer, who received the degree M. F. from Cornell in 1915, has been appointed Forest Assistant on the Quinault Indian Reservation near Taholah, Wash.

Allen H. Hodgson has been transferred from the office of Lands at Portland (Forest Service, District 6) to the office of Operation, where he will have charge of the Section of Geography.

The marriage of Miss Helen Adams of Kingston, N. Y., and George A. Bright occurred on February 4. Bright is stationed at the Portland office of the Forest Service.

Neal T. Childs has sold out his nursery business and is devoting himself entirely to landscape engineering and consulting forestry. His address is Foxcroft Building, San Francisco.

Davis W. Lusk has been promoted to be Supervisor of the Dominion Forest Reserves, situated in British Columbia.

George W. Hutton, of Olympic National Forest, was married on March 15 to Miss Elsie Wilburn, of Olympia, Wash.

J. D. Gilmour, recently District Forester at Cranbrook, has been transferred to the head office, Victoria.

H. B. Murray, formerly District Forester at Kamloops, is now in charge of the Cranbrook District.

E. B. Prowd, formerly District Forester at Kamloops, B. C., has been transferred to Nelson, replacing G. H. Prince, who has resigned to accept a position in connection with the forest survey of Crown lands in New Brunswick.

L. R. Andrews, formerly District Forester at Vernon, is now in England, a lieutenant in the Canadian Expeditionary Force. At present he is training for aerial service. G. P. Melrose is Acting District Forester for the Vernon District.

7. *Hawaii, the Philippines and the Orient*

W. F. Sherfesee has been appointed as forestry adviser to China and Co-Director of the Forestry Bureau at Peking.

Wilhelm Klemme has resigned from the Philippine Forest Service.

Miss Dorothy Constance of Milford, Pa., was married on February 5, to William Crosby at Manila, P. I. Crosby is stationed at Zamboange, P. I.

COMMENT

During the last year or so the British Columbia Forest Branch has been strenuously and most efficiently at work to secure increased markets for the mill product of the Province. This has been done by installing promotion offices and exhibits at industrial centers and by publishing various series of bulletins. One of these is entitled Farm Building Series, of which eight have reached us, each of which takes up one class of wooden structures, such as General Purpose Barns, Sheep Barns, Horse Barns, Piggeries and Smoke Houses, Poultry Houses, Implement Sheds and Granaries, etc. These bulletins are written for the prairie farmer and give detail instructions, as to plan, dimensions, quantities, etc., and as they are prepared in cooperation with Agricultural College instructors may be supposed to be thoroughly practical.

A second series called the Timber Series discusses British Columbia woods, their uses and proper handling, e. g., How to Finish British Columbia Woods, Boxwoods, Tie Timber, Dimension Timber, Red Cedar Shingles, Western Larch, Douglas Fir, Western Soft Pine (an unfortunate name given to the Yellow pine!). Each of these gives a brief description of the tree, its habitat, qualities of wood and its uses, profusely illustrated. One handsome summary discusses the timber resources of British Columbia in general, and more briefly than in the series the different species and products and their uses in various directions.

A third series appears under the title Markets Bulletin, of which some ten numbers have reached us. While the other series are addressed to the consumer, this series is to keep the loggers, mills and trade informed of market conditions not only at home, but abroad.

To cap the climax of this remarkable activity of the Forest Branch in securing markets, the Chief Forester, Mr. H. R. MacMillan, who is responsible for developing this phase of the Forest Branch, was appointed Special Trade Commissioner of the Dominion Department of Trade and Commerce, and has been traveling for nearly a year to all parts of the world, with a view of establishing trade connections for British Columbia mill products and of furnishing insight through personal knowledge into special requirements of markets.

Of course, all this literature, which is distributed freely by the hundred thousands, is frankly propagandist and advertising matter, but considering the source, must be truthful and authoritative, devoid of extravagant claims which a private concern might make.

From the forester's point of view at first sight, this canvassing would appear out of his field, but as a matter of fact, application of forestry methods can only be afforded when the cost of the dead work—dead for the present—, always involved in any forestry work—work for the future—, is covered by the price obtainable for the present product. To find profitable markets and extension of use of minor materials particularly seems to us a most needful undertaking, especially in British Columbia, where for years the lumber industry has been suffering by its distance from markets.

There is one result which will come to the Forest Branch from this well directed propaganda, which must not be underrated, namely, that it will ingratiate itself with the lumber industry and through that with the politicians, so that it will be possible more readily to inaugurate conservative processes of forestry practices. We congratulate Mr. MacMillan on his enterprise in going out beyond mere routine administrative work!

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FORESTRY QUARTERLY

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THE RELATION OF FORESTRY TO SCIENCE

By Barrington Moore[1]

In every activity the point of view determines the nature of the work and the accomplishment. What is our point of view toward forest research; what constitutes forest research, and what are its aims?

Only recently, on this side of the Atlantic, every forester was an investigator on his own account. Working under new and unknown conditions it was felt to be the duty of every trained man entering the woods to glean as much knowledge as he could and to record this knowledge. His aim was the accumulation of data which would form the basis of silvicultural practice.

The facts so collected, incomplete and fragmentary, form the groundwork of our silviculture.

This collecting of information by observation, though still going on, is giving way to more accurate methods, and the work is being concentrated in the hands of specialists. Forest investigation is becoming a distinct phase of forestry. There are practitioners and there are investigators, as in medicine; for one man cannot do justice to both. Each kind of work requires its own type of mind.

This is the moment to decide what should be the nature and aims of the work of forest investigators. It is agreed that the ultimate aim should be the upbuilding of sound methods in all lines of forestry. But what is our conception of the nature of the work necessary to fulfill this aim?

There are two distinct points of view. There is, first, the point of view of the world at large, that research must aim at solving some definite need of the community, research must be practical. Secondly, there is the point of view of the scientist, who believes that research should seek fundamental knowledge. The acquisi-

[1] Private research, New York.

tion of knowledge, rather than the immediate gain in the wealth or welfare of the community, is the guiding impulse, though the ultimate benefit of society which knowledge brings is always one of the motives of the scientist.

Which of these two points of view guides forest investigators in this country? We must, in all frankness, admit that it is the first or so-called practical point of view. This has not always been the case. Formerly, although the facilities were limited, foresters saw the importance of seeking fundamental facts. They were not afraid of thinking out problems and evolving theories, though realizing that their theories were insufficiently grounded and must be revised from time to time as more knowledge was secured. But today as the opportunities broaden, the viewpoint narrows; and practical considerations rule. This is not research, not science. It is superficial pseudo-science, obvious as such to scientists. Professor Lillie, in *Science* for April 16, 1915, says:

"It is the *fundamental* investigations which are chiefly important for science, and lay the foundations for those later applications affecting mankind generally. Thus, in this sense we owe wireless telegraphy to Maxwell and Hertz rather than to Marconi, our freedom from many forms of disease to Pasteur, our mastery of the air to Langley and others who studied the lifting power of moving planes; and many other similar examples could be given. In general, we may say that if an adequate body of theoretical knowledge has once been gained, it is a relatively easy matter to make the desired practical applications. It is when there is no guiding theory and we have to work empirically that problems are difficult or impossible of solution."

The last sentence well expresses the status of forestry today. Most of the work must be empirical, and many of the problems are impossible of solution until a more adequate body of theoretical knowledge has been gained.

The problems bearing directly on the handling of the forests, or practical problems, must be solved, nobody denies that, but they can be studied by men having the average forest training, while the deeper problems require men of a higher degree of preparation. As a science advances its problems become more complex, research must go deeper. As one forester said, "the binoculars and canteen must give way to the microscope and burette."

Fundamental work has come to include such problems as the intricate relationship between the plant and its environment. The causes of forest types lie at the root of silviculture; to know how to treat a piece of forest, or to plant a denuded area, we must know all the factors influencing the forest or the plantation. So far all efforts along this line have been purely empirical or based on guesswork. It cannot be otherwise until we have determined what are the factors affecting plant life, and what is the response of the plant to each factor and to the various complexes or combinations of factors. This involves, among other things, the quantitative measurement by delicate instruments of the response of the various plant functions to carefully measured, or sometimes controlled, external conditions. Whether trees or herbaceous plants are studied is immaterial to the larger problem, though herbaceous plants offer more promise of evolving fundamental laws which will apply equally well to trees. This work requires a far higher training than that ordinarily received by the forester; it requires thorough grounding in physics, in chemistry, in plant physiology and in other sciences, combined with skill in instrumentation, facility in absorbing vast quantities of literature in foreign languages, as well as a special type of mental ability. It means the hardest kind of work, generally with no popular recognition, because most of the results are but inconspicuous facts in the foundation of knowledge. It is seldom that investigators are able to bring out brilliant and startling pieces of work. But this very lack of recognition is fortunate in tending to exclude from such work all but those possessing the peculiar qualifications, chief among which is an inborn love of knowledge for its own sake.

Many will say that this class of work is beyond the scope of forestry, that it is work for the meteorologist, the ecologist and the plant physiologist. True it is that most of the work which is building the foundations for forestry, such as the work of Shantz, of Livingston and of Cowles, is being done by men who are not foresters, and, what is more humiliating, whose names are scarcely known to the body of foresters at large. This situation, far from being an argument against foresters undertaking investigations of this character, is the strongest reason for their doing just such research. For, unless forestry can contribute its share of fundamental knowledge to the world, it must cease to call itself a science, and drop into the list of skilled trades.

That forestry can make this contribution is proven by the men who have prepared themselves to do true scientific research. It is for the profession to say whether these men shall be allowed the opportunity of giving their training and ability to forestry and to science, or whether they will be crushed under the wheels of the practical juggernaut.

The practical point of view is not peculiar to foresters; it runs through all the scientific work of the country. Professor G. A. Jacobson (in *Science* for October 29, 1915) points out that in Professor Pickerings' tabulation of eminent scientists,[2] America produced only ten scientists accorded the distinction of being elected foreign associates of two or more of the leading scientific societies of the world, whereas Norway and Sweden, with a combined population of less than eight million, have produced nine scientists of the same distinction.

Foresters have been forced, by the nature of their work, into close connection with the economic life of the country. This is advantageous in that it is enabling them to assist in solving some of the great economic problems to the permanent benefit of all concerned. Unquestionably, the strictly practical point of view is essential for foresters as a body. But there must, if forestry is to be more than mere empiricism, always be a certain small proportion of foresters engaged in scientific work. These few men should not, under any circumstances, be forced to assume the utilitarian point of view toward their investigations.

No work comes into more direct contact with economic life than chemistry, for what could countless industries do without chemistry, yet chemistry is not overwhelmed by the utilitarian point of view.

Professor Jacobson's words about agricultural experiment stations, applying as they do equally to forest experiment stations, strike home with peculiar force:

> "The cry in the experiment stations is for something practical, not realizing that the most fundamental is the most practical in the long run."

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[2] *Popular Science Monthly*, February, 1915.

To obtain the best results, the scientist must have freedom. To place an investigator under an administrative officer is folly. This, it has been argued, keeps alive the interest of the administrator in investigative work, and keeps the investigator practical. True, but the harm done is out of all proportion to the benefit received; investigation degenerates into hand-to-mouth empiricism, and the fundamental problems are left untouched.

A HISTORICAL STUDY OF FOREST ECOLOGY; ITS DEVELOPMENT IN THE FIELDS OF BOTANY AND FORESTRY[1]

By Dr. R. H. Boerker[2]

CONTENTS

I. INTRODUCTION

In a recent paper (91)[3] the author attempted to point out in a general way the scope and the methods of forest ecology and to show how this new science can help the silviculturist to work out his problems. The present paper, which is intended to supplement my former article, will attempt to treat the subject of forest ecology in a historical manner, and it is hoped that this study will lead to a clearer understanding of the subject and will suggest to the forest ecologist problems for investigation.

It is becoming generally recognized by foresters, and especially by teachers of silviculture, that a thorough knowledge of forest ecology is essential in the practice of silviculture. Hence, in order to apply forest ecology in all its phases, it is necessary to be familiar with the principles, methods, and aims of the main body of ecological thought, namely, plant ecology. It is logical, therefore, for silviculturists to study plant ecology before forest

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[1] Being the introductory portion of a series of investigations in forest ecology carried on in 1914-15 by the author, at the University of Nebraska, for the degree of Doctor of Philosophy.

[2] Forest Examiner, U. S. Forest Service.

[3] Numbers in parentheses refer to Bibliography at end of article, p. 430.

ecology, and to turn from the hitherto narrow viewpoint of forest ecology to the broader and modern conception of plant ecology. In pursuing this method of study not only does forest ecology become broader in its scope and meaning, but, in turn, it is able to render a greater service to silviculture.

The science of forest ecology is rather difficult to treat historically because it embraces research in two important fields, namely, plant ecology and silviculture. The interrelation between these two fields is a very intimate one. Forest ecology developed long before plant ecology, but mostly along applied lines. For example, in the study and measurement of habitat factors forest ecology antedates plant ecology. Strange as it may seem the real founder of forest ecology was a botanist and not a forester; and even down to the present day both botanists and foresters are working in this field. Foresters have worked out problems in plant ecology because of their direct application to silvics or silviculture. More than 50 years ago foresters studied the influence of the forest upon local climate by means of systematic meteorological observations. On the other hand, plant ecologists have contributed not a little to the field of forestry because plant ecology in its principles and methods includes also the field of forest ecology, and because the forest offers working material, *par excellence*, for the plant ecologist. Plant geographers and ecologists like Schimper and Warming have taken much of their working material from the forest. Certain phases of plant ecology like the study of plant succession have been studied largely in the forest. In the determination of light values plant ecologists and foresters have often worked together in the forest because of the greater significance of the problem there than in smaller vegetation. It is indeed striking to note what a large part of the problems recently worked out by well-known plant ecologists, both here and abroad, have a more or less direct bearing upon silvics or silvicultural practice. On the other hand, foresters have recently largely contributed to the field of plant ecology. Many of the practical problems that are being worked out by forest investigators are really problems of an advanced phytoecological character, notably those investigated by van Schermbeek and Erdmann in Holland and Germany respectively. *On account of these intimate relations of the two fields it is desirable for the proper development of this paper to briefly sketch the* *historical development of plant ecology and then of siviculture, and in so doing trace the progress of forest ecology in both fields.*

In the space allotted to this paper it is obviously impossible to go into many details and still cover the ground. I desire merely to broaden the general conception of the subject by a historical and in part descriptive treatment of the main body of ecological thought (namely, plant ecology), and to show that plant ecology has developed by progressive stages from the study of plant distribution to that of plant associations and formations, and lastly to the study of habitat factors and experimental ecology. I will, then, treat of a similar development in silviculture and attempt to show how it developed from an art based upon empiricism to a science based upon the fundamental natural sciences.

A historical study of this kind, it is hoped, will be of value to the investigator as well as to the teacher. In pursuing it, we leave for the moment the study of the mere facts, theory, and technique of science and turn our attention to the broadening and cultural effects of scientific study. Most of us have heard and read too much of the orthodoxy of science and its tendency towards over-specialization, both in practice and in teaching, and not enough of the appreciation of science from the historical point of view. Therefore, this paper may not be out of time or out of place. The historical development of the principles and methods of a science, the evolution of the science itself, showing its progress from unsystematized simplicity to organized complexity, and the correlation and interrelation between its different phases are subjects worthy of more attention in the future than has been given them in the past.

A historical study of a science like forest ecology, which is of great economic importance, reveals many valuable lessons. History broadens the perspective. The psychologist would say that it strengthens our apperceptive basis for further study. By its study we learn the great men and the valuable literature which have made the science what it is, and we fix in our minds the important dates which indicate milestones of progress. We learn which phases of the subject are new and which had their origin many years ago, and in that way learn to appreciate the present stage of the development of a science. By a historical study of forest ecology in a country like Germany, which is far advanced in that particular branch, we are able to prophesy, to a certain extent, the future development in a country not so far advanced, like our own. At least we can benefit by the experience of others, avoid mistakes and take short cuts.

II. THE HISTORICAL DEVELOPMENT OF PLANT ECOLOGY

In 1866, E. H. Haeckel, the distinguished German naturalist, defined "oecology" as the science treating of the reciprocal relations of organisms and the external world. Until quite recently writers both here and abroad used the term "biology," meaning to cover by it what is now included under ecology; but it is quite clear now that biology is a general term including both botany and zoology and that ecology is a subdivision under each of these. Plant ecology is that branch of botany which comprises the study of the relations of the individual plant, or the species, or the plant community to the habitat. While the term "plant ecology" has come into use only comparatively recently, I am applying this term throughout the history of the science because what was years ago known by another name is nevertheless today included in the modern conception of plant ecology. The same explanation will also hold for my use of the term "forest ecology."

Plant ecology, at the present time at least, is a science with only general delimitations. It overlaps many sciences and its study presupposes a foundation in the basic principles of physics, chemistry, physiography, geology, meteorology, and the morphology, physiology, and taxonomy of plants. It is largely due to this complexity that the science of plant ecology is today so imperfectly organized and systematized. However, a start in this direction has been made. Generally, two aspects of the science are recognized, the one has to do with the individual plant and the other with groups of plants or plant formations. Recently the terms autecology and synecology have been suggested by Schroeter[4] for these fields respectively. Autecology may be further subdivided into morphological and physiological ecology; synecology is sometimes spoken of as physiographic ecology.

The science of plant geography has always been closely allied with plant ecology. For this reason it is desirable to speak briefly of this relationship. Plant geography had its beginnings among

[4] Flahault and Schroeter—Phytogeographical Nomenclature: Reports and propositions. (Zurich, 1910.)

the systematic botanists of the ancients. These men studied the distribution of plants over the then known world. This phase of plant geography flourished greatly when explorations and military conquests opened up new and unknown parts of the globe. Since the middle ages the study of vegetation as a whole and the various climatic and geographic units of which it is made up claim the attention of plant geographers. This study naturally was the outcome of the purely taxonomic study of plant distribution that preceded it. The corner-stone of plant ecology was laid in the beginning of the 19th century, when the plant formation was recognized as the fundamental unit of vegetation. Historically speaking, therefore, this event may be taken as the dividing line between plant geography and plant ecology, but this does not mean that the two are separable into distinct sciences. In its broadest sense plant geography includes plant ecology, the latter being merely the latest stage in the development of the former. From our point of view, therefore, it is neither necessary nor desirable to speak of their historical development separately.

Plant geography is usually defined as the science dealing with the geographical distribution of plants over the earth's surface both past and present. The problem of plant distribution presents a twofold aspect: it has, first, to map out the surface of the earth into "districts" or other "areas of vegetation" and, secondly, to investigate the causes which brought them about and have led to their restriction and to their mutual relations. The complexity of this science is due to the intricacy of geographical and geological evolution. If the surface of the earth were of the same elevation all over, and if it had been symmetrically divided into land and sea and these had been evenly distributed in bands parallel to the equator, the character of the earth's vegetation would depend practically upon temperature alone and the study of plant distribution would be a comparatively simple matter. But land and sea are distributed in an extremely irregular way, and within each of the earth's temperature zones there is the great local diversity of moisture, elevation, and isolation, with correspondingly great variations in vegetation.

Warming (15) subdivides plant geography into *floristic plant geography* and *ecological plant geography*. The former deals with the division of the earth's surface into major districts characterized by particular plants or taxonomic groups of plants.

with the subdivision of these floristic districts into minor units, and with the geographical distribution of taxonomic groups, such as species, genera, and families. *Ecological plant geography* investigates the distribution of plant associations and formations and inquires into the relation of the factors of the habitat to the distribution of plants, plant forms, and plant communities. In other words, *this is plant ecology*. Generally speaking, floristic plant geography is concerned with *species*, ecological plant geography with *vegetation*. As has been intimated above, the study of the distribution of species dates back to the time of the *early systematists*, the study of vegetation to the time of the *early botanical travelers*. So far as this paper is concerned, it will treat largely of ecological plant geography.

The Philosophical Trend of the Science (1).

The earliest and simplest development of plant ecology, therefore, concerned itself with the distribution of plants; and this phase of botanical knowledge may be said to have originated as an off-shoot of systematic botany. Plant geography, which at that time was merely a study of the effect of the distribution of plants, may therefore be looked upon as the embryonic stage of plant ecology. Curiously, though perhaps naturally, botanists studied the effect before inquiring into the cause of the geographical distribution of plants.

The first important step in the development of plant ecology was the recognition by Grisebach, in 1838, that *the plant formation was the fundamental unit of vegetation*. (This date also marks an important step in the organization and development of forest ecology, since the term *forest type*, used by foresters, is synonymous with the term *plant formation*. While foresters well knew before 1838 what a *forest type* was in forestry practice, they did not appreciate its significance to forest ecology. Forest ecologists are therefore indebted to Grisebach for pointing out the true significance of this unit.) Grisebach may be said to have laid the foundation of plant ecology (and forest ecology as well) by inquiring into the structure of vegetation and reducing his inquiry to a definite principle. He defined a phytogeographic formation as a group of plants, such as a meadow or a forest, which bears a definite physiognomic character. Besides Grisebach, the phytogeographers of the 19th century who contributed most towards the sum total of ecological knowldege were De Candolle, Schouw, Engler, von Humboldt, Drude, Schimper, and Warming.

The last half of the 19th century was given over to investigations and writings (2, 3, 4, 5, 6) upon the nature of plant formations, their development, behavior, and classification. It was in this period that certain phases of vegetation known as association, succession, and invasion were studied and vague ideas about these phenomena began to crystallize into definite conceptions. But it was not until 1895 that a definite advance was made in this direction. In that year, Warming (7) made the first attempt to treat the then new subject of "oecological plant geography" and to compile the data that had accumulated up to that time into a book, guided by a few general principles.

Since 1895, the tendency has been to study plant formations more critically. The emphasis has been shifted from the *formation* to the *habitat*. The works of Drude (8), Warming (9), and Schimper (10) bear witness to this new development of the science. The encyclopaedic work of Schimper not only treats of habitat factors as preliminary to a discussion of plant formations and associations, but it also emphasizes the physiological point of view in plant ecology. Both of these facts are unmistakable earmarks of the modern trend of ecological thought.

Experimental plant ecology, another phase of the science which has developed only very recently, may be said to have taken its beginning in the experiments of Bonnier between 1890 and 1895 (11, 12, 13). His experiments in determining the effect of altitude upon plant development, being performed under natural conditions, may be said to be the real beginning of field investigations in plant ecology. We are indebted to him also for the first attempt, in this connection, of ascribing changes in plant structure to a definite cause.

The determination of the physical factors of the habitat begins about this time. In the early nineties, Ramann, a great student of soil physics and soil chemistry, made what were among the first soil moisture measurements in the vicinity of Eberswalde, Germany, to determine the moisture content of different kinds of soils and also the variations in soil moisture content arising from different methods of forest regeneration. It is interesting to note that Ramann was chiefly an investigator of soils from the *forestry* point of view. But the real beginning of this phase of ecology was made by Wiesner, an Austrian botanist, with his determination of light values in 1896. In 1898, F. E. Clements first began in the United States the study of habitat structure and the determination of the various factors by means of instruments. He also developed about this time methods of control experiment in the plant house under definitely measure differences of light and water (*i. e.,* he synthetized an artificial habitat).

Modern ecology is dynamic. It deals largely with the forces of Nature which affect plant life, and it is largely experimental because it is seeking to determine quantitatively the physical factors of the habitat. In this country, Clements has been the chief contributor. He is the author of several ecological works published between 1904 and 1907 (1, 17, 18, 19, 79). The most important of these is his *Research Methods in Ecology*, which is an important contribution to the science, not so much in accumulating and recording facts as in pointing out the methods and principles which should be used to secure facts of ecological significance. Cowles, in conjunction with others, is the author (1911) of a textbook on morphological and physiological ecology, in which he treats rather extensively the relation of the habitat to the structure and behavior of the plant. Abroad, English and Danish plant ecologists have been the largest contributors. In 1905, H. Solms-Laubach published his very suggestive work; and Warming, in 1909, making use of a large fund of material, gave to the world his book on the *Oecology of Plants* which is considered one of the best works on the subject. The most recent work of importance covering the subject in a general way is Drude's *Die Oekologie der Pflanzen*, which appeared in 1913.

The Historical Development of the Study of Vegetation (18)

The above brief sketch will indicate in a general way the trend of the science. By far the greater part of the history of plant ecology, however, has to do with the development, structure, and classification of plant formations, since this unit is the *sine qua non* of the science. Some of the earliest observations of ecological significance deal with certain fundamental phenomena of vegetation known as association, invasion, succession, zonation, and alternation. Plants both as individuals and as communities have their peculiar structure, habits, and behavior; both have a more or less distinct life cycle and must face the struggle for existence. In the following pages, in a brief historical way the development of these phases of vegetation will be considered.

The association of plants is a fundamental law of vegetation and may be defined as the co-habitation of two or more individuals or species of plants. Plants may be grouped into association upon various bases. The most important of these are the stratum to which they are attached, the water-content of the soil, and light. Humboldt (20), De Candolle (21), Schouw (22), Meyon (23), Drude (24), and Warming (7) distinguished various kinds of associations based on the stratum to which plants are attached. Schimper (10), in 1898, brought order out of chaos by reducing the number to four, namely: lianas, epiphytes, saprophytes, and parasites, and showing that all other kinds were either identical with these or only slight modifications of them.

Schouw (22), in 1823, was probably the first to recognize the importance of light associations. He divided plants into darkness plants, shade plants, and light plants. This classification holds good to this day and has been adopted, with small modifications in some cases, by nearly all later investigators, notably Kabsch (25), Warming (7), and Clements (26).

As early as 1820, De Candolle (21) summarized the characteristics of land and water plants, but he did not evolve a classification of them. Schouw (22), the noted Danish botanist and plant geographer, was also a pioneer in this connection for he was the first to classify plant associations on the basis of the water-content of the soil. He distinguished: 1. *swamp plants;* 2. *plants which grow in moist meadows;* and 3. *plants that love a dry soil.* Meyen (23) added little to Schouw's classification, but Thurmann (27) pointed out that the physical and not the chemical properties of the soil determine water-content. A. de Candolle (28) also recognized this fundamental relation. Warming (7) not only summarized the development of this line of inquiry, but he even went so far as to make water-content of the soil the basis of his entire work. *His great contribution to ecology lies in his recognition of the fundamental importance of the water-content association.* He recognized four types of vegetation: *hydrophytes, xerophytes, halophytes,* and *mesophytes.* Later (15), Warming modified this classification and made 13 groups also based upon the water-content of the soil, but this new system is considered by many too involved to come into general use. Perhaps the best course open to botanists and foresters is to select such terms as may appear to be helpful. Schimper (10) made a distinct advance in the science when he distinguished between physical and physiological dryness of the soil. He made practically the same divisions of water-content associations as Warming did in 1895. Schimper, likewise, divided vegetation into three great climatic formations, namely: *forest, grassland,* and *desert,* which is merely another expression of the water-content of the soil. He classified the vegetation of the earth's surface into four districts based upon temperature, and these into groups of climatic formations. These groups are simply vegetation units whose physiognomy is related largely to climatic conditions, but principally to soil moisture.

Warmings' classifiation based upon the water-content of the soil is doubtless the best possible classification if but one factor is considered. Graebner's (29, 30) classification based upon soil characters includes the advantages of Warming's classification and adds desirable new features. This scheme is based in the main on the chemical and physical properties of the soil. The primary divisions are chemical, depending on the richness or poverty of the soil in plant food materials, and the secondary divisions are based upon soil moisture. This is interesting in the light of Thurmann's ideas, and simply points to the beginning of the two schools of thought that are developing, namely, one claiming that the physical properties of the soil are most important in determining local vegetation, and the other school adhering to the chemical point of view.

Invasion was defined by Goeze (31), *in* 1882, *as the movement of plants from an area of one character into one of a different character and the establishment of the plants in the latter area.* Two distinct ideas are involved, first the movement from one place to another and secondly the germination, growth, adjustment, and final establishment of the plant in the new environment. The former is often called migration, the latter ecesis (the making of a home). Migration consists of at least four distinct processes, namely: mobility, agency, proximity and topography. Mobility has to do primarily with the character, size and weight of the seed; agency with the means for transporting the seed, such as winds, water, birds, mammals, etc.; and proximity and topography deal mainly with natural barriers such as large bodies of water, deserts, mountain ranges, and even such vegetational barriers as swamps and forests in so far as these affect dissemination. Ecesis consists of three important processes: germination, growth, and reproduction. It is important to note that ecesis is not complete unless a plant can perform all of these processes. The germination of the seed depends upon its viability and the nature of the new habitat. The viability depends, among other things, on the character of the fruit, the seed coat, and the endosperm. After germination the probability of its growing, maturing, and reproducing depends upon how nearly its own physical requirements match those of its new habitat.

Linné (32) as early as 1745 was the first to mention migration. In his *Philosophia Botanica* (33) he gives an excellent analysis of seed dissemination. Hildebrand (34) and Kerner (35) go into minute detail in discussing and classifying the agents of distribution and the movability of seeds. De Candolle (21) first used the term barriers, and Grisebach (36) in 1872 established a fundamental law of barriers.

Succession is the phenomenon in which a series of invasions occurs in the same place. It is apparent especially when the natural course of events has been distributed by either physical or biotic forces. In either case a series of successive invasions will occur, the vegetation gradually becoming more like the original until finally equilibrium is again established between the environment and the vegetation it supports. The ultimate or *climax* vegetation to which all series of successions lead is the most mesophytic which the area in question will support.

Previous to 1880 we must go to writers upon forestry subjects for records of observations of this phenomenon. The reason for this is probably that nowhere in vegetation is succession so apparent as in the forest. As early as 1749 succession was mentioned by Biberg (37). Humboldt (38) recognized the presence of succession in vegetation when he stated that cryptogams prepare the way for for the growth of grasses and other herbaceous plants. Henfrey (39), A. de Candolle (28), Hoffman (3) and Middendorff (5) recognized the occurrence of succession. Hoffman was the first to study succession on burned-over pineries. Hult (40), however, was the first to study succession in a systematic fashion. He recognized the fact that most formations are merely transition stages and that there are but a few climax or ultimate formations. Senft (6) followed the succession of vegetation on bare xerophytic slopes. He noted in successive stages, lichens, mosses, grasses, herbs, shrubs, woody thickets, and lastly forest on the same area. Warming (7) contributed largely to this field of investigation in bringing together and summarizing the many results up to his time. He considers the changes of vegetation under three heads, namely, whose occurring on newly formed soils or upon surfaces exposed for the first time; those due to slow changes upon soils with a vegetative cover; and those occurring without accompanying changes in climate and soil. From the standpoint of succession he establishes three kinds of associations: *initial, transitional* and *climax*.

The more recent investigations in plant succession have endeavored to follow very closely the different stages in sucession, and if possible to ascertain the physical factors which determine succession. Cowles (41) has shown that the forest succession on the sand dunes of Lake Michigan consists principally of associations dominated by cottonwood, pine, black oak, white and red oaks, and beech and maple, in the order named. These represent a continuous series extending from the pioneer xerophytic trees to the mesophytic climax forest of the region. Fuller (42) defined "growth water" as the soil moisture in excess of wilting coefficient, since he believed that none of the water absorbed from the soil whose moisture content is below the wilting coefficient is used for the growth of the organism. Later the same writer (43) based a study in succession upon the ratio of evaporation to growth water. This ratio for the beech-maple forest, oak-hickory forest, oak dune, pine dune, and cottonwood dune associations were shown to have comparative values of 100, 65, 200, 17, and 15 respectively and differences thus indicated are sufficient to be efficient factors in causing succession Roberts (44) finds the order of succession in the Holyoke range as follows: bare soil, herbs, cedar, birch, pine, oak-hickory, chestnut, and the beech-maple-hemlock forest. In a most interesting manner the author shows by diagram that should fire destroy any of these stages the series must begin all over again; but if one of these associations is logged off it will usually revert to the preceding one before again returning to the original form. This is a most significant result of forest fires in the succession of plant formations and it might be well worth the forest investigator's attention to study this phenomenon more closely. Perhaps one of the most recent, and at the same time most interesting, studies in plant succession is that conducted by Cooper (90) in the Palo Alto region of California. On the alluvial deposits near the bay he finds: 1. algae in the shallow water of the bay; 2. salt marsh; 3. composite-willow formation; 4. oak forest of *Quercus lobata* and *agrifolia;* 5. chaparral. His investigations show that the salt marsh replaces the algae soon after the soil surface emerges at low tide. The willow formation follows with the elimination of salt from the soil. The oak forest appears when there is sufficient soil depth for the tree roots above the water table. The chaparral follows when the distance to the water table becomes so great that the oaks cannot obtain sufficient soil moisture. The chaparral formation is permanent because it flourishes independently of moisture supply from the ground water. This succession progresses from halophytic to mesophytic and thence to xerophytic.

Many recent studies in plant succession, as will be noted from the above discussion, are in reality investigations in forest succession. Plant ecologists evidently find in the forest a fruitful field for study. On the other hand, I know of no foresters engaged in such studies. Probably the reason for this is that these studies are too purely scientific for the forester who is in a good position to look at such investigations only in the light of their application to silvics or silvicultural practice. Here, as elsewhere, the forest investigator would do well to follow the plant ecologist. He should adopt his methods of studying and of gathering data so that the results secured by plant ecologists and forest ecologists will be mutually helpful.

The phenomenon known as zonation is perhaps the oldest one recognized by phytogeographers. *Zones may be due either to some growth character of the plant or to one or more of the physical factors of the habitat.* The latter is by far the more common and more obvious cause. It has long been recognized that vegetaional zones based upon moisture parallel great bodies of water, while zones based upon temperature parallel the equator. The zones found on mountain slopes, which are essentially due to a combination of these two factors, follow the contours of the topography.

Tournefort (45), in 1717, was perhaps the first to recognize zonation when he compared the vegetation of all Europe to that found on the slopes Mount Ararat. Raimond (46) studied and described the zones of vegetation of the Pyrenees Mountains. Humboldt and Bonpland (47) used the word "region" to designate the zones of mountains and the word "zone" to designate the vegetative belts determined by latitude. Schouw (22) followed this use of the terms zone and region, but differentiated between zones of latitude and longitude. Grisebach (36) established zones based upon the dominant trees. Koppen (48) and Drude (49) established certain zones based upon temperature. Many studies have been carried on to determine the zonal arrangement of plants on small areas. Raunkiaer (50) noted zonal arrangement in the dune valleys of Jutland as early as 1889. Magnin (51) studied the zonation of the Jura lakes and MacMillan (52) in our own country described zonation in the sphagnum moors of Minnesota. These are merely some of the more important efforts. It is interesting to note that during the last century alone not less than 60 different proposals of geographic zones and regions have been published.

Modern Plant Ecology

Plant ecology, as will be seen from what has been said, has developed along at least four distinct lines, namely: *plant distribution, plant formations* and *associations, experimental ecology,* and the *study* of *habitat factors.* This large and diversified field of inquiry has only within the last 20 years become more unified and systematized. The whole was put into a huge melting-pot, as it were, and a few guiding principles were crystallized out. The science was more closely delimited and divided into natural groups. These groups were defined and classified. Grisebach's conception of a plant formation was amplified and extended by dividing and redividing this unit of vegetation into its component parts. As vegetation was analyzed more closely, the underlying causes of the various vegetative units came into the lime-light. This led to the dynamic ecology of the present day.

Dr. Carl Schröter, the eminent Swiss ecologist, is often spoken of as the *father* of modern ecology, principally because he brought order out of a chaotic condition of affairs. Schröter divided the whole field of ecological inquiry into two great divisions, namely:

autecology and *synecology*. *Autecology* is defined as the relation of the individual plant to the external world. It is a study of the influence of environment as it is mirrored in the structure of the plant. *Synecology* deals with the relations of plant communities to external factors. It is essentially the study of the influence of the environment as mirrored in the structure, behavior, and the development of the plant formation and it also deals with its origin, migration, and succession. The former division deals with individuals, the latter with groups of individuals or complexes. The further subdivision of these two groups of ecological knowledge will undoubtedly come in time so that ecologists will have a well-built framework upon which to erect the superstructure of the future.

Modern ecology has shown a strong tendency towards establishing a more rational ecological classification of vegetation. The views of Drude (24), Clements (1, 18, 79), Warming (15), Cowles (76), Moss (77), Tansley (78), and others are practically unanimous as to the relative weights the terms "plant formation" and "plant association" should have in descriptive ecology. These terms have been used with a variety of meanings for almost a century, but today the conception that a formation is an *ecological genus* and an association an *ecological species* is becoming generally accepted in principle. A *plant association* is defined as a community of plants of definite floristic composition. It may be characterized by a single dominant species or by a number of prominent species. Associations may be further subdivided into *plant societies*, *communities*, and *families*. A *plant formation* is group of associations occupying habitats which are in essentials *identical* with each other. The connection, therefore, between the *habitat* and the *formation* is so close that it would be illogical to apply the term *formation* to a division greater or smaller than the *habitat* (1). Plant formations may be classified upon two distinct bases, namely: the identity of habitat conditions, and a common plant form.

Numerous American and English investigators (53) have done a great deal in the last 20 years not only to systematize the science, but also to give us a better understanding of the relation of the individual plant and the plant formation to their physical environment, and they have also suggested original methods for determining this relation. In America, Clements, Livingston, Cowles, Transeau, Fuller, Shantz, Shreve, Pool, and others have contributde to this field, while in England such men as Tansley, Oliver, Crump, Moss, and Yapp have covered practically the same ground. These men have placed their emphasis upon the measurement of habitat factors in the study of plant and forest distribution; upon determining the factors which cause plant succession; upon the moisture requirements of plants of economic value; upon determining the wilting coefficients of plants in various soils; upon methods and means of determining more satisfactory ways of classifying vegetation on the basis of climatic factors; and upon a variety of other phases of comparatively lesser importance.

As has been said before, modern plant ecology is *dynamic*. More recently it has shown a tendency to become *applied* in character (witness Shantz's work). While plant ecology started as a study of plant distribution, it was not until about 1895 that the emphasis shifted from the effect to the cause of plant distribution. This led to the study of habitat factors. These were found to show their influence mainly in the behavior of the plant, hence plant ecology allied itself more closely with plant physiology. The present physiological trend of work in plant ecology shows two important phases (92). The one deals with correlating physical factors with the distribution of plant and plant communities; the other deals with the correlation of physical factors and physiological functions or processes. There is an ever increasing number of works, especially on distributional problems. Among those in this field in our own country we find Shantz in the Great Plains, Fuller in the Chicago region, Pool on the Nebraska prairies, Transeau at Cold Spring Harbor, N. Y., Weaver in Washington, Clements in the Rocky Mountains, and Shreve in Southern Arizona (93). Among some of the workers on the comparative physiology of associated plants we find Cannon upon the optimum growth temperature of roots, Livingston and Shreve upon the transpiring power of plants, Harris on the osmotic strength of the saps of plants, and Richards and MacDougal on several physiological aspects of the cacti. In this category is also included the author's recent work upon the effect of habitat factors upon the germination of forest tree seeds (94).

Some of these investigations deserve further mention. The recent work of Briggs and Shantz upon the wilting coefficient of soils and the water requirements of plants is certainly an important contribution, but since this work, in its present stages at least, is not directly applicable to forestry I will pass it by. Only the future can tell what the value of this work will be to the forester. This class of work is now in its infancy; in fact some very excellent work on the water requirements of plants, which has been conducted for a number of years by Kiesselbach ana others at the Agricultural Experiment Station at Lincoln, Nebraska, promises to make Briggs and Shantz's work (and all other work, for that matter) appear ephemeral, if not entirely antiquated. The work of Clements in the Rock Mountains, from a forestry as well as from an ecological point of view, is important. In his study of plant succession he analyzes the development of the vegetation of the western mountain ranges. This work, which has been carried on for over 10 years, will go a long way toward solving the forester's problem of the successional development of forest types. Then, also, the ecological work of the Desert Laboratory of the Carnegie Institution of Washington, located at Tucson, Arizona, is worthy of attention. MacDougal with a large scientific staff and excellent equipment is directing the botanical work, a large part of which is along autecological lines. This station is a model; it is to be hoped that some day American forestry will be able to boast of one like it.

The fact that the British have taken the lead in plant ecology is evidenced by the formation of *The British Ecological Society* in 1913, which publishes quarterly *The Journal of Ecology*, the only periodical exclusively dealing with ecological subjects. The recent work of the British ecologists has been brought together quite complete by A. G. Tansley in his *Types of British Vegetation* (Cambridge, 1911).

The latest development in plant ecology in the United States, and one which is of the greatest significance, is the formation in April, 1916, of *The Ecological Society of America* which includes in its charter membership no less than 258 scientists interested in one or more phases of ecology. The idea of such a society originated among plant ecologists but it is gratifying to note the large number of foresters and forest ecologists included in its ranks. For this reason this society establishes the first formal bond between plant ecology and forest ecology and marks, I hope, a new era for both phases of this important science.

A glimpse into the future of plant ecology points unmistakably to the necessity of a physiological classification of plants. While considerable work has recently been done in habitat relations, only a very small part of it touches this most fundamental aspect of plant ecology. I refer to the physiological point of view emphasized by Schimper (10). The questions involved in relating the facts of the distribution of plants to the factors of the habitat are very imperfectly understood. There is also a great lack of precise knowledge of the various habitat factors and of the physiological responses made by plants to these factors. Until ecologists work out the nature of habitat factors, and until the effect of the factors on the plant has been more closely investigated by physiologists, it will be impossible to place ecology on a physiological basis. And when the *nature* and *effect* of ecological factors are more fully understood, the artificial classification into geographical, physical, and biological factors will be discarded and a classification based upon the *action* of the various factors will come into use. In the present state of our ecological knowledge such a physiological classification of plants is impossible.

Many schemes have been propounded for the classification of plants according to their gross anatomical and physiological characteristics. Among these classifications of growth forms, life forms, or vegetation types, as they have been variously called, are those of Humboldt, Grisebach, Warming, Raunkiär, and Drude. The recent growth forms of Drude, in which he attempts to classify plants according to their ecological characteristics, is considered by many ecologists the best thus far, and certainly a big step in the right direction.

III. THE HISTORICAL DEVELOPMENT OF SILVICULTURE

The development of silviculture has had a great deal in common with that of agriculture. Both are founded upon one or more of the various phases of botanical science and are therefore often spoken of as the two most highly developed branches of applied botany. From earliest times their development and progress have had a great deal in common; even today we look upon them as sister sciences, compare them and speak about the influence each has had upon the other. Both are concerned with the use of the soil for the production of crops; both are arts born of necessity; both developed along applied lines long before the value of purely scientific investigation was felt; and today both are being put upon a firmer foundation by the scientific development of their botanical phases.

The agricultural man has for ages stumbled upon many important facts and principles that the botanist has later explained, thereby making more scientific farming possible. Many agricultural phenomena have been seen by the farmer but not understood until theoretical botanists explained them. In exactly the same way foresters for centuries have based forestry practice upon certain biological facts and principles whose underlying causes they did not understand until the scientific forester worked them out experimentally.

It is an interesting fact that plant ecology also developed along applied lines long before the value of purely scientific investigation was felt. Furthermore, plant ecology first was applied in the woods where it found working material—*par excellence*—and where it found a wide sphere of practical utility. In other words, applied plant ecology developed in silvicultural practice long before scientific plant ecology made its appearance.

While forest ecology as a science is distinctly modern, many phases of it, as I have intimated above, have been known to practising foresters for a long time. In fact, botanists and foresters, note especially the latter, have studied forest ecology for over 100 years in an unsystematic, empirical way; but only within the last 50 years has the science been systematically developed as a branch of forestry. Many observations which were strictly ecological in nature can be traced back more than one hundred years. For example, as early as 1683 certain foresters in Germany recognized the fact that all sites are not suited to all species of trees and that conifers usually occupied the poorer sites. By this observation foresters very early learned to adapt their planting material to the site. Long before 1800 foresters abroad used volume tables and yield tables based upon different site classes. In these very tables they had a deal of forest ecology crystallized. They were also familiar with the process of natural selection as it worked out in the woods many years before Darwin's *Origin of Species*. They understood the practical workings of many other laws of tree societies as they affected silvicultural management, even though they did not understand the underlying causes. This was a purely utilitarian attitude; it was upon this empiricism that the modern science of silviculture laid the corner-stone of its foundation. The most recent development of forest ecology has to do with the testing of old theories and practices of silviculture by scientific investigation and in that way substantiating or modifying our old ideas.

Before discussing the development of the biological phases of silviculture (*i. e.*, forest ecology), I will speak briefly of the development of silviculture based upon empiricism.

The Development of Silviculture Based upon Empiricism (54, 81)

As Fernow has so ably pointed out, if there is one lesson that can be profitably derived from the study of the history of forestry, it is that history repeats itself. The same principles, theories, method, and practices which are occupying the attention of American foresters today have confronted foresters elsewhere at some earlier time, because all countries pass through the same periods of development. For this reason in no science like in forestry are we able to profit so much by the mistakes of others.

The beginning of silviculture in the forest history of a country properly begins with the first attempts to secure young forest growth. Usually natural reproduction methods are first employed to accomplish this. As to just what time in the history of a country this stage of development sets in, and how fast it progresses when once started depends upon industrial, social, economic, and political conditions. The time of its inauguration, as we well know, may even vary greatly in different sections of the same country. Owing to such conditions being particularly favorable, the greatest and most universal development of silviculture is to be found in Germany, the pioneer nation in the practice of forestry. In its forest history we find all the stages through which other nations have passed or eventually will have to pass. Moreover, the forest policies of many nations have been modeled after the German plan and many nations have been influenced in their silvicultural practice by German precedent. For these reasons I will confine the historical discussion of silviculture largely to Germany, although the data given will apply equally well to most other European countries where conditions are similar.

The latter part of the middle ages in Germany saw forest conditions in a great many respects similar to those which obtained in this country within the memory of the present generation. Most of Germany had experienced an era of forest devastation in many ways like that which we have seen our country pass through, and which is still going on in some parts of the United States. The best timber was culled out and no attempt was made to secure the reproduction of the forests. Beginning with the 12th century this was followed by an era in which regulative and restrictive measures were adopted in the treatment of the forest. During the 14th and 15th centuries the first beginnings were made to obtain new forest growth. Strange to say this was by sowing or planting. The beginning of the 16th century, in other words the close of the middle ages, like the beginning of the 20th century in our country, saw not only a strong tendency towards conservative lumbering but also sporadic attempts to cut timber with an eye towards securing reproduction. These were the beginnings of a silvicultural policy; founded at first upon empiricism, refounded in the 19th century upon science.

Even though the middle ages cannot boast of the introduction of an orderly system of silvicultural management, still we must concede that comparatively early some very noteworthy beginnings were made in this direction. The oldest system by which wood was removed from the forest was the selection method; but this was usually carried out without any regularity in felling. Owing to the destruction caused in removing the timber by this method and also unrestricted grazing, it soon became evident that reproduction was greatly hindered where this system was used. This led as early as the 12th and 13th centuries to a restriction in the use of this method to certain localities. The ability of certain hardwoods to reproduce readily by sprouts when cut led early to the application of coppice methods. As early as 1346 this method was known in Bavaria. In the 15th century one finds many references to the use of the coppice and the coppice with standards methods. In coniferous forests, the selection system was used until 1500. In the Harz mountains, especially in the mining districts, the ease with which pine seeds were disseminated by the wind led to the adoption of the seed tree method. This method was applied to spruce as early as 1524.

So far as artificial reproduction is concerned, no particular methods had developed before 1500. In hardwoods this method was entirely lacking before that date. In conifers the sowing of seeds for reforesting purposes was known near Nuremberg as early as 1368. About 1420 Frankfurt boasted of a young fir forest that had been started by seed. These early attempts were very much localized in portions of the country where industrial conditions were particularly favorable; it was not until several hundred years later that these methods came into general use.

It was not until the 18th century, after the great economic and industrial setback caused by the Thirty Years' War, that silvicultural technique began to develop. Before this time the natural methods of reproduction already spoken of were the ones chiefly employed to secure the regeneration of the forest. But about this time a new silvicultural system came into use. In the hardwood forests of western Germany in the beginning of the 18th century the shelterwood system developed from the selection system. The first step in its development was to confine the cut in selection forests to certain areas or compartments instead of selecting the mature trees for cutting without regard to their location as had been done before. The general regulations for selection forests were that wherever a tree was cut the opening should be reforested. In carrying out these rules an interesting observation led to a further step in the development of the system now known as the shelterwood. The turning loose of hogs in the beech and oak forests prepared the soil for beechnuts and acorns and, therefore, assisted to a considerable extent the natural reproduction of these species. The result was that soon the younger age classes predominated. But in order to keep the hogs from damaging the young trees which they had helped to get started, the animals were excluded until the young forests grew out of reach and formed a closed canopy. The result was a more or less even-aged forest secured by natural reproduction from seed. In this purely empirical manner the shelterwood system came into being, and it was in this form that it was first used between 1720 and 1730. By 1736, three distinct cuttings had developed: the seed cutting, the light cutting, and the final cutting. It was not until 1767 that the preparatory cutting was added. By 1770 the system was fairly well understood. From that time on and for almost 50 years the shelterwood system dominated silvicultural practice. The modern theory of the shelterwood system, especially its management in periodic cuts, was developed by Sarauw.

While artificial reproduction dates from the 14th century, it was not until the beginning of the 16th century that some progress was made. By 1547, hardwoods were used for establishing wind mantles. In the second half of the 16th century planting was done in other parts of the forest, especially for filling in fail places where natural systems were used. At this time, also, the technique of forest nurseries developed, since before this time only wildlings had been used in planting work. There are also some records of direct seeding in oak forests. In this century also acorns and beech nuts were preserved in sand over winter.

Even though artificial reproduction had been practiced for a long time, still it served in the main only for the purpose of filling in fail places which occurred in the practice of natural methods and to afforest barrens and waste lands. For four centuries various phases of artificial reproduction had been known, but it was not until the middle of the 18th century that it came into general use to reforest cut-over areas. The introduction of seedlings and transplants, and the perfection of transplanting instruments and methods came in the beginning of the next century. In fact, the greater part of the technique of forest nurseries and of field planting as we know it today, developed in the first half and middle of the 19th century.

The history of thinning practice, like that of the development of silviculture in general, is long drawn out and it was not until recently that real progress was made. As early as 1531, it was observed that thinnings improved and stimulated the growth of the remaining stand, but in 1514 there were instructions for thinning practice which stated that poles should only be cut out where the stand was too dense and where the removal of individuals could be accomplished without damage to the remaining stand. These instructions were not amplified or improved during the 16th and 17th centuries; hence it is not possible to speak of a systematic thinning practice at that time. In fact on account of lack of market for small material thinnings made slow progress until the middle of the 19th century. Only that material was removed that had a sale value. In theory the art of thinning fared better, for literature and instructions could discuss phases of the subject that could not be put into practice. In the 18th century such men as Langen, Zanthier, and Oettelt emphasized the advantages of thinning practice. They recognized the favorable influence the practice had upon the growth of the main stand and also realized its financial advantages.

G. L. Hartig summarized and systematized what science and practice had developed up to the end of the 18th century in the realms of thinning and improvement cuttings. He was the first to use the word Durchforstung (*thinnings*). He emphasized the idea that only the dead and suppressed trees should be removed, and that the crown cover should remain unbroken. Cotta at first also believed in light thinnings, but later went to the other extreme. Pfeil was of the opinion that it was impossible to generalize, but that thinning practice should be regulated according to the needs of the species and site. Carl Heyer is responsible for the terse instruction: "early, often, moderate."

The true scientific basis for thinnings, however, was not developed until the forest experiment stations came into being. Before this, numerous attempts were made to explain the biological basis for thinnings, perhaps the earliest of which was the observation by Spaeth in 1802 that the soil is not capable of furnishing food materials for all the individuals of a young stand. The physiological and ecological reasons for the practice of thinning were particularly advanced by the botanists Goeppert and Robert Hartig and by the foresters Kraft, Lorey, Borggreve and Wagener in the latter part of the 19th century.

Previous to 1800, perhaps the only silvicultural works worthy of mention are Carlowitz's *Silvicultura Oeconomica* (1713) and the encyclopaedic works of the Cameralists. The former was the first book which divorced forestry from hunting. The Cameralists deserve credit for having collected in large volume the empirical knowledge of the so-called "holzgerechte Jaeger." The 19th century saw a reaction to monographic writings, although at first the tendency was to treat the subject as the Cameralists did. The works of the *old masters* Hartig, Cotta, Pfeil, Heyer and Hundeshagen should be mentioned here, since they began to put silviculture upon a scientific basis. In 1855, appeared Burkhardt's book *Säen und Pflanzen*, a volume which had great value in the development of artificial reproduction by planting. Fuerst's *Pflanzenzucht im Walde*, which appeared in 1882, was a similar work. Between 1880 and 1885 Gayer, Wagener, Borggreve and Ney contributed modern works on general silviculture.

The transition from silvicultural practice based upon empiricism to that based upon the fundamental sciences and experimental forestry ecology is a very gradual one. In fact, it covers a period of almost 100 years. The best idea I can give my reader at this point concerning this transition is to point out the great steps which characterize it. These steps are: the founding of the science of forest ecology by Duhamel du Monceau in 1758; the first scientific treatment of silviculture by the fathers of modern forestry, Hartig and Cotta, in the beginning of the 19th century; the beginning of forestry investigations; and the establishment of forest experiment stations in 1870 which laid the corner-stone of modern forest ecology. Later sections of this paper will discuss this transition more fully.

The Development of the Ecological Phases of Silviculture (54, 81)

In this way silviculture developed along empirical lines largely under the influence of the Cameralists, who were usually at the head of the forest administrations, and the "holzgerechte Jaeger," to whom naturally fell the work in the woods. It is needless to say that under the cameralistic regime technical forestry work was held back because these men, while well informed in financial and legal matters pertaining to the forest, were rather ignorant of natural science and technical forestry. The hunters who were versed in forestry, likewise had no schooling in science of forestry but usually possessed a great fund of practical knowledge derived from years of experience in the woods. Moreover, hunting and forestry were carried on together, and hunting often had superior claims to forestry. Even the higher forest service positions had duties in connection with the chase as well as the forest. This lasted until about the middle of the eighteenth century, when, due to the increasing economic importance of the forests, hunting was to some extent divorced from forestry and scientifically trained foresters began to supplant the Cameralists and hunters. Towards the end of the century, German forestry history is fortunate to be able to record the names of an array of *coryphaei* who exercised their beneficial influence in various branches of forestry and made possible the present high stage of development of the science. These men were not only administrators and practical foresters but scientists and teachers as well. The first of these foresters, who combined the empirical knowledge of the hunters with the scientific learning of the Cameralists, and thereby founded the science of forestry was G. L. Hartig, who became chief of the Prussian forest administration from 1811 to 1837.

His most famous contemporaries were Cotta, Hundeshagen, Koenig, Pfeil and K. Heyer.

Due to this change in personnel more than to any other cause, forestry began to break away from a merely empirical basis and to seek a firmer foundation in the fundamental sciences. Mathematics assisted in the development of such fields as forest mensuration and forest valuation. The various branches of biology, such as forest botany, plant anatomy and plant physiology, pathology, zoology, and entomology helped to lift forestry out of the shackles of empiricism and to make a scientific treatment of the forest possible. Physics, chemistry and biology put our knowledge of the soil upon a scientific basis and thereby revolutionized many silvicultural practices. In fact, the whole field of forestry experienced a great *renaissance;* forestry was remodeled, as it were, according to modern standards. Thus was born the science of forest ecology (called by modern German foresters, *Die Lehre vom forstlichen Verhalten der Waldbäume.*)

The founder of the science of silvics or forest ecology was a French scholar, Duhamel du Monceau. With a great knowledge of botany at his command, Duhamel made many valuable observations and investigations, which like all his work had under consideration the application of scientific results to practical work. Especially famous are his attainments in the field of plant anatomy which he published in his master-work *Physique des arbres* in 1758. Duhamel also made exact investigations on silvicultural questions and developed some excellent views. His works are a rich storehouse of material for forest historians. His works upon forestry and forest botany have been translated into German. Out of these works the Cameralists obtained a large part of their knowledge of forest botany.

Enderlin was the first German forester who possessed a good schooling in the natural sciences. He built upon the foundations laid by Duhamel but he likewise made use of a considerable amount of botanical literature. Enderlin worked especially in the field of plant anatomy and plant physiology, but unfortunately omitted to perform the necessary experiments to give his work permanent value. In 1767, he published a book upon *The nature and characteristics of forest trees and their soil together with their nourishment and the causes of growth*, which contained little more than ingenious speculations.

Among German botanists of the eighteenth century, Gleditsch was the most noted. In 1775 he wrote a manual in two volumes which he called *A systematic introduction to the newer forestry upon a physico-economic basis*, the greater and best part of which concerned itself with forest botany. Burgsdorf, his successor as director at the Forest School at Berlin, wrote excellent monographs upon the oak and the beech, touching especially their botanical silvical relations. His plan was to treat all other species important to forestry in a similar way, but the pressure of his office duties did not permit this. Later, however, he published a manual in two volumes (1788, 1796), in which he treated particularly the subject of forest botany.

Among those who advanced forest botany in the first decade of the nineteenth century should be mentioned Walther, Borkhausen, Reum, and in a lesser degree Bechstein. These men wrote manuals of forest botany and treated the life histories of trees and other forest flora of Germany. Among the later forest botanists should be noted Willkomm, Goeppert, and particularly T. Hartig who gained renown not only in forest botany, but especially in the field of anatomy and physiology. T. Hartig's classic, *Anatomie und Physiologie der Holzpflanzen* appeared in 1878.

Worthy of mention are the writings of Cotta and Meyer in the beginning of the nineteenth century in the realm of plant physiology. Cotta wrote in 1806 on *Observations upon the movement and function of sap in plants with special reference to woody plants*. Meyer in 1808 wrote on *The science of the effect of natural forces upon the growth and nourishment of forest trees, based upon theory and practice.*

These early attempts, which were all of a forest botanical nature, have comparatively little significance so far as tangible results are concerned, but great significance in so far that they were the first indication that the life of trees and forests and their relation to the environment were being scrutinized more closely. Likewise these sporadic attempts opened the eyes of many foresters, and not a few at one time or another recognized how meager was the knowledge at hand concerning the science of silviculture. Heinrich Cotta in his preface to his *Anweisung zum Waldbau*, which was published in 1817 said, that thirty years ago he prided himself on knowing forestry science well, but that during this long period he had come to see very clearly how little he knew of the basic scientific principles of forestry.

The publication, in 1852, of Gustav Heyer's *Verhalten der Waldbäume gegen Licht und Schatten* marked one of the earliest attempts to analyze one of the habitat factors which operates in the forest. This date is an important one not only for forest ecology but for plant ecology as well. This volume (it contains only eighty-eight pages) is also very interesting from the fact that it comments upon the status of silviculture at that time. The condition in which silviculture found itself in the middle of the nineteenth century cannot be stated more clearly than in Heyer's own words and in order to give the complete situation I will quote *in extenso*.

"Der Waldbau, ohne Zweifel die wichtigste Disciplin der Forstwissenschaft, bestand ursprünglich in einer Reihe von Erfahrungen und Beobachtungen, aus denen man späterhin Folgerungen für die praktische Bewirthschaftung der Waldungen ableitete. Man hatte bemerkt, dass diese oder jene Holzart unter bestimmten Verhältnissen ein eigenthümliches Gedeihen zeige; daraus liessen sich Regeln für diese Holzart bilden. Das Gebäude des Waldbaus erweiterte sich um so mehr, je grösser die Zahl der Erfahrungen wurde, welche die Forstwirthe sammelten. Es scheint, als ob dieser Theil der Forstwissenschaft seinem Abschluss nahe stünde, wenigstens ist nicht zu vermuthen, dass durch neuere Entdeckungen das Materielle desselben in nächster Zeit wesentliche Abänderungen erleiden könnte.

"Dagegen macht sich der Mangel einer systematischen Behandlung der Lehren des Waldbaus sehr fühlbar. Diese wird nur dann stattfinden können, wenn man die gemeinschaftlichen Ursachen aufsucht, welche den Erscheinungen zu Grunde liegen.

"Unsere Holzgewächse ernähren sich auf Kosten der Bestandtheile der Luft und des Bodens, ausserdem haben die Meteore auf ihr Wachsthum den grössten Einfluss. Alle Beobachtungen, welche man über die Natur der Waldbäume gemacht hat, müssen deshalb ihre Erklärung in den allgemeinen Gesetzen finden welchen alle organismen ohne ausnahme unterworfen sind."[4]

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[4] "Silviculture, without doubt the most important branch of forestry science, consisted originally of a series of experiences and observations, from which later conclusions were drawn for the practical management of forests. It had been observed that this or that tree species under certain conditions showed special thriftiness; from this rules could be formulated for this species. The building of silviculture was enlarged the more, the greater the number of experiences which the foresters gathered. It appears as if this part of forestry science is nearing its conclusion; at least it is not to be expected that by newer discoveries the material part of it could experience in proximate time essential changes.

"But a lack of systematic treatment of the teachings of silviculture makes itself very much felt. This can be overcome only when the causes in common, which are fundamental to the phenomena, are found.

"Our tree species are nourished at the expense of the components of air and soil; in addition, the meteors have the greatest influence on their growth. All observations made on the nature of our trees must therefore find their explanation in the general laws to which, without exception, all organisms are subject."

This is perhaps the most simple, yet at the same time the most explicit statement in forestry literature explaining the need for the development of the science of forest ecology and why it is necessary in silvicultural practice.

Besides forest botany various other phases of biological science were applied to silviculture, namely: pathology, entomology, and zoology. The very important subject of forest pathology did not receive treatment until about fifty years ago, first at the hands of Willkomm, and later, much more thoroughly, by Robert Hartig. The former's work upon the diseases of forest trees and timber appeared in 1866-7, and Hartig's treatises upon plant and tree diseases in 1874, 1882, and 1900.

Forest zoology made slower progress than did forest botany. Enormous damage by bark beetles made investigations along entomological lines imperative, especially in the latter part of the 18th century. The life history of these beetles was very imperfectly understood. Cramer (1766) was the first to describe *Bostrychus typographus*, but he assumed, as did his precedessors, that this insect attacked only diseased trees. A very excellent book which for the first time correctly explained the biology of this insect and also gives numerous accounts of insect damage in the Harz Mountains was by a Doctor of Medicine, Gmelin. Gleditsch, and later Burgsdorf, worked the field of forest entomology more systematically, but still left much to be desired. Good works were also written by Borkhausen (1780–94) and Bechstein (1818), but the founders of scientific forest zoology were Ratzeburg (1801) and T. Hartig. To these must later be added Eichhoff, Altum, Judeich, and Nitzsche.

It is impossible to speak of a successful and scientific application of chemistry and geonomy (*Bodenkunde*) to silvicultural management until the pioneer work of Liebig, the great German chemist, was given to the world. His investigations, beginning about 1835, revolutionized both organic and inorganic chemistry. The older works of Krutzsch, Behlen and Hundeshagen are therefore of no particular value. Also the works of G. Heyer and Grebe are to a large extent obsolete. It was not until Ebermayer (1873), Schröder, Lorenz (1878), R. Weber (1874), Wollny and Ramann (1893) worked in this field that exact investigations were begun. The best work on forest soils is attributed to Ramann, who in 1893 published the first edition of his *Forstliche Bodenkunde und Standorts-*

lehre, which after revision appeared again in 1911 in its third edition as *Bodenkunde*. The science of the soil and its relation to forest trees is here elaborated in such a manner that the book has become an indispensable asset to the silviculturist and the forest ecologist.

The Beginning of Forestry Investigations and the Establishment of Forest Experiment Stations

The application of the fundamental sciences like biology, physics and chemistry to the theory and practice of silviculture was only the *first* step in the development of forest ecology. The beginning of *forestry investigations* and the *establishment of forest experiment stations* were the *final* steps which put forest ecology upon a firm and rational basis.

The need for exact investigations in forestry made itself felt very early. Probably the first suggestions for these were contained in the instructions for the investigation of the growth of coppice forests by Reaumur in 1713. Early in the 19th century investigations were for the first time *carried out* by G. L. Hartig upon the durability of wood and by Hundeshagen upon the influence of the removal of forest litter. But it was early recognized that isolated investigators with limited means could accomplish little. As early as 1826, Wedekind, inspired by the work of Hundeshagen, proposed an organization in the form of a committee whose business it should be to gather existing data and to review and organize it. Within the next decade experiments were instituted in the field of forest regulation.

In numerous meetings of German Foresters in 1838 and 1839 suggestions were made that the various forest administrations should take it upon themselves to promote the investigative phase of forestry. Perhaps the most enthusiastic of these was C. Heyer who, in a meeting in 1845, proposed the founding of an organization for the promotion of forest statics. He received instructions at this meeting to formulate a plan for such an organization. In 1846, he laid before a similar meeting his *Introduction to Investigations in Forest Statics*, which contains the first explicit plan for the organization of forest investigations. Due, however, to a quibbling among officials, this plan was never put into effect. In 1857, G. Heyer, Faustmann and Baur emphasized again the need for investigations in forest statics, while, in 1861, Ebermayer recommended the organization of forest experiment stations.

The practical result of these suggestions was that between 1860 and 1870 such investigations were begun by numerous German states, but without proper organization. Prussia began to solve problems of the removal of forest litter; Brunswick and Saxony instituted investigations in thinning; Bavaria established stations for the study of forest meteorology and also began investigations in the removal of forest litter; and numerous other states, like Württemberg, Baden and Hesen, began similar studies.

The subject of the actual organization of forest experiment stations was introduced by an article which appeared in 1867 by Gayer, entitled *On Forest Experiment Stations, Particularly in Bavaria*, while, in 1868, Baur's work on *Forest Experiment Stations* also introduced a formal plan of organization. These plans constituted the foundation for further discussions and served as a guide in the establishment of forest experiment stations a little later.

In a meeting of German foresters in 1868 a committee of five was chosen and instructed to formulate a plan for the organization of investigative work in forestry and to indicate problems whose solution was most urgent. This committee consisted of Wessely, G.Heyer, Ebermayer, Judeich and Baur, and met at Regensburg in November, 1868. The result of the work of this committee was the organization of forest experiment stations in Baden (1870), Saxony (1870), Prussia (1872), Württemberg (1872), Brunswick (1876), Hessen (1882), Alsace-Lorraine (1882), and Bavaria (1882).

The introduction of forest experiment stations in Germany brought *new life* into almost every phase of silviculture. Carefully planned and executed experiments were instituted to solve the many complex silvical and silvicultural problems that had baffled empiricists for centuries. From that time on silviculture, relieved of the shackles of empiricism, made progress along scientific lines. *These stations developed the experimental phases of forestry and thereby inaugurated the era of* MODERN *forest ecology.*

The proposal of the Regensburg committee to organize an association for the promotion of the common interests of forest investigators led to the formation in 1872 of the *Association of German Forest Experiment Stations*. The most important work of this association is the adoption of uniform methods and principles in carrying out investigations so that results will be comparable.

Following the good example set by German states, other forestry practising nations established forest experiment stations, viz: Italy, Austria (1875), France (1882), Switzerland (1888), Japan (1887), Hungary (1898), Sweden (1902), Finland (1902), Russia, Belgium, and the United States of America (1909). In 1892, the *International Association of Forest Experiment Stations* was organized. This included, in 1903, the experiment stations of Germany, Austria, Hungary, Switzerland, Russia, Sweden and Belgium, also various administrations or institutions in Spain, United States, Italy and England. This association has held meetings, in 1893, 1896, 1900, and 1910.

The administration of these forest experiment stations is a matter worthy of attention. Very soon after their establishment the question was debated whether they should be placed under *bureaucratic supervision* or under *academic guidance.* Without going into the details of this controversy, it is interesting to see how the matter worked itself out. Practically in every state or country, except Austria and the United States, which have organizations for forestry investigations and also have schools or academies for instruction in forestry, the forest experiment stations are connected with the *academic organization* and *not* with the bureaucratic forest service of the state or nation. The advantages of this organization are obvious. The first and most indispensable asset which forestry investigators can possess is independence, and freedom from bureaucratic influence above everything else. The supervision of forest experiment stations by office men who are chiefly administrators and often lack entirely the scientist's point of view is a great mistake. Furthermore, these men often have the additional power to throttle appropriations and to limit the work and influence of the station in other ways. To take these stations out of the influence of men who have little sympathy for their work and place them under the direction of the large forest schools is a step which has proven to be the right course to take. The station in this case is under direct supervision of the director of the forest school, who in turn is more or less guided by the Chief of Forest Investigations of the state or government bureau. For example, in Prussia which has one of the largest investigative organizations, the central forest experiment station (as distinguished from the many sub-stations in the woods) is connected with the Forest Academy at Eberswalde, whose director is at the same time the head of the experiment station. It comprises six departments:

forestry proper, *meteorology*, *geonomy*, *plant physiology*, *plant pathology*, and *zoology*, and each department is in charge of a chief.

The work as carried on by the Prussian organization is fairly indicative of what is going on in other parts of Germany. Quite naturally the problems which are taken up depend largely upon local conditions. The work of the experiment stations as organized under the International Association of Forest Experiment Stations consisted, in 1904, principally of the study of the special ecology of species, inquiring into their physiology, phaenology, relation to soil conditions, plant associates, manner of germination, and their geographical distribution.

In Sweden, where forest conditions are very much like those which obtain in this country, the experiment station a few years back was working upon ecological investigations of forest types, upon the races of pine and spruce, upon methods of thinning, yield tables, upon methods of natural reproduction in selection forests, upon brush removal, and upon methods of assisting natural reproduction by the preparation of the soil.

The Determination of Light Values (72, 75)

The determination of light values has, without doubt, received more attention than has the measurement of any other habitat factor. Light is one of the master factors affecting plant life and is second only in importance to water. Both plant ecologists and forest ecologists have contributed to this field. It is a problem that has been given much study and investigation by some of the German and Austrian experiment stations. Hence it is desirable to at least mention the more important investigations on this phase of ecology.

It was Ingenhousz in the latter part of the 18th century who first clearly perceived the tremendously significant interrelation between *light* and *life*. It was he who showed that plants take carbon dioxide from the air and give off oxygen. His great genius saw more than this, however. Since oxygen is necessary for animal life, and this gas, which is necessary for respiration, can only be regenerated by plant life, it was clear that light is necessary for animal life as well as plant life. From the time of that important discovery dates practically all our knowledge concerning the complex relation of light to plant life.

Early in the 19th century trees were recognized as being either tolerant or intolerant of shade and there were several gradations between. This classification had been obtained in a purely empirical manner, and while it does not pretend to be accurate, it has great practical value and is generally used even today. It was not, however, until about 50 years later that the scientific determination of light values was first attempted.

The first attempt to measure light rays was made by Bunsen and Roscoe about 1862 when they introduced the use of photographic paper for determining light intensities in climatological investigations. Theodore Hartig was one of the first to attempt to determine quantitatively the light requirements of trees by this means. His experiments were made about 1877. Reinke in 1884 to 1885, by means of an instrument which he called the *Spectrophore*, broke up light by means of a prism and directed certain colored rays upon plants to determine the effect. Cieslar did much work upon the rôle of light in the forest, and Wiesner has measured light and determined the minimum intensities in which both tolerant and intolerant species could endure. These two men have done most of their work in the last 25 years.

It was with the hope of giving mathematical expression to light requirements of trees that led Wiesner about 1896 to devise his *insolator*. This instrument makes use of the well known law, formulated by Bunsen and Roscoe, that products of light intensity and time of exposure correspond to darkenings of silver chloride paper of like sensitiveness. This method is the common one in use today. The instrument, however, which is most used in this country for this kind of work is the Clements Photometer, devised in 1905 upon the same principles as the Wiesner instrument.

The most serious objection usually raised against the use of this method is that it measures the light rays which produce chemical changes on photographic paper and not those that are of importance in the chlorophyll apparatus. It is well known that photographic paper is affected mainly by the blue to violet rays of the spectrum and that chlorophyll utilizes mainly the red rays. This is not an unsurmountable objection, since it is well known that the intensity of the red and yellow rays of the spectrum may be proportional to the intensity of the blue to violet rays. In other words, the chemical rays are proportional to the photosynthetic rays and, therefore, their effects are proportional, so that the record we get on photographic paper will give us a notion as to the relative intensity of the photosynthetic rays even though the other set of rays are the ones that are actually measured.

One of the first attempts to measure separately the different rays of the solar spectrum was made in 1907 by Zederbauer, of the Austrian Forest Experiment Station at Mariabrunn. His theory was to measure the *quality* of light as well as the quantity, since a forest cover affects the light that penetrates it and trees are known to have the power of selective absorption. It is known also that intolerant trees use mainly the red rays and that tolerant trees use principally the blue to violet rays of the spectrum. These notions led to the invention of Zederbauer's spectrophotometer, and instrument which records the rays of varying length of which sunlight is composed. This is a complicated instrument, unsuited for field use. There is no instrument for measuring the quality of light in the field. For field use, the Clements photometer, even though it does not take into account the quality of light, is so far the best instrument we have.

Probably the most recent investigations upon light determinations are those of Knuchel. In an article (80) which appeared in 1914 in the Proceedings of the Central Forest Experiment Station of Switzerland he not only summarizes the work done in that field, but gives us some new ideas concerning the quality and the quantity of light in the forest, especially as it is affected by the crown cover. By means of an instrument devised by himself he measures the vertically incident diffused light and he shows of what importance this is to plant life. The work by Knuchel is probably the last word in light investigations and is worthy of more discussion than it is possible to give here.

The Application of Modern Forest Ecology to Silviculture

Before 1870, silviculture received its first scientific treatment at the hands of the old masters and their contemporaries. Not long after modern forest ecology was founded it began to exert its influence upon silvicultural thought and practice. The investigative attitude began to pervade every phase of the art and the experiment stations began to throw light upon many problems which the practitioner had been unable to solve. The works on general silviculture published between 1880 and 1885 by Gayer, Wagener, Borggreve, and others show the results of this new attitude. These men began to interpret the behavior of the tree and the forest in the light of the fundamental laws to which all plant life, without exception, is subjected. But the highest development to date of the application of modern forest ecology to silvicultural practice is to be found in the recent works of Wagner, Mayr, Duesberg and others.

The last decade has seen the development not only of modern plant ecology, but it has likewise witnessed an important change in the science of forestry in that it has introduced modern ecological ideas into the practice of silviculture. *Just as modern plant ecology in its study of vegetative units, is today concerned with the investigation and determination of habitat factors, in a similar manner modern forest ecology is trying to explain every observation, whether it deals with the individual tree, the forest formation, or with some silvicultural practice, in terms of one or more of the factors of the habitat.* Not only are we making use of broader ecological knowledge, but foresters are studying their problems in a systematic manner, making working plans for each investigation; they are not relying upon the blind, groping methods of the past to lead them, perchance to the proper solution of their problems. In other words, empiricism has called science to its aid. As Mayr points out, neither empiricism nor science alone can solve the intricate and manifold problems of *forest building*, as the Germans call silviculture; it is necessary to study first and then experiment, for only this method of procedure will obviate costly, time-consuming, and purposeless silvicultural practice and lead to stable and rational forest management.

There are four important silvicultural works of which I desire to speak which really mark a new era for silviculture. In 1907, Christoph Wagner published his *Die Grundlagen der räumlichen Ordnung im Walde* and two years later appeared Heinrich Mayr's suggestive book *Waldbau auf naturgesetzlicher Grundlage*. In 1910, Duesberg wrote *Der Wald* also *Erzieher* and in 1912 Wagner wrote a book on his pet system *Der Blendersaumschlag und sein System*. These books mark the *climax*, up-to-date, of this new development.

Wagner's first book is a valuable contribution to forestry literature. Most of the book is devoted to silviculture and deals with the requirements of silviculture in formulating the principles of local order. In this connection he places silviculture first and regulation second. In his discussions of methods of reproduction, and especially of natural reproduction he makes use of all modern ecological development. Mayr's work treats silviculture in the light of the various habitat factors which affect tree growth. *His contribution to forestry is his recognition that climate is the basis for biological differences not only in industrial trees and tree formations but also in silvicultural practice.* His *dicta* are suggestive working hypotheses upon which the future superstructure of silviculture might be reared. Duesberg's book is not merely a scientific treatise on silviculture but it is a *philosophy of the forest.* He has developed rules and principles with due regard to historical, economic, legal, ethical, and aesthetic relations in nature and society. By a critical investigation of the interrelation of forest and soil he shows how the even-aged high forest outrages nature and that mixed, uneven-aged forests are the ideal towards which silviculturists must work. Every paragraph contains shrewd observations and a wealth of detail, every one of which is supported by whatever facts scientific investigators have contributed either to support or contradict. We have in this work the modern principles of ecology applied *par excellence.* Wagner's latest book deals largely with silvicultural systems and its discussion will be relegated to the next section.

The Influence of Modern Forest Ecology upon Silvicultural Management

Before the experiment stations came into being, pure, even-aged stands were the rule in many parts of Germany. Shortly after these stations were established, the investigative attitude began to pervade every branch of forestry. It was due largely to this new investigative point of view that a reaction set in in silvicultural management. The return to mixed selection stands was advocated by many foresters who saw in this purely formal treatment of the forest the violation of many fundamental natural laws. In the protest against the old system which ensued, forest ecology was again brought into play and in the general controversy that followed, quite often the ecological discussions waxed so hot that the main issue of the discussions was lost sight of, much to the advantage of forest ecology.

Natural reproduction methods were chiefly employed until almost the middle of the 19th century. The selection and coppice systems were used until Hartig and Cotta brought the shelterwood system into favor. Hartig's eight rules for the application of the shelterwood system were soon applied universally, even to the northern pine forests. The result was that pure, even-aged, high forests in many cases succeeded mixed forests. When the transplanting of conifers became general, about 1840, the clear cutting and planting system was widely applied, especially in the pineries. The result was, that since the middle of the 19th century the common form of management in northern and central Germany was the establishment of pure stands of even-aged, high forest. The old masters, Hartig and Cotta, and those that followed them brought about this management because it fitted very well the conditions of the woodlands at that time and also because this system was best from the standpoint of yield.

The reaction set in during the last quarter of the century. While the formation of pure stands was going on, investigations in natural methods of reproduction lingered. On the other hand, the old method of management became unexpectedly cut and dry and inelastic. Moreover, the shelterwood system, which had been developed according to the requirements of the beech was applied to pine and spruce. When failures became evident, much opposisition arose against the use of this system. Foresters began to realize that the formation of large areas of pure stands was in many ways antagonistic to the natural requirements of the trees. An era then set in which brought modern forest ecology to the fore to show the necessity of imitating nature's methods. Gayer, in 1878, set forth the advantages of mixing species and later developed the formation of uneven-aged mixed stands. In 1885, Borggreve pointed out the evils of clear cutting and the advantages of natural reproduction over the practice of planting. These men and others advocated a change from the shelterwood system in hardwoods and the clear cutting as applied to pines to the selection system and from pure forests to mixed forests.

Two schools of silvicultural management then sprang up adhering to two opposite principles: the *natural* and the *economic*. The former school favored natural reproduction, many-aged stands, and the selection system; the latter school advocated the greatest possible return, even-aged stands, and the clear cutting and planting method. Without doubt modern European silviculturists have been guided by the *economic* principle. As a result, the *natural* principle which preserves the productive power of the soil has been neglected. Even today the clearing system has made most progress and the selection system has almost vanished, being replaced by the group and the shelterwood methods.

But that does not mean that the *natural* school had no adherents or in any way gave up the controversy. Gayer, Ney, Burkhardt, Borggreve, followed by Wagner, Mayr, Duesberg, Dittmar, and others have championed its cause during the last 30 years (88). And in so doing they have given the world some of its *most suggestive* and *most original* silvicultural literature. They have tried to solve the problem, each in an original way. By making use of the latest ecological investigations they have endeavored to show why the natural system should replace a thoroughly artificial one. For a time the controversy between the two theories was eclipsed by the painstaking research towards the study of the natural laws underlying the two silvicultural systems.

Wagner (83) prefers natural reproduction because this produces a race of trees adapted to the site and gives rise to mixed stands. His practice is to cut the forest in narrow strips running east and west, beginning at the northern edge of the forest, a narrow strip being thinned in advance of cutting to start the natural reproduction. Mayr's ideal (59) is quite the opposite: a small pure stand in which species are mixed as small stands, not as individuals. It can be reproduced by artificial or by natural means and soil production is secured by underplanting. Wagner's method has been tested in the forest; Mayr's is based upon purely theoretical grounds. Both claim universal application for their method.

Other men have limited their observations and reflections to local conditions and are willing that their results should be applied only to those conditions. In the west we find van Schermbeck, Gräbner and Erdmann; in the east Godberssen, Dittmar, Reuss and Duesberg. Van Schermbeck's problem was to rejuvenate run-down pine lands in the heath country of Holland which had become sour due to the exposure and the presence of pure pine stands. It was essentially a problem in the biology and chemistry of the soil and a *classic* among ecological investigations. His warning was to avoid pure stands of pine. Erdmann had a similar problem on heath lands. He studied the changing relations between the soil and the stand on heath soils and came to the conclusion that mixed stands and the avoidance of clear cutting was the only way to prevent the deterioration of the soil. Godberssen

(86) was inclined to differ from these men. He asserts that mixtures are better than pure stands, but that natural reproduction is not ideal. His opinion is that after all is said and done the clear cutting and planting method, judging from past performances, has produced the best results. Dittmar (87) held that clear cutting was unnatural and that natural reproduction was nearest to nature's method. As early as 1901, Reuss wrote about the detrimental effects of planting methods upon the future conditions of the stands with partiular reference to the spruce. He called the clear cutting method unnatural and considered its use *mismanagement.* Later, (85) in his splendid manual upon forest reproduction, he established the golden rule: the simplest method of producing a crop without sacrificing the soil was to be the sole criterion between natural and artificial reproduction and between pure and mixed stands.

Duesberg (84) proposed a system which is probably the most radical and at the same time the most thoroughly original one that has been propounded. In a most thorough and painstaking manner he seeks to break down the arguments which are in favor of large, pure stands. In doing this, he brings into play a *great wealth* of silvical observations and investigations. His thesis is that Nature, unguided by man, produces a forest which is in complete harmony with the soil and the plant and animal life in the forest. Man should not interfere with Nature's work, but should seek to understand the life-history of an unmanaged forest and the natural laws which determine it. With this knowledge he should decide upon the proper method of management, try to improve upon Nature's method and direct the natural forces to the production of economic values. Duesberg proposes a simple type of selection forest, which recognizes every essential of the uneven-aged forest, produces the highest yield and is most simple to manage. This selection forest has for its unit small areas of a size determined by the diameter of the crown of a full-grown tree in the virgin forest. These areas differ with the different species and their typical shape is a regular hexagon. Seven of these hexagons are termed a *group*, each one of the *group* being a *clump*.

Duesberg's system impresses one as being too complex for general introduction and certainly too difficult to insure its inauguration and success at the hands of the average forester.

Like the proposed systems of Gayer, Ney, Wagner and Mayr this latest one is artificial. Moreover, it is based upon but a few experiments in the field. The real value of these systems must not, however, be measured by how widely Gayer's *Femelschlag*, or Ney's *Ringfemel*, or Wagner's *Blendersaumschlag* are applied to German forests. The value of the systems proposed by these men is in the *detailed, incisive criticism* which they have called forth against a purely formal treatment of the forest. *In propounding their favorite systems they have penetrated to the bottom of the basic principles of silviculture. They have applied forest ecology as it never has been applied before.* In a striking manner they have shown the relation between certain *practices* and the *results* which they produced and have formulated most excellent codes of directions and advice in dealing with both systems.

No system can claim universal application. Each system will be accepted only in so far as it proves of service to the conservative practice of forestry. As Reuss has pointed out, the safest procedure is to consider what method is best adapted to the *fundamental laws* of Nature and the *economic needs* of the community. When once arrived at, this method becomes the ideal towards which the forester should slowly work.

The result of all this excellent literature upon the ideal selection system will be that foresters will turn more to natural reproduction and the formation of uneven-aged mixed stands in localities where conditions will warrant. Before applying any system, foresters who have read these works will try to emulate these modern masters and *thoroughly investigate the natural laws which are involved.*

The Progress of Investigations in Forest Ecology in the United States

In tracing the development of forestry in the United States we are impressed with the fact that ecological investigations have had to give way to the more important problems of forest organization and administration. A brief sketch of the federal forest policy will illustrate this point. It is desirable to mention three periods in the development of the forest policy of the nation and to speak of the development of ecological investigations in each period.

In 1876, Congress created the office of Commissioner of Forestry. The period from 1876 to 1891 may well be characterized by the term *meristematic*, for in this period the attempt was made to mould public opinion in favor of a more rational use of forest resources by means of systematic propaganda. In the second period this formative condition gave rise to *differentiated* and more *permanent structures*. The period from 1891 to 1909 may be termed the period of the creation of National Forests, the adjustment of their administration, the building-up of an organization for their protection, and the beginning of effective appropriations for making the forests accessible and useful. In this period the names of *Theodore Roosevelt*, *Gifford Pinchot*, *Bernhard E. Fernow* and *Filibert Roth* deserve special mention. From 1909 to the present time is distinctly a period of the perfection of the organization at hand and the real beginning of forestry investigations of all kinds. *Henry S. Graves* has been instrumental in bringing about rational progress in the former field of activity and *Raphael Zon* has done more than any other forester in establishing silvical investigations on a firm basis.

It is quite obvious that previous to 1909 the time was not ripe for intensive ecological investigations. Greater and more urgent problems needed attention. It is true, however, that during the first two periods investigative work was initiative. While much of the work done, especially in the first period, has small value from the scientific standpoint, still some investigations carried on in the second period are pioneer works of permanent value. The establishment of forest experiment stations since 1909 was, of course, the actual beginning of experimental forest ecology; just as the erection of a forest products laboratory was the beginning of industrial forest investigations.

During the incumbency of F. B. Hough as Commissioner (1876–83) appropriations for forestry work were very limited and special original research was, of course, excluded. Hough compiled three large "Reports on Forestry" (1877, 1880, 1882) which were published by Congress. These contained information upon a wide range of subjects, including some dealing with silviculture. Hough, however, treated the subject of forestry as an interested layman, not as a professional forester, and his reports, while valuable compilations of existing facts, contained no original investigations. Eggleston, his successor (1883–86) was a preacher and like Hough did not see the subject from the scientific point of view. He compiled one report (1884) which was published by the Department of Agriculture. Its chief value lies in containing what may be termed the first silvical notes dealing with forest conditions in various parts of the country. His report treated, among other things, of tree planting on the prairies and plains, the decrease of woodlands in the state of Ohio and forest conditions in other states.

B. E. Fernow, the successor of Eggleston was the first professional forester to occupy this important post. During his incumbency (1886–98) investigations along several lines received a great impetus. *Fernow was really the man who put forest investigations upon a scientific basis* (82). The first separate appropriation for forestry investigations was made in 1887, with the result that numerous silvical and silvicultural problems were attacked including the growing of seedlings for field planting, the introduction of exotics, the planting of waste lands, and planting on the plains. In 1886, a number of botanists were engaged to make a study and report of the life-histories of some of our most important forest trees. This work however, was soon found to be foreign to these men because they did not see the problems from the forester's point of view. However, some interesting and valuable notes resulted. Twelve species were treated in this way, but only the life-histories of four important Southern pines (1896) and that of the White pine (1899) were published. The magnificent work on the Southern pines was the first attempt in the United States of a monographic study from a forester's point of view of the economic and technical phases and the silvicultural and habitat requirements of forest trees.

Forestry literature, so far as government bulletins, circulars, and pamphlets dealing with forest investigations or one or more of the various phases of applied forest ecology is concerned, dates from 1886. The forest investigations carried on under the direction of Fernow, from 1886 to 1898, cover a broad field, about one half being original investigations and the other half being data adapted from foreign sources. The most important of these are the investigations of Filibert Roth, Johnson, and others in timber physics, between 1892 and 1898. These men investigated the general laws of the structure and of the physical and mechanical behavior of the wood of various species of trees and their work called forth great praise from no less a forestry authority than Dr. Schwappach. Other investigations were a forest botanical description of our forests, work by Roth upon the properties, characteristics, and identification of American woods (1895), and investigations upon the relation of the forest cover to waterflow, soil and climate (1893). The last mentioned study included a review of forest meteorological observations in

Europe, and additional notes upon the relation of forests to water supplies and sanitary conditions. Since 1898, the new idea of making working plans for private timberland owners developed and much valuable silvical data has been gathered in this way.

While the creation of forest reserves dates from 1891, a management of the established reservations was not attempted until 1897. But the policy which was adopted even at that late date was far from efficient. The new law placed the authority over the forests in the hands of the Secretary of the Interior and the technical and scientific work with the Secretary of Agriculture. In the former department the administrative work was carried on by the General Land Office, and the surveying, mapping, classification, and description of the reserves was done by the U. S. Geological Survey. This anomalous condition lasted until 1905 when the entire forestry business was handed over to the Department of Agriculture. It was while the administration of the forest reserves was in this chaotic condition that an important piece of work was done by the Geological Survey. This work concerned itself with the survey and description of the reservations and cost over a million and a half dollars. The results of these investigations were published in handsome volumes and they serve not only as a useful educational work but *they mark a distinct advance in the field of silvics* in the United States. It is true that this work was of an observational rather than of an experimental nature but that fact does not detract in the least from its value. It was a *pioneer* work *well done* and upon a *gigantic* scale. The forests of the country had been studied by *botanists*, but no attempt had been made to gather *silvical data* describing the conditions of the forest lands, not only those still bearing timber but also those lands cut or burned over. The men sent out by the Survey gathered information upon the character of the soil, litter, humus, underbrush, young growth, size of the timber, stand per acre, height, clear length, age, soundness, fire resistance, rate of growth, burned areas, geographical and altitudinal distribution of species and many other matters. This data was usually taken by legal subdivisions, and over 70,000,000 acres were covered both in the East and in the West. Among the men engaged in this work should be mentioned Graves, Leiberg, Ayres, Plummer, Dodwell, Rixon, and Sudworth. Of the dozen or more engaged in this work there were only two or three foresters, the rest being geologists, surveyors, etc.

By far the most *important* fact to be noted during the period beginning in 1909 is the establishment of 9 *forest experiment stations* and one forest products laboratory by the Forest Service. *This date marks the beginning of the application of the principles and methods of modern ecology to American silvical and silvicultural problems and begins a new era for American silviculture.* The creation of these stations has given a much needed impetus to the investigative phases of forestry. Since they are scattered over the western half of the United States, the work of these stations covers a great many phases of silvicultural management and silvical problems of an extremely varied character. Reforestration problems are taken up under seed testing, nursery work, and planting. Of great present value are investigations in methods and systems of cutting and the study of growth after cutting. The requirements of species and of the important forest types are being determined by systematic meteorological observations. Grazing investigations, being intimately wrapped up with a great national industry are of special importance and have begun to receive the attention which they deserve. A study of the ecological life histories of grasses and other forage plants which grow on Western grazing lands has been begun for the ultimate purpose of increasing the carrying capacity of these lands. One of the largest tasks undertaken by a single experiment station is the study in Colorado of the influence of the denudation of a watershed by lumbering upon the flow of the streams within it. This problem is scheduled to run over a period of years. In the main it is the purpose of these stations to attempt to solve those problems which confront the Forest Service on the various National Forests, hence they are of an *applied* rather than a *purely scientific* character.

The recent literature upon the subject includes numerous reports, circulars, bulletins, etc., of a more or less silvical character by both government and state bureaus dealing with the forests and with forest conditions on government, state, and private lands. The data so far published by the forest experiment stations is very meager, being confined almost entirely to short contributions to periodical literature. This lack of literature, however, is not due to any lack of material but rather to a lack of facilities for having this kind of work published.

Some forest investigations have been carried on by plant ecologists at State Agricultural Experiment Stations, notably in Vermont. This is the proper place for these investigations and it is to be hoped that *every state in the Union will emulate Vermont. This would eventually lead to a Forest Experiment Station coordinate with the Agricultural Experiment Station in every state.*

The most important recent contributions in government literature have been in the direction of the effect of forests on climate and streamflow (64, 65, 66, 67, 89). Zon has summarized the work done in this field both here and abroad very completely (68). A bulletin by Bates (69) upon *Windbreaks* studied the influence of windbreaks upon climate, especially humidity, wind and temperature, and being worked out according to modern ecological methods, marks a distinct advance. A bulletin by Graves and Zon (72) upon *Light in Relation to Tree Growth* gives a resumé of the work done in determining light values in the woods. It is a sure indication of a closer scrutiny of habitat factors in silvicultural work. A third bulletin along the same lines was written by Clements (73) upon *The Life-History of Lodgepole Burn Forests.* This was an investigation in forest ecology by a plant ecologist and was one of the first attempts to apply the principles and methods of plant ecology to a forestry problem.

The periodic forestry literature (70, 71) dealing directly or indirectly with applied ecology in the United States during the last 12 years reveals the beginning of the study of certain great silvicultural problems in a systematic manner. The contributions are almost entirely by members of the U. S. Forest Service who are in an excellent position to undertake the study of the varied field problems. Although the data are to a considerable extent based on general observations rather than on conclusions based upon quantitative data yet we must admit that they have no small value. That foresters have followed the observational method for gathering their facts rather than the experimental is due to difficulties over which they have no control. We have begun to study our problems in an empirical way, but the methods of plant ecology are beginning to make themselves felt. When we happen upon a title like *The Climatic Characteristics of Forest Types* we begin to realize that the exact determination of silvical facts by means of systematic experimentation has begun. The complete silvical description of our important species based upon field studies is nearing completion. The effect of fires, snow and insects, both as they affect forest succession and the life of the individual tree have been studied. Problems in nursery practice and in field planting have been treated extensively. The chaparral type on the Pacific Coast has attracted no little attention, principally on account of its planting problems and its value as a watershed protection. There have been good articles upon the tolerance of trees and there have been symposia upon the principles involved in determining and classifying forest types. Some work has been done to determine the effect of exposure upon coniferous seedlings during transplanting. By far the greatest emphasis, however, has been placed upon reforestation. Men who have had direct charge of such work have described their experiences in various forest regions of the country: in Arizona and New Mexico; in the sandhills of Nebraska; on the sand plains of Michigan; in the brushfields of California; in the prairie states; and in the Black Hills.

In all this work, whether experimental or observational in character, modern ecological ideas have been brought into play. *It is apparent that the attempt is being made to correlate the results obtained in various branches of silvicultural work with habitat factors.* We have in our possession a vast and rapidly growing body of ecological facts concerning the individual tree, the forest formation, and almost every silvicultural practice, from which a few general principles are gradually being crystallized out; each established principle is one step nearer to our ultimate goal in the development of the science of forest ecology, and therefore in the gradual building up of a rational American silvicultural system.

IV. HISTORICAL SUMMARY

Plant ecology, as we have seen, is the latest stage on the development of plant geography; the earliest stages of plant geography dealt merely with the description of vegetation and the distribution of plants. The science of plant ecology was founded in 1838 when the *plant formation* was recognized as the fundamental unit of vegetation and the unit with which plant ecology is chiefly concerned. The next step was the study of the plant formation and its various phenomena. This led to the development of ecological plant geography, which was first treated in a systematic manner by Warming in 1895. Then followed the development of experimental plant ecology and a more critical study of the plant formation. Beginning with 1895, the emphasis has shifted from the study of vegetation to the investigation of the underlying causes of vegetative units. The works of Schimper, Warming and Drude are the best examples of the present trend of the science.

Silviculture, on the other hand, began as a practice based upon empiricism. When forest ecology was founded in 1758 the fundamental sciences began to put silviculture upon a scientific basis. During the last half of the 18th and the first half of the 19th centuries the tendency was to investigate tree and forest problems from the ecological point of view. As a result forest botany, forest pathology, forest entomology, and the anatomy and physiology of woody plants developed. At the beginning of the 19th century silviculture received its *first scientific treatment* at the hands of the fathers of modern forestry—Hartig and Cotta. Modern forest ecology was inaugurated when the forest experiment stations were established in 1870, and thereupon began a new era for silviculture. These stations forthwith began the task of basing silvicultural practice upon experiments. The investigative attitude began to pervade every phase of forestry. In this new era the investigations of forest ecology were brought into play to explain not only every observation dealing with the individual tree and the forest formation, but also every silvicultural practice. The application of modern forest ecology has found its highest expression in the recent works of Mayr, Wagner and Duesberg and in the controversy that developed between two opposite schools of silvicultural thought.

Thus it will be seen that three centuries before the corner-stone of plant ecology was laid the practice of silviculture upon an empirical basis began and that even during this early period the applied phases of many ecological problems were known to foresters About 80 years before plant ecology was founded the science of forest ecology had its beginning, when the fundamental sciences were applied to the study of the relation of the forest to its habitat. Plant ecologists began the determination of habitat factors in 1895, but foresters took such data at meteorological stations in connection with the study of forest influences between 1860 and 1870. *In the study of this phase of ecology, therefore, forest ecology antedates plant ecology by more than* 30 *years*. In spite of their interrelation, the two sciences developed independently; plant ecology chiefly along purely scientific lines and forest ecology mainly along applied lines. Since forest ecology came into being first, it would be an anachronism to say that forest ecology developed as an offshoot of plant ecology.

The *parallelism* of these sciences is evident when we consider that plant ecology deals with plants as a whole and forest ecology only with trees. From the time of Schouw and Grisebach to that of Schimper and Warming, a span of nearly 100 years, the two sciences often worked in the same fields, even though they looked upon the same problems from different viewpoints. In the determination of light values, in the study of plant succession, and in many other phases of ecology foresters and botanists have worked together. It is significant that Mayr was for more than 25 years associated with the eminent forest botanist Robert Hartig both in botanical and in forestry investigative work. There can be no doubt that a mutual benefit was derived from this association. Certainly Mayr must have gathered considerable inspiration for his *Waldbau.* The *coincidence* of these two sciences at the present time is evident when we consider that both are inquiring into the causes of vegetation. It is significant that modern plant ecology and silviculture based upon natural laws are developing simultaneously. This fact is especially emphasized when we note that Warming's *Ecology of Plants* and Mayr's *Waldbau auf naturgesetzlicher Grundlage* two epoch-making works both appeared in 1909 and both are concerned with the *investigation of the relation between the plant and its habitat.*

While plant ecology and forest ecology developed independently (the former along purely scientific lines, the latter along applied lines), we are witnessing today a period in which they are becoming mutually helpful. *Modern plant ecology will have the tendency to make forest ecology a more orderly science.* Forest ecology has never been properly organized and systematized. Plant ecology long ago recognized the plant formation as its fundamental unit; why should not the same unit (called by foresters a forest type) be recognized as the fundamental unit of forest ecology? Also the recently established sub-divisions of plant ecology, namely, autecology, and synecology, apply just as well to forest ecology? *Plant ecology will also make forest ecology broader in its scope and meaning.* While they have developed to a certain extent independently, I see no reason why they should continue to progress so. While forest ecology will always be looked upon as one of the applied phases of plant ecology there is no reason why the methods and principles of plant ecology cannot be applied *in toto* in pursuing its most important branch. *Plant ecology will also have the tendency to make forest ecology, which previously existed only for applied reasons, more purely scientific.* In the organization of the work of the forest experiment stations in the United States the principles and methods of plant ecology were employed with the result that forest ecology was put upon a more scientific basis. The forest investigator's viewpoint is apt to become narrowed by the applied nature of his investigations. For this reason he does not always use those methods that give the best results; hence, the necessity of plant ecology which will give him the purely scientific point of view. Present-day plant ecologists are usually scientists of attainment, many of them well-known teachers of the subject and in a position to be thoroughly in touch with the literature and progress of the science. Foresters are largely field men; most of them very practical; a few with investigative ability. They have the advantage of being near to Nature, but they are usually far removed from academic influence, good libraries, and other facilities for carrying on research. The investigator of forestry problems of the near future must possess a combination of these qualities and opportunities.

The following table shows in a comparative manner the three great periods in the development of plant ecology and silviculture.

Plant Ecology	Silviculture
Before 1838. *The era of plant geography;* a period dealing with the study of vegetation as a whole and with the geographical distribution of plants.	1346–1758. *Forestry practice based upon empiricism;* the development of silviculture by practice with little reference to the fundamental natural laws involved.
1838–95. *A period dealing with the study of the plant formation;* the plant formation recognized as the fundamental unit of vegetation, thus laying the cornerstone of plant ecology; the division of vegetation into units; the beginning of the study of plant succession.	1758–1870. *The development of the biological phases of forestry,* including forest botany, forest pathology, morphology and physiology of woody plants, etc. The theory of light and shade in the forest elaborated by Heyer.

1895–1916. *The period of modern plant ecology; dealing with the study of the habitat;* the exact determination of physical factors; ecology allied itself with plant physiology; whole field of plant ecology divided into autecology and synecology and otherwise organized. The works of Schimper, Drude and Warming characterize this period.

1870–1916. *The period of modern forest ecology;* period characterized by the establishment of forest experiment stations by most forestry practicing nations. The beginning of experimental ecology and the measurement of habitat factors. Forest experiment stations take up the study of forest soils, forest influences, forest litter, forest climatology, the effect of source of seed, and the ecological bases for thinnings. Works of Wagner, Mayr and Duesberg are the highest expression of the application of modern forest ecology to the practice of silviculture.

V. BIBLIOGRAPHY

1. Clements, F. E., Research methods in ecology. Lincoln, Nebr. 1905.
2. Berg, E. von, Das Verdrängen der Laubwälder durch die Fichte und Kiefer. Grisebach Berichte 15. 1844.
3. Hofmann, H., Der nördliche Ural and das Küstengebirge Pae-Choi. 1856.
4. Warming, E., Fra Vesterhavskystens Marskegne. Vid. Medd. Foren. 1890.
5. Middendorff, A., Die Gewächse Sibiriens. 1864.
6. Senft, F., Der Erdboden. Just, 45. 1888.
7. Warming, E., Plantesamfund, Grundtrok af den oekologiske Plantegeografi. 1895.
8. Drude, O., Deutschlands Pflanzengeographie. 1896.
9. Warming, E., Lehrbuch der oecologischen Pflanzengeographie. 1896.
10. Schimper, A. F. W., Pflanzengeographie auf physiologischer Grundlage. Jena. 1898.
11. Bonnier, G., Les plantes arctiques comparées aux mêmes espèces des Alps et des Pyrénees. Rev. Gen. Bot., 6:505. 1894.
12. Bonnier, G., Cultures experimentales dans les Alps et les Pyrénees Rev. Gen. Bot., 2:514. 1890.
13. Bonnier, G., Recherches experimentales sur l'adaptation des plantes au climat alpin. Ann. Nat. Sci. 7:20:218. 1895.
14. Solms-Laubach, H., Die leitenden Gesichtspunkte einer allgemeinen Pflanzengeographie. 1905.
15. Warming, E., Oecology of plants. Oxford. 1909.
16. Clements, E. S., The relation of leaf structure to physical factors. Trans. Am. Micro. Soc., 25. 1905.
17. Clements, F. E., Peculiar zonal formations of the Great Plains. Am. Nat. 31:968. 1897.
18. Clements, F. E., The development and structure of vegetation. Rep. Bot. Survey Neb. 7. 1904.
19. Clements, F. E., Formation and succession herbaria. Univ. Nebraska Studies 4:329. 1904.

20. Humboldt, A. von, Ideen zu einer Physiognomik der Gewächse. 1806.
21. De Candolle, A. P., Essai élémentaire de géographie botanique. 1820.
22. Schouw, J. F., Grundzüge einer allgemeinen Pflanzengeographie. 1823.
23. Meyen, F. J. F., Grundriss der Pflanzengeographie. 1836.
24. Drude, O., Handbuch der Pflanzengeographie. 1890.
25. Kabsch, W., Das Pflanzenleben der Erde. 1865.
26. Clements, F. E., A system of nomenclature for phytogeography. Engler. 31. 1902.
27. Thurmann, J., Essai de phytostatique appliquée à la chaîne du Jura et aux contrées voisines. 1849.
28. De Candolle, A., Géographie botanique raisonée. Paris. 1855.
29. Graebner, P., Gliederung der westpreussischen Vegetations-formationen. Bot. Centralblatt, 75. 1898.
30. Graebner, P., Ueber die Bildung natürlicher Vegetations-formationen im norddeutschen Flachlande. Bot. Centralblatt, 77. 1899.
31. Goeze, E., Pflanzengeographie. Stüttgart. 1882.
32. Linné, C. von, Flora Suecica. 1745.
33. Linné, C. von, Philosophia botanica. 1752.
34. Hildebrand, F., Die Verbreitungsmittel der Pflanzen. Just. 73:224. 1873.
35. Kerner, A., Pflanzenleben. Leipzig. 1891.
36. Grisebach, A., Die Vegetation der Erde. Leipzig. 1872.
37. Biberg, I. J., Oeconomia Naturae. Amoen. Acad. 4:1. 1749.
38. Humboldt, A. von, Views of nature, 125, 213. 1850.
39. Henfrey, A., The vegetation of Europe. 1852.
40. Hult, R., Försok till analytisk behandlung af formatioerna. Medd. Soc. Fenn. 1881.
41. Cowles, H. C., The ecological relation of the vegetation of the sand dunes of Lake Michigan. Bot. Gaz., 27. 1899.
42. Fuller, G. D., Soil moisture in the cottonwood dune association of Lake Michigan. Bot. Gaz., 53. 1912.
43. Fuller, G. D., Evaporation and soil moisture in relation to the succession of plant associations. Bot. Gaz., 58. 1914.
44. Roberts, E. A., The plant successions of the Holyoke Range. Bot. Gaz., 58. 1914.
45. Tournefort, J. P., Relation d'un voyage du Levant. 1717.
46. Ramond, L. F. E., Voyages au Mont-Perdu et dans la partie adjacente des Haut-Pyrenees. 1801.
47. Humboldt, A. von, and Bonpland, A., Tableau physique des regions equatoriales. 1805.
48. Köppen, W., Die Wärmezonen der Erde. 1884.
49. Drude, O., Atlas der Pflanzenverbreitung. 1887.
50. Raunkiar, C., Vesterhavets Ost-og Sydkysts vegetation. Bot. Cent., 41. 1889.
51. Magnin, A., Recherches sur la végétation des lacs du Jura. Rev. Gen. Bot., 5. 1893.
52. MacMillan, C., On the occurence of sphagnum atolls in central Minnesota. Minn. Bot. Studies, 1. 1894.
53. De Forest, H., Recent ecological investigations. Proc. Soc. Am. Foresters, IX. 1914. (For bibliography of recent literature.)
54. Fernow, B. E., History of forestry. Toronto. 1911.
55. Heyer, G., Verhalten der Waldbäume gegen Licht und Schatten. Erlangen. 1852.
56. Heyer, G., Lehrbuch der forstilchen Bodenkunde und Klimatilogie. Erlangen. 1856.
57. Ramann, E., Forstliche Bodenkunde and Standortslehre. Berlin. 1893.
58. Ramann, E., Bodenkunde. Berlin. 1911.
59. Mayr, H., Waldbau auf naturgesetzlicher Grundlage. Berlin. 1909.
60. Wagner, C., Die Grundlagen der raumlichen Ordnung im Walde. 1907.

61. HARTIG, T., Anatomie und Physiologie der Holzpflanzen. 1878.
62. EBERMAYER, E. W. F., Die gesammte Lehre der Waldstreu. 1876.
63. FERNOW, B. E. and others, Forest influences. Forest Service, U. S. Dept. Agric., Bull. 7. 1893.
64. BRAY, W. L., The timber of the Edwards Plateau of Texas. U. S. Dept. Agric., Bureau of Forestry, Bull. 49. 1904.
65. HALL, W. L., and MAXWELL, H., Surface conditions and stream flow. U. S. Dept. Agric., Forest Service, Cir. 176. 1910.
66. SCHWARZ, G. F., The diminished flow of the Rock river in Wisconsin and Illinois and its relation to the surrounding forests. U. S. Dept. Agric., Bureau of Forestry, Bull. 44. 1903.
67. TOUMEY, J. W., Relation of forests to stream flow. U. S. Dept. Agric. Yearbook. 1903.
68. ZON, R., Final report of the National Waterways Commission. U. S. Senate Doc. 469. 1912.
69. Bates, C. G., Windbreaks. U. S. Dept. Agric., Forest Service Bull. 86. 1911.
70. FORESTRY QUARTERLY. Washington, D. C. Vols. I–XIII. 1903–15.
71. Proceedings of the Society of American Foresters. Washington, D. C. Vols. I–X. 1906–15.
72. ZON, R., and GRAVES, H. S., Light in relation to tree growth. U. S. Dept. Agric., Forest Service Bull. 92. 1911. (Contains bibliography.)
73. CLEMENTS, F. E., The life history of lodgepole burn forests. U. S. Dept. Agric., Forest Service Bull. 79. 1910.
74. GANONG, W. F., The organization of the ecological investigation of the physiological life histories of plants. Bot. Gaz., 43. 1907.
75. WIESNER, J., Der Lichtgenuss der Pflanzen. Leipzig. 1907.
76. COWLES, H. C., The physiographic ecology of Chicago and vicinity; a study of the origin, development, and classification of plant societies. Bot. Gaz., 31:73–108, 145–182. 1901.
77. MOSS, C. E., The fundamental units of vegetation. New Phytologist, 9:19–49. 1910.
78. TANSLEY, A. G., The problems of ecology. New Phytologist, 3:191–200. 1904.
79. CLEMENTS, F. E., Plant physiology and ecology. New York. 1907.
80. KNUCHEL, H., Spektrophotometrische Untersuchungen im Walde. Mitt. d. Schweiz. Central. d. forst. Versuchs., XI:1. Zürich. 1914. (For review *see* Proc. Soc. Am. Foresters, X:1. 1915.)
81. LOREY, T. VON, Handbuch der Forstwissenschaft. Tübingen. 1903.
82. FERNOW, B. E., Report upon the forestry investigations of the U. S. Department of Agriculture, 1877–98. Washington, D. C. 1899.
83. WAGNER, C. H., Der Blendersaumschlag und sein-system. Tübingen. 1912.
84. DUESBERG, R., Der Wald als Erzieher. Berlin. 1910.
85. REUSS, H., Die forstliche Bestandesgründung. Berlin. 1907.
86. GODBERSSEN, H., Die Kiefer. 1904.
87. DITTMAR, H. J. A., Der Waldbau. Neudamm. 1910.
88. JENTSCH, F., The rise of silviculture. Translated by F. Dunlap. Forestry Quarterly, IX:4. 1911.
89. REYNOLDS, R. V. R., Grazing and floods. Forest Service, Bull. 91. 1911.
90. COOPER, W. S., Plant succession in the Palo Alto region. Science, N. S., XLII:1094:877. 1915.
91. BOERKER, R. H., Some notes on forest ecology and its problems. Proc. Soc. Am. For., X:4, 405 ff. 1915.
92. SHREVE, F., The weight of physical factors in the study of plant distribution. Plant World, 19:3, 53–67. 1916.
93. SHREVE, F., The vegetation of a desert mountain range as conditioned by climatic factors. The Carnegie Institution of Washington. 1915.
94. BOERKER, R. H., Ecological investigations upon the germination and early growth of forest trees. Univ. Nebraska Studies, 16:1, 1–89. January, 1916

NEW TOPOGRAPHIC SURVEY METHODS

By J. H. Bonner[1] and F. R. Bonner[2]

(Note: The following article appeared in the January 6th issue of *Engineering News* and the March issue of *The Timberman*, and has been widely commented on by engineers as presenting something entirely new and valuable. Perry Baker, editor of the *Engineering News*, in commenting on the article, said: "It is not very frequently that the editor can direct attention to new methods in surveying, but the reader will find this article to describe some truly radical improvements in the field work of topographic surveying.")

The last few years have witnessed a remarkable change in methods used in the logging industry in the Pacific Northwest. It is only a few years ago that a man with a quarter section of timber land, a team of horses and limited capital could engage in the logging business. But times have changed; the close-in timber has been logged; keen competition has reduced prices; and the future logging operations of the large companies are planned out on a comprehensive scale for years to come. The old "tote" road is being supplanted by the logging railroad. The passing of the small-mill man is marked by the advent of the logging engineer, a profession unknown a few years back. Practically all of the companies doing railroad logging in the Pacific Northwest now employ an engineer more or less continuously, who plans and directs the entire field operations.

Time was when a company in building a logging railroad followed the general contour of the ground, with narrow roadways, steep grades, and insufficient drainage. But modern business efficiency no longer permits such methods; the logging companies are now doing on a small scale what our transcontinental railroads are undertaking—eliminating sharp curves and reducing grades on the main lines. Such construction increases first cost but the logging engineer no longer plans on tearing up the steel in a few years when the area has been logged. The grade is so constructed that the owner of a body of timber beyond can afford to buy the road and haul his logs over it in preference to building another railroad. Also in special cases, owing to the present-day demand for logged-over lands for farming purposes, there is a chance of the road being used as a common carrier in years to come.

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Accurate Map Essential

The logging engineer's first demand in taking over a new job is for an accurate topographic map not only of the area that his company intends to log, but of all the adjacent territory. There is no need to dwell on the necessity for an accurate contour map. It becomes the working plan of the logging engineer on which he makes the locations for railroads, spurs, flumes, chutes, roads, camps and cable systems.

The cruiser's maps, giving locations of streams and ridges, with occasional elevations taken with the aneroid barometer, served their purpose in their day, but modern logging business requires more detail. The topography must be accurately mapped, the reports must give a careful classification of all timber, for each species as standing, dead and down, timber suitable for piling, poles and ties, with an estimate of probable defects; also soil classification reports, conditions of undergrowth and mineral indications.

The surveys for topographic maps for logging operations are made in various ways. The method to be used is determined by the lay of the land and the density of the forest growth. Until a year or two ago the custom was to make all such surveys by the aneroid method, which is simply a refinement of the methods used by timber cruisers. Elevations were determined by primary leveling along certain lines selected as base lines. If the area has been previously covered by the survey of the United States General Land Office, it is customary to establish the base along section lines; while in unsurveyed territory irregular traverses are run along roads, trails or ridges, the work usually being done by transit and stadia and the elevation computed at fixed intervals. From these base lines parallel "strips" are run.

The strip crew usually consists of a compassman and an estimator. The compassman runs a rough line by a box compass and paces the distances. Also he carries an aneroid barometer which he sets with a stationary camp barograph in the morning and sketches the contours each side of the line on his map. It is also necessary to record the time at which the aneroid readings were taken in order to make the corrections for the fluctuations of the instrument during the day.

The aneroid, while a handy instrument for taking rough elevations, is too eccentric to be relied on to do accurate work, as any engineer is aware who has used one in mountainous regions subject to frequent and sudden atmospheric changes. As the working aneroid goes through the changing atmospheric conditions during the day, it is necessary to correct the readings in proportion to the fluctuations of the camp barograph.

After the day's field work is completed and the aneroid reading corrected, there follows the difficult work of adjusting contours to form the finished map. It the topographer has been conscientious and is skilled at his work, he has gathered a wealth of topographic detail which is all to be lost and wasted when his contours are put through the "juggling" process. The very lack of preciseness and the knowledge that the map must be adjusted greatly discourages careful and conscientious sketching in the field.

It is very evident that the map cannot be accurate except in a general way. All topography is approximately correct, but would hardly answer on a map on which to make the paper location for a railroad or a flume. The cost of making surveys using the method outlined above is from 5 cents to 35 cents per acre.

Such was the condition when the engineers of District 1 of the Forest Service commenced their series of experiments to develop a more efficient method of topographic surveying. Ordinary topographic-survey practice was not applicable. Heavy timber and dense brush and undergrowth prevented efficient use of plane-table method, as it was necessary to get beneath the cover of the forest in order to get the topographic detail required. Also the operations must necessarily be combined and co-ordinated with the timber estimating and appraisal work, and could not, therefore, follow the methods that would be adopted for the production of a topographic map alone. Low cost was an important consideration.

The first tests were made with the ordinary Abney level or clinometer familiar to all engineers. While the results were satisfactory, it was a cumbersome method, in which the field men were compelled constantly to refer to reduction tables in order to ascertain their true horizontal position. The instruments as then made were not constructed for such work and it was almost impossible to keep them in adjustment. By constantly experimenting and making improvements, a new Abney level was developed that is now manufactured expressly for work of this character. Simplified methods, introducing greater speed and accuracy, were worked out.

New Abney Level and Its Use

The improved Abney level, as illustrated in Fig. 1, is only slightly larger than the old Abney, and its cost is about the same. The arc is made larger and graduated to read directly the difference in elevation per chain (66 feet) of horizontal distance; a prism has been substituted for the German silver reflector; the bubble tube is made longer and with adjustment devices similar to those on the bubble tube of a transit. Also the bubble tube support is attached rigidly to the indicator arm of the arc, thus eliminating the inevitable lost motion between these two parts existing in all old-style Abneys. The bubble tube is arranged to allow adjustment to eliminate refraction, which made the old-style instruments so unreliable in measuring steep slopes. A semi-circular lens placed in the fore end of the eye-piece tube, as in the Locke level, magnifies the movement of the bubble so as to greatly facilitate accurate sighting. The various changes introduced have so improved the instrument and the results of its intelligent operation have proved so surprising, that the new Abney will doubtless meet with favor among the entire engineering profession, and its scope of use in field work of all kinds greatly extended.

Aside from the special graduation shown in Fig. 1, which is applicable to all topographic work, plates with the usual degree and per cent graduations are furnished and also a special graduation to give directly horizontal distance from slope chaining. This graduation has found much popularity in cadastral surveys.

Topographic Surveys of Timber Lands

There was some objection at first to the Abney method on account of the necessity of taping the slope distances, but two years of use have proved that this work can be done with practically the same convenience and time as pacing.

The unit of measurement adopted was the chain of 66 feet for the reason that a large portion of the work is the retracement of land survey lines recorded in that unit, and also for convenience in timber estimating. Obviously a definite horizontal unit is necessary for operation without the use of tables, and after thorough trial it was found that a distance of 2 chains was the most convenient for rough country covered with heavy timber. A special $2^1/_2$-chain tape has therefore been designed for use with the Abney method, the tape proper consisting of 2-chain lengths

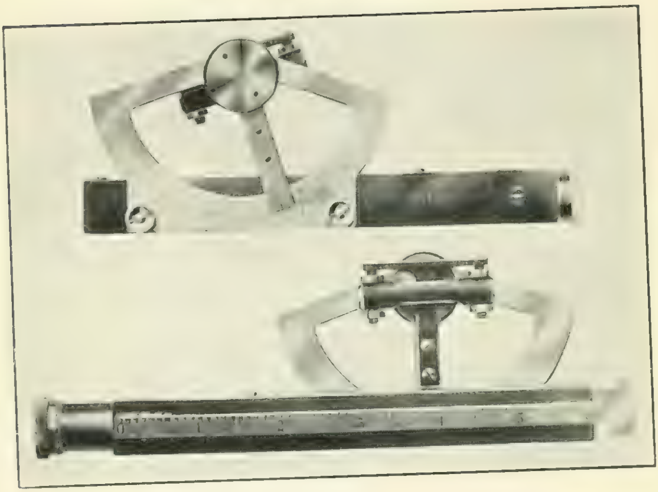

Fig. 1—Improved Abney Level or Clinometer

divided into links, with an additional half-chain "trailer." The trailer is graduated in order to allow the proper slope measurement for the excess of the hypotenuse of a triangle, the base of which is 2 chains. For example, suppose the crew to be ascending a slope as indicated in Fig. 2. The topographer reads from the arc that the rise per chain on that slope is 38 feet. The rear chainman (usually the timber estimator) then looks for the 38 etched beyond the 2-chain tag on the tape, which in this case would be 20.42 feet beyond. By stretching the tape tight, the point *b* is then located and is known to be 2 chains distant from and 2 x 38 feet higher than *a*. The topographer then sketches his contours, taking side shots in order to locate the distance between contours, and "side walking" if necessary.

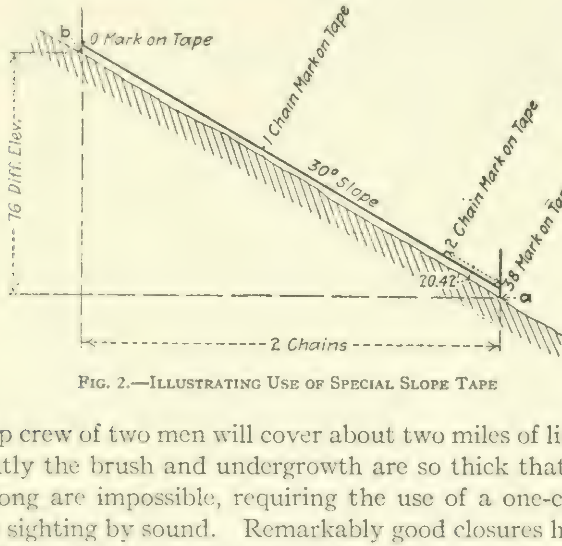

FIG. 2.—ILLUSTRATING USE OF SPECIAL SLOPE TAPE

A strip crew of two men will cover about two miles of line a day. Frequently the brush and undergrowth are so thick that sights 2 chains long are impossible, requiring the use of a one-chain distance or sighting by sound. Remarkably good closures have been obtained in many cases employing the latter method. In dense and dark forests it is usually necessary for the estimator to carry a small mirror in order that the topographer may sight on the flash. In this way sights are obtained through brush that seems almost impenetrable to the eye.

The general method followed is similar to that used in the aneroid method. Primary controls fixing the geographic position of the area both horizontally and vertically on the face of the earth are obtained by precise connection to adjacent primary stations of the

United States Geological Survey. Secondary control lines are run around a block of sections or topographic unit, stakes or posters on trees being left at periodic intervals from which the strip surveys may be begun or closed.

The Abney instrument is used for the control as well as for the strips, it being found to be just about as accurate as direct leveling, and much faster. The work on control lines is, of course, much more carefully executed than on the strip lines, two Abneys being used.

The control system is so planned that the strip surveys will not be run more than two miles without closing upon a control line. The strip surveys are run along parallel lines usually an eighth or quarter mile apart, depending upon the density of the timber and the degree of detail required.

It is customary to combine the mapping with either the timber estimating or the soil classification work, thus making one survey serve two purposes and reduce the cost of each. The crew con-

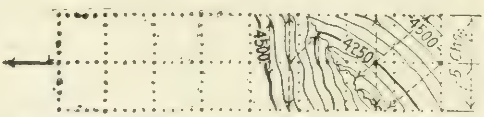

FIG. 3.—LOCATING CONTOURS BY THE ABNEY METHOD

sists of the topographer, who keeps his direction with a staff compass, operates the Anbey and sketches the topography, and the estimator, who "snubs" the rear end of the tape, making the proper allowance for slope, and estimates the timber on a strip 33 feet wide on each side of the line. Experience has shown that the time lost by the estimator in holding the rear end of the tape to be practically negligible.

The strips are usually belts 10 chains wide, the line being run along the center line and topography sketched for 5 chains on either side. It will be noticed that the method is not a system of determining the elevation of points along a profile line, and interpolating the intermediate contours, such as the aneroid method, but a number of points are located through which each contour must pass, by taking side shots at right angles to the general direction of the contours, as indicated by the dotted lines and arrows in Fig. 3. Although the skeleton of the topography is thus accurately obtained mechanically, the sketching or filling in of the topographic detail depends entirely upon the skill and judgment of the topographer, which may only be attained through considerable experience and some amount of natural talent, often called "topographic sense."

As the price of stumpage increases, the accuracy and detail demanded on topographic maps increase. Some of the larger companies now have their strips run at 2½-chain intervals, estimating each tree separately and trusting nothing to averages.

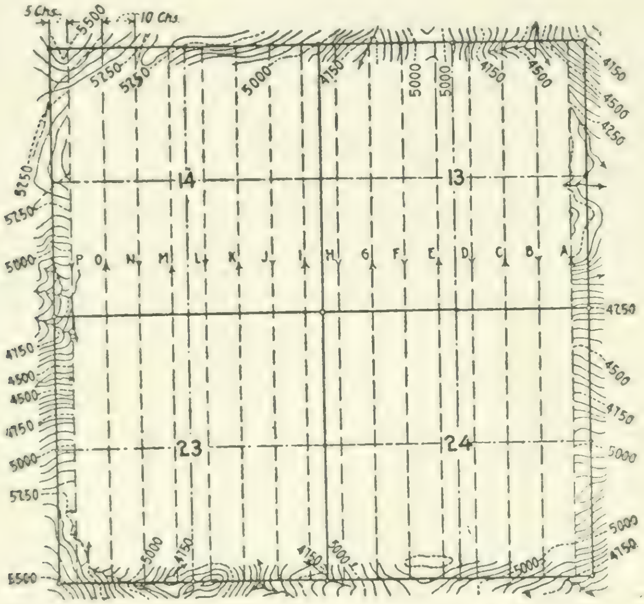

FIG. 4.—PRELIMINARY STEPS IN ABNEY METHOD

Accuracy of Method—Error of Closure

The results attained by those who have been working with the Abney method as outlined are truly marvelous. On one project, comprising 54,000 acres in the Coeur d'Alene National Forest in northern Idaho, completed during the 1915 season, 64 miles of control line were run with an average elevation closure of one foot to the mile.

The area mapped was very rough and mountainous and the timber cover consisted largely of heavy stands of Idaho White pine accompanied by heavy undergrowth and dense brush. The greater part of the area had been previously covered by both the

General Land Office public survey and by the Geological Survey small scale topographic quadrangles, so that no primary control had to be executed. On this same project, over 500 miles of strip surveys were run with an average elevation closure of 10 feet to the mile. The minimum error on such lines was one foot to the mile, while the maximum allowed was 30 feet.

The errors of closure for alignment and distance on the strip surveys each averaged one-half chain to the mile. Mapping was done on a 4-inch to the mile scale, using a 50-foot contour interval. It is readily apparent, therefore, that the errors of closure resulting can be readily adjusted so as to be almost negligible on the scale of the map.

The cost of the work, including the control, mapping, timber estimating, etc., was approximately 12 cents an acre. The results of this project furnish an average example of what is being accomplished on a large amount of similar work. In less rugged and more open timber, as in the Yellow pine and Lodgepole pine stands, for example, closing errors and costs are more favorable.

COST OF LOGGING LARGE AND SMALL TIMBER

By W. W. Ashe[1]

It is well known that it costs more to operate small than large trees, since in converting the small trees it is necessary to handle more logs representing an absolutely larger cubic volume and there are more pieces of lumber per thousand board feet. The following data seek to show for several of the different steps of a sawmill operation what is the comparative cost of handling trees and logs of different sizes, and to call attention to the field of utility of the results: (1) as a factor to be considered in determining the cost of producing lumber; and (2) as a potent argument in certain cases in favor of leaving the small trees to grow to larger size for future cutting. The results which are submitted can however be regarded only as an aperçu, preliminary to intensive studies of different types of operations and the costs of production at individual operations, together with their bearings upon the introduction of conservative methods of cutting and forestry practice.

Notwithstanding its evident importance, from the point of view of production costs particularly in the operation of stands in which the trees have a wide range of diameters, the subject apparently has never been thoroughly investigated. Each operator has fixed his cutting diameter according to his best judgment, but seldom with the basal data which would permit him to arrive at positive conclusions. If he was conservative in not cutting small trees, being apprehensive that to do so might cause a reduction in profits or even a loss, his precautions might result in leaving timber which could have been removed advantageously; and this is particularly the case when logging is done by contract and it would be to the interest of the contractor to leave the small trees. On the other hand, when the stumpage is purchased by the acre there is an incentive on the part of the owner to clean-cut in order to reduce the cost of the stumpage per M, and in many cases this results in the cutting of timber of such small size as to be unprofitable.

The results are intended to show comparative cost for different diameters; but not absolute cost as applicable to any particular operation or class of operations. However, they do show that the

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[1]Forest Inspector, U. S. Forest Service.

comparative costs for different diameters are approximately in the same general ratio for the same classes of operations, and they can be accepted as presenting these ratios. The conclusions, moreover, could seem to open a field for exact accounting, with the tree as the basis which is supplemental to the system developed by Mr. Goodman for tracking the production costs of grades and stocks.

The mill and field data which are presented cover several types of operations and classes of timber. The initial data were collected for a Shortleaf pine operation in 1909 and a summary of the conclusions therefrom has already been made.[1] These results are supplemented with figures which have been obtained as occasion admitted in connection with other work.

The field work for (a) felling and bucking and (b) skidding was carried on at both large and small operations of pine and hardwoods in Tennessee, Virginia and North Carolina. The data for (c) loading and hauling were obtained from a large hardwood operation in North Carolina and a hemlock operation in Virginia. The figures for (d) mill sawing were obtained from pine and hardwood operations both with circular and band saws in Tennessee and North Carolina. They cover both railroad and team operations.

In a railroad operation there are four major stages in the progress of conversion in which the decrease in the size of the timber tends to increase the cost of the operation. These stages are: (a) felling and bucking; (b) skidding from the point where the tree is felled to the skidway or log pile; (c) loading logs on cars, hauling from the woods to the mill and unloading: (d) sawing at the mill.

In addition to these major stages there are less important stages

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[1] Small Timber and Logging Costs, Proceed. So. Log. Assn. Nov., 1914. North Carolina Pine, 127, 1915.

In the appraisal of stumpage of small trees on cutover and heavily culled land and of small trees sold to the Government with the surface by vendors who reserved the rights to operate the larger timber on land being acquired under the Act of March 1, 1911, under which National Forests are being established in the Eastern States, the necessity for more complete data covering the cost of operating small timber was soon apparent. Information bearing on this subject was consequently secured from time to time as occasion arose in connection with the appraisal of different properties. Most of this was obtained according to a definite plan so that it is now possible to coordinate it and determine certain general relations applying to the costs of operating timber of different diameters. The data embrace field and mill work by Messrs. E. M. Bruner, W. J. Damtoft, H. M. Sears, Geo. E. Marshall, J. L. Cobbs, Jr., L. H. Steffens and others of the Forest Service, R. C. Staebner of the Little River Lumber Company, of Townsend, Tenn., and Andrew Gennett of the Gennett Lumber Company of Franklin, N. C. The work of Bruner and Damtoft on felling and skidding is particularly noteworthy.

in the operation the costs of which are also adversely influenced by the decrease in the size of the log. These are notching, bumping, nosing, brushing and swamping; grading and tallying at mill; sorting and stacking; and regrading and loading for shipment. Other items entering into the cost of production such as the overhead and the construction, both for mill and for transportation, are proportionately over-large, and the costs of these items per unit of product decline with the inclusion of smaller timber until a comparatively small diameter is reached.

In a portable mill operation, the lumber being delivered by wagon, (b) skidding and (d) sawing are of increased moment; (c) haulage of logs on railroad or tram is eliminated or subordinated while (a) felling and the minor stages retain their relative weights in so far as decrease in the size of the timber affects operating costs. On the other hand the low overhead charges and small investment in construction, though reduced by larger volume, are never major elements of cost. Wagon haulage of lumber enters as a fixed cost factor unaffected either by bulk of volume or grade of product, and consequently not influenced by a shifting of the diameter of the trees embraced in the felling.

Felling and Bucking

In securing felling and bucking data the crews were accompanied all day and the time taken from notching one tree to notching the next. Time spent in going from tree to tree was included in the cost figure of each tree, but time spent in saw-filing, etc., and wasted time, such as that spent in resting, was segregated and distributed equally among the total number of trees sawed each day. Such periods of idleness and saw-filing were found in one operation to exceed two hours daily or more than 20 per cent of the 10-hour work day. In another case these items, together with the time spent in going to work, for which the men were paid, amounted to nearly 30 per cent of the total time. The time for felling and bucking a M-board-feet mill-cut from trees of different diameters is shown by the curves in Fig. 1. Brushing, nosing, bumping and superintendence are not included. While, in case cost per hour is substituted for time in Fig. 1, the average cost of felling at a given operation is less than 50 cents per M board feet mill-cut for trees 20 inches and over in diameter breast high, the cost rises to 75 cents per M for trees 14 inches in diameter, and in excess of $1 for trees 10 inches in diameter. Eighteen inches may be regarded as the diameter below which rapid rise in cost takes place. The cost seems to be lowest for trees between 30 and 38 inches in

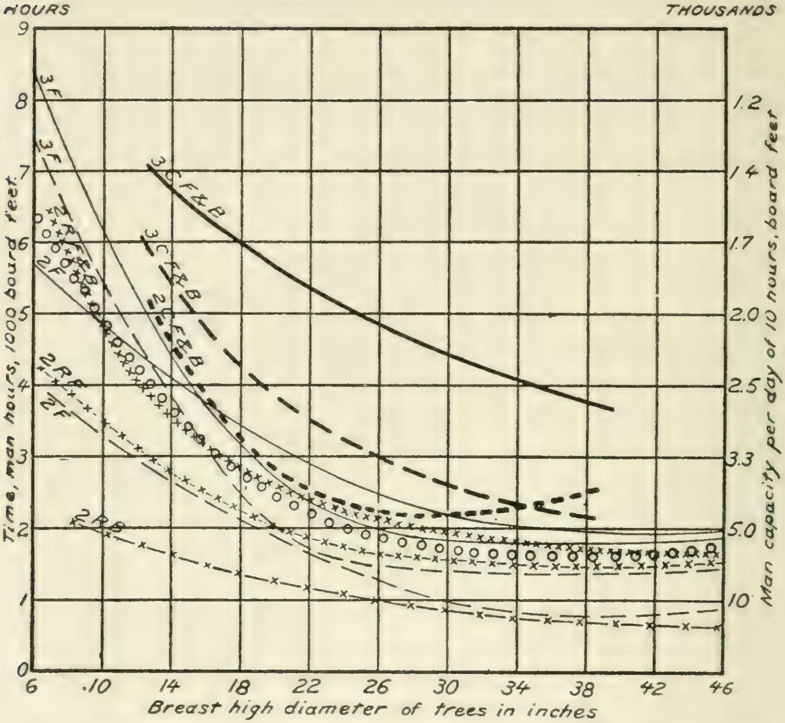

Fig. 1. Relative time per 1000 board feet mill cut, of felling and bucking trees of different diameters and capacity per man for 10 hr. day.

LEGEND:

Operation 1.
Felling and bucking.

3C F&B ———————— 3 man-crew, day labor.
3C F&B — — — — — 3 man-crew, contract.
2C F&B •••••••••• 2 man-crew, contract.

Operation 2.

3F Oaks ———————— 3 man-crew felling.
3F Pine and poplar — — 3 man-crew felling.
2F Oaks ———————— 2 man-crew felling.
2F Pine and poplar — — 2 man-crew felling.

Operation 3.

2RF&B xxxxxxxxxxxx 2 man-crew felling & bucking.
2RF x-x-x-x-x-x-x-x-x 2 man-crew felling.
2RB x—x—x—x—x 2 man-crew bucking.

Average of all o o o o o o o o o o

diameter, increasing in the operations investigated for those of larger as well as for smaller diameters. With the same class of crew the cost of felling oak, with which are included birch, beech, maple, and other species of heavy wood, is shown to be about 20 per cent greater than the cost of felling the lighter and softer woods such as White pine, Yellow pine, poplar, and basswood. A three-man crew would seem to be a more efficient working unit in felling larger sized timber; but with smaller trees felling was more economically done by a two-man crew. This is shown in two different operations. This superior efficiency of the two-man crew for felling small timber is explained by an examination of the detailed field figures which show that the third man is not entirely busy in notching and bumping when small trees are felled and, moreover, the same absolute length of time is required to go from tree to tree when the trees are small as when large, adding in the case of a three-man crew to the relative time during which no actual work is being performed and increasing the proportional cost. Nosing and bumping are not included in operation 1, these being done by separate men who follow the felling crews. A comparison of the three curves showing time at operation 1 shows very clearly the superior efficiency of the three-man contract crew over the three-man day labor crew, which is also the least efficient of any crew which was timed. It is unfair, however, to make comparisons of such work at different operations without explaining the conditions under which the work in each case is being done. In operation 1 the trees were largely being felled on the slopes and were short bodied, a larger number of trees being required per M feet than in the other operations. This also affected the regularity of the three-man curves in this operation. This might be taken as representative of short bodied timber of comparatively poor quality. Of the trees felled, it was necessary to butt 70 per cent on account of fire scarred butts, while 4 per cent of the trees felled were abandoned on account of defect. There were 60 per cent of one-log trees. This also includes the full time of superintendence, and all time required for sharpening tools. In operations 2 and 3 the timber largely consisted of 2 and 3-log trees.

These figures for time man-hours can readily be changed to costs by inserting the appropriate rate of pay per hour for men in either two- or three-men crews.

Skidding

The skidding data are represented in Fig. 2 on the basis of time required to skid M board feet mill cut in logs of different diameters but of a uniform length of 16 feet and cost of skidding; and are computed to a uniform linear distance of 1,000 feet. This embraces for the team skidding only the time of team and driver and includes no time allowance for road costs, brushing, swamping or superintendence. The sum of these items, usually amounting to about

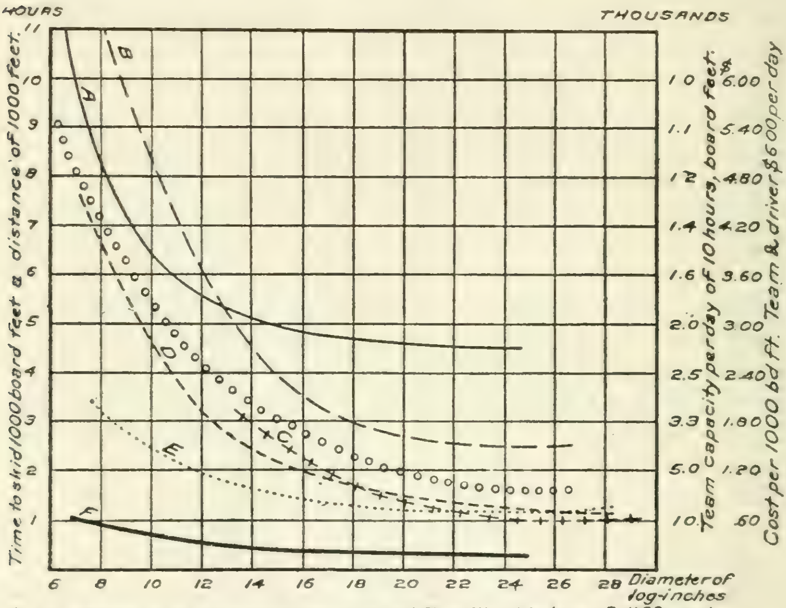

Fig. 2 Relative time required to skid 1000 bd ft, mill cut in logs of different diameters a distance of 1000 ft. and team capacity per day of 10 hours. Team work only. Lost time omitted. Data obtained 1912-1916.

LEGEND

Team Skidding

Virginia operations A ——— B — — —

Tennessee operations (hardwoods) C + + + + D - - - - - -

Tennessee operations (white pine) E. . . . .

Curve of average (Team Skidding) o o o o o o o o o o o o

Overhead skidder (Spruce) F ———

25 per cent of the total costs, should be added to the skidding costs as given by prorating on the basis of the number of logs per M board feet mill cut.

Placing the price of a double team and driver at $6 per day, the cost of skidding by team 20-inch logs varied from 75 cents (White pine) on smooth surface to $2.75 for oak in a much rougher terrain.

Each operation, however, shows the same rapid increase in cost of skidding logs smaller than 14 inches. The average of the data shows that under conditions where it costs less than $1 to skid timber when the diameter of the average log is 20 inches, the costs are doubled when the size of the log is 14 inches, and trebled when it is 10 inches. In skidding, it is customary to handle small logs in connection with logs of larger size, when it is possible to do so. When there are only a few small logs, such as are obtained from the tops of medium sized trees, they are handled practically at minimum cost by attaching them to trails of larger logs. However, when small trees constitute such a large part of the stand that they form a large proportion of the trails, or when they cannot be skidded entirely in connection with trails of larger logs and it becomes necessary to handle them in separate trails, there is a decided increase in the cost of skidding the smaller timber. In securing data on the relative cost of skidding large and small timber, it was necessary to consider the trails as they were actually made up and to obtain the average size of the logs in each trail. Most of the small-log trails contained at least one medium or large-sized log and the trails of large logs usually contained at least one small log. In stands which contain so large a proportion of small timber that it would be necessary to skid most of the small timber in trails without large logs, the relative cost of handling the small timber would be higher than is shown for any operation in the data presented. The data were obtained by timing individual teams, measuring the contents of each trail, and obtaining the size of the average log in each trail. The work of individual teams handling the same class of timber (heavy or light) and skidding on the same character of surface was then combined. The cost of skidding is most affected by loading teams below or beyond capacity. The absolute cost varies even for logs of the same size in different operations and camps according to the character of the surface and efficiency of the operation. Skidding with an overhead skidder is not comparable with team skidding. It shows, however, that the time required for handling 1,000 feet in logs which average 8 inches in diameter is practically three times that for handling 1,000 feet in logs averaging 24 inches in diameter.

The following table shows in detail the spruce skidding figures. The logs were handled in bundles, the number of logs in each bundle averaging as shown. Actual length of logs varied from 8 to 24 feet. Actual skidding distance was 2,200 feet.

Skidding Time with Logs of Different Sizes—(Overhead Skidder)

Average Diameter at Small End of 16′ Logs	*Time Required to Skid M Bd. Ft. a Distance of 1000 ft. Minutes*	*Average No. of per Loads Reduced to 16′ Basis*[1]	*Board Feet per Load Mill Cut*
8	55	8	325
9	48	7.3	365
10	43	6.6	410
11	38	6	450
12	34	5.4	490
13	31	5	525
14	28	4.4	560
15	26	4	585
16	24	3.6	610
17	23	3.2	630
18	22	2.9	650
19	21	2.6	665
20	19	2.4	680

Loading and Hauling

The cost of loading varied almost directly with the number of logs per M board feet mill cut. The cost of hauling varies with the weight of the logs, and consequently it varies somewhat more than the mill factor or the ratio of the number of board feet mill cut to the cubic feet of round timber. This amounts, as shown in the table, to doubling the cost of hauling between logs averaging 10 inches in diameter and 15 inches in diameter. In loading, as in skidding, large logs and small ones were mixed indiscriminately on cars and it was necessary to compute the average sized log from the cars as loaded.

The following table gives, for logs of different diameter, the loading time per M board feet; the number of logs loaded per car, and the number of board feet per car of logs of different average sizes.

It requires nearly six times as long to load a car with logs which average 10 inches in diameter as to load a car with logs which average 24 inches. At the same time the car capacity in board feet is three and one half times as great when loaded with logs averaging 24 inches in diameter as when loaded with logs averaging 10 inches. Shortening the length of logs also adds to loading time and decreases carrying capacity per car. The weight of a loaded car is practically the same irrespective of the average size of the logs, consequently a locomotive can haul less than one third of the volume in board feet of logs averaging 10 inches in diameter as of

[1] The fractional logs are due to logs not having a uniform length of 16 feet.

logs averaging 24 inches. In a rough country this would have considerable bearing on supplying a large mill with logs.

Loading Time for Logs of Different Sizes

Average Diameter at Small End of 16′ Logs	*Loading Time per M Bd. Ft. Minutes*	*Average No. of Logs per Car*	*Board Feet per Car*
10	29	23	1150
11	23	22	1360
12	19	21	1580
13	15	20	1760
14	13	19	2000
15	11	18	2200
16	10	17	2420
17	9	16	2620
18	8.3	15	2820
19	7.6	14	3020
20	7.1	13	3220
21	6.6	12	3420
22	6.1	11	3600
23	5.5	10	3770
24	5.1	9	3940

The cost of piling and loading lumber varies almost directly with the number of pieces of lumber which must be handled per M board feet. The lumber from logs 16 inches and over when these costs are about 60 cents per M feet increases to 90 cents for lumber from logs 10 inches and under in diameter. There is, however, a proportional increase in handling extra wide lumber from very large logs and also in handling large sawed timber from large logs, but on the whole there is so small a proportion of lumber of these classes that it can be neglected as a factor in most eastern operations.

Sawing at Mill

In keeping the sawing time at the mill the logs have been separated into the heavier and harder woods such as oak, beech, birch, and maple, and the softer and lighter woods such as pine, chestnut, basswood and poplar; as well as into length classes. The curve (Fig. 3) showing the sawing time for the harder woods does not quite parallel that for the softer woods, but rises appreciably as the diameter becomes smaller, indicating that a relatively longer time is required for sawing M feet. This is due to the fact that the harder woods of small diameter cut out absolutely less than the corresponding diameters of the softer woods and consequently more logs must be handled per M feet of lumber produced. Nearly all of the softer woods have smooth, round and straight logs even when they are of very small sized trees whereas the small sized logs of oak, beech and maple are prevailingly crooked and give a smaller mill cut.

The characteristic feature of the data from all mills is the rapid increase in time for sawing which takes place when the logs become smaller than 16 inches in diameter. In band operations, and the same would undoubtedly hold true in circular operations of large capacity, there is a gradual but very slight decrease in sawing time for logs larger than 22 inches, the time practically being the same

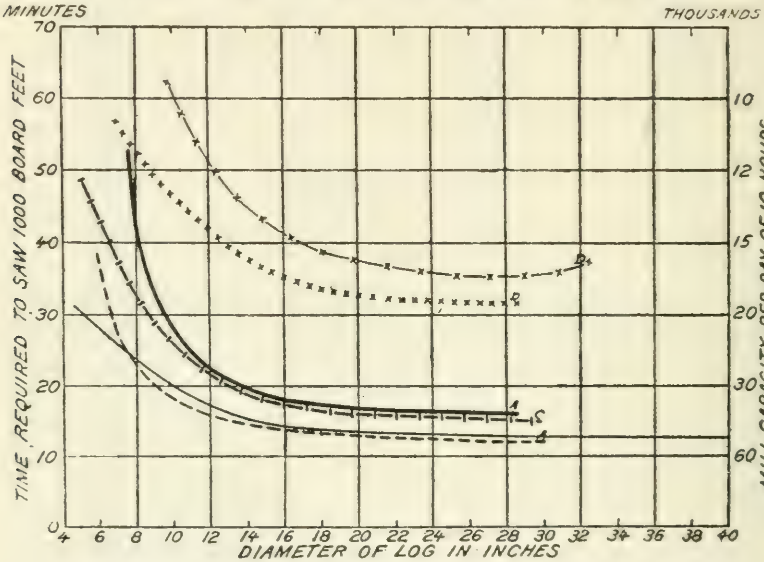

FIGURE 3. TIME IN MINUTES REQUIRED TO SAW 1000 BOARD FEET FROM LOGS OF DIFFERENT DIAMETERS; AND RELATIVE DAILY CAPACITY OF MILL SAWING LOGS OF DIFFERENT DIAMETERS. BASIS: LOG 16 FEET LONG.

BAND SAWED:-
OAKS-MILL A.
PINE, POPLAR, CHESTNUT-MILL A.
PINE, POPLAR, CHESTNUT-MILL B.
PINE-MILL C.

CIRCULAR SAWED:-
PINE-MILL D.
HARDWOODS-MILL D.

for all diameters of the same length and kinds of wood of the same hardness above 25 inches. However, in the case of portable circular mills with low power capacity the sawing time after reaching a minimum again rises as the size of the logs increases on account of insufficient motor power of the plant. The diameter at which this rise occurs varies with the motive power of the plant, but is lower for hardwoods than for softwoods.

There is a marked difference also in the time required for sawing logs of different lengths (Fig. 4). The difference in time required to saw M board feet progressively increases as the logs become shorter or on account of the fact that more logs must be handled to secure a M feet, and the difference in sawing time is the additional time required for handling the extra logs and the extra time lost by the log carriage in returning.

In order to employ the results which are given for the different steps in operating in actuary calculation, it is necessary to convert them to the unit base of costs of the particular operation. This unit base will vary (*a*) according as to whether the conduct of the operation is more or less efficient than those at which the data submitted were obtained; (*b*) proportionately to the logging difficulties of the site; and (*c*) for sawing as the capacity of the mill. These variations affecting costs apply particularly to sawing at

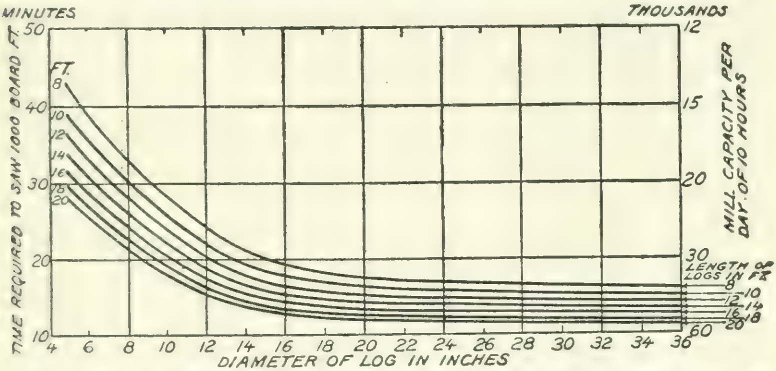

FIGURE 4 TIME IN MINUTES REQUIRED TO SAW LOGS OF DIFFERENT LENGTHS AND DIAMETERS AND RELATIVE DAILY CAPACITY OF BAND MILL SAWING SUCH LOGS. SOFT WOODS.

the mill and to skidding and hauling. There is less opportunity for variation influencing cost of felling, its controlling factor in variation in timber of the same hardness and log length being the efficiency of the individual felling crew and there being more variation in the capacity of individual crews on specific operations than between the average felling work of different operations. For a specific operation, data for such a comparison can be secured in several ways, but the most accurate method is to test, for the operation being investigated, the different phases which are under consideration and to determine by means of a comparatively small volume of data so taken their relation to the standards which are here submitted. For skidding it will be necessary to obtain the average skidding time and the total board feet contents of a number of trails. These data should be converted to a unit basis of M board feet per M feet of distance skidded; and the average diameter of the logs forming the trails computed on a uniform length; that of 16 feet being used in this paper. The results showing the time required for skidding M feet of different diameters can be plotted as points directly upon Fig. 2 and a curve drawn through these points paralleling the curve shown for the corresponding type of operation or class of timber, or it may be necessary to obtain the average of groups of these points and plot the curve through the new points. The reading from this curve in minutes or the time unit employed should give the comparative time required for logs of different diameters to pass through this stage of the operation. The comparative cost can be obtained by substituting the cost per unit of time for this stage of the operation, and taking the comparative readings.

There are no difficulties in computing mill sawing time per M board feet and felling time.

NOTES ON A METHOD OF STUDYING CURRENT GROWTH PERCENT

By B. A. Chandler[1]

During the last two years the writer has had occasion to predict the current growth of several uneven-aged stands that have been lumbered under market conditions which permitted various degrees of utilization. The first really satisfactory results were obtained by using the following method: the diameter for the last 5 and 10 years for each d.b.h. class was determined and a curve produced through these points for the next 10-year period.[2]

The details of the method differ slightly from that described by Mr. Stetson.[2] Plots were not used because our growth studies were made in connection with valuation survey estimates. To determine growth for the whole stand, rates of growth were determined for each diameter class and these were applied to the volumes of the corresponding diameter classes, as shown in the stand table. No special study of height growth was made; the height curve made for these estimates, representing the height of the whole stand, was used to predict height growth. Therefore, the trees which were bored to get the growth for the last 5- and 10-year periods were scattered over the whole stand and were selected in practically the same way that the trees for the height curve were selected. The second change consisted in plotting the current growth figures on the basis of d.b.h. in order to even off the irregularities between trees of different but consecutive diameters. Diameters were plotted on the abscissae and radial growth on the ordinates (Fig. 1). The points so plotted were evened off by a curve which showed the relation of current growth to diameter. As growth was measured separately for the 5- and 10-year periods, separate curves were made. It should be noted that it was the total growth for each period that was used for this set of curves, and not the average growth for each 5-year period.

In taking the field data it will always be necesary to classify the trees in groups of some kind. The character of the classifica-

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[1] Assistant State Forester, Vermont.

[2] Forestry Quarterly, Vol. VIII. Page 326. Suggestions on Predicting Growth, by J. G. Stetson. This method was devised by Prof. H. H. Chapman in 1909.

tion will depend on the object of the study. In studying even-aged stands, Mr. Stetson simply ruled out the diameter classes which would die before the expiration of the period for which growth is being predicted. In uneven-aged, unculled stands Mr. Stetson classified his trees according to the degree of suppression as indicated by crowns. For such stands it is probably the best classification to use, but in stands which were culled of their spruce and best hardwood, 15 to 30 years ago, this kind of crown classification will not produce good results. The writer found it almost impossible to classify the trees in the field by this method; moreover, the data, when computed, showed that there was no real need for a such a classification. In these culled old growth stands we are now using a classification for both the estimate and

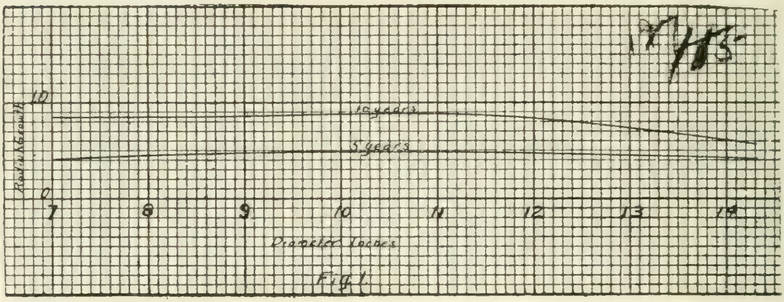
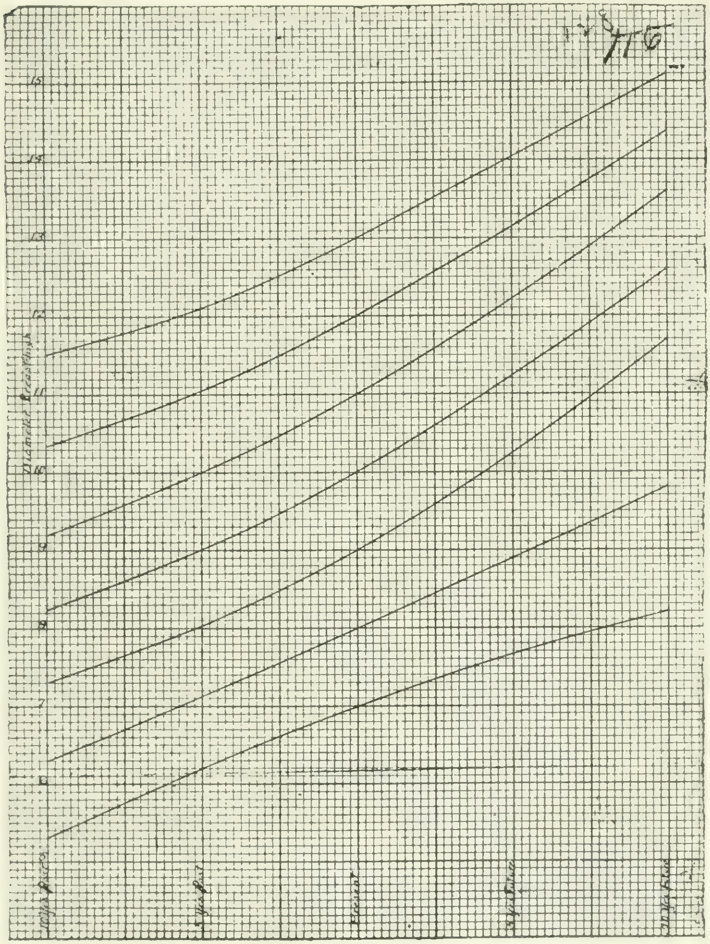


Fig 1.

growth based on form; this includes the size and shape of crown, total height, ratio between total and merchantable height, form of bole and quality of lumber it will saw out. There are three of these form classes and they correspond to the typical tree of the three sites. Our classification grew out of the fact that in estimating by the strip method in these culled stands so many typical third quality form trees were found on second quality sites that the site as a unit, over which one height curve could be applied, was abandoned. Site was, however, considered as a basis for dividing the forests into stands or sub-compartments. Instead of making a separate height curve for each type, one was made for each form class. The trees belonging to different classes were tallied separately regardless of the type or site on which they were found. Thus, the taking of height data was the first step in making the estimate of any particular forest. The height data and the knowledge of the timber obtained while collecting it enabled the estimator to determine how many form classes were necessary for that forest and fixed the typical form of each class in the eye and mind of the caliper men so that they could properly classify them, when calipering. The writer recognizes this classifi-



cation as a makeshift, but believes that it is an improvement, and a step toward tree classification for estimating by means of form quotients. The method of computing from this point on, does not differ in principle from that used by Mr. Stetson, although the details vary slightly.

From the set of curves (Fig. 1) the diameter 5 and 10 years ago is computed and a curve made for each diameter, showing the direction of the growth for the last 10 years (Fig. 2). This curve is produced to show what the diameter of each diameter class will be in 10 years if the growth continues as indicated by the growth curves for the past 10 years. In order to predict the volume growth it is necessary to determine the height growth. Since no special study of height growth is made, it is assumed that the present height curve will apply to the stand and form class 10 years from now. That is, a 10-inch tree will have the same height as an 11-inch tree now has when it has grown to be 11 inches in diameter. With both height and diameter growth measured, it is possible to compute a percent growth figure for each diameter class by means of a volume table. Any method of interpolation in the volume table will accomplish this. The writer's method is as follows:

The first two columns in the tabulation (Table I) are the same as used in computing a volume estimate by means of a volume table. The volumes given in column 2 are for the height taken from the height curve for this particular stand. Since this height curve is assumed to apply to this stand 10 years from date, the difference in volume between any inch class and the one next higher is the measure of the increase in volume for a tree in that stand and form class while growing from one diameter to the next higher. This increase for each diameter is given in column 3. The expected increase in diameter during the next 10 years, as shown by the second set of curves (Fig. 2), is tabulated for each diameter class in column 4. This column shows the growth in diameter in inches which may be expected during the next 10 years. For example, a 9″ tree is expected to grow 2.7 inches and to be 11.7 inches in diameter 10 years from now. Therefore, in order to get the growth in volume which may be expected in the next 10 years from a 9″ tree, we must add the growth of the 9-inch diameter class, the 10-inch class, and .7 of the 11-inch class, making a total of 13.8 board feet, which the 9″ tree may be expected to produce in volume during the next 10-year period. The increase in volume computed in this way for each diameter class is tabulated in column 5. This increase in volume for each diameter class during a 10-year period divided first by 10, to reduce it to a one-year basis, then, by the volume of a single tree of that diameter as given in column 2, gives, the percent of growth for each diameter class. These percents of growth are tabulated in column 6.

TABLE I

1 Present D.B.H.	*2* Vol. Single Tree Used in Vol. Estimate of Stand. Bd. Ft.	*3* Increase Vol. for Each Inch in D.B.H. Bd. Ft.	*4* Increase D.B.H. for 10 Yrs. Predicted by Curves. Inch.	*5* Increase Volume for 10 Yrs Bd. Ft.	*6* Percent Annual Volume Growth.
7	23.5	5.0	1.2	6.0	2.55
8	28.5	5.0	1.8	9.0	3.15
9	33.5	5.0	2.7	13.8	4.12
10	38.5	5.01	2.6	14.4	3.74
11	43.5	5.5	2.6	16.3	3.75
12	49.0	6.5	2.4	17.4	3.55
13	55.5	7.2			
14	63.2	9.3			
15	72.5				

NOTE: The volume table used is based on the Vermont Rule and was constructed by the frustum form factor method (FORESTRY QUARTERLY, Vol. X(1912), p. 215—*Proceedings, Society American Foresters*, Vol. III (1908), p. 278.

The following tabulation, Table II, shows the results which were obtained by the above method for one stand, and form class on an 800-acre tract, in the town of Sherburne, Vermont.

TABLE II

PERCENT CURRENT ANNUAL GROWTH
STAND (IA), FORM CLASS II

D. B. H.	*Spruce*	*Balsam*	*Yellow Birch*	*Beech*
7	10.3	12.6	2.55	1.5
8	8.1	6.9	3.15	1.6
9	6.0	4.2	4.1	1.2
10	4.3	2.7	3.7	.8
11	3.0	1.9	3.7	.8
12	2.1	1.5	3.5	1.0
13	1.6	1.3	3.4	1.0
14	1.35	1.2	3.5	1.8
15	1.2	1.2	3.1	2.3
16	1.2		2.7	

These growth percent figures for each species and diameter, if averaged in proportion to the volume of each diameter class in the volume estimate, will give a true average percent of growth for all the diameter classes so averaged. This figure, applied to the total volume of those diameter classes of the given species, gives the volume growth for that species, over the whole stand, for the diameter classes included.

The figures given in Table II were taken in a culled hardwood stand which was cut over some 20 years ago. Trees were selected for these growth data which would fairly represent the growth

TABLE III

Tabulation of Timber Left and Growth

Species	Est. Vol. Left M. Bd. Ft.	Est. Vol. Growth in 10 Years Per cent	Est. Vol. Growth in 10 Years Vol. M. Bd. Ft.
Stand Ia—Area 304 acres			
Spruce	356	4.4	156
Balsam	124	8.1	100
Yellow Birch	400	3.2	13
Beech	22	1.4	3
Maple	17	2.0	3
Stand Ib—Area 237 acres			
Spruce	131	4.7	61
Balsam	38	8.3	31
Yellow Birch	60	3.25	20
Total	1148	....	387

after the next cutting. By taking a few rough sample plots the percentage of the present volume which would be left after this next cutting was determined. By averaging the growth percent

TABLE IV

Summary of the Growth of the West Rutland Forest

Species	Present Stand Board Feet	Present Stand Additional Cords	Per cent Annual Volume Growth	Annual Growth Board Feet	Annual Growth Additional Cords
Spruce	10,000	200	2.6	260	5.2
Oak	90,000	200	3.0	2,700	6.
Basswood	90,000	....	2.5	2,100	3.4
Ash	20,000	150	2.3	450	3.5
Maple	150,000	300	3.8	5,700	11.5
Yellow Birch	40,000	80	5.2	2,080	4.1
Poplar	......	170	9.4	.....	15.9
Beech and Others	......	400	3.7	.....	14.8
White Birch	......	800	4.7	.....	37.6
Totals	400,000	2,300	...	13,400	102.0

figures, for the diameter classes as outlined above, and applying this average to the total volume to be left, the figures shown in Table III were derived. It should be remembered that these figures include only trees over 7 inches in diameter which will be left after the next cut, and, therefore, do not represent the total growth of the whole stand. In different kinds of timber and under more intensive market conditions, the estimate and growth data could be advantageously continued to smaller diameter classes.

The same method as outlined above applied to a small State forest at West Rutland, gave the result shown in Table IV. This forest is made up largely of second growth stands, and represents very different conditions from the culled forest discussed above.

No cutting will be possible on this forest under present market conditions and, therefore, these growth figures were taken to represent present conditions. The growth per cents of ash and basswood, for example, are not at all normal, for both these species are being suppressed. In fact, basswood is almost an understory of the White birch.

In comparison with these figures the results from a second growth stand on another State forest may be interesting. It was impossible to find a volume table which would apply to this particular stand, and so the stand was estimated by the Arbitrary Group Method and both the diameter and height growth were studied on the sample trees cut. The resulting growth figures for the groups were averaged in proportion to volume to get the average per cent of growth for the stand. Results are as follows: Yellow birch 2.6 per cent, maple 2.4 per cent, beech 3.4 per cent, ash 2.9 per cent, basswood 4.3 per cent, White birch 3.2 per cent. Again, ash is below the average, because it happens to be a suppressed species, but basswood takes its normal place. It will be noticed that beech in both of these second growth stands shows a much better growth per cent than in the culled stand.

It seems to the writer that in collecting growth data, we have been putting too much stress on species, and not enough on the conditions under which the trees are growing.

The University of Vermont college forest is the only place where Prof. Chapman's method has been tried out in comparison with any other method. The growth of this forest was at first computed by Schneider's formula, and later from a new lot of field data by Prof. Chapman's method. The writer had nothing to do with either the collecting of data or the computation and so cannot judge as to whether all the difference is due to the methods used or to other causes. These differences compensate each other so that the growth for the whole forest is practically the same by either method. This data is given in the following Table V.

TABLE V

Stand	*Type*	*Age*	*Growth Per cent* Schneider's Formula	*Growth Per cent* Chapman's Method
c	White pine	70–75	1.0	2.0
d	"	65–75	1.0	2.0
e	"	65–75	1.0	2.0
f	"	65–75	1.0	2.0
h	"	65–75	1.0	2.0
m	"	50–100	3.0	1.5
n	"	40–50	3.0	2.9
o	"	45–50	3.3	2.9
p	"	65–70	1.3	2.0
q	"	65–70	1.3	2.0
s	"	45–50	2.7	2.9
u	"	50–55	2.8	2.8
w	"	40–50	2.6	2.9
x	"	40–50	3.2	2.9

NOTES ON STATE FORESTRY IN IRELAND

By H. R. MacMillan[1]

Ireland, alone of the four divisions of the United Kingdom, has made an organized beginning in State development of forestry. That this should be so is one of the fruits of the remedial land legislation of the last two decades. Mainly through the exertions of Sir Horace Plunkett and the movement for better use of the land, which he initiated and to which he lent such steady support, an Act was passed in 1899 creating for Ireland a Department of Agriculture and Technical Instruction, charged with the supervision of matters so unrelated as agriculture, forestry, technical instruction, fisheries and light houses.

Previous to the passing of this Act, Ireland had become the most distinctly agricultural portion of the United Kingdom. The area of woodland was steadily decreasing, and though there was a certain amount of tree planting by private owners, chiefly for shelter or beauty, there were practically no well managed woodlands. The land area of the island was, according to use, roughly divided as follows:

	Acres
Use for agriculture (crops and pasture)	15,250,000
Mountain land	2,208,000
Peat, bog and marsh	1,575,000
Woods	304,863
Water, roads, fences	1,033,000

The cultivated land was broken into very small holdings, averaging 25 to 30 acres each. The mountain land, which, according to many writers dealing with forestry in the British Isles, and according to the reports issued by various Commissions considering the subject, is the land most readily adaptable for forest purposes, could not be taken unreservedly as available for timber production. The small average size of the farms, the pressure of population, the dependence of agriculture upon farm stock give mountain land a high value for grazing during certain seasons of the year.

The value of such land in many localities may be taken at one sheep per acre. To withdraw the land from grazing, and it is probable that the best grazing land only would repay planting,

[1] Timber Trade Commissioner for Canada, and Chief Forester, British Columbia Forest Branch.

would seriously disturb the agricultural population. Such disturbance could only be accomplished by a gradual change in the habits of the population, and by demonstrating that the profit from forest planting is greater than the profit from grazing, and that the plantations are on the whole, by affording employment for labor, more of a source of support to the community than the animals they displace.

A large proportion of the mountain land cannot be expected to profitably produce timber. Due chiefly to the prevailing Southwest wind, which dries the trees out and checks growth, the upper limit of commercial forest in Ireland is about 1200 feet absolute elevation; the limit of the growth is in the neighborhood of 1500 feet. Towards the West coast, where the influence of the wind is more strongly felt, the limit of commercial forest is about 900 feet. As the upper limit of tillable land over the greater part of the island is around 700 feet there is not a great area, even not allowing for the grazing, available for commercial forest.

The woodlands which go to make up the 300,000 existing acres of tree growth are chiefly in bodies of 1,000 acres or less. Previous to 1899, none belonged to the state. Small areas were degenerated forest, the remnants of early royal forests and perhaps of the forest primeval of the island. The greater part were plantations made within the past century. Unfortunately, the productivity of these forests is not what it should be because of the lack of silvicultural knowledge amongst farmers and landowners, this lack leading to poorly planned, poorly thinned and poorly tended plantations. The slow progress of forestry under private initiative in the past was undoubtedly due to the lack of silvicultural knowledge. Owners who made plantations received such poor financial results that neither they nor their neighbors were tempted to proceed farther with forest plantations.

The Department of Agriculture and Technical Education, therefore, had a varied problem to face when it undertook the improvement of the forest situation.

The first necessity was the building up of a competent technical staff. Soon after the passage of the Act, a Scotch forester, Mr. A. C. Forbes, entered the service of the Department as Chief Inspector of Forestry. The Department at that time was unable to devote money to forest work. The duties of the Chief Inspector were for a time confined to giving advice to private owners and making a forest survey of several Irish counties.

One of the most pressing needs for the improvement of existing woodlands was a higher standard of forestry knowledge. The Department, therefore, acquired in Wicklow, a well wooded county, the old homestead of Parnell, consisting of 300 acres of woodland and 200 acres of grassland upon which to conduct experimental planting work and establish a training school for foresters who might later enter the service of the state or of various owners of woodlands or plantations. Six working apprentices were taken in annually and given a course extending over three years. The number trained annually is not now so great owing to the supply having caught up to the demand.

The chief attention at this, the leading forest station in Ireland, is now centered on conducting experiments in the planting of species presumably adapted to Irish conditions. An Arboretum has been established and over 100 acres of sample plots of various species planted. The average cost of planting with two-year-old plants at the rate of 3,000 per acre has been about $34.20 per acre.

Many North American species have been tried and the results given during the first five years by the North American species, as compared with European and other species, are interesting. The plantations are on a light loamy soil. The rainfall averages 40 inches per annum. While the winter temperature does not go below 10 to 20° F., there are frequent frosts in May and June which seriously affect many species. The climate is typical of that of the greater part of Ireland. The elevation varies from 200 to 450 feet. The plantations are in nearly all cases evenly mixed with nurse trees of European larch, and are spaced about 4 by 4 feet, the plots varying in size from one to three acres. North American species are evidently better adapted to Irish needs than many of the European species. Those species from the Pacific coast seem especially provided for Irish conditions. Nine of the eighteen conifers showing the best results up to date are North American and of these, eight are from the Pacific coast.

The early success of the Pacific Coast species is borne out by what may be seen of older plantations. Douglas fir at 40 years old in pure plantation has reached an average height of 80 feet; the average annual product from Douglas fir plantations, totalling eight acres in extent, and averaging 40 years in age was 200 cubic feet per year per acre, quarter girth measurement. This is the highest yield given by any tree in Ireland. The wood is very well liked. Douglas fir has not done well except in pure stands as it is too fast growing for other species. It is not considered adapted for use on limestone soils.

Thuya plicata has been given a fair trial. At 40 years it has reached 70 feet in height in a pure stand; but rot starts early and diminishes its value.

Picea sitchensis is now considered one of the most important trees for use in Ireland because of its ability to withstand the constant winds. It is doubtful if the seed of any of the Pacific coast species planted in Ireland has been secured from those districts where winds are most prevalent. It would be worth while experimenting with specially selected seed from exposed localities such as the West coast of Vancouver Island to learn if strains might be developed particularly adapted to exposed hillsides in Ireland.

A Land Act passed in 1903 had resulted in the purchase of estates by the government in order that the agricultural lands comprised within the estate might be distributed amongst the tenants in pursuance of the policy of breaking up the large estates. There frequently remained wooded areas for which no disposition was possible to the Government Estate Commissioners except the sale and clearing off of the timber. Under this policy the area of forest land was actually being decreased through Government action. Accordingly, in 1908, an annual grant of $28,000 was made for the acquisition and management of such tracts. The Department had up to 1914 acquired ten timbered areas varying in size from 240 to 1900 acres and totaling 7,000 acres. These are under permanent management by the Department as demonstration areas and as local sources of timber. About 800 acres have been planted in these woodlots.

A Departmental Committee on Forestry in Ireland, of which the Chief Inspector of Forestry was a member, recommended that an area of 200,000 acres of mountain land should be purchased and planted for forest purposes. It was estimated that of the 2,000,000 acres of mountain land in the country this much at least might safely and profitably be used for timber production and that argument about the total area available might reasonably be left over until action had been taken on 200,000 acres as a start. Obstacles are numerous in the way of public purchase of land in the British Isles. A strong fear of the nationalization of land exists in certain quarters. The titles and usages existing over the land are frequently complicated, making it difficult to secure the land required from the various parties interested at a reasonable valuation. The agricultural habits of each community have become so settled that the removal of a few hundred or a few thousand acres from the grazing resources of a valley inevitably involves difficult readjustment. The Irish Forest Department alone has overcome these difficulties in any measure by actually purchasing land for planting. An advance of $120,000 was made in 1910 by the Development Fund for acquisition and replanting of mountain land. Up to 1914, 7,000 acres, in three blocks, had been purchased, and further purchases were under consideration. The cost varied from $9.60 to $14.40 per acre. Planting is now started in these areas. The aim of management of these areas is to increase the block of public forest in each centre to an economical size for management of 2,000 to 5,000 acres, and produce timber for the needs of the surrounding population.

Land Acts passed in 1903 and 1909 provided for advance of money by the government to tenants to enable them to purchase the land under their occupation. Numerous purchases have been made in this manner, and it has been found that the tendency of the new owners has been to destroy the existing woodlands.

The Forest Department has therefore been given power to require the preservation and proper management of this timber, and is thus placed in the position of being able to further influence farm forestry. Important educational work is being carried on by the officers of the Department in making working plans for and giving advice to private owners.

Powers, granted under the Agricultural and Technical Instruction Act allow county councils to raise taxes for the acquisition and preservation of woodlands. Three counties have acquired forest land in this manner. Counties may also, guided by the advice of the Department, raise money by taxation for the purchase of trees for distribution to agricultural owners. Altogether, up to 1914, about 1,000,000 trees had been distributed to planters by counties.

The forest work of Ireland is now carried on by an annual vote of $48,000, in addition to the $120,000 advance from the Development Fund. The superior staff consists of the Chief Inspector of Forestry and two foresters as Assistant Inspectors, in addition to a trained foreman in charge of the chief planting and forest stations.

The work can only be increased when the funds are increased, which is unlikely at present. The start already made, in addition to breaking the ice for the British Isles, cannot help but be of great effect in influencing the standard of forestry practised by land owners and (by showing results) in leading to the further state purchase of land for forest planting. The propaganda work carried on in Great Britain has not been of the proper type. The schemes proposed have been too sweeping and have frightened governments, land owners and tax payers alike. The published details, by being interwoven with plans for the utilization of the unemployed and by providing for the planting of areas not likely to produce timber at a profit, and by sweeping away grazing rights and moor lands at a stroke have earned for forest planting more opponents than friends. The industrial side of the question does not appear to have been sufficiently treated. It has not been made sufficiently clear, in a local manner, how the existence of even small forest areas would benefit towns and industries. Though the utilization of home resources is a burning topic in Britain, but little has been said of the present wasted forest opportunity, bound to continue so long as the planted and managed forests of France supply pit props to the coal mines lying beneath the denuded hills and valleys of Wales.

COUNTY OR COMMUNITY WORKING PLANS AS A BASIS FOR WOODLOT EXTENSION WORK

By W. D. Sterrett[1]

The Forest Service has recently completed a number of Statewide woodlot-marketing studies, made as a general basis for woodlot extension work. The next step, which was taken up to a certain extent last summer, is to follow up these general studies with studies of particular counties. I wish to suggest that it might now be desirable to have this county work centered on the preparation of detailed county working plans, based on thorough investigation of economic, silvicultural and agricultural conditions in given counties. This work might also well be taken up by any State forestry agency. Such a plan should consist in organization of a given county (or community) with reference to woodlot and forest problems, showing in detail for different classes of land the need for woodlots, and their possibilities and limitations as compared with other crops. Such a plan would require as a basis: (1) topographic and soil maps as a basis for land use maps; (2) economic data such as are being collected for representative counties by the Forest Service in cooperation with the Office of Farm Management (see attached form); (3) all available Census statistics in regard to the county, including population, rural and urban; total county area; area in farms; number of farms in different size classes; value per acre; per cent of farm land in woodlots; per cent in other unimproved land; and value of woodlot products cut on the farm, etc.; (4) complete market data, showing the market possibilities for all classes of woodlot material and transportation facilities; (5) silvicultural data, especially on the yield possibilities of the different important species on different classes of land.

It is important to select a county which forms a natural community unit, with one main town for outlet and intake and distribution of produce and supplies. The advantage of taking a county lies in the large amount of necessary statistical data which is already available for this unit.

In such plans an important thing is the recognition that the county or community, rather than the individual farm, is the

[1] Research Dept., U. S. Forest Service, Washington, D. C.

proper unit to be used in the solution of woodlot and farm problems. It is a part of the general problem to secure organization and cooperation of the farmers (who form the component parts of a county or community) in which the Forest Service finds the opportunity of assisting and pushing this most vital and progressive economic and social work. Permanent forestry development hinges on proper community organization and development all along the line. The forest problems should be outlined with reference to what the community *should do* rather than what it actually does—this is the progressive way. Both Federal and State forestry agencies may usefully join with other public agencies in this work of making plans for the rural communities as they should be.

One result of community organization and cooperation might be in marketing of woodlot products. The present woodlot marketing bulletins of the Forest Service, based on the *status quo* of the individual farm as the unit, advise the farmer that he limit himself, for the most part, to marketing of logs, bolts and billets, by which method the bulk of the total volume of material in his woodlot must usually remain unmarketable because of the expense of hauling. It is only by manufacture or partial manufacture in the wood-lot itself, through the agency of a portable mill set up in the woodlot, that the most can be got out of it, but the individual farmer, under present conditions, is usually not equal to producing and marketing manufactured material. It requires community organization and cooperation in manufacture, in finding markets, and in selling (in car lots) to attain this most profitable method of marketing.

A central feature of the county working plan should consist in outlining a double-barreled woodlot and forestry policy: (1) the policy for the individual farmer to adopt on his own land, which would be determined, of course, in a particular case, by the character of his land; and (2) the public forestry policy for the community as a whole.

Under the latter might be included some such features as these: location of shelterbelts, with reference to the community as a whole; changing and broadening highways in places and planting trees along them for park purposes or perhaps as a part of a shelterbelt plan; perhaps a plan for community forests, as in cases where needed to protect a community water supply system, or for recreation purposes. I doubt the advisability of community forests established mainly for wood and timber production, although this may come later.

In regard to a woodlot policy for the individual farmer, he should be made to realize the advantages of a woodlot and why it is an essential part of his farm, so that he will adopt a definite line of treatment for it. The following is a general analysis of the economic reasons for woodlots on the individual farm; these may be classified as direct or indirect:

1. The one direct, economic reason for occupation of land by woodlot is because it forms the best money crop which can be grown on a particular area. This, of course, is possible, particularly for poor and rough classes of land, such as are found in the mountainous sections of the State.

2. Most frequently woodlot occupation of farm land can only be justified by indirect, economic considerations, as the land is usually intrinsically adaptable to more valuable crops and for this reason it should usually occupy but a small per cent of the total farm area.

The important indirect reasons, a number of which are usually active in any particular case, are: (1) for convenience of home use, fuel, posts, and other; (2) as a windbreak for buildings or crops; (3) as a shelter for stock; (4) for protection of land from erosion; (5) as a temporary, soil-renewing crop on worn out land; (6) as furnishing work for man and teams during sparetime; (7) for purely esthetic reasons and for recreation purposes, for which reasons alone a farm with a well-located grove of trees, however small, will sell for more than one without; (8) as a temporary crop on intrinsically good agricultural land, which it is wished to hold for future clearing and development. The great reduction in woodlot area, which is continually going on, should be constantly held in check by the following considerations: (*a*) the possibility of holding timber crops for more favorable market conditions; (*b*) the advisability of allowing thrifty, immature timber to mature, rather than removing it as a total loss; (*c*) and the advisability of working up intensive agriculture on areas already cleared before clearing up additional areas which are in growing woodlot.

In order to analyze the possible advantages of having a woodlot occupy a particular area or areas of a farm the farmer must be familiar with (1) the above economic reasons which justify woodlot occupation of land; (2) the possible yields and returns from growing different kinds of timber crops as compared with growing agricultural crops on the land under consideration; (3) knowledge of markets and methods of sale, which will insure the highest net returns from the sale of woodlot products.

Woodlot Economics

UNITED STATES DEPARTMENT OF AGRICULTURE

OFFICE OF THE SECRETARY: FARM MANAGEMENT

In Cooperation with the Forest Service

No.---------

State------------------County------------------Date-------------------------

Operator-----------------------------P. O. address--------------------------------

Landlord-----------------------------P. O. address--------------------------------

Township------------------Miles to market----------Area of farm---------------acres

Value of farm $-----------Soils and topography of farm----------------------------

----

Topography and character of woodland---

How much of the woodland would be good farm land (if cleared)?----------------------

Kinds of timber--

Age of timber-------------------Estimated value of total timber---------------------

Value of the woodlot as a windbreak-------------------For shade----------------------

If woodlot is pastured, state how many mature cows or steers it would support during the pasture season----------------------How many months in the pasture season?-----------

CLASSIFICATION OF LAND ON THE FARM

Kinds of land	Area a.	Value per a.	Kinds of land	Area a.	per a. Value
Plow land[1]			Woodland pastured		
Permanent meadow			Woodland not pastured		
Permanent pasture not in woods			Roads, streams, waste land, etc.		

[1] Including meadow and pasture in rotation with other crops.

WOODLOT PRODUCTS USED ON THE FARM ANNUALLY (AVERAGES)

Kinds	Firewood	Fenceposts	-----------	-----------	Sugar and Syrup
Quantity	-----------	-----------	-----------	-----------	-----------
Value	-----------	-----------	-----------	-----------	-----------
Proportion produced on farm	-----------	-----------	-----------	-----------	-----------

WOODLOT PRODUCTS SOLD FROM THE FARM ANNUALLY (AVERAGE)

Kinds	Firewood	Fenceposts	-----------	-----------	Sugar and Syrup
Quantity	-----------	-----------	-----------	-----------	-----------
Value	-----------	-----------	-----------	-----------	-----------

Days work obtained annually in harvesting and marketing woodlot products on the farm—

Man------------------Horse-------------------

Season at which this work is done---

Annual expense, if any, in keeping up the woodlot-----------------------------------

Character of these expenses---

How many acres of woodlot such as you have would be required to supply the needs of your farm for woodlot products?---

Per cent of stand of timber in woodlot---

Kinds of winter work available to you--

Do they serve to keep you occupied during the winter?--------------------------------

Would you prefer to have your present woodland in woods or cleared and in use for other purposes?---

How many acres now clear on your farm and in pasture or crops do you believe should be in woods?--

Record taken by---

MODEL OF A REGULATED FOREST

By D. Y. Lin, M.F.[1]

A mechanical model designed to show the growth of a forest under regulation was built and has been used for lecture work by the Lecture Department of the National Committee of the Young Men's Christian Association of China. The model is like the one described in Forestry Quarterly, Vol. XII, No. 4, very much modified and improved. Professor C. H. Robertson deserves all the credit for having improved the mechanism. Since the first lecture series on conservation of forests was given here, in Shanghai, some time during last June (1915) as many as 32,000 people have seen the model, and, as a part of the lecture equipment it has always formed the centre of attraction.

The model shows a series of ten areas, each a different age class, ranging from one to ten. When in opeartion, the stand on each area will slowly grow taller until the end of the rotation when it will disappear and a new crop start on the depleted area. The starting of a new crop on the depleted area represents planting and this is to follow immediately after cutting in order to get the proper results.

The incentive for making such a model was a desire to visualize to the people looking on a growing forest and convey the idea of how a forest under systematic management can be harvested at regular intervals and at the same time produce continuously. We have found that the model is a great help to us in our lectures. People who are interested in the model will always see the points we want to demonstrate. We mention this to show that the model is worth while and well worth having, especially in schools where forestry is taught.

The model is 7′ 2½″ long, 19″ wide, and 14″ high. It has adjustable legs of 2½′ to 4′ high and these can be removed when the model is not in use. Each of the ten areas or stands consists of a galvanized iron plate with "trees" fastened to it. The plate is 17″ by 7″ and the "trees" are arranged in seven rows, ten trees in four rows and nine trees in three rows, making sixty-seven trees in all for each area. The "trees" are made of hemp

[1] Secretary, Conservation Division, Lecture Department Committee, Young Men's Christian Association of China, Shanghai.

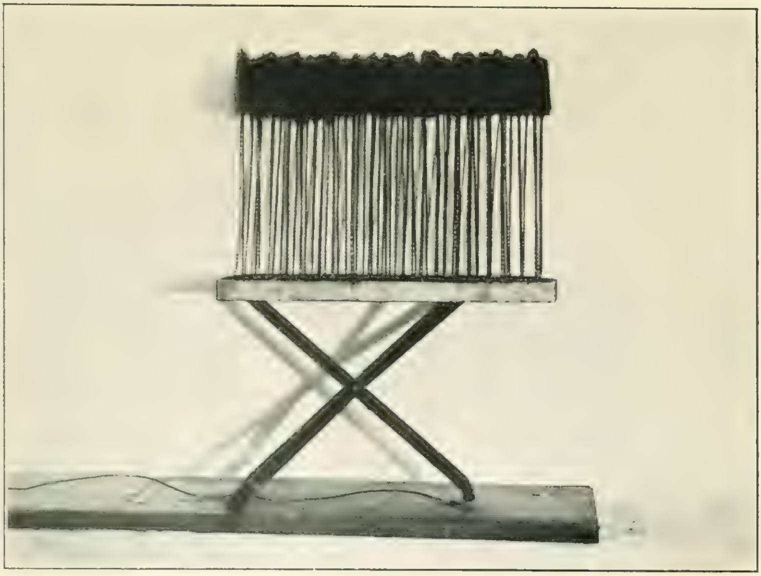
fiber brushes, 12″ long, the brush part being 3″ long and $^7/_8$″ in diameter at the bottom and $^1/_2$″ in diameter at the top. The brushes are stained green and the double wired part that gives them support is made brown.

To make the forest floor look real, a special board is prepared through which 670 holes are made. The board is painted greyish brown and to anyone who looks at the model at close range the growth of these trees through this perforated board is most interesting.

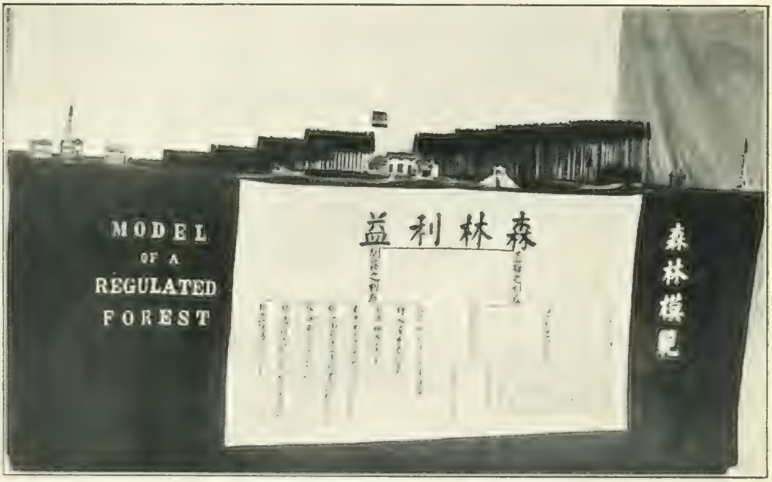
While the model is only 7′ 2″ x 19″ x 14″, resembling a long box, we have made it look very much bigger by building a little sawmill in the middle and a sort of scaffold all around the model. Covering this scaffold is a large piece of green cloth which after encircling the model box is allowed to come down to the floor. The green cloth gives the appearance of a meadow and on it we have put little wooden houses, pagodas, wheel-barrows with passengers, bridges, etc., and painted roads, and canals, making the place look like a Chinese village.

A description of the machinery which actuates the rise and fall of these ten areas might be of interest. Beneath each plate which holds the area of trees is an X-shaped frame composed of two $^1/_2$-inch-wide strips of band iron with a rotating joint at the center. One of the lower ends of this X-shaped frame is fastened with a pin to the bottom of the box. The other leg is free to travel back and forth in a slideway under the pull of a small wire rope. When this rope is pulled, the two lower legs of the frame are drawn together and the plate is made to rise pushing up the trees through the holes in the top board. This wire rope winds around a grooved pulley.

To secure portability the long 7-foot box is divided in two, connected with hinges so that it can be folded together with the trees inside. This division necessitates dividing the operating mechanism so that half the pulleys are permanently on one side of the model and half with their stands on the other side. On each side of the center, therefore, five grooved pulleys are mounted on a shaft and the two shafts are connected by 6-inch gear wheels. When the outside handle attached to one of these shafts is turned, it rotates its own shaft directly and the other through the gears and their pulleys with them, and thus the wire is pulled in and the plates with the forest sections made to rise.



Showing X-Shaped Frame Supporting an Area of Trees



Ready for Operation

The chart (in Chinese characters) pinned in front of the of the model is an outline showing the direct and indirect utility of forests.

The drop is accomplished by a pall which engages a single ratchet up to the point where the drop occurs, when the outside end of the pall comes in contact with a dead shaft parallel to the one bearing the pulleys. The pall is lifted out of the ratchet and that pulley is free to turn back under the pull on the wire rope exerted by the weight of the forest area in dropping. As the handle continues to turn this pall again engages the ratchet and the area again rises at the proper time. The gear wheel in each half comes just to the edge of its box so that when the rwo halves are unfolded the two gear wheels mesh with one another. They are marked so that they are brought into contact at the proper point to make the sections rise and fall in their proper order. When the two halves are folded together the open ends thus exposed are covered by suitable boards. These are hinged to the halves and hang down under the model when not in use.

The principal cost in the construction of such a model will be first in the "trees" which at $4^1/_2$ cents per "tree" will amount to about Mex. $30.00, and second, in the wages of two mechanics who may require two weeks for the work. Roughly speaking the total cost of both material and labor should not exceed Mex. $100.00 or $50.00 gold.

CURRENT LITERATURE

Seeding and Planting in the Practice of Forestry. A Manual for the Guidance of Forestry Students, Foresters, Nurserymen, Forest Owners and Farmers. By J. W. Toumey. John Wiley & Sons, New York. 1916. Pp. 455; figs. 140.

The outstanding feature of this book is the thoroughness and completeness of treatment, the excellent illustrations and the clearness of presentation. The author has happily combined a comprehensive discussion of the fundamental principles of artificial regeneration with the practical details of nursery and planting operations, derived from his own wide experience and that of others working along this line.

The book is divided into Part I, Silvical Basis, and Part II, The Artificial Formation of Woods. Part I deals with general methods of reproduction, the choice of species in artificial reproduction, the principles which determine spacing and which govern composition of the stand. The discussion of these is introductory to Part II, is well condensed, forming approximately one-sixth of the total number of pages in the book and is good in its treatment of the choice of species and the statements relative to the principles determining spacing. Prof. Toumey has in the latter topic presented European practice and has brought out pertinent facts concerning the spacing of plantations in American practice.

Part II has an excellent arrangement in its consideration, first, of forest tree seeds; second, protection and treatment of planting areas; third, direct seeding; fourth, nursery practice, and fifth, planting practice.

Particularly striking throughout the whole of Part II are the painstaking details into which the author has gone in this treatise on forest planting. European literature has been freely drawn on, but almost invariably the application to American conditions has been pointed out, the best present practice cited and careful comparisons and comments given. The information given concerning forest tree seeds is especially full comprising Prof. Toumey's experiments at the Yale Forestry School, where he is director and also Professor of Silviculture, and the results of experiments abroad and in this country. The chapters on seed collecting and care of seed will be of great value to foresters.

In the exposition of nursery and planting practice the author's endeavor seems to be to present clearly every pertinent fact of practice. The description of tools and equipment is given in great detail as well as their uses. This makes the book of great value as a textbook, especially since the relative importance of different practices is made clear. The usefulness of the book is further enhanced by its unusually good illustrations and diagrams. The chief criticism of the book is likely to be on the great amount included in it. The author himself has, however, recognized the possibility of criticism because he has included in his book many methods and tools not used in the United States, but has forearmed himself in the preface by two succinct statements: "No method should be blindly followed. The practitioner should have a broad knowledge of many methods," and "He must have a broad knowledge of methods and tools in order that he may attain successful regeneration at least cost." So complete an exposition, we feel, will undoubtedly be the means of improving many of our present methods of reforestation. This book is highly commended to the profession and is deserving of careful study and use.

S. N. S.

Traité Pratique de Sylviculture. Par Antoine Jolyet, Professeur à L'Ecole Nationale des Eaux et Forêts, 8°, 724 pages avec 130 Photogravures. Broché 18 Fr. J. B. Bailliere et Fils, Paris.

Since a copy of this new French Silviculture has not been received by the reviewer, the gist of a review by Edouard Vivier in the *Revue des Eaux et Forêts*, March 1, 1916, is reproduced. This book is really a complete second edition of the work entitled, *Les Forêts*, by Boppe and Jolyet. The former publication, however, has been largely augmented by much additional information; the total number of pages has been increased from 482 to 724 and instead of 94 figures there are now 130. The new volume differs from *Les Forêts* not only in the additions and corrections, but in the arrangement of the material.

It is now divided into two parts: The first concerns natural forest stands where natural regeneration exists; the second part is of technical forestry work pertaining to the "artificial" forest. In the first part, the form, reproduction, longevity, and characteristics of trees and stands are discussed. The author intentionally looks at the tree from the strictly forestry viewpoint, rather than from that of the botanist. Jolyet reviews the various types of forests formed by the different species and the methods by which each may be exploited and regenerated. These chapters include special notes on sub-alpine forests and special stands characteristic of the various regions of France. Due emphasis is placed upon cleanings and thinnings.

The second part forms more than half the work and includes data on the forestation of forests and the restocking of denuded ground. Information is also given on the establishment of under-stories in oak high forests and in the pineries, as well as the introduction of coniferous species into coppice-under-standards. The results of practical experience of introducing exotics are given at some length. The collection and storage of seed and the establishment of nurseries is described. Under protection, Jolyet describes at length the protection of forests against fires, rodents, insects, tree diseases, etc.

According to Vivier, this book on silviculture has been written in a very clear style and is based on the result of professional practice. It is said to be a book that every forester should consult.

T. S. W., Jr.

Transpiration and the Ascent of Sap in Plants. By H. H. Dixon. MacMillan's Scientific Monographs. 1914. Pp. 213.

Prof. Dixon and his associates at Trinity College, Dublin, have been studying the problem of the ascent of sap in plants for the past twenty years. The results of these researches have been published from time to time in various scientific journals. Now, we have them gathered together and presented in one volume of the above title. Not since the 1100-page volume of Strasburger on this subject has anything as complete and conclusive appeared.

The first chapter of the book is concerned with the nature of transpiration in plants. The two following chapters are criticisms of the physical theories and the vital theories, respectively, regarding the ascent of sap in stems. The subject matter of the remaining eight chapters bears directly or indirectly upon the elaboration of Dixon's own theory of the phenomenon.

The first chapter presents an interesting possibility in regard to the nature of transpiration. We know from the brilliant investigations of Brown and Escombe that the flow of water vapor through an aperture is proportional to its radius and not to its area. The rate of diffusion at the margins is greater than over the middle of the apertures. Therefore, an aperture having the longest margin relatively to its area will be the most efficient. The slit-like form of the average stomatal opening tends to produce this condition. The distances between the stomata are such that the diffusion currents from one do not interfere with those of another. Thus, the diffusion of gases through the stomata may be explained on simple physical principles. This applies as well to the diffusion of water vapor from the chambers, lying above the stomata, into the adjacent atmosphere.

The next step is to consider how water from the contiguous cells is supplied to these chambers. The conducting tubes, containing the rising sap, are separated from the intercellular spaces by a layer of one or more thin, cellulose-walled cells, and these walls are permeable to water and its dissolved substances. Behind the wall of one of these cells is a layer of semi-permeable protoplasm, which encloses the cell sap of the vacuole. Cells like these impinge upon the conducting tubes whose walls are permeable to water, but do not enclose a layer of protoplasm. The imbibitional forces of the cells in contact with the intercellular spaces of the leaf will draw off water from their vacuoles through the protoplasmic layer until the vapor pressure in the walls and in the vacuoles is equal. Now, if the vapor pressure of the water menisci in the minute interstices of the cell wall is greater than that obtaining in the intercellular space, the water will leave the cell wall and the menisci will retreat into it. This will cause their curvature to increase and will raise their capillary forces so that they will extract water from the solution in the vacuole. A concentration of the solution in the vacuole results and consequently the osmotic pull on the water in the adjacent conducting tubes is increased. Hence, it follows that a transference of water from the conducting tubes will take place so long as the vapor pressure of the water in the conducting tubes is greater than that in the intercellular spaces of the leaf.

Based upon the above phenomena, the explanation of the process of transpiration in plants may be made entirely physical. None of the vital activities of living cells need to be called in to aid. There are certain conditions, however, where it would seem that the living cells do play a part in the process. For example, when the leaves of a branch are killed, not only is the flow of water greatly reduced, but finally the leaves dry up and ultimately fail entirely to raise water in the branch. It is true that in this case not only are the vital actions removed, but also one of the most important features of the mechanism, that is, the semi-permeable membrane is destroyed by coagulation of the protoplasm. It is evident, however, that after the death the capillary forces of the cell wall of the leaf cells alone are unable to raise the water under the new conditions, and this would suggest that unaided they may be insufficient in the living leaf. This line of reasoning would indicate that the protoplasm may not only act as a semi-permeable membrane by allowing water to pass through to a region of diminished pressure, but it may also actively *secrete water on its outer surface.* We know that such glandular action of protoplasm takes place on the exterior of the filaments of certain fungi, and on the leaf margins of certain higher plants. The author collected the drops exuded on the margins of a leaf and found that they were practically pure water, their density being less than that of tap water. The author concluded that osmotically the exudation may be regarded as pure water, and consequently the process must be one of secretion involving the intervention of living protoplasm and the expenditure of stored energy.

Now, the question arises as to how far the glandular function of certain leaf margins can be transferred to the mesophyll cells bordering the stomatal chambers of transpiring leaves. The author performed several experiments bearing upon this point. In one of these he fixed a leafy branch water-tight into the low opening of a glass receiver, so that its upper part and leaves projected into the interior, while its base extended into an aqueous solution of eosin. The receiver was then filled with water, so that the branch was completely submerged. The proper precautions were taken before the experiment began to equalize the gas pressure in the branch with that of the atmosphere. Although the leaves were covered with water, and although they were subjected to hydrostatic pressure due to the depth of water, sufficient in some cases to drive the liquid back into the intercellular spaces of the leaves, the eosin mounted rapidly into the branch. The eosin rose most rapidly when the apparatus was in strong light and when bubbles of oxygen were being given off at the surface of the leaves. When the apparatus was placed in the dark, there was little or no ascent of eosin in the stem. Under these conditions, it would seem that the rise of eosin in the branch was due to secretory action of the protoplasm and not to evaporation from the leaf surfaces.

In regard to the causes of the ascent of water in stems, the author dismisses the various gas-pressure theories with the statement that either the conditions postulated do not exist in the stems, or if they do exist, the proffered explanations of them will not stand the test of physical laws. He reinvestigated, with numerous careful experiments, Sachs' theory that the water of the transpiration stream travels in the walls of the conducting tubes, not in their cavities, and he confirmed the conclusions of earlier investigators, that, while some water did pass upward in this manner, the quantity was not sufficient to meet the requirements of leaf evaporation. The various theories based upon the assumption that living cells of the wood, either the wood parenchyma or the medullary rays or both, furnish the effective forces for lifting the water, become untenable as the result of experiments which demonstrate that when such cells are killed, the water continues to ascend. Such experiments have been performed at intervals for the past 100 years, yet the vitalistic theories cling to life with great tenacity. They have been rejuvenated with considerable vigor within the past decade by Ewart and Urspring. In killing the stems with steam, they found that the rapidity of leaf wilting above the killed portion was dependent upon the length of the killed portion: the longer, the quicker the leaves wilted. Therefore, they argued that living cells were necessary to supply the leaves with sufficient water. Dixon repeated these experiments and got similar results, but his interpretation of them was different. He found that as a result of the disorganization and decomposition of the cells subjected to steam, poisonous substances were produced and these carried to the living cells of the leaf produced their death, hence the leaves wilted and died. When a zone of a stem is killed without the disorganization of the cells, as for example, by a jacket of hot wax, the poisonous substances are not produced and such treatment does not interfere with the passage of water. Also when the contaminated steam-killed portions are flushed out by injecting water through them, the leaves did not wilt more readily than in the control experiment. Therefore, Dixon believes that living cells of the wood are not necessary for the ascent of water in stems.

Dixon's theory of the ascent of sap, elaborated in great detail in the present volume, assumes that the water in the conducting tubes of high trees hangs by virtue of its cohesion, re-enforced by its adhesion to the walls of the conduits. These surface tension forces are greater than that of gravity, so the water hangs suspended in the minute conducting tubes. When columns of water adhere completely to a rigid envelope, as is the case in the conducting tubes, it assumes a pseudo-rigidity, and it is capable of sustaining and transmitting tensile stresses. Experiments with tension tubes showed that air-free water can sustain a tension whose minor limit was equivalent to 50 atmospheres pressure. The author's experiments with cell sap from ilex and beech demonstrated that, under various conditions of temperature, it could withstand a tension varying from 47 to 207 atmospheres. The experiments were necessarily made with glass tubes. It was found, however, when pieces of wood were introduced into the tubes, that the rupture would always take place along the surface of the glass, not along the wood surface, thus indicating that water in wooden tubes, as in the plant, would stand a greater stress than experimentally determined in glass tubes. Resistance to a current of water moving through wood at the velocity of the transpiration stream is approximately equivalent to a head of water equal in length to the wood traversed. Hence the tension applied to the upper end of the water columns, which will be able to raise the transpiration stream in a tree must be equal to the pressure produced by a head of water twice the height of the tree. In a tree 100 meters high, therefore, a tension of 20 atmospheres must be produced.

If the evaporation from the outer surfaces of the mesophyll cell of the leaves is extracting water from the conducting tubes more rapidly than the lifting forces can supply it, then the water in the tubes must fall into a state of tension. The only effective lifting forces are those of atmospheric pressure and root pressure. The former cannot supply water higher than 33 feet, and the amount supplied by the latter is insignificant compared with the losses due to evaporation. The water in the conducting tubes above this level is always in a condition of tension, and in times of vigorous transpiration, whenever the loss cannot be made good by the lifting pressure of the atmosphere, the water in the conducting tubes below 33 feet is doubtless also in a state of tension.

Since the wall of the tubes is permeable to water, the water in one conducting tube is continuous with that in its neighbors, and consequently the tension in one is transmitted to the water in the adjacent conduits. Thus, when the leaves of a tree are transspiring, the cohesion of their sap explains fully the transmission of the tension downwards and consequently explains the rise of the sap.

When evaporation from the transpiring cells removes water faster than it can be supplied, the menisci formed in the substance of their walls support the tensile columns of water in the plant. Evaporation from these menisci provides the traction to raise the water. The entry of water at the root depends upon the gradient of pressure on passing from the outside of the root to the inside of the conducting tubes. The fall of pressure due to the tension of water is continuous all up the stem to the leaf. *The flow of water up the highest tree is due, then, to the evaporation and condensation produced by the difference between the vapor pressure in the soil spaces and that obtaining around the leaves.*

The ultimate source of energy for evaporation from the mesophyll cells of the leaf is heat. Evaporation lowers the temperature because the less energetic molecules are left behind in the process. This causes the heat from the surroundings to flow inwards, which in turn stimulate the activity of the molecules, and so continues the process of evaporation. Thus an evaporating leaf acts as "a sink of energy." The transpiring mesophyll cells of the leaf nominally remain turgid during transpiration. Thus, in tall trees, the osmotic pressure keeping the cells distended must correspond in magnitude to the tensions necessary to raise the sap. The author found these pressures always sufficient to resist the transpiration tension. The author believes that water lost by evaporation through the stomata may be secreted on the outside walls of the cells lining the stomatal chamber by the vital activity of the protoplasm. By various calculations, he shows that the stored energy set free by respiration is quite sufficient to do the work of secretion against the resistance of the transpiration stream.

It will be evident upon consideration of the above outline of Dixon's theory of the ascent of sap, that while he does not consider the living cells in the stems as active agents in the process, the activity of living cells in the leaves is quite necessary to uphold his theory. The author believes that the structure of the various wood elements is to be more logically explained from the requirements of his theory than from those of any of the theories heretofore advanced. The presence of so many cross walls offering, as they do, enormous resistances to flow, is incomprehensible in any view which regards water as being forced through the stem. From the standpoint of his theory, however, they become necessary to confer stability on the tensilely stressed transpiration stream. The various thickenings on the walls of the conducting tubes seem suited to resist crushing forces, but no such forces are called for in the previous theories, and they seem needlessly strong. But for tensile stresses these thickenings are essential and the strength of the tubes may be severely tested in times of excessive evaporation when high tensions develop in the sap. This line of reasoning, however, might lead one into tangled paths. For example, suppose we had two trees of the same size and leaf area, but with great differences in the thickenings and reenforcements of the wood cells, as is the case in an oak compared with a poplar; shall we say that the tensile stresses developed by performing the same amount of work vary in magnitude, or shall we say that nature blundered and made the cells too strong in one case or too weak in the other.

The principal objection brought against Dixon's theory in explanation of the ascent of water in trees, is that it would require continuous columns of water unbroken by gas bubbles to support and transmit the required stresses, and that such unbroken water columns do not exist in a tree. Dixon meets the objection with evidence that the conducting tubes in the leaves rarely, if ever, contain gas bubbles, and that probably the same condition exists in the conducting elements of the newer wood through which most of the transpiration stream passes. In addition, he holds that the presence of some gas bubbles in the columns would not militate against his theory. A gas bubble in a tube would spread until it met the side walls, then if the tension was sufficient, it would spread longitudinally until it occupied the entire tube, but owing to imbibitional forces the retreating water would be held with great tenacity by the walls of the tubes. The gas could pass only with extreme difficulty through the wet membrane. So the bubble would become practically rigid and the water would pass around it as it does in the case of an island in a river. One-half of the tracheal tubes, Dixon asserts, might thus be occupied by gas and yet sufficient channels remain for the transpiration stream to supply the needed water for evaporation from the leaves. Only when the gas bubbles extended continuously in a horizontal plane across the entire diameter of the stem could they make his theory inoperative. This condition undoubtedly never occurs in a living tree.

When dealing with living organisms, it is, in the opinion of the reviewer, practically impossible to select a definite factor and say that it is the cause of a given phenomenon. It is probable, therefore, that several forces, such as osmotic pressure in the living wood elements, and surface tensions in the dead wood elements, contribute a portion of their energies to the rise of water in trees. It is probable also that some of the forces are more effective than others, and in reading the book under review one can hardly help being convinced by Dixon's masterly presentation of his theory.

C. D. H.

The Killing of Plant Tissues by Low Temperature. By W. H. Chandler. Research Bulletin 8, University of Missouri. Columbia, Mo. 1913. Pp. 143–309.

While the subject matter of the above bulletin is chiefly concerned with the conditions of freezing of fruit trees, yet it contains considerable data of general application in regard to the phenomenon of freezing. The results of many investigations have shown that during freezing (which may or may not result in freezing to death), ice forms in the tissue, generally not in the cells, but in the intercellular spaces, the water moving out of the cells to form crystals in these spaces. The most commonly accepted theory is hat killing from cold results from the withdrawal of water from the protoplasm. The amount of water loss necessary to result in death varies with different plants and different tissues. Some interesting variations of this theory have recently been developed. For example, one investigator found that when plant sap is frozen, certain proteids may be precipitated out and apparently those plants most easily killed by freezing have their proteids precipitated out at the highest temperature. Thus begonia, which is very easily killed, had its proteids precipitated out at —3° C., while the sap of pine needles, not easily frozen, required a temperature of —40° C. to precipitate any proteids. He accounts for this precipitation by the greater concentration of the salts in the sap as water is removed to form ice crystals.

Another investigator, working with wintergreen plants of Southern Sweden, has found that with most of them, at least during cold weather, the starch is almost entirely changed to sugar, though on the return of warm weather starch may again be deposited in the cells. He assumes that this sugar is formed during cold weather as a means of protecting the plant against freezing by lowering the freezing point of the sap due to its increased concentration.

The author performed a long series of experiments to test these theories, using the leaves, twigs, flowers and fruits of fruit trees in various stages of development besides the leaves from a large number of cultivated herbaceous plants, and he found that the killing temperature of plant tissues that kills at relatively high temperature was reduced whenever the sap density of the tissue was increased. With one or two possible exceptions, there was no indication of the precipitation of the proteids in the cell sap at the killing temperatures.

Other interesting conclusions may be gleaned from the author's summary. For example, with a few exceptions, there is no indication that the rate of thawing has anything to do with the amount of killing at a given temperature. There seems to be no constant relation between the rate of growth of plant tissue and resistance to low temperature. Young leaves of fruit trees kill at higher temperature than do old, mature leaves, while young leaves of lettuce withstand a lower temperature than do the older leaves. The most important feature affecting the hardiness of plant tissue is maturity, that is, the condition of resistance that the plants reach during the winter dormant period. Maturity in case of the cambium may be intimately associated with the process of drying out. However, this cannot be true in case of the cortex of winter twigs. There is very little difference between the moisture content of unfrozen cortex in seasons when it is very tender and in seasons when it is hardy. The wood at the base of the trunk and at the crotches of all rapidly growing branches seems to reach a condition of maturity more slowly than does most other tissue.

C. D. H.

Ground-Wood Pulp. By J. H. Thickens and G. C. McNaughton. Bulletin 343, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 151.

This is a highly specialized and yet practical publication, which in the official monthly list of publications is listed as "none for free distribution and none for sale." Supposedly, those commercially interested can secure it by special correspondence. It is a supplement to Bulletin 127, on the grinding of spruce, recording experiments not only on spruce, but besides a few hardwoods on a number (19) of other coniferous woods, eleven of which are found suitable for the production of news print, while such species as tamarack and Jack pine, owing to their dark color, do not lend themselves to this use.

A price curve of news print paper from 1878 on shows strikingly the gradual substitution of the cheaper ground pulp for more expensive paper materials; the price per 100 pounds in 1878 of $7.25 having fallen in 1898 to less than $1.75. Other curves show the movement of exports and imports. The equipment and methods used in the experiments are described. The effects of steaming, boiling, pressure, temperature, and time of cooking, and other conditions in producing spruce pulp were investigated with a view to increasing efficiency, reducing power consumption and increasing yield per cord.

Cooking prior to grinding produces stronger-fibered pulp, but requires more power than untreated wood. No difference in quality from steaming or cooking was observed. Under high pressure the yield per cord in spruce is greater than at low.

Maps show the distribution of the various species investigated. In one appendix the results of tests are tabulated in detail, and in another appendix paper samples from the various woods treated in different ways are added, allowing the manufacturer or consumer to judge the quality.

B. E. F.

Year Book, 1915. U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 616.

Too often the Year Book of the Department of Agriculture immediately upon receipt is relegated to a top bookshelf. The 1915 volume has more of interest to the forester than usual. A total of forty-five pages out of the entire 616 is devoted to subjects of direct value to the forester, while forty-five additional pages are taken up with articles also of interest to the American forester. The tables showing the areas of the National Forests, and especially the tables showing the increase of 92,656 head of cattle being grazed on the National Forests in 1915 over 1914, and a decrease of 120,881 sheep, or a net equivalent increase of 32,435 head of cattle (on the ratio of four sheep equal to one head of cattle) are of value. To the National Forest officer in the West, Mr. Jardine's article on the "Improvement and Management of Native Pastures in the West," is of extreme interest and value. The part of the secretary's report devoted to the National Forests includes thirteen pages and is a very clear, concise summary of accomplishments of the past year and future plans. Other articles of direct interest to the forester to be found in this book are: Pointers on Marketing Woodlot Products; Improvement and Management of Native Pastures in the West; Osage Orange Waste as a Substitute for Fustic Dyewood; and the tabulations by National Forests to be found in the appendix. Of the articles of indirect value, but of interest to the forest officer are the following: How Engineering May Help Farm Life; Unprofitable Acres; Animal Disease and Our Food Supply; and Stories of the Atmosphere.

J. D. G.

Glimpses of Our National Parks. By R. S. Yard. Department of the Interior. Washington, D. C. 1916. Pp. 48.

This is an attractively illustrated and popularly written pamphlet on the eleven more popular and better known National Parks of the United States. There is given on the inside cover a chronological list of these parks, with the name, location, area in square miles and, what is of most value to the sight-seer and tourist, the distinctive characteristics of each of the eleven parks covered. There are fourteen National Parks in the United States, as follows: Hot Springs, Yellowstone, Yosemite, Sequoia, General Grant, Mount Rainier, Crater Lake, Mesa Verde, Platt, Glacier, Rocky Mountain, and three smaller and of less popular interest, Sully's Hill, Wind Cave, and Casa Grande Ruins.

The Grand Canyon, although a national monument, is included probably because it ranks with the most widely known of the National Parks in scenic grandeur, and also because it may eventually become a National Park. What is too often confusing to the lay mind is made clear, namely, the difference between a national park and a national monument, as well as the difference between a national forest and a national park.

Persons wishing to secure more detailed information regarding traveling and living facilities, expenses of trips, etc., are advised to write to the Secretary of the Interior for the General Information Bulletins of any particular National Park.

The pamphlet contains nineteen illustrations of scenes from the different National Parks and a map showing roughly the location of the parks. The bulletin is plainly intended for popular distribution and is admirably gotten up for such a purpose and will undoubtedly prove of great value to the traveling public.

J. D. G.

Personnel and Employment Problems. The Annals of the American Academy of Political and Social Science. Vol. LXV (No. 154 complete). Philadelphia, Pa. May, 1916. Pp. 310.

The entire thirty-two articles in this volume, all from the minds of specialists in their line, have for their central theme what may be called the science of human engineering. The following is the keynote of this special volume:

"Considerations affecting the interests of the personnel are more and more being accorded their proper place in industrial management. The correctness of this policy is accepted by the more progressive and thoughtful employing concerns, not only because social opinion requires that employers should squarely face the human problems in industry, but also because scientific study and attention to the selection and development of, and cooperation with, employees furnish one of the most fruitful present sources of increasing business efficiency."

In forest organization, whether Federal, State or private, the personnel problem is recognized as of supreme importance, and as the foundation stone of all forest administration. Therefore, to the forester this volume of the *Annals* has much of interest and more of value. However much we may become interested and involved in abstract silvicultural and range ecology problems, we can not wander far from the ever-present personnel question in forest work. It is an open question whether the American federal forester has availed himself of what scientific management and its allied study of the human machine can give towards increased efficiency in federal forest officers. To review *in extenso* the many good things in this volume is tempting. Suffice it to merely mention some of the outstanding contributions: The Employment Manager, by Ernest F. Nichols, President of Dartmouth College; The Employment Problem in Industry, by W. C. Redfield, Secretary of Commerce; Personal Relationship as a Basis of Scientific Management; Hiring and Firing; Written Specifications for Hiring; Problems Arising and Methods Used in Interviewing and Selecting Employees; The Instruction of New Employees in Methods of Service; Records and Reports of Work; The Relation of Home Conditions to Industrial Efficiency; The Three Position Plan of Promotion.

J. D. G..

OTHER CURRENT LITERATURE

Forest Service Investigative Program, 1916. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 52.

State Forestry Laws: Idaho, Illinois, Indiana, Louisiana, Maryland, Minnesota, Missouri, Montana, North Carolina, Oregon, Texas, Virginia, Washington, Wisconsin, Wyoming. U. S. Department of Agriculture. Contributions from the Forest Service. Washington, D. C. 1915 and 1916. Pp. 5, 6, 5, 7, 6, 14, 2, 6, 5, 7, 3, 6, 8, 16, 3.

Forest Conservation for States in the Southern Pine Region. By J. G. Peters. Bulletin 364, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 14.

This bulletin points out the essential elements in the various forest problems that confront the States in the Southern pine region, shows how these problems are interrelated, forms a basis on which may be founded a plan for solving them, and discusses matters of great importance to lumbermen, farmers, and all others interested directly or indirectly in the conservation of the timber resources of that region.

Measuring and Marketing Woodlot Products. By W. R. Mattoon and W. B. Barrows. Farmers' Bulletin 715, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 48.

Quantity of Wood Preservatives Consumed and Amount of Wood Treated in the United States in 1915. By R. K. Helphenstine, Jr., American Wood Preservers' Association in cooperation with the U. S. Forest Service. Washington, D. C. 1916. Pp. 18.

Proposed Regulations for the Protection of Migratory Birds. Service and Regulatory Announcements. U. S. Department of Agriculture. Contribution from the Bureau of Biological Survey. Washington, D. C. 1916. Pp. 4.

Forest Pathology in Forest Regulation. By E. P. Meinecke. Bulletin 275, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 63.

Mistletoe Injury to Conifers in the Northwest. By J. R. Weir. Bulletin 360, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916 Pp. 39.

Carrying Capacity of Grazing Ranges in Southern Arizona. By E. O. Wooton. Bulletin 367, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 40.

The White-Pine Blister Rust. By Perley Spaulding. Farmers' Bulletin 742, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 15.

Cooperative Shelter-Belt Development in the Northern Great Plains. U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry, Office of Dry-Land Agriculture. Washington, D. C. 1916. Pp. 3.

Cooperative Shelter-Belt Planting on the Northern Great Plains. U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry, Office of Dry-Land Agriculture. Washington, D. C. 1916. Pp. 7.

Egg and Manner of Oviposition of Lyctus planicollis. By T. E. Snyder. U. S. Department of Agriculture. Reprint from the Journal of Agricultural Research. Washington, D. C. May 15, 1916. Pp. 273–6; pls. 4.

Lumber Markets of the East Coast of South America. By R. E. Simmons. Special Agents Series 112, U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce. Washington, D. C. 1916.

Central America as an Export Field. By G. Harris. Special Agents Series 113, U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce. Washington, D. C. 1916. Pp. 229.

The Birds of North and Middle America. By Robert Ridgway. Bulletin of the U. S. National Museum, No. 50, Part 7. Washingtoh, D. C. 1916. Pp. 543; pls. 24.

Proceedings of the Society of American Foresters. Volume XI, Number 2. Washington, D. C. April, 1916. PP. 171–270.

Contains: Suggestions as to Possibilities of Silviculture in America, by B. E. Fernow; Utilization of Wood Waste by Chemical Means, by H. F. Weiss; Top Diameters as Affecting the Frustum Form Factor for Longleaf Pine, by H. H. Chapman; Water Requirements and Growth of Young Cypress, by W. R. Mattoon; The Woodlot: Its Present Problems and Probable Future Status in the United States, by C. R. Tillotson; A Forest Census of Alabama by Geographical Divisions, by R. M. Harper; Professional Ethics, by T. S. Woolsey, Jr.; The Factor of Top Diameters in Construction and Application of Volume Tables Based on Log Lengths, by H. H. Chapman; The Biltmore Stick and the Point of Diameter Measurements, by D. Bruce; What is a Forester? by F. E. Olmsted; The English Names of Some Trees, by W. W. Ashe; Scientific Notes and Comments; Reviews.

Tree Planting, an Arbor Day Handbook for Use in Maine Schools. By J. M. Briscoe. Forestry Department, State of Maine. Waterville, Me. 1916. Pp. 37.

Handling the Farm Woodlot. By C. W. Eaton. Extension Bulletin 105, University of Maine Agricultural Extension Service. Orono, Me. 1916. Pp. 16.

Third Annual Conference of the Woods Department of the Berlin Mills Company, Burgess Sulphite Fibre Company, Fitzgerald Land and Lumber Company, Brown Corporation. Berlin, N. H. 1915. Pp. 37.

Contains, beside a record of attendance at the Conference, which was held at Berlin, November 23 and 24, the following articles:

Kraft Paper and Its Uses, by W. R. Brown; Forest Pathology, by E. R. Linn; Hardwood, by J. W. Keenan; Mechanical Log Haulers and Their Development, by S. Brown; Pulpwood Loading and Receiving, by P. McCrystle; Cooperation, by F. W. Farrington.

Annual Report of the Park Commissioners of the City of Fitchburg, Massachusetts, 1915. Fitchburg, Mass. 1916. Pp. 52.

Fire Protection Map of the Adirondack Forest. Compiled by Karl Schmitt. New York Conservation Commission. Albany, N. Y. 1916.

The Structure of the Common Woods of New York and the Wood Collection. By R. P. Prichard. Bulletin of the New York State College of Forestry. Syracuse, N. Y. 1915. Pp. 31.

A Street Tree System for New York City, Borough of Manhattan. By L. D. Cox. Bulletin of the New York State College of Forestry. at Syracuse University, Vol. XVI, No. 8. Syracuse, N. Y. 1916. Pp. 89.

Report to the Honorable Cabot Ward, Commissioner of Parks, Boroughs of Manhattan and Richmond, New York City.

Some Insect Enemies of Shade Trees and Ornamental Shrubs. By M. W. Blackman and W. O. Ellis. Bulletin of the New York State College of Forestry at Syracuse University, Vol. XVI, No. 26. Syracuse, N. Y. 1916. Pp. 122.

Annual Report for the Year Ending October 31, 1915, Department of Conservation and Development of New Jersey. Trenton, N. J. 1916. Pp. 77.

Report of the State Forester, pp. 41–6.

Report of the Chief Forest Fire Warden for Pennsylvania for the Year 1915. Bulletin 13, Department of Forestry. Harrisburg, Pa. 1915. Pp. 182.

The Prevention and Control of Erosion in North Carolina, with Special Reference to Terracing. By F. R. Baker. Bulletin 236, North Carolina Agricultural Experiment Station. Raleigh, N. C. 1916.

Potash. By T. E. Keitt and C. J. King. Bulletin 182, South Carolina Agricultural Experiment Station. Clemson College, S. C. 1915.

The Physiographic Ecology of the Cincinnati Region. By E. Lucy Braun. Bulletin 7 (Vol. II, No. 3), Ohio Biological Survey. The Ohio State University. Columbus, Ohio. 1916. Pp. 211.

Mid-West Forestry Association. Columbus, Ohio. 1915. 2 leaves.

The Freezing Point Method as a New Means of Measuring the Concentration of the Soil Solution Directly in the Soil. By G. J. Bouyoucos and M. M. McCool. Technical Bulletin No. 24, Michigan Agricultural College Experiment Station, Division of Soils. East Lansing, Mich. December, 1915. Pp. 44.

Forest Planting in Wisconsin. By W. D. Barnard. Bulletin 1 of Conservation. Madison, Wis. 1916. Pp. 34.

Heavy Timber Mill Construction Buildings. By C. E. Paul. Engineering Bulletin No. 2 (General Series No. 25), National Lumber Manufacturers Association. Chicago, Ill. May, 1916. Pp. 66.

Wood Construction (as Applied to All Classes of Buildings) in Relation to Fire Losses in Europe and America, Being Authentic Data Here First Collated, with Supplement, Containing Graphic Chart and Complete Analytic Tabulations. Document No. 1, National Lumber Users' Educational Series on Wood (General Series No. 20). National Lumber Manufacturers' Association. Chicago, Ill. 1915. Pp. 16.

Renewing the Shelterbelt. By G. B. MacDonald. Circular 27, Iowa State College Agricultural Experiment Station. Ames, Iowa. 1916. Pp. 16.

The Ames Forester, Volume IV. The Forestry Club of the Iowa State College. Ames, Iowa. 1916. Pp. 72.

Trees for Kansas. By C. A. Scott. Circular 55, Kansas Agricultural Experiment Station. Manhattan, Kan. 1916. Pp. 19.

Trees of Texas. By I. M. Lewis. Bulletin 22 of the University of Texas. Austin, Texas. 1915.

Creosoting Douglas Fir Bridge Stringers and Ties without Loss in Strength. By O. P. M. Goss. Published by Association of Creosoting Companies of the Pacific Coast. Seattle, Wash. 1916. Pp. 27.

The University of Washington Forest Club Annual. Vol. IV. Seattle, Wash. 1916. Pp. 71.

This publication contains, besides matters of immediate interest to members of the Club, the following articles: Reforestation in the State of Washington, by G. S. Long; Efficiency in Lumber Manufacturing, by J. S. Williams; A Growth and Volume Study of Lodgepole Pine in the Ochoco Mountains, by E. J. Hanzlik; A Modified System of Cruising,by H. G. Foran; Labor and Cost of Production, by J. B. Gibson; Grazing of Stock on the National Forest, by R. P. Huff; Trend of Stumpage Prices in Western Washington, by R. Brindley; Correcting Aneroid Elevations in Surveyed Country, by H. A. Durfee; Telephone Line Construction in the Forest, by H. A. Browning.

Forestry Kaimin. Forestry Club, Forest School of the University of Montana. Missoula, Mont. 1916. Pp. 128.

A Handbook of Forest Protection. California State Board of Forestry. Sacramento, Cal. 1915. Pp. 87.

A handbook of information relative to the forest policy of California. It contains the forest laws of the State with interpretations of certain sections, together with a synopsis of the game laws of the State and the forest fire report for the year 1914.

Citrus Canker. By F. A. Wolf. Bulletin 190, Alabama Agricultural Experiment Station. Auburn, Ala. 1916. Pp. 100.

Palmyra Island with a Description of Its Flora. By J. F. Rock. Bulletin 4, College of Hawaii Publications. Honolulu, Hawaii. 1916. Pp. 53.

Maple Sugar. Bulletin 324, Laboratory of the Inland Revenue Department. Ottawa, Canada. 1915. Pp. 25.

Report of the Minister of Lands, Forests and Mines of the Province of Ontario, 1915. Toronto, Ont. 1916. Pp. 89.

The White Pine Blister Rust: A Dangerous Disease of White Pine. Forestry Branch of Ontario. Toronto, Ont. April, 1916. Pp. 2.

Forest Products of British Columbia, 1913 and 1914. Markets Bulletin 9, Forest Branch, Department of Lands. Victoria, B. C. 1916. Pp. 85–99.

Market for Timber in India. Markets Bulletin 16, Forest Branch, Department of Lands. Victoria, B. C. 1916. Pp. 177–88.

Report from British Columbia Lumber Commissioner in Great Britain. Markets Bulletin 17, Forest Branch, Department of Lands. Victoria, B. C. 1916. Pp. 189–201.

Annual Report of the Forest Administration in Ajmer-Merwara for the Year 1914–15. Mount Abu, India. 1916. Pp. 28.

Report on Forest Administration in the Andamans for 1914–15. Calcutta, India. 1916. Pp. 38.

Annual Progress Report on Forest Administration in the Presidency of Bengal for the Year 1914–15. By C. E. Muriel. Calcutta, India. 1915. Pp. 47.

Note on Blackwood, Dalbergia latifolia Roxb. By E. Benskin. Forest Bulletin 27. Calcutta, India. 1915. Pp. 12.

Note on Dhauri. Lagerstroemia parviflora Roxb. By E. Benskin. Forest Bulletin 28. Calcutta, India. 1915. Pp. 11.

Note on Sundry Timber, Heritiera minor Lam. By R. S. Pearson. Forest Bulletin 29. Calcutta, India. 1915. Pp. 8.

Compilation of Girth Increments from Sample Plot Measurements. By R. S. Troup. Forest Bulletin 30. Calcutta, India. 1915. Pp. 8.

Pinus longifolia Roxb., a Sylvicultural Study. By R. S. Troup. The Indian Forest Memoirs, Vol. I, Pt. 1. Calcutta, India. 1916. Pp. 126; pls. 33.

Note on the Economic Uses of Rosha Grass, Cymbopogon martini (Stapf). By R. S. Pearson. The Indian Forest Records, Vol. 5. Pt. 7. Calcutta, India. 1916. Pp. 50.

The Tapping of the Para Rubber Tree—Some Physiological Experiments. By E. Bateson. Department of Agriculture, Federated Malay States. Kuala Lumpur. 1914. Pp. 54.

A Critical Revision of the Genus Eucalyptus. Vol. III, Pts. 5 and 6 (Pts. XXV and XXVI of the complete work). By J. H. Maiden. Sydney, N. S. W. 1915; 1916. Pp. 81–102; 103–24. Pls. 104-7: 108–11.

Bulletin de la Station de Recherches Forestières du Nord de l'Afrique. Gouvernement Général de l'Algerie, Service des Forêts. Algeria. 1916. Pp. 114.

Indberetning om det Norske Skogvaesen . . . for Kalender-Aaret 1914. Kristiania. 1915.

Analyses of Genuine Swedish Pine-Needle Oil . . . Manufactured by . . . Alfr. Carlssons . . . By Count Carl Th. Mörner. Jönköping, Sweden. 1914.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

Bulgarian Forestry

The prominence of the Balkans in the Great War lends special interest to the article by Weiss-Bartenstein based on his volumes on Bulgaria published in 1913. He starts with the surprising statement that in spite of low wood prices the extraordinarily low cost of exploitation of the virgin woods for a long time brought a greater net yield than farming. Hence there has, until lately, not been any danger of excessive clearing. But increase in labor cost and "land hunger" and difficulties in transportation from distances recently changed these conditions, and the forest area has diminished. In 1908, the forest per cent was somewhat below 30 per cent (about 8 million acres), but in the South it rises to 60 or 65 per cent.

Oak and beech, with other hardwoods, are the most prominent species; of conifers pine, spruce and fir are found. Four forest zones can be differentiated: the warm zone occupying the lower valleys up to 1400 feet, with a vegetation typical of Southwest Europe, mostly deforested and turned to farm use; the mild zone with similar flora, still containing considerable old timber; the third zone on the slopes up to about 5500 feet, where beside extensive beech forest, inaccessible, the conifers become prominent; and the mountain zone with *Picea excelsa* and *peuce*, and *Pinus mughus* up to timberline.

The ownership is in three classes, the State owning about one third, municipalities and communities holding the bulk, about one half, and private ownership or mostly church societies owning the balance, mainly in small woodlots; only about 5 per cent belongs to large landed proprietors, magnates being rare in Bulgaria. Ownership conditions appear, however, to be uncertain and the adjustment of titles and boundaries is still the order of the day. The population still considers the forest *res nullius*. Rough exploitation is still the rule and much of the area is maltreated, except where lack of transportation makes it unprofitable. In spite of the forest wealth, imports exceed exports, even of fuelwood. In the first 10 years of the century, the import of building material exceeded the export sixfold. Lately, a few small furniture factories, a Belgian match factory, and a few large sawmills have been established, but most of the mills and factories run only part of the year.

The first attempt to bring order into the management at least of the municipality forests dates from 1869, when Bulgaria was still under Turkish rule. This law remained absolutely a dead letter.

Soon after the autonomy was established, in 1879, legislation was had, but fared no better, because of lack of machinery. Finally, in 1884, a comprehensive law was passed and a start of an organization with forest inspectors, foresters and guards, to apply the law under the Ministry of Finance was made. But, with the inimical disposition of the people, the uncertainty of ownership conditions, and inadequate personnel not much of the excellent provisions on paper found application in the woods.

New legislation was added from time to time, notably in 1889, 1897, 1904, and the personnel was increased until now in the State forests some 500, in the communal forests some 2,000 guards are employed. Nevertheless, theft and other "irregularities" are still the order of the day. The legislation concerns itself first with the settlement of property conditions; classification of forests, and, in communal forests, adjustment of the rights of user, especially as regards pasture; restrictions of exports; enforced reforestation; organization under working plans; forest police; a State nursery for distribution of plant material; forest schools which seemingly did not materialize.

In the State forests and in communal forests, which are under direct State control , the utilization takes place under a felling plan, usually under contract or timber license,, secured at an auction, or also in private sales.

The State administration handles the business of the municipalities and turns over to them what it considers the surplus, which is usually not large, the members of the community having all rights of user, exercised with a great deal of favoritism and graft. In 1911, the total income from these communal forests was less than $400,000; 90 per cent being fuelwood, while the State forests netted hardly $120,000; nearly 40 per cent being workwood. The price of the workwood averaged about 2.5 cents per cubic foot, that for fuelwood about half a cent.

Selection forest, unregulated, is still largely the method of utilization and silviculture.

Bulgarien's Forstwirtschaft. Tharandter Forstliches Jahrbuch, 1916, Bd. 67, Ht. 1, pp. 31–59.

Forestry in Morocco

According to Long, Chairman of Agricultural Organization in Morocco, the Waters and Forests Service, organized in 1914, has made excellent progress, even with a reduced personnel of two superior officers and 20 rangers and guards. The receipts for the first year almost covered the expenses.

The best cork oak forest, that of Mamora, fast being ruined by the natives, was immediately placed under management and 120,000 trees were peeled in 1914 and 1915. Already 101 kilometers (62.8 miles) of fire lines 30 meters (32.81 yards) wide have been opened up as a protection against fire. In addition, three groups of ranger houses were constructed in 1915 and 4 other groups contracted for in 1916. The cost of these houses was estimated at 10,000 francs ($1930) per guard or 20,000 francs ($3860) for a double house, but the actual cost proved to be 25,000 and 50,000 francs ($4825 and $9650). Each single house included three rooms for the guard's family, hallway, and room for the native assistants, a court-yard surrounded by high walls for purposes of defense, a stable, a cellar, a tool shop, and a forge. The water had to be secured from a 30 to 35 meter (32.81 to 38.27 yard) level, thus adding to the expense. The budget approved for a period of three years is as follows:

	Francs	*Dollars*
Regeneration and improvement of damaged stands	800,000	(154,400)
Fire lines	600,000	(115,800)
Construction of 20 to 25 ranger houses	1,000,000	(193,000)
Nurseries and miscellaneous betterments	100,000	(19,300)
Peeling and exploitation (about .30 per tree)	2,000,000	(386,000)
Total expense for three years	4,500,000	(868,500)

It is estimated that the annual revenue will amount to more than 2,000,000 francs ($386,000) after five or six years of management.

On account of the disturbed political conditions, the splendid cedar forests south of Fez and Meknès cannot be exploited.

T. S. W., Jr.

L'exploitation des Forêts au Moroc. Revue des Eaux et Forêts, June 1, 1916, pp. 178–81.

BOTANY AND ZOOLOGY

Causes of Tree Form

In a highly suggestive article Dr. Leon discusses structures developed in both animals and plants, developed to perform the function for which they exist, starting from the idea that "the continuous use of an organ conditions its progressive adaptation to the purpose for which it exists, and vice versa the non-use debilitates it." Tree forms may be explained in this way. The bast and woody tissue in the full-grown individual, the collenchyma in its development period serve to strengthen the plant organs.

Trees are frequently not circular, but have an oval cross-section, the diameters in west-east direction being longer than in north-south direction, a result of the prevailing winds. Small trees fastened so that they can sway only in one direction increase their diameter mainly in this direction. Trees securely fastened to poles in all directions increase in diameter much less than those free to move, and if unfastened rapidly make up for delay, if they are still capable of standing up. On those parts of stem and branches which are continually or mainly required to withstand tensile stress a different wood structure is formed than in those under compression, hence one may speak of "tension wood" and "compression wood," or according to the color (when fresh) of "white wood" and "red wood." Woodchoppers correctly call the windward side of the tree, the "soft" side, the opposite the "hard" side. It is in tensile strength that the soft side excels, the hard side excels in resistance to indentation.

A leaning tree develops red wood on the lower, tensile wood on the upper side; similarly, a one-sided branch development produces red wood. With the change of the load a change in the character of the wood takes place. Owing to the response to tensions, the quality of the wood in the lower portion of the trunk is mostly superior to that of the upper portions; at the insertion of branches a more solid, stronger wood is formed than in neighboring portions. Metzger and Schwarz claim that tree trunks are built as, or at least closely resemble, beams or columns of equal resistances.

Such dynamic responses explain the greater taper of trees grown in the open, and other form development, hence this knowledge is of importance to the forester. The mathematical theory and law, after Metzger, under which the tree trunk assumes its general form is developed by the author.

If we follow on the basis of this theory, the development of a tree in the open, *i. e.*, a tree with a crown which remains at equal distance from the ground, the following relations will be found: In the branchless portion the ring width will increase towards the base; in the branched portion it will remain constant. In close stand, on the contrary, the reverse will hold as far as the branchless bole is concerned; the ring width decreases toward the base. By freeing such a tree (if the crown is still alive) the area exposed to wind pressure is increased; an increased increment "due to light" takes place which can be approximately calculated. The stem becomes more tapering as corresponds to experience and theory. In some cases, with the increase of ring width toward the base a reduction in the upper portions of the stem takes place.

Green pruning has the opposite effect; the crown is curtailed, the wind pressure reduced; dimensions are changed, and often the annual ring up to a certain height fails to form for some years. If the annual height growth rate is known, the point up to which this will occur can be approximately calculated. The stem thereby becomes less tapering. Theory and experience also support the rule that the form factor in close stand increases with age and height in trees with equal opportunity, but predominant stems have a more tapering form than the lower ones because they are more subjected to wind pressure.

In the branchless portion relations do not change if cross-sections are compared which are equi-distant from the resultant of forces working on the cross-section.

If the crown approaches conical shape in trees in the open, annual ring width increases from top to root collar; in trees in close stand, on the other hand, the ring width experiences a maximum at the point where the crown starts.

In trees with crowns of a shape narrower than a cone, theoretically, if grown in the open the ring width at the base of the crown must experience a minimum; in close stand the ring width must increase from root collar to tip.

Guttenberg, however, denies the occurrence of a minimum in the practical field, and other authors, among them Jaccard, combat this mechanical explanation of tree form altogether, making a single mechanical factor responsible for the laws of growth.

According to Jaccard, the trees in comparison to the beam of equal resistance are "over-dimensioned," near the soil and near the crown base, and towards the crown the shaft would have to be relatively stouter than Metzger's formulae demand. This objection is in part met by the experience that the quality of the wood with increasing height becomes poorer.

Guttenberg has pointed out that in close stand the influence of wind is very small.

Jaccard considers the tree trunk "a shaft of equal water conductivity." The unreliability of Metzger's formulae is increased by the fact that they are derived from sticks with constant cross section, while here we have to deal with bodies of constantly varying cross section.

Where the roots of a tree change into stem, at the root collar, there is a place of sudden change in cross-section and a curvature; here the formulae based on the simple beam are not applicable. In considering the static significance of the root collar, it is not any more the physiologically admissible use of the wood, but the admissible requirement of the soil that is at work. Tropical trees, rooted in soft morass (mangrove), are supported by stilts which transfer the pressure of the entire superior weight of the tree to the subsoil.

Other static conditions of various forms of vegetation are also interestingly discussed.

Technik und Naturwissenschaft. Centralblatt für das gesammte Forstwesen, July-August, 1915, pp. 254–72.

Climate and Leaf Margins

Bailey and Sinnot have investigated the distribution of the various types of leaves among the dicotyledonous plants in the principal plant-geographic regions of the earth in the endeavor to throw some light upon the question of rigidity of leaf characters and their modification by environmental factors. From the floras of various regions, the authors tabulated the occurrence of leaves with entire margins and non-entire margins among the trees, shrubs and herbaceous plants. They found that leaves and leaflets with entire margins are overwhelmingly predominant in lowland tropical regions; those with non-entire margins in the mesophytic cold-temperature areas. In tropical zones non-entire margins are favored by moist uplands, equable environments, and protected, comparatively cool habitats. In cold-temperate zones, entire margins are favored by arid environments and other physiologically dry habitats. Transitional forms reach their best development in the intermediate environments. In the case of those families which possess both types of leaf margins, it is very significant that their distribution corresponds to that outlined above. These facts are, however, best exhibited by trees and less so by small shrubs and herbaceous plants. This is to be expected when one considers the greater exposure of trees, their longer life cycle and their relatively smaller mobility in migration. The presence of a limited number of non-entire-leaved types in lowland-tropical environments and the comparatively few entire-leaved species in mesophytic cold-temperate regions may be explained by the fact that not all the species will have been subjected to the effects of the prevailing climatic conditions for equal lengths of time or an equal number of generations; nor is it necessary to suppose that all species or groups of plants will respond with equal rapidity or in an exactly similar manner to the influences of environment.

In view of these facts, the authors assert that it is highly probable that the present distribution of entire and non-entire dicotyledonous leaves and leaflets is largely due to factors of environment rather than to those of heredity. It does not necessarily follow, because a certain foliar character has remained unaltered through long periods of geological time, or has varied greatly among closely related forms, that the leaf is inherently "conservative" or "inconstant." The authors believe that the character of the leaf margin of fossil plants may be legitimately used as a criterion for interpreting the climatic conditions in the different periods of the Tertiary and Cretaceous dicotyledonous floras. The interpretation of the physiological significance of the entire and non-entire leaf margins is to be considered in a subsequent paper.

C. D. H.

The Climatic Distribution of Certain Angiosperm Leaves. American Journal of Botany, January, 1916, pp. 24–39.

Evolution of Forest Types

An interesting biological evolutionary history is observed in Norway in the fight for supremacy between Norway spruce and Scotch pine in Norway.

The appearance of spruce (*Picea excelsa*) on leached deposits of sand and gravel, on soils with a general deep water table, on land covered with dense xerophytic moss and creepers among which is a species of Ground pine, and upon other typical pine sites, has of late occasioned considerable concern. It is, of course, true that such ground, which offers little of the nourishment requisite for healthy spruce development, cannot be the best sites upon which to grow this species; but by closer observation, we shall find that in most such cases spruce fills an important function for a longer or shorter period, especially as a stand-forming tree giving protection on lands where pine is found scattered and slow growing. This is, perhaps, more the case on the first three kinds of site mentioned. We often make a serious mistake when we, as the saying goes, want to polish up our stands, by clearing away all small undergrowth in order to clear the forest floor, without taking sufficient thought of the soil characteristics. On the poorer sites, and particularly where there is danger of drying out or an invasion of weeds, this treatment is undesirable. Every bush and twig should be preserved until the forest is ready to be reproduced.

On the moister pine lands one runs the risk that by allowing the spruce to continue within the stand it will reach up and mix in the upper crown space belonging to the pine, with the result that the latter grows unnecessarily tall at expense of diameter growth. Should the spruce be tolerated too long, it may drive the pine out entirely. On moist sites within the pine type, therefore, it is best to hold the spruce in check. Up toward timberline it becomes necessary to employ the greatest care in the treatment of spruce. Spike-topped trees with green limbs in open stands are omens pointing to conservatism and a certain minimum density. In fact, it is hardly ever good policy to cut in this upper belt. It is pretty axiomatic that where pine will grow it should be most zealously preserved, and the same holds for spruce toward timberline.

I feel quite certain that the general preference for pine on what is considered pine land is largely responsible for the desire to get rid of spruce there. It is justifiable to combat spruce at certain low areas, but within the protection forest the intruder spruce needs a great deal of attention, because the spruce is the timberline tree of the future.

The upper line of tree growth has a tendency to recede. It retreats down the mountain from one century to another. Timberline has previously been higher, which we deduce from the remnants of pine trees dug up from former lakes and ponds within the barrens above the present upper limits of tree growth, and over the denuded alpine regions.

The pine is on the decrease, not only at lower elevations where it is being suppressed by the spruce and where it previously reigned supreme, but also on the slopes, and we must face this truth. How much of this can be laid to the spruce? We know that spruce is a comparatively late immigrant in this country (Norway). Slowly but surely, under cover, it has penetrated deep passes and valleys, always behind and under some other species, so that now in the east and south it is on a par with the original stands of pine. It has won out in Tröndelagen, further north and throughout Helgeland. It is the same in the lowlands, up the principal water courses, both on sunny and shaded slopes, except that progressing up the valley spruce lags behind on sunny slopes, while in the shade its advance takes place more rapidly.

Differently in different watersheds, and above these temporary limits the pine reigns still, and above the pine is the birch. The situation, therefore, is this: spruce crowds the pine from below and birch crowds it from above, and between these we find mixtures and transitions in all kinds of variation in ascending order. Below are the unbroken spruce columns, ahead and further up the ragged pine and spruce formations, on the field of battle; still farther ahead and up the stronger individuals in hand to hand conflicts with a host of the enemy.

The pine will continue to decrease in area with a corresponding increase in the spruce type, and spruce will replace pine in the upper belts as well as in the valleys and on the general slopes. There is at present no sign that the reduction of the pine type will be halted, and spruce has already gained the summits and upper limits in several places on the shaded slopes farther south.

The White birch gives help to the advance of the spruce. The conifers go higher when protected by birch, stand denser and bear seed at higher elevations. But where it is missing, which happens after careless cutting or because it has never been established, the conifer stands are open, more scraggy and decadent, discouraging seed production. In presence of birch, and especially where this has sufficient nourishment to stand close, we find the spruce already considerably advanced toward the summit. Where the birch from above and the spruce from below have grasped each other's hand the pine is doomed. This union of spruce and birch takes place first on shaded slopes and better sites, and on the more friable formations; slower on exposed slopes, shallow or rocky soil and where the rock formation weathers slowly. It does not follow that the pine yields as soon as the two competitors have effected a union, but it is only a question of time until it is reduced to scattered individuals tenaciously clinging to the drier knolls within a forest of spruce and birch. Their tall clear boles and spreading crowns telling of a subdued race; subdued because conquerors are able to improve the soil conditions and turn it to their own benefit, and by dense thickets prevent pine reproduction.

The natural tendency of the spruce to creep toward the birch and timberline, crowding out the pine, is greatly accelerated by opening the stands in logging. Pine forests are being culled everywhere. These come up to birch and so close that they are difficult to penetrate; and where these thickets appear some distance above the vanguard of the advancing spruce, the birch and spruce union is effected much sooner than it would be if the pine had remained. For the protection and nourishment furnished by the birch leaf and litter and the increased amounts of shade and moisture are factors greatly enhancing the stealthy progress of spruce toward the upper slopes.

In this war against the pine the moose and other game animals assist, and even inorganic Nature, of which water plays an important part, is limiting the exterior boundaries of the pine type both from above and below, partly by the formation of swamps made by a rising water table after logging, in which the pine flounders, while the spruce survives.

In taking up the question of assistance to the pine, it must be decided which tree, spruce or pine, best performs the duties imposed upon a tree toward timberline. On these areas a coniferous forest with birch cannot be as productive in the same sense as a forest on the lower slopes. The great difference as far as productivity goes lies in that the upper forest is most productive when left uncut.

It is of greatest use *in situ.* It is the office of the timber on the upper slopes to protect the lower in such a way that the latter will yield regularly. If man fails to grasp this important relation and reduces the higher and upper stands in the same manner that he would the lower, he will soon realize that when he comes to cut a second and third time the distance he can go up the slope for timber decreases with each cutting, unless the birch covers up his sins with a cloak of mercy. *The office of the upper stands is therefore so to protect the lower that the latter may keep up a constant yield.*

The author then goes into detail inquiry as to what particular function trees in protection forests are called upon to perform and how the three species come up to these requirements. Trees within the protection forest must be able to resist storms. Spruce by its form and lower branching is superior to pine in preventing snow drift, and even in wind firmness spruce is given the preference: root systems of both species in these locations are alike, but pine has its center of gravity above the middle of the bole and is easily thrown, while spruce offers least resistance in the top and breaks only bit by bit. The ability of the spruce to form dense thickets in pure stands over extensive areas counts also in its favor. It also by its low crown protects the forest floor better and accumulates a copious litter.

The amelioration of site at higher elevations by spruce is not unlike that of birch, both of these species rehabilitating through long years the deterioration wrought by centuries of pine stands.

The many enemies of pine hinder reproduction in a large measure, and this is one of the chief reasons for its yielding and recession on the higher slopes. Furthermore, the seed of pine requires a longer period for ripening—three years high up, and the seed years are infrequent. In addition, it is at best offered a very poor seed bed, so that what few scattered pine seedlings do occur there can hardly be derived from the trees overhead; but have come mostly from the trees lower on the slope. In contrast, we know that the seed of spruce germinates in much less time, and where pine seed ripens in three good seasons, that of spruce ripens in one less; if it be unusually warm it may ripen in one season. Aside from reproduction from seed upon which the pine depends solely, spruce is able to regenerate by sprouts from buried limbs, and this process is more rapid than generally believed. It is an interesting thing to see an old spruce thus surrounded by a close thicket of descendants. And when to the superiority of spruce within the protection forest as compared with pine, we consider the greater tolerance of the former, which enables it to migrate upward under cover of birch or any other tree, and that it by virtue of tolerance finds room for five within a space required by one pine, increasing in a geometric ratio as compared with pine, we will have to acknowledge that a future predominance of spruce on the upper slopes and at timberline may have its benefits.

Spruce together with birch will bring the timberline higher. These two species will at least stay the receding tendency of pine. But where pine occurs alone the timberline will continue to recede.

J. A. L.

Tidskrift for Skogsbruk, January, 1913.

Root Rot of Seedlings

A. H. Graves reports the appearance in the nursery of the Yale Forest School, during the spring and summer of 1914, of a serious root rot. About 20 per cent of a bed of one-year-old Red pines (*Pinus resinosa*) were destroyed while 5 per cent of a bed of one-year-old White pines (*P. strobus*), several thousand two-year-old Red pines, as well as a few seedlings of one-year-old hemlock (*Tsuga canadensis*) succumbed.

The disease first became noticeable through a dark red or reddish-brown discoloration of the tips of the leaves. By slow degrees this color was extended and subsequently became brown or yellow brown. Diseased seedlings were examined and showed a root system entirely dead.

Repeated efforts were made to isolate a fungus without success, but a study of the soil beds showed that the soil was stiff and clayey. This, together with the fact that the disease caused most destruction early in the season and disappeared when dried conditions prevailed, has led to the conclusion that it is due to the lack of oxygen in a soil which is saturated with water.

Phytopathology, April, 1915, pp. 213–7.

SOIL, WATER AND CLIMATE

Muskeg Soil and Tree Growth

A highly interesting series of determinations of mineral constituents in an artificially forested peat soil is reported by Ramann and Niklas, of the Soils Division of the Bavarian Experiment Station, which gives an insight into the character of such soils and silvicultural possibilities of the same.

At the Moor Culture Station Bernau, Dr. Ebermayer, in 1896 to 1898, planted or sowed, with application of various fertilizers, spruce, birch and other conifer and deciduous species.

The sowed birch stand grew thriftily into a thicket, until 10 years, when the height growth ceased and the crowns rounded off. A thinning revived the height growth. Then, in order to find out the influence of thinnings on mineral constituents, the present investigation was inaugurated by laying in a severe thinning in half the area, leaving the other half untouched.

Since moor soils are independent as to water, but relatively poorly supplied as to mineral constituents, they furnish good objects for such investigation of the relation of minerals to tree growth. In such soils, the minerals are either highly fixed, so that they cannot be taken up by the roots, or else, like the alkali easily soluble. By extracting the entire salt contents with a Kohlrausch apparatus and measuring the electric resistance of this extract, the presence of soluble salts can be readily determined. Thirty sample spots 5 to 10 *m* apart were analyzed in this way, besides 10 spots were investigated for the underground. The samples were taken at 5 to 20 *cm* depth in the surface soil and 40 to 60 *cm* in the underground. The analyses were repeated in 1911 and 1912, and are tabulated. Further details of the procedure are given.

From the results apparently one might conclude that the contents of soluble salts was higher on the thinned area, and only in the autumn after leaf fall somewhat lower than on the unthinned. The authors, however, caution against this conclusion, since the variations in the single analyses lies within very wide limits. But the possibility of this highly important influence of thinning is indicated.

Very close, however, is the relation between salt contents of the soil and the development phases of tree life, especially the leaf fall. In both years, in spite of great climatic difference, the change of salt contents proceeded alike, low in May, rising in July, again declining in August and September, highest in November.

In May, the distribution of salts is dependent on relation of precipitation and evaporation. The latter brings water from the depths and enriches the upper layers with minerals. This goes on up to July, and in the dry year 1911 in greater degree than in the moister year 1912. Here a difference between thinned and unthinned area is noticeable. The thinned, open stand is strongly sunned, the temperature of the surface soil rises and with it evaporation and water conduction and movement of nutrients. "*It is very probable that in this relation an essential part of the influence of thinnings rests.*"

In August and September, probably the birch mainly takes up nutrients which accounts for the lower figures, while in November, with the leaf fall, the concentration of soluble salts rises to double and four-fold the amount of previous months. Without any other assignable cause the litter alone must account for this great increase and accentuates its value.

The authors in conclusion point out the advantage of these moor soils for investigations into plant nutrition, mineral requirements, etc., on account of their independence on water and relative poverty of mineral salts.

Der Einfluss eines Baumbestandes auf den Gehalt an gelösten Salzen in einem Moorboden. Zeitschrift für Forst- und Jagdwesen, January, 1916, pp. 3–12.

Litter Influence

The removal of litter by raking for stable use, which in its effects is probably not much different from its removal by fire has been studied by Ganter in 120-year beech stands, III and IV site, verifying former findings.

The largest water contents and smallest evaporation are found in the undisturbed area (5 to .7 *cm* cover). The area raked every 5 years had the lowest water content and evaporated almost as much as the undisturbed area. The explanation seems to lie in the number of trees, 310 against 410 on the unraked area per hectare.

The litter of the unraked soil prevents the washing out of the silt. The yearly raked soil experiences increased weathering and hence increase of silt. The greatest volume of pores are found in the areas never raked or raked only every 5 years.

The highest temperature is found on the yearly raked, the lowest on the unraked area. The largest humus and nitrogen contents are found in the latter, contrary to Ramann's finding, probably due to presence of mosses.

The increment conditions are as one would expect, except that the average basal area increment per cent of the 5-year area was found .1 per cent higher than the unraked area; no reason being assigned.

Bodenuntersuchungen über die Rotbuchenstreuversuchsflächen im Forstbezirk Philippsburg in Baden. Allgemeine Forst- und Jagdzeitung, February, 1916, pp. 41–2.

SILVICULTURE, PROTECTION AND EXTENSION

Mézenc Forestation Difficulties

In Central France, the altitude of the Mézenc region is between 1400 and 1750 meters (4593.16 to 5741.45 feet) with slopes up to 50 per cent. The soil is quite easily eroded and the climate is severe, the snow remaining on the ground more than six months with dangerous spring and fall frosts. The winds are particularly violent, especially at the higher altitudes and near the passes. The soil is rocky, gravelly, porous, and easily dried out.

Paul Buffault gives an interesting account of the history of forestation in this region that is illustrative of the difficulties the French have had to contend with in their mountain forestation work.

Historically, six periods of forestation activity are distinguished:

1. From 1863 to 1877, was an experimental period during which widely spaced plantations of fir and beech planted in the open without any cover except heather and bilberry were failures because the species planted were not sufficiently protected under such rigorous climatic conditions. Scotch pine (from Haguenau), and Austrian pine sown at altitudes between 1500 and 1600 meters (4921.2 to 5249.3 feet) did not succeed. In 1882, there was hardly a trace of this work which had been executed on 460 hectares (1136.6 acres). The lack of success in the sowing was attributed chiefly to drying out of the soil, to frost and to weeds.

2. From 1878 to 1884, seed spots were tried and the bilberry and heather were left close to the plants as a protection. Cembra

pine, Mountain pine and spruce, as well as larch, were the species used on an area of 250 hectares (617 acres). In addition, spruce was sown on 60 hectares (148.3 acres) in sheltered areas. The results were fairly complete stands on 220 hectares (543.6 acres) with the species distributed as follows:

Cembra Pine	55 Hectares	(135.90 Acres)
Mountain Pine	95 "	(234.7 ")
Spruce	70 "	(173.00 ")

The percentage of success being respectively, 80, 50, and 76 per cent.

3. From 1885 to 1889, local Scotch pine seed (pin d'Auvergne) was sown at the rate of 8 kilograms (17.64 pounds) per hectare on 276 hectares (681.99 acres). On an area of 133 hectares (328.64 acres), spruce, larch, Scotch pine, Mountain pine and Cembra pine were planted in the proportion of 85, 23, 8, 13, and 3. The results obtained during this period were 96 hectares (237.22 acres) of forest, of which Scotch pine occupied 42 hectares (103.78 acres), spruce 38 (93.90 acres), and Mountain pine, larch, and Cembra pine together 16 hectares (39.54 acres). The Scotch pine showing was successful on 12 per cent of the area. The plantations were successful to the extent of 70 per cent for Mountain pine, 45 per cent for spruce, 62 per cent for Cembra pine, and 22 per cent for larch. The Scotch pine which apparently was doing well at the start did not continue successful, and plantations did not really succeed on more than 9 per cent of the total area planted.

4. From 1890 to 1896, sowing was completely abandoned. Four hundred and ninety-one hectares (1213.26 acres) were planted with Scotch pine, spruce, larch, Mountain pine, fir, and beech in the proportion 347, 128, 11, 7, 7, and 1. The characteristic of this period was the extensive use of Scotch pine which was a costly error. The only results obtained were 63 hectares (155.67 acres) of spruce, larch and beech, and a cover of 85 hectares (210.03 acres) of spruce and fir under the shelter of Scotch pine and Mountain pine dating from 1880 to 1886. The use of beech and fir under the shelter of existing stands proved an excellent innovation. During this period, the percentage of success was 60 per cent for the Mountain pine, 50 per cent for the spruce, 43 per cent for the fir, 30 per cent for the larch, and only 6 per cent for the Scotch pine.

5. From 1897 to 1903, there was a tendency to plant fir, beech

and spruce. The last plantation of Scotch pine was made in 1897 without any better success than formerly. In addition, sowing was resumed on 236 hectares (583.15 acres) with Cembra pine mixed with spruce. The success was about 50 per cent. The success for the plantations was 70 per cent for the beech, 60 per cent for the fir and spruce, and 46 per cent for the Cembra pine.

6. From 1903 to 1913, work of forestation was practically stopped except for 30 hectares (74.13 acres) of spruce planted in 1911 and 1912 of which 95 per cent succeeded on 17 hectares (42.01 acres) with rather poor results on the balance.

The local force now favors the establishment of local temporary nurseries in order to acclimatize the plants to the rigorous climate and to avoid costly and dangerous transport. In 1907, experimental planting was made with Japanese larch, Douglas fir, and *Tsuga canadensis* with poor results. It appears that Scotch pine, larch, Cembra pine, and Austrian pine will be entirely discarded in favor of Mountain pine and spruce and fir under nurse trees. Beech will only be used under established stands. A detailed history of a reforestation project such as this shows the difficulties with which the French have had to contend.

T. S. W., Jr.

Revue des Eaux et Forêts, June 1, 1916, pp. 153–61.

Application of Strip Selection System

Those who wish to acquire silvicultural wisdom and especially to understand the essential features of Wagner's strip selection method, will do well to read the article by Forstmeister Wessely, in which he discusses in an entirely objective attitude some of the objections to Wagner's system as raised by Dr. Hufnagl.

The essential features of Wagner's method are the progress of fellings from north to south, and small felling areas; the preparation and partial regeneration of a strip by selection method; to be followed when young growth is established by a clear cutting of the strip and filling out of the young stand by marginal seeding Incidentally, it appears that the progress of fellings from north to south in small strips has been practised for 40 years by Wachtel to overcome the May-beetle pest which followed clearing with artificial reforestation.

While Wagner condemns artificial reproduction and advocates his system everywhere, Wessely points out that the conditions favorable to natural regeneration under Wagner's method are also favorable to artificial reproduction. The question as to whether regeneration or reforestation are applicable depends on conditions of precipitation. Where in this respect optimum conditions exist, there is no need of preparing favorable conditions and regeneration comes readily and special measures of management are uncalled for. Where conditions of precipitation are entirely unsatisfactory, Wagner's method might be, but to only a small degree, an improvement, and only if it is not objectionable from economic points of view. The strip selection system, then, belongs into localities of medium precipitation and where weather conditions generally are such as to require an increase of safety. Here, where there is still to be found tendency to natural seeding, the beginning of cutting on the north side in strips favors the young growth by protecting it against sun, wind and frost.

An objection which is raised because of the age-class arrangement under the old system which is based upon the progress of the fellings from east to west, and which under the change would require cutting unripe stands, is met by various propositions to overcome this. Incidentally, it is shown that the determination of financial ripeness of the same stand by various methods may differ by 30 years.

Das Blendersaumschlag-system und seine Bekämpfung. Centralblatt für das gesammte Forstwesen, May-June, 1915, pp. 179–88.

Height Growth of Young Spruce

An extensive study by Forstassessor Nachtigall concerns itself with the progress of and influences on height growth in young spruce stands in one season.

The author refers to the great variation in form of spruce, citing a number of such variations, the cause of which has so far escaped discovery. There are at least seven classes of influences to be recognized: 1. Food materials of soil; 2. Carbonic acid of air, electric, magnetic forces and gravity; 3. Other conditions of air and soil (some seven are enumerated); 4. Age and individual tendencies, heritage; 5. Competition with neighbors; 6. Natural enemies, including frost, drouth, winds; 7. Influences of man.

Reference is made to Prof. Klebs' observations in the tropics (*see* F. Q., vol. XIV, p. 83), and to measurements by Engler on four specimens of spruce through one season; also to the volume of forest-phaenological observations edited by Wimmenauer, 1897, and a few findings resulting from these observations are cited.

The author's investigations were to prove that age, elevation and soil differences in one and the same revier determine variations in the height growth of young spruce in the same year, and that temperature and humidity are determinative to a large degree.

The measurements were made in seven stands at 250 to 500 *m* elevation, on 25 to 50 spruces in each, from 4 up to 15 years old; each specimen being numbered and a graduated rule being attached to it, so that every few days the growth of the leader could be read off. From 1 to 3 parallel series were made in each stand. In two of the stands, maximum and minimum thermometers and hygrometers were suitably placed. Other temperature and barometer readings were also made and measurements of the previous performances of the trees under observation.

The measurements were platted in curves with time (days) and lengths (*mm*) as co-ordinates. These curves permit close study of behavior.

Without going into the details, we may record some of the more interesting findings. In a special series, it was shown that at first the basis of the shoot lengthens most prominently, but gradually the region of greatest increment progresses toward the tip. This can be also observed by the density of the needles which first are closely and evenly packed around the shoot, then show greater intervals at the base and further show the region of greatest growth. Also, the length of the needles show the same progress. In one series, the most rapid growth took place from May 30 to June 4 (curves steep), then a falling off interrupted by two rapid periods. This periodicity repeats itself in all series. No spruce, however, takes a rest of several days, the progress is uniform, day and night mostly alike. By middle July the growth is ended, only few continue 10 days longer. The early sprouters continue ahead all summer and the late lag behind all the time.

In the 4-year-old spruces, however, different from the 8 to 12-year-old, the height growth closes earlier. By June 7 half the specimens ceased growing; eleven, however, after a period of rest, between June 18 and 25, made a small addition. From the curves, it can be deduced that 25 specimens are enough to reveal the character of the growth. In the natural spruce undergrowth under oak the growth is still more uniform, its maximum occurs earlier (June 1), but, of course, the total is smaller. The end of growth was reached by July 16.

Observations on 21 specimens of 65-year-old trees show that earliness and lateness of shooting are characteristics of individuals. This knowledge is of practical value in choosing plant material.

Placing the average curves of the seven stands in comparison, it appears that 10 days after the buds burst suddenly an increased lengthening of the shoot takes place; by middle of June again an increase takes place, and then for about 14 days a very considerable decrease of rate takes place, by middle of July to be again somewhat increased. Rest periods were observed only in certain spruces, especially poorer growing ones, while according to Engler roots experience a general rest. The decided increase of rate in June and July is a characteristic of whole stands.

In the four plantations the difference in total performance was only $2^1/_2$ *cm* and the differences were in direct relation to the elevation; this, while small, in 100 years would make $2^1/_2$ *m*, and probably the difference will be greater, since probably the difference of annual performance in the polewood stage will be greater.

Detailed measurements were made of the conditions of growth, soil differences, progress of temperatures, humidity and rain, soil moisture, light; account was made of physical condition, soil, elevation, aspect, etc., to secure an insight into their relations to growth.

The conclusions are: During growth of the shoot in height the growth zone progresses from the base to the tip. The maximum growth in the year 1913 fell in the beginning of June with all series, yet each series, each stand, each individual exhibits a special law of progress circumscribed by interior (individual) and exterior conditions; age, temperature, humidity, nutrients and elevation exercising most prominent influence as regards earlier or later beginning, culmination and conclusion of growth, and rapidity of progress. To secure characteristic growth curves for a species, would appear from this a most difficult problem. Not all individuals grow without interruption, they may experience rest periods. The earlier sprouters remain ahead through the season. This earlier or later sprouting was found to be an individual peculiarity. Hence late sprouters can be recognized and be avoided in planting.

The duration of growth on the average was from middle of May to middle July. Early cessation occurs in young (four-year-old) and with poor weather conditions. Total growth in young spruces increases from year to year, hence strictly even-aged stands are necessary for comparison. For securing an accurate average on a site, 25 spruces suffice. The best time for comparative measurements is when the maximum growth occurs, beginning of June, when differences are greatest. A dry site which warms up more quickly produces early beginning, rapid increase with increased temperature and early close of growth. With elevation, the shoots remain shorter, but the beginning of sprouting occurs at very nearly the same time.

In undergrowth conditions only $^4/_5$ to $^2/_7$ of the increment in the open stand was secured.

For a continuation of such investigations, the author suggests as desirable still greater uniformity in age, height, growth, habit, measuring of the progress, temperature, etc., in all stands on the same day, and more frequency, especially with weather changes.

Der Gang des Höhenwachstums in jungen Fictenbeständen im Jahr 1913 und die begleitenden Bedingungen. Forstwissenschaftliches Centralblatt, March 1916, pp. 55–75, 131–50.

Fertilizers in Nurseries

Rusnov reports from the Austrian Experiment Station experiments in the use of fertilizer in growing pine and spruce, especially the effect of phosphoric acid additions. The first trials were made with deglutinized bone meal and Thomas slag, both of which are slowly soluble and should therefore, be of more persistent value. The result in general was very moderate, greatly varying quantities of fertilizer (from 100 to 800 kg. P_2O_2 per ha.), producing no demonstrable differences in the development of the plants. Evidently, the conifers cannot make use of phosphoric acid in not easily soluble form.

Fertilizing in comparison with a combination of potash, ammonia sulphate and superphosphate showed very variable results, and it was learned that the character of the locality, the site, and weather had a great influence on the effectiveness of the fertilizer. The plants were left two years in seedbed and then transplanted for one year, being measured in height after two and three years from seed. The actual average and the percentic increment, the latter based on the results of the unfertilized plats, are given in tables.

Out of the six parcels fertilized with superphosphate only four showed superior results, in two the effect was less than the parcels with bone meal. While at one station after three years the superphosphate plants were 19 per cent taller than the unfertilized, they were only 1 per cent taller than the bone meal plants. The explanation was found in the washing of the soil combined with the greater solubility of the superphosphate, and hence leaching out. At the station Mariabrunn, with the lowest precipitation and no washing, the results were most favorable for the superphosphate, being in the two years 40 and 35 per cent greater than the bone meal plants. Tentatively, the conclusion is drawn that in the first year the vegetative effect of superphosphate on spruce seedlings is mostly greater than of bone meal, while in the next year the effect of both fertilizers in rainy localities is very nearly alike, and in very humid stations the effect of superphosphate is less. On dry soil superphosphate appears continually superior to bone meal.

Ein Düngungsversuch im forstlichen Pflanzgarten. Centralblatt für das gesammte Forstwesen, May-June, 1915, pp. 173–9.

Behavior of Exotics

Four coniferous species were introduced on a large scale in Denmark about 150 years ago. They have shown varying behavior. *Larix europaea* has found a home in many places, but has also disappeared from localities where plantations had been made. *Pinus silvestris* wherever planted in original forest ground has done well, but plantations on the heath have disappeared during early or middle life. *Picea excelsa* has established itself thoroughly wherever planted, on the heath as well as elsewhere. *Abies pectinata* was introduced in 1764. It appears only in larger, isolated groups. Its best development is found on the island of Bornholm, where the absence of deer and elk is a factor in its favor. Several sample plots, the details of measurements having been taken every 5 years from 1872 to 1896 and tabulated, show that its growth compares well with I and II sites in the Black Forest.

J. A. L.

Edelgranens Voekst paa Bornholm. Det Forstlige Forsögsvaesen i Danmark, Vol. IV, No. 1, 1913.

Assortments in Beech

Oppermann reports from the Danish Experiment Station the percentage of assortments graded into three principal classes in beech 67 to 115 years old. The material taken to a 4-inch limit averaged 52.6 per cent of class I, suitable for manufacture; 30.6 per cent split fuel; 16.8 per cent round billets. Cut into 26-inch sections, the amount of clear material fit for manufacture was represented by the following volume percents:

Section	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Per cent	100	96	88	85	79	71	57	47	42	34	27	15	9	7	2	0	0	0

The three classes of material are further divided into three grades each and their participation from section to section tabulated.

Data in considerable detail are given to show what amounts of each class of material can be expected at different ages and different degrees of density.

The resumé is that young stands should be stocked sufficiently dense to prune very early; the first thinning to remove only defective and crooked trees until the bole is cleared for 25 to 40 feet, according to site. When this is attained, say at 45 to 60 years of age, the thinnings should be made so as to prevent further clearing. This severer thinning, however, must come gradually, especially if the earlier thinning practice was neglected. Under good management, class I material may be cut at 40 to 50 years of age and will increase to 60 or 70 per cent of total volume; but in poorly managed stands may drop to 20 or even 30 per cent below this.

J. A. L.

Hoidelag i Bogebevokstinger. Det Forstlige Forsögsvaesen, Vol. IV, No. 1, 1913.

Picea orientalis

Apropos of the capture of Erzerum by the Russians, A. Jolyet reviews the characteristics of the Oriental spruce (*Picea orientalis*). According to Jolyet, this species of the spruce genus is found below 40° north latitude "in a climate both hot and dry in summer."

In the native habitat, the annual rainfall is said to be less than

50 centimeters (19.7 inches) and the average temperature during the month of July about 19° Centigrade (66° F.) at an average altitude of 1300 (4265.1 feet) meters. Moreover, it is found for the most part at even lower altitudes commencing with 600 meters (1968.5 feet). Jolyet argues that, if this species can grow in a country where, at 600 meters (1968.5 feet) altitude, the average temperature for the entire year is 15° Centigrade (59° F.) and 22.5° Centigrade (72.5° F.) for the month of July and the rainfall less than 50 centimeters (19.7 inches), it could certainly be introduced commencing with elevations of 200 meters (656.2 feet) in all parts of France, except in Corsica where it might be planted beginning with 600 meters (1968.5 feet).

This species commends itself because it is hardy and moisture resisting. It reaches a total height of more than 50 meters (164 feet) and at least 2 meters (6.6 feet) in diameter, breast-high. It makes excellent timber, being heavier than the Norway spruce which has been planted so extensively in Europe. Its sole weakness—slow growth up to 10 or 15 years of age—is probably due, in part, to the greater development of its root system.

Five specimens, cut in 1913 at Bellefontaine, averaged 11.7 meters (38.4 feet) in height at 35 years of age. If grown in suitable mixture with broad-leaf trees, Jolyet recommends the oriental spruce for lower elevations where it might be desirable to propagate conifers on account of the greater proportion of timber which they yield.

T. S. W., Jr.

Revue des Eaux et Forêts, May 1, 1916, pp. 129–37.

Fighting Insects and Parasites

A few generally interesting biological data may be briefed from an article by Seitner on observations during a pine moth pest in the Great Forest near Vienna during 1913-4.

The use of insect lime at the right time must be considered a thoroughly effective means of combat, in spite of some of the caterpillars wintering on the trunks of trees. The usual reconnaissance for the early discovery of the pest is, of course, essential.

The experience made elsewhere of the Ichneumonidae being the most prominent enemies of the pine moth must not be generalized. These, at the station mentioned, fell into third place, playing a subordinate rôle, tachinae and sarcophagus species being more important. This may, however, have been due to specially favorable development conditions for these in the particular year. It is pointed out that there is a difference in the relative frequency of occurrence of parasites in different localities. Of the 39 ichneumonidae parasitic on pine moth known to Ratzeburg, in the Great Forest almost 80 per cent were absent.

The fungus infection of the caterpillars, which winter on the ground, is greatly increased by a goodly cover of litter—(a new argument for its preservation and the bane of forest fires!). In the end, besides liming, the parasites on the summer caterpillars and cocoons beginning their work in June, were most effective, hence the investigation of health conditions must be extended to the summer caterpillars.

Beobachtungen beim Kiefernspinnerfrass im Grossen Föhrenwald. Centralblatt für das gesammte Forstwesen, May-June, 1915, pp. 161–73.

MENSURATION, FINANCE AND MANAGEMENT

Mensuration Methods Compared

Professor Zoltan Fekete, of the Hungarian Mining and Forestry School, has investigated various sample area methods as regard their accuracy, time requirement and costs; he has also investigated the value of the German volume tables for Hungary. The investigations were made in 57, mostly mixed, stands, beech, oak, fir, etc., the total area of the test plots being nearly 1500 acres, the stock being calipered and determined as around 7.5 million cubic feet. All were ripe stands, but greatly varying in other conditions. The three methods of selecting sample areas were used, the common square, the circular, and the strip.

As regards accuracy, comparing with the total calipered results, the position was:

Circle method	+2	per cent
Strip method	+1.2	" "
Common square	+1.9	" "

Dividing the trees into three diameter classes, with equal volumes, the errors in the single classes varied within the following limits:

Circle method	+ .4 per cent	and	− 5.1 per cent
Strip method	+ 4.0 " "	"	− 1.1 " "
Common square	+17.6 " "	"	−27.1 " "

The more detailed the comparison is made, the wider become the limits of error.

If each species is differentiated into three size classes and within each the deviations from the true volume are ascertained, the following limits of error are found:

Circle method	+ 6.3	per cent	and	−10.5	per cent	
Strip method	+11.1	"	"	"	−10.1	" "
Common square	+30.9	"	"	"	−42.2	" "

These figures show that as regards accuracy there is not much difference between the circle and strip method; but the common square method is liable to great error. This fact is still more strongly brought out by comparing the figures not of the whole series, but of each stand separately. To secure a general measure of accuracy an error limit must be assumed below which the estimate will be considered still as sufficiently accurate. If, for instance, a deviation of 10 per cent is not to be acceptable, the relative accuracy of the three methods, calling the results of calipering 100, was 100 : 74 : 74 : 55, *i. e.*, out of 100 estimates only 55 times will a satisfactory result be attained by the common square practice, the other two methods satisfying 74 times; or comparing only the three methods with each other, they stand as 100 : 100 : 74.

The author adds that the stands due to the composition and conditions and great variation furnished a difficult basis for accurate estimates. In uniform stands there might not be found any difference with the different methods. It was observed that on gentle slopes all sample area methods work more accurately than on steep slopes. In denser stands, they furnish more accurate results than in opener stands. The circle and strip methods furnish better results than the square method even if the size of the square is considerably increased beyond the customary 1⅓ acre (1 hectar).

As regards the time requirement of the different methods, the number of men employed makes a difference, also whether sample trees are felled or volume tables are used, and lastly what per cent of the total area is measured. A table attempts to give results under various assumptions.

The interesting conclusion is that the common method, which is the least accurate, is also the most time consuming, no matter whether volume tables are used or sample trees felled; the strip method being most favorable. This relation between the methods holds also as regards cost under given conditions, although the cost difference is not so great as the time difference.

The common square method is, then, practically applicable only when not enough personnel is at disposal, for it can be worked with 3 as against 4 and 5 men, the latter for strip method. The strip method is recommended where saving of time and cost is desired, especially in pure stands where, therefore, no differentiation by species is needed. Here the circle method is only advantageous by giving closer knowledge of dimensions. In mixed stands, if the admixture is very uneven or the species of very different value, the circle method is desirable.

The strip method is applicable with special satisfaction in large areas, where it is a great time saver. In very open stands, with uneven distribution of trees, the circle method is preferred. The same on steep slopes, locating along contours, while the strips should here be laid across contours which is fatiguing. For good work and to secure its advantages, the strip method requires 5 men. If these are not available, the circle method is preferable.

As regards the use of the German volume tables in Hungary, some 184,000 trees were measured and compared with the volume tables. The difference in the total volume was only $-.6$ per cent, and the extreme deviations for the three species (beech, oak, fir) differentiated into three size classes lay between $+6.5$ per cent and -6.1 per cent, but the total volumes without size differentiation differed only as follows: beech, -1.1 per cent; oak $+.5$ per cent; fir -1.9 per cent. Applied to stands of varying stock density, for open stands (.4 to .7), the actual volume differed by $+2.9$ per cent from the volume tables; in complete stands (.8 to 1), -1.9 per cent. The conclusion is reached that the volume tables are applicable also to Hungarian conditions.

The time saving in using the tables as against sample trees in the sample area methods was found from 40 to 50 per cent, and the saving in cost from 40 to 60 per cent.

Versuche aus dem Bereiche der Holzmesskunde. Centralblatt für das gesammte Forstwesen, July-August, 1915, pp. 241–54.

Heresies Regarding Normal Stock

Biolley in iconoclastic fashion declares the conception of "normal stock" absurd and "abnormal," and objects to the whole theory of the normal forest.

Normal stock is a *fata morgana*, unknown to the French. Our knowledge of the complex development of a forest is still too indefinite to permit us to "force free nature into the corset of a narrow absolute theory." At length the author sneers at and ridicules the attempt to jibe nature and theory. If it is impossible to secure a practical comparison between the normal and actual stock in pure forest, it is still more so in mixed forest, Flury's "variable constant" (*see* F. Q., XIII, p. 108) notwithstanding. Irregularities in mixed stands are too unending, normal condition cannot be conceived. The laudable desire of the formula methods to insure sustained yield is not accomplished by guarding the normal stock, for this is, after all, an unsafe, indeterminate quantity dependent on the arbitrarily chosen rotation; for rotation is a personal determination of the manager. Again uncertainties arise from the practice of measuring the actual stock only in the oldest age classes estimating the younger; moreover, from the data of the yield tables arbitrary deductions are to be made for losses in logging, etc. Hence normal stock in itself and as object of management is a delusion besides involving two special defects in silvicultural and in economic direction.

The classical German conception of the normal stock ignores the biological function of the actual stock, which depends on its treatment, while the normal forest idea proposes (the author mistakenly asserts) to force its development according to a mere hypothesis through its whole life: this formalism makes the normal stock itself the end instead of means to an end—production; the end product of management here is "determined by official prescription;" the silvicultural moment is powerless.

In discussing the biological function of the stock, the author points out that while the tree has a limited life, the stand, the tree association, lives forever: the tree does not live any more as single individual but as part of a whole, each influencing the other. This idea is elaborated and the need of recognizing the mutuality and of working for increased increment is accentuated. "In not recognizing this mutual relation between condition of stand and increment lies the silvicultural mistake of the normal stock theory."

From a yield table of spruce I site, the author shows that after the 40th year the ringwidth decreases and asks, "Does this not prove a steady deterioration of the nutrition?" (Not at all!) Everything has remained the same excepting one thing—the volume or stock. To the accumulation of volume, therefore, we must ascribe it that the trees, the stand, are disturbed and impeded in their function of nutrition; the stand suffers from overcrowding. The defenders of the normal stock idea in a way admit their mistake by attempting to arrest the sinking of the increment by thinning and interlucation practices by which "to create more favorable conditions of nutrition" in the so-called "normally" stocked stands. "May one really talk of normal conditions, if by this normality the production is limited and can be lifted out of this limit (in the last age classes) only by giving up normality? Or is it a normal condition, if stock exists in such insufficient amount (lower age classes) that it lacks the ability to utilize all actually present nutrients? How can a forest be called normal in which during its life of 80 to 120 years the increment conditions only for a very short time are what they should be, *i.e.*, normal? Briefly, the silvicultural mistake consists in putting growing stock in place of increment and forcing the free functions of life into a rigid frame."

The economic mistake in the conception of the normal stock, the author asserts, is illustrated by comparing the increment curve with the stock curve, which show a disproportion at the same time between interest and capital, espcially for the older age classes, *i. e.*, for the time when the accumulated stock reaches nearly a maximum. "Undoubtedly," he asserts, "the normal forest suffers by an insufficiency of wood capital in the early stages and by a surplus of poorly paying wood capital at the end of its life." This defect injures the owner as well as the whole country, whose interest is to secure the maximum production of volume per acre (?). If this maximum yield is once established, every single acre should be managed for this maximum annual product. The normal stock methods cannot satisfy this demand because they do not pay attention to the current increment.

Moreover, these methods cannot satisfy market fluctuations and changes in demand for different size, species, etc.

The author, then, comes to the constructive part of his discussion. After all, he does not propose to abandon the normal stock idea, as the French do, but to change its name to "rational" stock, as basis of a rational increment management. "This stock would naturally have to be frequently revised as regards determining its productivity." Thus the normal stock is not any more a predetermined wood volume, but a variable quantity. In place of a dogma stands the experiment."

He, then, discusses the application of the French *méthode du contrôle* (*see* F. Q., xiii, pp. 43, 260). "This does not know a normal stock which is supplanted by the more elastic principle called *étale*, a conception which may be translated into stand optimum (rational stock)." This *étale* is that volume of stand which is necessary and sufficient to continually produce the best performance per acre. He conceives that the accumulation of increments which make the stock leads finally to overfilling, a condition impeding increment; hence when this occurs a felling is indicated. The exact time for such is expressed by the behavior of the current increment. The stand must also be so formed that without damage according to silvicultural principles wood can be taken out. This is done by selection until finally only the best individuals remain to make the stand. Revisions in short periods for every stand and the whole forest are necessary.

This method allows the manager at any time when a detrimental accumulation has arrived to reduce every single stand to the desirable amount of stock. No predetermined cycle, as in the normal stock methods, troubles him, nothing absolute in its condition, neither the stock per unit nor the percentic composition by diameter classes, nor a determined maximum diameter. In building up the "rational stock" regard must be had to silvicultural needs, surrounding physical, labor, and economic conditions, wood prices, special needs, interest on capital, etc.

How is sustained yield secured, he asks, when the sure foundation of the normal forest is abandoned? What is yield? Is it not increment? As long as the basis for growth remains, yield is sustained. If every stand, every acre is so managed as to produce the maximum increment, a careful and frequent determination of the increment and of the condition of stands assures the sustained yield; more than that, an increased yield is secured through this "rational stock."

See Comment!

Das Abnorme im Begriff "Normalvorrat." Schweizerische Zeitschrift für Forstwesen, March-April, 1916, pp. 53–67.

Increment and Budget Regulation

In his usual lucid and authoritative style Dr. Martin discusses the basis of a proper regulation of the cut or budget with special reference to the Prussian practice in the past and present. It will astonish most of our readers to learn, that the increment which would appear the natural, permanent basis for determining the possible cut or felling budget, and which should be cut unless there are reasons for deviation, is not in actual practice of Prussian and other State administrations used as such a basis; neither in the past practice nor in the new instructions of 1912, does the increment appear as a prominent factor.

An interesting historical account of the development of forest organization in Prussia shows that there were three prominent influences at work, namely Hartig, Pfeil, and Cotta.

Hartig in his instruction of 1819 for the organization of Prussian State forests, based on volume methods, did require increment data to be ascertained and used as factors in budget determination, and gave correct methods of ascertaining it. Practically, however, this requirement was neglected, and altogether working plans which did not work were the result of the volume method, on account of its cumbersomeness. Pfeil's influence was inimical to the attempt of laying down rules of general application, and espcially to the ascertainment of and basing felling budgets on increment data, on account of the wide variations which would be encountered. He accentuated the localized and specialized conditions of increment as inimical to its use for felling practice.

Cotta's influence was indirect, in that Reuss, successor to Hartig, in 1837, was his pupil and he it was who made the area the prominent regulator of the cut, which to this day and in the new instructions remains so.

While it is customary to point out differences in the Saxon and Prussian organization, they are alike in this use of the area allotment method, and now being satisfied with endowing the first period only with a normal area allotment and a mere age-class area statement for the rest of the rotation.

Meanwhile, the experiment stations, in their normal yield tables, have demonstrated the lawfulness in the progress of increment (against Pfeil's contention), and a satisfactory formula for its determination has been furnished by Schneider.

It should, however, be recognized that the yield data of the tables must be used with discretion. The tables cannot be generally applied for the east and the west, for mountain and plain; the conception of normality is not fixed and remaining the same, being variable like all economic factors. Stands with varying stem numbers, varying diameters and volumes may be considered normal.

It must, also, be kept in mind that silvicultural problems influence the method of organization. In the uniform, planted spruce or pine forest, under a clearing system an area method may suffice. On the other hand, natural regeneration, if correctly managed, is opposed to the schematic area allotment; here nature rules and the cutting must take into consideration the condition of soil, the occurrence of seed years, the requirements of the young growth. Hence, in Baden, in the territory of the naturally regenerated fir the area method has long been abandoned, for natural regeneration cannot be forced into a fixed time scheme; if the annual or periodic area is fixed, natural regeneration is hampered; larger areas than the so-called normal periodic area must be at the disposal of the manager.

In such modern silvicultural methods as interlucation in pine and oak, which consist in a severe, but gradual opening up, the area is also not entirely cut; similarly, thinning practice in older stands and salvage fellings, which furnish considerable material in pine and spruce forest, are in antagonism to the determination of yield by area, especially as it is difficult clearly to differentiate final yield and intermediate yield. The instructions, to be sure, require such differentiation, but in practice this is frequently not possible: whether, *e. g.*, the results of a preparatory regeneration cut or a severe thinning are to be counted one way or the other.

The author insists that in a properly organized forest it must be shown that the sustained yield is being maintained, and this can be done only by increment determination. This is done in the southern State departments much more fully than in Prussia. In Baden, for instance, for every stand the average total increment, *i. e.*, the total average production in final and intermediate yield for the rotation and given species and management is to be ascertained, as well as the current (periodic) total increment to be expected for the next decade. Not the volume of the stands, artificially ranged into the I period, is a proper measure of the cut;

nor the increment which accumulates until the final cut, but the total increment of the whole working group is the basis and aim of forest production. Only in this total increment, the possibility of producing a certain yield comes to expression: the current increment of all the stands.

Normal yield tables may be used for this with discretion, for in the broad practice stands are far from normal. In the yield tables for oak, *e. g.*, on II site at 140 years, the diameter is stated as 18 inch; in the actual forest diameters may be 12 or 24 inch. Similar variations will be found in pine, spruce, etc., from natural regeneration, or sowing or planting in different spacing.

Der Nachweis der Ertragsfähigkeit des Waldes. Tharandter Forstliches Jahrbuch, 1913, pp. 26.

Value Production

An important contribution to the discussion of this difficult problem is furnished by Dr. Martin. Not the production of large quantities, but of high values should be the aim of forest management, but, according to Dr. Martin, while theoretically this is admitted, in practical application there is considerable lack. Indeed, yield tables usually give only volumes, and little has been done to secure data which must underlie value production. This is due to the difficulties involved in establishing values and value increments. Stand cost values should be basic but for old stands especially are unknown; expectancy values are liable to great variation; hence, in spite of their uselessness for young stands, use or sale values should be employed as much as possible; and this is officially recognized in the various instructions for forest valuation and value increment calculations.

There are two ways of ascertaining value increments, namely by a statistical inquiry into the sale value of the average unit of wood measure (*festmeter*) of stands of different age, or by investigating of sample trees.

Such statistical data have been collected for some time in Bavaria and are being collected since 1912 in Prussia, by merely tabulating classified sale results in typical districts.

Upon the basis of some of these data the influences on value production are briefly discussed: site conditions, location with reference to market, method of establishing and treatment of the crop. As regards site, on good soil not only is value production more rapid, but the difference between two age classes is found greater than on medium and poor sites. The relative progress of value increment does, however, not stand in direct relation to the site class, but special features of the site, *e.g.*, looseness and depth, temperature and light, rather than the total productivity upon which site classes are based, are influential.

A few examples of data collected in certain localities for pine have, of course, absolute values (mark per cubic meter) only for the locality and the time of collection, but, nevertheless, show the general tendency which would be of influence everywhere and at any time.

SITE II

Age:	*20*	*40*	*60*	*80*	*100*	*120*	*140*
Good Stands							
Favorable Market	1	4	7	10	13	16	19
Unfavorable Market	.4	1.4	2.4	3.8	5.4	7.4	10.4
Branchy Stands							
Favorable Market	2.5	6	9	11	12	.....	.....
Unfavorable Market	.7	1.6	2.4	3	3.6	.....	.....

SITE IV

Good Stands							
Favorable	....	2	4	6	8	10	12
Unfavorable	....	.7	1.3	1.9	2.9	4.4	6.4
Branchy Stands							
Favorable	1.5	6	8.5	9	.....	.....	.....
Unfavorable	....	.9	1.3	1.5	.....	.....	.....

These are values for wood cut, lying in the forest. Good stands show on good as well as on poor soils a very steady continuous rise in value, while poorly managed branchy stands decline rapidly in old age.

The difficulties in properly collecting and interpreting such data are then discussed. They lie in the facts, that uniform stands of great age variation are not often cut; that most stands which are cut have been subject to some influence which make them abnormal, like damage by rot; lack of satisfactory grading of logs.

The author then develops a method of arriving at value increment. In using sample trees for determining value increment either the mean tree of the stand may be used or preferably sample trees of three or of five stem classes. That the diameter is largely the maker of value has long been demonstrated. The problem resolves itself, then, to ascertain the time for the production of certain diameter or ring width on a certain cross section.

In general, the period from thicket to middle pole age is the time of most vigorous growth and widest annual rings. Later, the ring width in close stand declines, but with good thinning practice the differences between different age classes become small. It is also to be noted that the mean stems of the stand from one age class to another grow in greater proportion than their annual rings predicate, because, due to the exclusion of suppressed members, they get into higher stem classes. Taking account of these two disturbing influences, we may assume that the differences of the average ring width of mean stems of stands are for a long time so little that they can be neglected.

The steadiness of the increment of the mean stems appears from the ring width for different age classes figured from the yield tables.

Age:	*60*	*80*	*100*	*120*	*140*	
Beech (Grundner)	1.5	1.6	1.6	1.6	1.5	*mm*
(Schwappach)	1.1	1.3	1.3	1.2	1.2	"
Spruce (Grundner)	1.8	1.7	1.7	1.6	...	"
(Schwappach)	1.7	1.6	1.5	1.4	...	"
Pine (Grundner)	1.7	1.7	1.7	1.6	1.6	"
(Schwappach)	1.5	1.5	1.4	1.4	1.3	"

The author then on the basis of Bavarian statistics brings data for showing the actual value increments determined for oak, beech, pine and spruce.

In two oak districts, where trees are divided into five size classes, middle diameters differing by 4 inches, the following prices were obtained per cubic foot, without bark, cut in the woods:

Class	V		IV		III		II		I
Diameter Average	10		14		18		22		26
Cents	18.4		35.4		51.6		64.4		83
Differences		17		16.2		12.8		18.6	
Percent		64		37		24		24	

To translate these price relations into time relations of their production in the forest certain assumptions must be made. If the average height is taken as 100 feet, the clear boles under proper management will be about 30 feet, and if a height of 15 feet is attained in 20 years the average ring width of the mean stem is kept at $^1/_6$ *cm.*, *i.e.*, the diameter increases at $^1/_3$ *cm.* (1 inch in 7 years), then to produce stems of the five classes requires the following time:

Class	V		IV		III		II		I
Years	95		125		155		185		215
Yearly Value Increment, Per cent		2.1		1.2		.8		.8	

On poorer soils, where the average ring width is only $^1/_8$ *cm.* (1 inch diameter in 10 years), and where the 5 or 6 size classes are attained in the noted times, the annual value increment per cents in the two cases were:

Class	V		IV		III		II		I
Age	120		160		200		240		280
Increment, Per cent		1.6		.9		.6		.6	

To show the method of presentation in full, we translate the tabulation for the second district in detail:

Stem Class	VI		V		IV		III		II		I	
Diameter	33		40		47		53		58		65	*cm.*
Age	152		180		208		232		252		280	*Years*
Value	42.3		63.2		83.9		104.9		135.3		217.4	*Mark*
Differences		20.9		20.7		21		30.4		82.1		
Per cent		39		28		22		23		47		
Time		28		28		24		26		28		*Years*
Annual value Increment		1.4		1		.9		1.2		1.7		*Per cent*

The figures are significant in showing the impropriety of generalizing, if economic results are considered. While normal yield tables have their value, and are theoretically correct, in practice for organization purposes the special site, stand and market conditions must modify the judgment based on them. The figures also support the contentions of soil rent theory, that a low interest rate is in part compensated by a value increment, as well as by price increment. To exhibit the latter, an interesting table is given showing the change in price for the celebrated 400-year-old Rothenbuch oaks, which from 1860 to 1910 for the largest sized logs rose six-fold, 4 per cent per annum (from 25 cents to $1.54 per cubic foot), although the lower sizes increased less in price, II and III class at 3 per cent; the lowest from 13 cents to 20 cents.

From the discussion on the value increment of beech, which is historically interesting in showing the ups and downs of the beech wood market, we quote only the last sentences, showing that the value increment of clear boles rises more rapidly and continuously than that of branchy wood absolutely and relatively to the value of the stand. However the rotation is determined, the felling age for clear timber arrives later than for branchy timber, calling therefore for a proper care of stands.

The following discussion for pine and spruce is also based on Bavarian data for 1912. The assortment is made on the basis of top diameters at any height varying by 2 meters, when the time involved is that required for making the length (as determined by yield tables) and diameter (as found in each case by ring countings).

For spruce the tabulation is made for II site on the basis of an average diameter increment of the mean sample tree of $^2/_5$ *cm* (6 to 7 years per inch) and the annual value increments are for:

Age....................	63–77	77–90	90–107	107–127
Per cent................	1.5	1.2	.5	.2

This shows that even on good sites the production of the stoutest class cannot be the aim of management. Even the II class can only in a limited way be considered as one financially to be worked for. The rotation based on value production under the economic conditions where the data were gathered will on best soils be placed around 90 years, on middle class sites around 80, and on poor soils around 70 years.

Similar results follow from Saxon data:

Age	60–80	80–100	100–120	120–140
Value Increment, Per cent	1.2	1	.6	.2

The increment of 1 per cent up to the 100th year brings the index per cent up and defers the felling age somewhat, but the value increment then falls so rapidly that this delay can only be short, especially as the volume increment also declines. All considerations in Saxony have led to an 85-year rotation for spruce in general.

A similar calculation for pine is made upon the basis of Wimmenauer's tables based on a thinning practice which gives a constant basal area of 130 square feet to the acre (30 *qm* per ha.), when the average annual diameter increment from 60 to 140 years approximates $^2/_5$ *cm* (6 to 7 years per inch). The result is as follows:

Age..........................	55–70	70–85	85–103	103–123
Value Increment, Per cent..........	1.7	1.7	1.1	1.3

The great difference as compared with spruce is apparent. In pine the value of I class stems exceeds that of V class by 157 per cent, in spruce only 66 per cent. At 100 years, when value increment in spruce has ceased, the pine shows considerable increment, absolute and percentically.

Similar results have been secured from Baden and Hesse data, where under favorable growth conditions the value differences of different sizes is even greater. Here the price for I class, pine logs is 125 per cent greater than for I class spruce, and in Anhalt the difference is even near 240 per cent. Yet the relation of values for spruce and pine wood depends greatly on site conditions. In the average for the whole State of Prussia the superiority of the pine over the spruce is also illustrated, the price of II class logs for pine being 14 cents as against 12 for spruce; but in the western provinces where good spruce sites prevail the reverse relation is found, namely 17 cents for spruce as against 15.5 cents for pine.

Taking these value increment conditions together with the volume increments of the yield tables, there is no doubt, that on mountain soils with satisfactory humidity the spruce produces best and should be grown in pure stands. Only where considerations of soil conditions and safety exist is the admixture of other species indicated, but the pine has for these purposes no value, hence it is properly cut out. On pronounced pine soils, however, pine must be predominant and spruce added only as soil cover. Where both species find equally good growth conditions, especially in rolling country where soil conditions vary, a mixture is indicated and then besides local soil differences the question of value increment should influence the character of the mixture. Uneven-aged form of stands is here indicated. The pine produces best with 120 years, while spruce is mature at 60 to 80 years, hence pine should be planted ahead of spruce or the latter should be utilized earlier. The consideration re-establishes the value of the formerly much used, lately abandoned overholder management. Also underplanting with spruce, which invigorates pine stands remarkably and leads to best forms of pine, is recommended.

The rest of the article criticizes the method proposed in Prussia of arriving at value increment data.

Der Nachweis der Erzeugung von Werten. Tharandter forstliches Jahrbuch, 1913, pp. 126–324.

STATISTICS AND HISTORY

Prussia's Budget

The budget of the Prussian forest department for 1916 does not appear to be affected by the war to any extent; indeed, a net return of around $400,000 above 1915 is expected.

Area of forest (productive)	7,390,000 acres
Regular income	$38,600,000
Extraordinary income (sale of forest)	500,000
Regular expenditures	16,200,000
Extraordinary expenditures (occurring only once)	730,000
Surplus	22,200,000

The expenditures are provided with the same amounts as 1915, in salaries more, in general expenses less, and the income slightly less than the average of 1912 and 1913.

Forstwissenschaftliches Centralblatt, March, 1916, pp. 150–55.

OTHER PERIODICAL LITERATURE.

American Forestry, XXII, 1916,—

The National Forests. Pp. 153–7.

A resumé of the part the National Forests are taking in the economic and social life of the nation.

Our Forests in Time of War. Pp. 341–4.

Extracts from the report of the Forestry Committee of the National Conservation Congress, which met in Washington in May.

Journal of Agricultural Research, VI, 1916,—

Hypoderma deformans, an Undescribed Needle Fungus of Western Yellow Pine. Pp. 277ff.

Yale Forest School News, IV, 1916,—

The Place of Silviculture in the Utilization of Our Forests. Pp. 19–21.

Journal Industrial and Engineering Chemistry, 1915,—

What Chemistry Has Done to Aid the Utilization of Wood. Pp. 913–5.

A popular discussion of the rôle of chemistry in the conversion of waste wood into profitable by-products.

Sierra Club Bulletin, X, 1916,—

Number 1 is a *Memorial Number to John Muir.*

Canadian Forestry Journal, XII, 1916,—

Ravages of Insects in Canadian Forests. Pp. 563–6.

Forests of the District of Patricia. Pp. 375–80.

Pulp and Paper Magazine of Canada, XIV, 1916,—

Canadian Pulpwood Consumption in 1915. Pp. 243–9.

Western Lumberman, XIII, 1916,—

A Day in a Dutch Forest. Pp. 28–31.

Rod and Gun, XVII, 1916,—

"*One Hundred Game Protective Associations for Ontario by January 1, 1917*" is the object advocated in an article on pp. 1135–7.

Transactions of the Royal Scottish Arboricultural Society, XXX, 1916,—

Two Forest Arboretums near Brussels. Pp. 1–14.

Largely notes on growth rates.

The Forests of Australia. Pp. 34–43.

A very readable account of the forestry situation in the different provinces.

The author, who was for many years connected with the South African Forest Service, states that the forestry movement in Australia is a quarter of a century behind that in South Africa.

Mr. MacMillan, Special Trade Commissioner to foreign countries for Canada, in a recent letter, written after his visit to Australia, writes: "Forestry in Australia is in an interesting state. A wave of revival similar to religious enthusiasm is passing over the land—foresters being appointed; Governor-General exhorting on every occasion; schools being started (two of the ranger type already under way and one of university standing being debated); great discussion of study of forest utilization; bills being brought in creating in various States several million acres of inalienable forest reservations; planting policy being speeded up; federal forest department being created. . . . They are getting pretty good legislation, but are in terrible danger through lack of foresters."

Durability of Timbers. Pp. 44–6.

A discussion as regards the truth of the general dictum that "the more intense the color of the heartwood the more durable it is."

Indian Forester, XLII, 1916,—

Recent Progress in Cellulose Textiles. Pp. 85–90.

Agricultural Gazette of New South Wales, XXVII, 1916,—

Two Timber-destroying Fungi. Pp. 201–2.

Pleurotus nidiformis and *Pholiota adiposa* Fries.

Bol. Min. Agr., Indus. e. Com., Ser. B., 13, 1914,—

Cryptogamic Review for 1913. Pp. 146–57.

Besides brief notes of diseases observed in connection with forest, garden, orchard, field and other plants, about 25 cryptogamic diseases of conifers are listed and given a somewhat more extended discussion.

Allgemeine Forst und Jagd-Zeitung, 1915,—

Absteckung von einseitigen Weg-kurven. Pp. 105–9.

Describes a new, simple method of laying out road curves without the use of formulae.

Centralblatt für das gesammte Forstwesen, 1915,—

Etwas über die Wildschafe und die Einführung derselben als Gegenstand der hohen Jagd. Pp. 280–95.

Discusses in great detail the varieties of wild sheep, with illustrations.

NEWS AND NOTES

On August 29th and 30th, following an almost unprecedented spell of hot dry weather, a conflagration broke out in the Clay Belt of Northern Ontario, covering probably several hundred thousand acres, destroying a number of towns and settlements and partially destroying others, and causing the death of more than 400 people and the injury of many others. The greatest destruction was in the vicinity of Matheson on the Temiskaming and Northern Ontario Railway. Settlers' fires are reported as the agency responsible.

This is the greatest catastrophe of the kind, from the point of view of lives lost, that has ever taken place in Canada. It ranks at least equal in loss of life with the Hinckley fire, Minnesota, of 1894, and has apparently covered a considerably larger area. Apparently, the Clay Belt fire of 1916 is second, in its disastrous consequences, to no forest fire which has occurred on the continent save only the great Peshtigo fire in Wisconsin, in 1871, where 1500 persons lost their lives. It is, of course, a far greater disaster than the Porcupine fire, of 1911, in the same region of the Clay Belt as the 1916 fire, in which 164 lives were lost. The present fire is, to some extent, a secondary one, burning over territory on which the timber was killed in 1911. This illustrates the well-recognized fact that the first fire does not consume the standing timber altogether but generally only kills it, leaving the scene ready for a still worse fire a few years later.

A strong campaign is being waged by the Commission of Conservation and the Canadian Forestry Association in favor of the enactment of a law in the Province of Ontario, providing for the regulation of settlers' clearing fires, under the permit system, which is already in effect in a number of the other provinces. A thorough reorganization of the whole fire-ranging system of the Province is also considered essential.

Twenty-two of the leading Boards of Trade of Ontario have made representations to the Ontario Government for a reorganization of its forest protection system.

The Boards have specified two reforms: the reorganization of the rangers so as to provide for supervision and inspection, both in the head office and the field; secondly, that the Government should make some effort to keep down the timber damage resulting from settlers' clearing fires.

When it is considered that the limit holders' mutual associations in Quebec Province have built up efficient systems of forest protection at a cost of about one third of a cent per acre for fire protection, an efficient system in Ontario would involve little, if any, additional cost. A third of a cent an acre for protection makes a very minute showing beside a magnificent pine forest reduced to charcoal for lack of decent care. It has been estimated that forest fires in Canada destroy more wealth than would pay the annual interest on the last Dominion loan of 100 million dollars.

This summer's forest fires in northern Ontario reported to have been started by settlers' fires, which, as noted above, were terribly destructive of life and property, in some cases wiping out whole towns, should arouse the Provincial Government to their responsibility in the matter of prevention of fires. We hope the Ontario Boards of Trade and many other organizations also will seize this opportunity to press home the urgent need of reform in the existing legislation and its enforcement.

During the last session of the Quebec legislature several amendments were made to the fire act, calculated to add materially to its strength and efficiency.

One of these provisions requires that settlers engaged in clearing operations must, between April 1 and November 15 of each year, secure a burning permit from an authorized forest officer before setting out clearing fires. *A similar provision is urgently needed in northern Ontario, where there is practically no control of settlers' clearing operations.*

Another amendment to the Quebec act provides that the debris from settlers' clearing operations must, before burning, be piled in heaps or rows at a distance of at least fifty feet from the forest.

Holders of timber licenses on Crown lands are required to clear away the debris on a depth of one hundred feet from railway rights of way. This is an excellent provision, but should be made applicable to privately owned lands as well. In many cases, the efforts of railway companies in the direction of fire protection are largely neutralized through the presence of large quantities of the most inflammable debris on lands immediately adjacent to railway rights of way.

Another excellent provision of the new Quebec act is that any fire ranger or other forest officer may summon any male citizen between 18 and 55 years of age to assist in extinguishing any forest fire, the rate of pay being specified, and penalty being provided for failure to obey the summons.

The fire laws of the province of Quebec are among the most progressive in Canada, but larger appropriations are needed to make them fully effective. In particular, provision should be made for a larger staff of inspectors.

Satisfactory progress was made during 1915 in the railway fire protection work, which has been handled during the past four seasons under the regulations of the Board of Railway Commissioners. The co-operation of the various federal and provincial fire-protective organizations has been given freely, and, with very few exceptions, the railways have also co-operated heartily and effectively.

A total of 686 fires in forest sections is reported as having originated within 300 feet of the lines of railways subject to the Railway Commission's jurisdiction. Of these, 43.4 per cent are definitely attributed to railway agencies, 27.8 per cent to known causes other than railways, and 28.8 per cent to unknown causes. Of the total area burned over, amounting to about 37,263 acres, 33.1 per cent is chargeable against the railways, 20.9 per cent to known causes other than railways, and 46 per cent to unknown causes. The total damage done is estimated at $74,256. Of this, the railways are definitely charged with only 11.2 per cent, while 24.2 per cent of the damage is due to known causes other than railways, and 64.4 per cent to unknown causes. Thus the railways, *exclusive of Government lines and a few railways having provincial charters*, are directly charged with less than half of the total number of fires reported as having originated within 300 feet of the track; these burned over less than one third of the total area reported, and did only one tenth of the total estimated damage. This showing is distinctly favorable to the railways, especially when it is considered that this 10 per cent of damage totals less than $8,400. These figures show that the railways have been remarkably efficient in extinguishing their own fires, as well as those due to outside causes.

Of all fires reported, the causes are as follows: locomotives, 33.9 per cent; railway employees, 9.5 per cent; tramps, etc., 11.4 per cent; settlers, 12.5 per cent; other known causes, 3.9 per cent;

unknown causes, 28.8 per cent. It will thus be seen that the carelessness of tramps and settlers constitutes a very serious source of fire danger along railways, these two elements combined accounting for nearly one fourth of the total number of fires reported.

The Federal Trade Commission, Bureau of Foreign and Domestic Commerce, and Forest Service propose to cooperate in studying eventual markets for lumber in Europe after the war, following in this the example of Canada, whose Timber Trade Commissioner, Mr. H. R. McMillan, is shortly expected home from China, having made the circuit of the world.

Just to give an idea of how Mr. MacMillan, as Commissioner of the Dominion Department of Commerce, handles his work, and to show what is involved in establishing markets, we print verbatim the summary of his report on African trade as given in *Markets Bulletin* No. 11, of the British Columbia Forest Branch:

There is a constant market in South Africa for three of the important forest products of Eastern Canada, red deals, box-shooks and doors. The raw material for these manufactures is cheaper in Canada than in either the United States or Sweden, the two countries at present doing the bulk of the trade. It is only a question of organizing the manufacture on a competitive basis and seeking the business.

That there is any Douglas fir sold in South Africa is due entirely to the initiative of the South African merchants in seeking it, not to any selling efforts on the part of the producers of Douglas fir, who have committed here, as elsewhere, the fatal error of considering that their selling responsibilities have ended when they have finished competing with one another for the privilege of supplying lumber to a commission house. South Africa is a country importing $6,000,000 worth of timber a year. Douglas fir came into this market a new commodity a quarter of a century ago, unknown to purchasers, builders, architects, engineers, or merchants. As with all new commodities, there were prejudices against it. No one, not even the dealers were interested in it. Douglas fir manufacturers, the only persons interested, were 13,000 miles away and had no direct representatives.

The result was just as might be expected. Instances have been quoted showing the unreasonable, almost incredible, prejudices existing against the timber. These prejudices which differ in every part of the country have risen through ignorance of the timber. A cargo of flooring is affected by dry-rot. No one is in the country to take the question up at once and Douglas fir flooring is tabooed.

Merchantable is used for car-sills where select should be used; it is not satisfactory and the railroad goes back to Pitch pine or teak at twice the price. On the other hand, one mine of one hundred on the Rand uses Douglas fir and finds it satisfactory; no one finds it out and conducts a systematic campaign to educate the other mine managers. No one does these things because there is no one in South Africa whose business it is to do so. So long as timber is used, the timber merchants are secure. The money which might have gone to removing these prejudices and developing the market has gone to the merchants who charge four times as much profit on Douglas fir in South Africa as on Swedish timber. The profit on wholesaling Douglas fir in South Africa is greater than the total f. o. b. price in British Columbia.

The establishing of regular sailings, even of small vessels, once in two months between British Columbia and South African ports would greatly increase the exports of Douglas fir. The purchase of cargoes, with accompanying heavy investment, the holding of cargoes in stock, with interest charges accumulating and stock deteriorating, one year or more, would no longer be necessary. The importations would no longer be restricted to five or six merchants for the whole of South Africa. All persons engaged in the trade would import and more energy would be shown in pushing the sale of the timber.

The elements of a great and successful market campaign exist in South Africa. Douglas fir is delivered to South Africa cheaper than any other timber.

About $5,000,000 worth of timber is now imported yearly for general building and construction purposes alone. The country is yet undeveloped. Even greater quantities of building and construction timber will be required in the future. Every producer of Douglas fir knows it is a construction timber, then why does Douglas fir represent only 7 per cent of the imports of building timber to South Africa? Because no one in South Africa is selling Douglas fir, and the moment it arrives in the country it is robbed of its one greatest advantage, its cheapness.

It is only necessary that the problem be treated on broad lines. The timber industry, if organized, is wealthy enough and strong enough to market lumber in the same manner as gasoline, tobacco, or steel products are marketed. The cost of doing this in South Africa will be very small, and when it is done the exports will leap from insignificance to importance.

The lumber cut of the nation by species, with the values of the woods per thousand at 1915 prices is shown by a Forest Service report just announced. The table gives the incomplete reported cut of each principal species and the probable total cut of each included in the computed total production of lumber of all kinds, 37,013,294,000 board feet, which was announced the last of April.

The reported cut of lath in 1915 was 2,745,134,000 and is estimated that the total cut was 3,250,000,000. The reported cut of shingles was 8,459,378,000 and the estimated total cut 9,500,000,000.

The average 1915 value of each principal kind of lumber reported by the mills is also given. The figures are preliminary rounded values, but are based on the data reported by mills in the principal States producing each kind of lumber, and are therefore close to the final averages.

Kind of Wood.	*M ft. Probable Total*	*M ft. Reported*	*Per M Value*
Yellow pine	14,700,000	12,177,335	$12.50
Douglas fir	4,431,249	4,121,897	10.50
Oak	2,970,000	2,070,444	19.00
White pine	2,700,000	2,291,480	18.00
Hemlock	2,275,000	2,026,460	13.00
Spruce	1,400,000	1,193,985	16.50
Western pine	1,293,985	1,252,244	14.50
Cypress	1,100,000	926,758	20.00
Maple	900,000	771,223	15.00
Red gum	655,000	478,099	12.50
Chestnut	490,000	399,473	16.00
Yellow poplar	464,000	377,386	22.50
Redwood	420,294	418,824	13.50
Cedar	420,000	352,482	15.50
Birch	415,000	355,328	16.50
Larch	375,000	348,428	11.00
Beech	360,000	303,835	14.00
Basswood	260,000	207,607	19.00
Elm	210,000	177,748	17.00
Ash	190,000	159,910	22.50
Cottonwood	180,000	138,282	17.50
Tupelo	170,000	153,001	12.00
White fir	125,048	121,653	11.00
Sugar pine	117,701	115,109	....
Hickory	100,000	86,015	23.50
Balsam fir	100,000	71,358	14.00
Walnut	90,000	65,144	....
Lodgepole pine	26,486	22,672	13.00
Sycamore	25,000	19,729	14.00
All other kinds	49,531	37,826	....
Total	37,013,294	31,241,734	

A tree-planting machine was patented by Mr. Fernow in 1887. It never was manufactured because nobody wanted to plant 20,000 trees in a day on plow ground. Last fall, Mr. T. A. Hoverstad, Agricultural Commissioner of the Minneapolis, St. Paul and Sault Sainte Marie Railway Company, having a large number of trees to plant along the right of way, constructed such a machine (as it described in the Report of Chief of the Forestry Division of she

United States for 1888) and this spring used it. He writes: "We planted about 100,000 trees with the machine this year, and have planted more than 10,000 per day, including movements from cuts to cuts on the road. In straight planting we could doubtless plant 20,000 to 25,000 per day. When the machine was running, we planted 100 trees every three minutes. We are planning to build two more for our next year's work, making a few minor changes in them. . . . It seems to be very practical. The trees we planted with the machine seem to be coming along as well as the trees planted by hand a year ago. Last year, we planted 2,000 trees per day, with 12 men. This year, we planted 10,000 trees per day with 7 men and 3 teams. We had two teams pulling the machine and one team hauling trees. The trees planted were all broadleaf, boxelder, Green ash, poplars, and willows, the latter being in preponderance, 3 to 5 feet in height."

The machines to be built will be used to plant the 300 miles of protective belt along the road.

The railways of Canada are taking an increasing interest in the planting of trees and shrubs to secure better control of drifting snow and drifting sand, both of which interfere seriously with the operation of trains.

East of Montreal near Vaucluse, in Quebec, light drifting sand has given trouble to the Canadian Pacific railway since the very thin sod was plowed up. The ordinary right of way fence was covered by the sand, and cattle could stray out on the track. Snow fences were used to some advantage, but in a bad season these would be almost covered up.

In 1915 a number of grasses, including Brome, were planted but perished from the excessive heat of these exposed sand beds. This spring 3500 cuttings of cottonwood (*Populus deltoides*) and 1,000 one-year transplanted Jack pines were planted.

An examination made after the trees and cuttings were in the ground a month showed that approximately 95 per cent were making good progress, and the unusual amount of rain during this spring and early summer has contributed very materially to the prospects of success. If later results prove satisfactory, other situations along the company's line will be planted in the near future.

For a permanent snow fence which would grow rapidly and have sufficient foliage, 6,000 Norway spruce and 15,000 caragana were planted. The former were five-year transplants, of from 20 to 24 inches height, of heavy sturdy crown and well-developed root system. The caragana were from 30 to 48 inches in height and about three years of age. The caragana, as well as 1500 lilacs used in mixture for snow breaks, are from the nursery of the company at Wolseley, Saskatchewan.

The following methods of planting were carried out: Where the distance from the track to the right of way fence is over 50 feet, a "standard" break was put in, viz., one row of spruce was planted 8 feet apart, and in front of this, caragana were placed two and one half feet apart. The distance between the rows is 6 feet. If there was only 50 feet between the track and the fence, one row of Norway spruce was planted 6 feet apart, or two rows of caragana four to six feet apart. On several situations one row of caragana was planted.

At some of the company's stations, spruce, caragana and lilac were used for wind break and for improving the grounds.

The provincial forest nursery at Berthierville, Quebec, has this year shipped out 400,000 forest tree seedlings, in addition to those utilized by the forest service on Crown lands. Of these, 250,000 were sold to the Laurentide Company, for planting on their property near Grand Mere, Quebec. This shipment supplements the large supply available from the company's own nursery at Grand Mere, the capacity of which has been increased materially. Another progressive concern which is undertaking forest planting is the Riordan Pulp and Paper Company, which, like the Laurentide Company, employs a forester, and which has purchased 20,000 tree seedlings for planting on their property in the vicinity of St. Jovite, Quebec. The third large shipment from the Berthierville nursery was to the Perthius seignory, which purchased 50,000 young trees. This is the sixth year during which plant material has been secured from the Berthierville nursery for planting on this seignory. The balance of the 400,000 total was disposed of to colleges and private individuals. Gradually, the necessity for planting is becoming recognized, to secure the re-establishment of the forest where sufficient seed trees are no longer available for natural reproduction.

Since Confederation, in 1867, Quebec has derived a total direct revenue to the provincial treasury of more than $40,000,000 from the sale of cutting privileges on Crown timber lands. The revenue from this one source now averages well over $1,500,000 annually. The area of Crown land under license to cut timber is approximately 44,500,000 acres, while 78,000,000 acres remain unlicensed. About 6,000,000 acres of timber land in the province are in private ownership.

The following resolution, introduced by Professor P. S. Lovejoy, of the University of Michigan, was adopted by unanimous vote at the spring meeting of the Technical Association of the Pulp and Paper Industry, held at Kalamazoo, Michigan, and the secretary was instructed to send copies of it to the various State forestry associations, the Governors of States, and the press generally:

Since wood is an essential raw material of the pulp and paper industry, and

Since the supply of timber suitable for pulp manufacture is rapidly decreasing and its cost is rapidly increasing, and

Since there are great areas of non-agricultural lands in the Lake States, which lands once produced splendid timber, but are now practically barren as the result of lumbering and repeated fires,

We, therefore, urge that the pulp-producing States take immediate action,

1. Looking toward the better protection of these non-agricultural lands from fire;

2. Looking toward the restocking of such lands where necessary by planting.

Three field parties are now at work in New Brunswick, in connection with the forest survey and classification of Crown lands. The project is under the supervision of P. Z. Caverhill, Provincial Forester, subject to the general direction of the Minister of Lands and Forests. The size and importance of the undertaking is indicated by the fact that the Crown lands in this province comprise 10,000 square miles and return a direct revenue to the provincial treasury averaging more than $500,000 annually from timber alone, in addition to large revenues from the sale of hunting and fishing privileges.

There is considerable pressure upon the provincial government for the opening up of new lands, to provide for immigration and for the surplus native population. An important feature of the Act of 1913 was the provision for a classification of soils, with the object of directing settlement to lands really suitable for farming purposes. This wise provision is now being carried out, and the result will no doubt be to reduce to a minimum settlement upon non-agricultural lands. The evil effects of such settlement may be seen in every province of Canada.

The province of New Brunswick has undertaken to avoid the recurrence of such tragedies as were discovered by the Commission of Conservation to have been enacted in certain portions of the Trent watershed of Ontario, where settlers were allowed to locate on poor, sandy soils, then chiefly valuable only for their timber, the result being that with the removal of the timber and the exodus of the lumbering industry, the settlers were left stranded, with no opportunity to make a comfortable living, and faced with the necessity of constantly lowering their standards.

The work of land classification in New Brunswick is being carried on in connection with the timber estimate and mapping of Crown lands. The country is covered systematically and examinations of the soil are made at regular intervals. Beyond any doubt, the result will be the opening up of new lands for settlement and the establishment of new communities under conditions which will ensure comfort and a reasonable standard of living. This, in turn, will mean a permanent increase in the population of the province, by providing for the native surplus as well as for immigrants.

The Commission of Conservation has co-operated with the provincial government in laying the foundation for the land classification work.

Mr. J. F. Preston sends the following news notes from U. S. Forest Service, Missoula, Montana:

District 1, of the Forest Service, shows for the fiscal year ending June 30, 1916, a total net receipt for timber sales of $440,000, which is an increase of $37,000 over the same period last year. On the other hand, the actual cut decreased from 182,000 M feet to 162,000 M feet. The increase in receipts is due to the sale of an unusually large quantity of timber during the last few months of the fiscal year. During the period from April to June 30, something over 300,000 M feet were sold. The prices received were rather surprising. Timber advertised at $3 per M feet for White pine, was bid in at prices varying from $3.50 to $5.90 per M feet. This is, of course, a direct result of the upward curve in lumber prices during the last six months. The total receipts for the district from all sources amounted to $577,284.64.

The tentative draft of the report on the *lumber industry* study was completed some time ago. A final conference will be held in Spokane between Mr. Mason, Mr. Greeley, and interested lumbermen sometime during August or September, at which time all of the points will be considered.

On account of the large increase in timber sales in the Idaho region, the problem of the proper *marking of White pine* in order to secure reproduction has been very carefully considered. New rules are contemplated in their near future in which will be emphasized several new principles. A recent important development is the assignment of Joseph Kittredge to work involving almost exclusively the supervision of marking. It has been demonstrated that no set of general marking rules, however carefully prepared, can be applied to specific areas without, in some cases, considerable modification. Kittredge is engaged in formulating specific rules which will apply to specific areas, guided by the general priniciples which have been established for the species. In other words, his function is to put into practice the scientific facts established by the Experiment Station force.

The State of Pennsylvania has started a new attack on the chestnut blight, the White pine blister rust, and other tree diseases by going to Wisconsin to engage J. G. Sanders, Wisconsin State Entomologist, whose first step for the eradication of the White pine rust in Wisconsin was to destroy all the trees and berry bushes on the island where the disease was found. His insistence that the pine disease must be vigorously fought, if the pines of the nation were not to be destroyed forever, called attention of the Pennsylvania authorities to his work. Another Philadelphian, S. B. Detwiler, is now engaged in special work for the government, aiding in fighting this plague in New England.

An outbreak of the White Pine blister rust has been discovered in the Niagara peninsula of Ontario. The Dominican Botanist and the Provincial Department of Lands and Forests are co-operating in the work of detecting and eradicating this pest. E. J. Zavitz, Provincial Forester, is in charge of the field work, assisted by several inspectors.

A serious problem confronting foresters in many regions of the Northwest is that of the mistletoe pest. Trees most affected are

Western larch, Western Yellow pine, Lodgepole pine and Douglas fir. Reduction of the leaf surface of a tree causes reduction in both height and diameter growth. Severe infection throughout the crown of a tree often results in its death. Mistletoe infection, by weakening trees, makes them much more susceptible to fungi and insect attack. Young seedlings usually die shortly after receiving the infection.

Suggestions for control of the pest offered by the United States Forest Service, in a recent bulletin setting forth results of studies made along this line, are: (1) in logging operations infected trees should be marked for cutting; (2) pure stands of susceptible trees should not be established in regions where the pest is prevalent; (3) the mistletoe is a light-loving plant; also mistletoe seed may be carried great distances—one quarter of a mile was reported in one case; therefore close stands minimize the danger of infection; (4) all infected, isolated seed trees should be destroyed.

C. J. Humphrey, Pathologist in the Bureau of Plant Industry, United States Department of Agriculture, has prepared a useful bulletin (typewritten) on *Sanitary Handling of Timber*, calling special attention to the need of preventing infection with root-producing fungi during storage of timber, which are the cause of rot in buildings. The cause and conditions of rot are set forth with reference to usual conditions in practical handling. The means for prevention of infection are discussed with regard to location of yards, cleaning of yards, care in handling sticks and stacking lumber, construction of pile foundations, treatment with preservatives, and use in buildings.

Mr. G. N. Lamb has prepared an important chart, or calendar, which shows, for the common trees of the eastern United States, the dates of leafing, flowering, "in foliage," seed ripening, seed falling, and leaf falling. The chart is the result of a compilation of data obtained by observers of the Forest Service and also by individuals working alone. The major activities of plants indicate clearly the advance of the season, for these activities depend upon the interaction of a number of weather elements, e. g., temperature, precipitation, humidity, and evaporation. Trees, being the most conspicuous plants and living for many years, lend themselves to phenological observations. There is thus a large body of available material for study along these lines. The tree calendar will be useful to botanists, especially foresters, and to meteorologists, and will also have interest for intelligent observers of plant growth. The botanical range of the various trees is given, and a bibliography is included.

A Canadian Research Bureau has been established, the object of which is to investigate, organize and systematize our resources. It will carry on a scientific investigation of the mineral, metal, hydro-electrical and chemical resources of the nation and formulate plans for the lessening of the waste in forests, factories, mines and mills. The results of the Bureau's investigations will be sent out to manufacturers, merchants and others interested, in the form of bulletins.

The Engineering Bureau of the National Lumber Manufacturers' Association sent out its first technical letter in May. It is a discussion on creosoted wood block paving by Walter Buehler. On four letter size pages the details of size, species of wood and treatment with creosote are given, and the advantages of wood pavement elaborated.

It appears that Minneapolis alone has over 70 miles of block street, some 14 years old.

The Bureau of Forestry of the government of the Philippine Islands has learned already the lesson which lumbermen of the States are trying to drive home to every person interested in the lumber industry, the necessity for accurate grading of lumber, so that the consumer may secure the kind of wood exactly that he orders, and not something cheaper. The Philippine government proposes in the development of the industry in the forests of the islands, to start right, and grade lumber carefully at the very beginning of the operations, so that a fixed market may be secured, and the purchaser know definitely just what he will get when he orders a special kind of lumber. To assure this sort of results the Forestry Department is planning to import two well known lumber inspectors from the United States, men whose reputations will be a guarantee of the quality of lumber they inspect wherever it may be shipped.

The Canadian Forestry Association, through its Secretary, Mr. Robson Black, has been most active in its propaganda during this year of war, plying newspapers with articles, editorials and cartoons; giving public lectures; enlisting 300 new members since February 1; having interested 22 Boards of Trade of Ontario to petition the Minister of Lands and Forests for a reform of the fire ranging; circulating 15,000 copies of *Boy Scouts Forest Book*, and as many "A Matter of Opinion" booklets, and 6,000 School Stories, to settlers, railroaders, campers, teachers, some 2,000 of the latter co-operating; and distributing 4500 copies of the monthly journal.

To meet Canadian conditions, the Dominion Council of the Boy Scouts' Association has authorized a Forestry badge, in lieu of the Woodman badge. The conditions under which this badge may be secured by the boys are very comprehensive and will do much to interest Canadian boys in the Canadian forests and the wild life found therein. The conditions for passing the test are:

The scout must—

1. Identify the principal native tree species in own locality, and explain their principal distinguishing characteristics.

2. Identify five kinds of shrubs.

3. Describe the principal uses of ten species of Canadian woods. Visit a wood-using factory, if practicable.

4. Explain the aim of forestry, and compare with agriculture and unregulated lumbering.

5. Tell what are the effects of fires on soil, young forest growth and mature timber; principal causes of forest fires and how best to overcome them; three general classes of forest fires, and how to fight each.

6. Describe how the forest lands are protected and administered in own province.

7. Describe the general features of a lumbering or pulpwood operation; how the cutting is done in the woods; method of transportation to the mill, and of manufacture there. Visit some portion of woods operation, or sawmill, or pulp or paper mill, if practicable.

8. (Optional.) Discuss one or more of the enemies of trees, such as insects (leaf-eaters, bark-borers, wood-borers), or decay (fungus diseases), and tell something of how damage from these sources may be lessened or overcome.

The Forest Service has compiled a list of the institutions at which instruction in forestry may be obtained in the United States.

There are altogether 52 institutions listed, 23 with courses leading to a degree, 40 with elementary or short courses, 11 of which at colleges giving degree courses. At 8 of the degree-conferring institutions ranger courses are given, varying in length, lasting from 6, 8, 12 weeks to three sessions of five months. In six States two degree-conferring institutions exist, namely Colorado, Georgia, Michigan, New York, Pennsylvania, Washington. The courses at the degree-conferring institutions run from two years for graduates to 3, 4 and 5 years for undergraduates.

The Forest School of the Philippines has recently been separated from the College of Agriculture, making it a distinct school under the University of the Philippines. The Director of Forestry is thereby appointed ex-officio dean of the School. When the Forest School was first organized, it was thought advisable, on account of the use of the Agricultural College buildings and grounds, to place it under this College, but now that it has justified its existence and is considered an important adjunct to the University, it has been separated so as to work independently.

Arrangements for the new course in Forest or Logging Engineering at the University of California have been completed and instruction commenced at the opening of the college year in August. The course will require four years for completion.

The object of the course is to train men along lines somewhat parallel to civil, mechanical and electrical engineering, but specializing in work of the lumber industry. The training will be thorough, but will not specialize too closely, since conditions in lumbering vary widely. It will have the same foundations of mathematics, physics, etc., as the other engineering courses of the University. It will be broadened by the addition of courses in accounting and cost-keeping and scientific management, business organization, etc.

The course by years is as follows:

First Year—Algebra, analytical geometry, physics, surveying, chemistry.

Summer following First Year—Surveying field work, four weeks in camp.

Second Year—Differential and integral calculus, physics, descriptive geometry, shop work in wood, elements of steam engineering, elements of electrical engineering, accounting, first aid and camp sanitation, forest protection (from fire and insects).

Summer following Second and Third Years—Student is to be advised to drop out of college for one year and rustle a job with some lumber company unless he has had previous equivalent experience.

Fourth Year—Engineering mechanics, railroad surveying, forest mensuration (scaling, cruising, etc.), shop work in metal, cost-keeping, economics (factors of industrial efficiency and business organization), silviculture, strength of materials, wood technology.

Summer following Fourth Year—Field work in forest mensuration, etc.; in camp, eleven weeks.

Fifth Year—Forest improvement construction, logging, business law, scientific management, engineering contracts, forest administration, forest finance, timber trees of the United States, geology, tree planting, testing laboratory, forest utilization (timber preservation, destructive distillation, etc.)

The State College of Washington, at Pullman, is the third college we note to offer through its extension department and the department of forestry a correspondence course in Lumber and Its Uses. The New York State College of Forestry at Syracuse and the University of Minnesota also offer a course on this subject. These courses are specially designed to be of value to lumber dealers, contractors, carpenters, and others connected with the wood-working industries.

The Forest Service of the United States is conducting a comparative study with the Forest School of the University of Georgia, the object being to ascertain methods of marketing farm woodlot products and suggest improvements. The data will be placed before the farmers of the State in publications of the University.

With the idea that the many people who go into the Adirondacks each summer should know more of the forests and their wild life, The New York State College of Forestry at Syracuse as a part of its extension work, interested Mr. Melvil Dewey, President of the Lake Placid Club, in setting aside the last week of July as a Forest Week for the Club. The many people who come to the Club and to other resorts about Lake Placid had the privilege this year of hearing addresses by some of the best known foresters in the country. The program consisted of a round table discussion each morning in the week at 10:00 o'clock, at which the development of the forest, how it may be protected and the part the wild life of the forest plays in its development, was taken up and discussed; in the evening general addresses, in most instances illustrated, were given and each afternoon, small groups were taken out under the guidance of experts for the study of trees and shrubs and the wild life in the forest.

During the winter semester, 1915–16, there were enrolled in the University of Munich 6021 students, of whom 469 were women and 193 foresters, but 4450 of the male students were absent in the army.

The Forestry Club, Faculty and students, of the Montana Forest School at Missoula publishes an Annual under the title *Forestry Kaimin*, this Indian word meaning "something in black and white." The second volume, of 128 pages, is an unpretentious, *bona fide* student publication, fun, humor, poetry and information of various character being held at equal value. A spirit of all-round humanness and practical life pervades the volume. Perhaps the existence of a ranger school, attended last session (14 weeks) by 40 members, in addition to the two higher grade courses in forestry and forestry engineering, and a correspondence course, account in part for the practical spirit.

A short editorial on Training, Education and Culture, lays the stress insistently on training and makes the bold, but untenable assertion that "most of the permanent progress which has been made in the world . . . has been by virtue of the training . . . rather than by grace of education." Of the worth-while pieces of information, we may mention an article by Prof. J. H. Bonner and F. E. Bonner on "New Methods of Making Topographic Surveys," which we reprint in this issue, together with a description of methods pursued in the United States Forest Service Office of Geography, and two pages of illustration of defects in wood and the allowance for them in scaling.

At the sixth annual convention of the North Carolina Forestry Association, Mr. C. I. Millard, President of the John L. Roper Lumber Company of Norfolk, brought out strongly the need for experimental and demonstration forests and offered to give the necessary land for such an area in the Loblolly pine region. The gift was accepted by the State Geologist on behalf of the Geological board which has recently been empowered by the legislature to receive gifts of land for this purpose.

The example of the progressive Laurentide Company of Grand Mere is to be followed by the Riordan Paper Company, of Montreal, who have decided to commence planting operations on their limits. Doubtless, other companies will follow in their steps before very long, for such a policy will prove profitable in the long run. The Laurentide Company have at present about 2100 acres devoted to planting and experimental operations. The experiments include thinning, natural regeneration, timber growth studies, draining swamps, etc. After cutting operations all slash is piled and burned. Another noteworthy feature of these plantations is the system of dirt roads and fire lines which is being developed.

On October 24-27 a joint session of the Western Forestry and Conservation Association and the Pacific Logging Congress will be held at Portland, Oregon, where timber problems, lumber problems and logging problems are to be discussed by experts, with participation of the Department of Commerce, the Federal Trade Commission and the Forest Service.

The 1916 midsummer meeting of the Pennsylvania Forestry Association, held at Reading, June 27–29, had a splendid attendance of enthusiastic people: members of the American Forestry Association, instructors in a number of forestry schools, forestry students from the Pennsylvania State College and from the State Forest Academy at Mont Alto, members of the Berk County Conservation Association, organized two years ago. The meeting took the usual form of addresses, papers on forestry subjects and an outing to view the municipal tree nursery at Antietam Lake, which is a city reservoir, and contains 30,000 coniferous seedlings for future planting on city property. On the watersheds of Antietam Lake there have been planted 100,000 coniferous and broadleaf trees, the work of planting having been done mostly by pupils of the Girls' High School of Reading, all the coniferous seedlings having been furnished by the State Department of Forestry.

A new flagstaff has just been erected at Kew Gardens, London, to replace one which had been presented in 1861, but which when attention was directed to it for repairs was found to be rotting at the base, so that it would have been necessary to remove as much as 40 feet from the length. The new flagpole is a gift of the British

Columbia Government and was chosen as a representative of the giant fir trees of the Province. It measures 214 feet, $3^1/_2$ inches in length, the widest diameter at the base being 2 feet, $9^1/_4$ inches and at the small end 12 inches.

It is interesting to note the many articles necessary to civilization which have as their primary element wood. Two recent uses for kraft paper, which is manufactured from sulphate pulp, are paper pipe and furniture. The Berlin Mills Company is now producing paper pipe wound over cores of various diameters and made in various thicknesses, which is thoroughly permeated with a tar compound, forming a strong compact pipe capable of taking a thread and lighter and less expensive and more durable than iron pipe. These pipes are used for underground conduits, for electric wires for resisting action and corrosive acids, especially in coal mines.

Paper suits which are said to be equal, if not superior, to cloth or fur garments in keeping out cold are now being manufactured to be worn beneath outer garments by airmen. Paper being a non-conductor, furnishes an excellent protection from the cold experienced in ascending to high altitudes.

The use of artificial silk made directly from wood is increasing by leaps and bounds, reports *American Forestry*. Originally, its use was common in the manufacture of braids and trimmings, but recently the manufacture of hose from it has become an industry of vast importance. Other uses for artificial silk are woven goods of all kinds, linings, tapestries, etc., neckties, ribbons, sweater coats, etc. About $5^1/_2$ million pounds of artificial silk are used annually in the United States. The Forest Products Laboratory at Madison, Wisconsin, is investigating the artificial silk problem as a possibility for utilizing wood waste, and has on hand a variety of articles made from this material.

Philip T. Coolidge, M. F. (Yale, 1906), has opened an office for the practice of forestry at 217 Stetson Building, 31 Central Street, Bangor, Maine. He is prepared to make timber estimates and stumpage sales, and to do forest planting.

The American Academy of Arborists at its first annual convention, in Newark, N. J., chose *American Forestry* as its official organ.

The planting of 90,000 olive trees is the monument chosen by friends to commemorate Herzl, a prominent Zionist, and his work. Such a memorial would probably be more pleasing to all whose work is deemed worthy of commemoration than stone or bronze statues.

Dr. Richard Hess, the well-known professor of forestry at the University of Giessen, died on January 18, 1916, 81 years old. His volumes on forest protection, forest utilization, silvics, and the latest edition of Heyer's *Silviculture*, which he supervised, are well known as standard works to American students.

PERSONALITIES

1. *Northeastern United States and Eastern Canada*

Dr. H. N. Whitford has been appointed as Assistant Professor of Tropical Forestry at Yale and is to begin work next September.

R. B. Miller, of 315 Church Street, Fredericton, N. B., was married on June 8 to Miss Burchell of Sydney, N. S.

G. Harris Collingwood has been appointed as Assistant Professor of Forestry at Cornell University. He began his work—which will be as Extension Professor, succeeding Frank B. Moody—on July 1.

Dr. Charles C. Adams has been promoted to the professorship of Forest Zoology in the newly formed department of Forest Zoology in the New York State College of Forestry at Syracuse University.

Reginald D. Forbes has been appointed Assistant Forester of New Jersey, to succeed P. T. Coolidge, resigned. He began his work on July 1.

A. Oakley Smith has resigned as City Forester of Mount Vernon, N. Y., and re-entered the service of F. Vitale, Landscape architect.

Philip T. Coolidge, who has been Assistant State Forester of New Jersey since the beginning of 1915, has opened an office for timber estimating and forestry work in the Stetson Building, 31 Central Street, Bangor, Me.

D. N. Trapnell, assistant in the Forest Products Laboratories at McGill, was killed at the battle of Ypres.

G. H. Gutches, head of the New York State Ranger School, has resigned and will return to the Canadian Forest Service.

Lieut. Arnold M. Thurston, student at the University of Toronto Forest School, was killed in action in June. His commanding officer writes of his bravery and "that it was my intention to promote him to the rank of Captain, if he survived the present fighting."

Messrs. D. A. Macdonald and C. H. Morse, of the Dominion Forestry Branch, have been elected Associate members of the Canadian Society of Forest Engineers.

Mr. Morse went overseas in the spring with the 234th, Forestry Battalion.

Sub-Flight Lieut. J. R. Chamberlin, who had enlisted in the British Air Service, was killed in an aeroplane accident in England early in June. Mr. Chamberlin was a graduate of the University of Toronto Forest School, and a member of the British Columbia Forest Branch staff.

2. *Southern United States*

W. B. Greeley has been elected chairman of the executive committee of the Society of American Foresters for the current year.

Elwood Bushnell of Johnson City, Tenn., was married on June 21 to Miss Lucy Sitton of that city.

Walter G. Schwab has been appointed Assistant State Forester of Virginia. He assumed his new duties about May 15.

Ernest Bruncken, early patron of forestry and author of an elementary textbook on the subject, was dismissed from the position of Assistant Register of Patents in the Library of Congress because of alleged indiscretions in his utterances.

3. *Central United States*

Dorr Skeels, dean of the forest school of the University of Montana, has been appointed manager of the Western Pacific Lumber Company, Riordan, Ariz., of which Henry A. Porter, of Chicago, is president.

4. *Northern Rockies*

William M. Mace, of Ephraim, Utah, was married to Miss Pauline Olson of Salt Lake City, on May 17.

Miles B. Haman, who graduated from Cornell as Master in Forestry in June, 1916, has been assigned as assistant to A. W. Sampson on the Mauti Experiment Station.

5. *Southwest, Including Mexico*

Joseph C. Kircher has been appointed Forest Supervisor of the Sante Fe National Forest.

Thomas E. McCullough, for some time Forest Examiner on the Coconino National Forest, resigned on April 24 to go into private business at Flagstaff, Ariz.

Robert Stephenson, of the Forest Service, was married on February 18 to Miss Alice Helen Chapman of Tucson, Ariz.

Don P. Johnston, heretofore Supervisor of the Santa Fe National Forest, has gone to Tucson, Ariz., to assume charge of the Coronado-Chiricahua Forest.

Paul P. Pitchlynn has been appointed Forest Supervisor of the Sitgreaves National Forest, succeeding Chas. H. Jennings who has been transferred to the Supervisorship of the Alamo-Lincoln in New Mexico.

Supervisor C. C. Hall (known to fame as "Six-shooter Charlie"), of the Tonto National Forest has been transferred to the Santiam Forest in Oregon. He is succeeded by W. H. Goddard, hitherto Supervisor of the Datil.

The new Supervisor of the Datil National Forest is A. H. Douglas, heretofore Deputy Supervisor of the Gila Forest.

Clifford W. McKibbin, formerly Deputy Supervisor of the Coronado National Forest, has been transferred to the District Forester's office as Assistant in the office of Silviculture.

P. P. Porcher and Wyman have been assigned to the Fort Valley Experiment Station.

6. *Pacific Coast, Including Western Canada*

Professor M. B. Pratt, of the University of California, spent the summer vacation in the East, his trip including a three weeks' stay at the Madison Forest Products Laboratory.

M. L. Erickson, Supervisor of the Crater National Forest, at Milford, Ore., was married to Miss Gertrude Turner Hanna, of San Francisco, on April 29.

H. R. MacMillan, head of the British Columbia Forest Service, is now in China on his globe-encircling tour for the Canadian Government. He has already been in the United Kingdom, Holland, France, South and East Africa, Australia and India. He will visit New Zealand also

John D. Coffman has been promoted from Deputy Forest Supervisor of the

Trinity National Forest to Forest Supervisor of the California National Forest, with headquarters at Willows, Cal.

E. H. MacDaniels has been promoted from Deputy Forest Supervisor of the Crater National Forest to Forest Supervisor of the Chelan National Forest, with headquarters at Chelan, Wash.

Mr. Asa S. Williams, who some time ago was seriously injured in an accident on a log slide, has entirely recovered, and is now connected with the Empire Manufacturing Company, at Vancouver, B. C., as manager of their Logging Machinery Department sales.

Douglas K. Noyes has been transferred to the office of Silviculture at San Francisco.

Eric G. MacDougall, graduate of the Toronto University Forest School, 1911, of the British Columbia Forest Branch, has been wounded in battle.

It is reported that R. A. R. Campbell, student at University of Toronto Forest School, 1912–14, also of the British Columbia Forest Branch has been killed in action. Mr. Campbell enlisted with the Canadian forces in September, 1914, but later obtained the commission of Lieutenant with the West Yorkshire, a British Regiment.

7. *Hawaii, the Philippines and the Orient*

L. R. Stadtmiller of the Philippine Service will leave there in September for several months at home in Bridgeport, Conn.

Shoitsu Hotta, Assistant Professor of Forestry in the Tokyo Imperial Institute of Japan, has entered the Yale Forest School, having been sent there by the Japanese Government.

Arthur F. Fischer has been appointed Acting Chief of the Philippine Forest Service in the absence of W. F. Sherfesee in China. He succeeds Wilhelm Klemme who has resigned from the Service.

COMMENT

On p. 524 we have given a very full abstract of a highly interesting article by Biolley on normal stock which is certainly novel and thought compelling, although we are not at all convinced of the soundness of his arguments and, indeed, find it desirable to point out briefly a number of fundamental misconceptions.

The author has singularly failed to secure a proper conception of normal stock and its application as current among German foresters; he misunderstands the meaning and value of yield tables. Even the biology of the forest on which he lays so much stress in the interesting exposé is, we believe, not quite clear in his mind; nor is the object of thinnings. We may also find some flaws in his conception of the business of forestry in general.

The gist of the whole discussion is to make prominent the need of silviculture and to substitute for a regulated organization free will and judgment of the manager.

It is an organic mistake of the French in general, at least in their literature, to mix up silviculture and organization. The laudable endeavor to join the two in practice leads to unclearness, especially as to the function of organization. There is hardly a German forester who would not admit that silviculture—production—is the important branch of forestry, and that it can be practised only through recognition of biological laws of development. There is no sane German forester, on the other hand, who considers, as the author asserts, that normal stock is the object and not a means to an end—sustained production. Least of all can any one admit that the normal stock is "determined by official prescription."

Yield tables from which normal stock may be figured are not constructions of the brain, but are records of actual occurrences and accomplishments in nature and under certain treatment. They are not mathematics to which the management must conform, but attempts to measure what silviculture under given conditions can accomplish, a standard measure of our silvicultural endeavor.

The concededly best formula method was elaborated by Karl Heyer who took great pains to warn against an attempt to rely upon a normal forest formula or to consider the formula anything but an assistant guide. Biolley overlooks that the normal forest and normal stock idea contains a normal increment, i. e., a best, attainable increment, and that the attainment of this admittedly can only be accomplished by silviculture.

The conception of the biology of the forest, according to which apparently every stand experiences regularly a natural deterioration of its producing capacity in early life, which condition can be corrected by fellings, is, to say the least, novel.

A singular misconception is that of the object of thinnings "to create more favorable conditions of nutrition." This may, under certain conditions, be one of the objects, but the main object is to shift the increment from the large number of components to a select few; to improve the increment in quality. That a tree, a stand, an animal, a man shows in its growth and development the periodicity which gives rise to the growth curve exhibiting rises of rates and declines, is a phenomenon which the best silviculturist cannot overcome, although to a small extent he may disturb the periods to his advantage, as German silviculturists have shown, most beautifully in Wimmenauer's demonstrations of keeping the annual ring width approximately equal for several decades. (*See* F. Q., vi, p. 432.)

The charge of arbitrariness in determining the normal stock on the basis of yield tables becomes ludicrous in comparison with the arbitrariness in the determination of his own "rational" stock or *étale*. The former relies upon measurements of actual, carefully chosen standards, the conditions of which are known; the latter on nothing but personal opinions. He charges against the normal stock methods what is chargeable against the lack of business judgment on the part of the manager in applying the method, or what is chargeable to the fluctuations of business in general. The ideal manager who can do what Biolley wishes him to do is, indeed, a *rara avis*, and the intensity of application which he provides is in large State properties hardly anywhere practicable.

We may add that the *méthode du contrôle* was designed for selection forest and since there is no other satisfactory practical method of organization for this character of forest, this silvicultural prescription may be applied with advantage. For other than selection forest the conception of the normal forest and its use for measuring silvicultural success on the very ground which Biolley correctly demands—maximum increment, quantitative and qualitative—is still useful and practicable, even to the man who desires freedom from formalism.

Mistletoe Damage on Jack Pine. On Nisbet Reserve near Prince Albert, Saskatchewan. [*See* Article, p. 567.]

ANNOUNCEMENT

With this issue, the FORESTRY QUARTERLY completes its fourteenth volume, and with it, concludes its existence.

With the year 1917, it will begin a new life in amalgamation with the *Proceedings* of the Society of American Foresters, under the title "JOURNAL OF FORESTRY." The new magazine is to be published in eight monthly issues, containing approximately as many pages as the two original publications together, at a subscription price of $3 per annum.

Since it is expected that for some time at least the chief editors of the former two publications will have charge of the new magazine, the character of the new journal will essentially remain the same as the present publications, with an attempt at improving, as opportunity is afforded, the good features of either. The departments of the QUARTERLY will be kept up with little change.

The Editor of the QUARTERLY wishes to take this opportunity of extending heartfelt thanks to his co-editors for the generous cooperation which they have shown in the fourteen years of existence of the journal, giving unpaid service year after year—a labor of love—without which it would hardly have been possible to maintain the publication.

From a modest student publication in 1903, of 176 pages, the QUARTERLY has grown, until now a volume of 700 pages can hardly cover the ground adequately. The fourteen volumes form a reference work of rare character recording the advance of forestry science in all lands and the development, from all points of view, of the profession in the United States and all other countries.

To make it as useful as possible as a reference work, it becomes necessary to have a complete INDEX to all volumes. Such an index had been promised before to cover the first twelve volumes, but since the amalgamation was then begun to be considered, it appeared desirable to wait with its publication until the matter was decided and the index could include the whole set of volumes. We hope to be able within the coming year to issue such an index.

The Editor bespeaks for the new JOURNAL OF FORESTRY the generous support of the profession.

ERRATA

In the article of Dr. Boerker in this volume, on pp. 375-432, the proofreader has overlooked a number of errors. The following, which do not correct themselves, the reader is asked to correct.

Page	*Line*	*Errata*
388	9	Meyon *should be* Meyen
391	31	200 *should be* 20
416	5	industrial *should be* individual
418	24	production *should be* protection
421	19	initiative *should be* initiated
428	34	*insert* why should not *after* Also

FORESTRY QUARTERLY

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SOME SUGGESTIONS ON THE CONTROL OF MISTLETOE IN THE NATIONAL FORESTS OF THE NORTHWEST

By James R. Weir[1]

Recent field studies have shown the need of some action being taken in the control of mistletoe in many of the Western National Forests.[2] Although anyone familiar with the present difficulties entailed in obtaining both a successful silvicultural and financial result on the average sales area recognizes the futility of attempting many things known to be good forestry; still, some things can be done. Very frequently conditions are such that no very elaborate plans can be sustained, but it is the duty of the practical forester to seek out opportunities for applying the principles which underlie the building up of a better forest, better in the sense of less waste resulting from unchecked ravages of disease-producing agents. It is a mistaken idea that all the forester has to do is to continue harvesting mature timber, great as this necessity may be, and plant denuded areas without some thought of the future health of the forest. The present condition of mistletoe infection in many regions is far from what it should be to insure the realization of the best and largest amount of merchantable material. This is the result of long years of unchecked growth of these parasites. It is an injury that will increase in intensity not only because of the absence of any organized plan in forest manage-

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[1] Forest Pathologist, U. S. Bureau of Plant Industry.

[2] Weir, James R. Larch Mistletoe: Some Economic Considerations of Its Injurious Effects. U. S. Dept. of Agri. Bul. 317. January 20, 1916.

Weir, James R. Mistletoe Injury to Conifers in the Northwest. U. S. Dept. of Agri. Bul. 360. June 17, 1916. *See* other publications by the same author.

Meinecke, E. P. Forest Tree Diseases Common in California and Nevada. Misc. Pub. U. S. Forest Service, pp. 54–58. 1914.

Hedgcock, G. G. Notes on Some Diseases of Trees in Our National Forests. Phytopathology 5:3, pp. 175–181. 1915.

ment to check it in many regions where the parasites most abound, but very often the method of cutting is such as to directly insure the propagation of the parasites. I refer in the main to the leaving of heavily infected trees on sales areas. Very often such trees, although of merchantable size and which otherwise would come under the cutting clause, are so seriously burled and infiltrated with pitch that very little merchantable material can be obtained from them and they are allowed to remain standing. This in itself is in direct opposition to the most fundamental principles of forest sanitation which has for its object the prevention of permanent injury to reproduction or to more mature forest growth. The leaving of broomed, burled, and spike-topped mistletoe-infected trees would not in itself be so serious a matter, although in many regions it involves the loss of large sums, but the ease with which the reproduction is permanently infected from such trees shows the necessity of their destruction. The fact that the older infected trees introduce other factors of prime importance in the deterioration of the stand is of additional concern. A tree that can not eventually yield the best and largest amount of material when growing on its normal site should not be allowed to exist among its healthy neighbors. This is the principle of human hygiene applied to forestry. Mistletoe-infected trees during the years preceding and in the last stages of suppression are apt to be carriers and distributors of serious wood-destroying fungi, resulting not only in the decay of the trees themselves, but transmitting or maintaining these agents in the forest. Since in many cases the ground is extensively shaded by low, sprawling, mistletoe-infected trees, air and light are excluded from an otherwise fertile soil for young growth. The space occupied by such trees is wholly wasted and the opportunity for the maximum yield for the type is entirely lost. A more direct influence on the future of the oncoming forest is the small size and poor quality of the seed produced by trees seriously suppressed by mistletoe. Considering the trying conditions under which forest tree seed must at times germinate and under which the young seedling must become established, the best quality of seed is none too good. Add to this the fact that mistletoe brooms and eventually the uninfected parts of the tree cease altogether to produce seed, the practice of leaving trees of this kind for seeding purposes is not good forestry. This is all the more important when it is considered that such trees when isolated or left in seed plots may exhibit this deficiency in seed production before the allotted time for an adequate reseeding has expired.

No one questions the expenditure of large sums for the control of fire. The effect of a heavy infection by mistletoe over large areas results in a great loss in increment which, when coupled with other defects caused by the parasite, is analogous in some respects to the immediate destructiveness of fire. It is well known that fire when not causing death directly precedes serious injury by fungi and insects due to a weakening of resistance to these agents. Mistletoe in regions where it is in great abundance may be considered quite as great a factor in initiating the ravages of fungi and insects as fire. Many forest fires result from lightning, striking trees which have a large amount of dry wood either of the lower branches or at the top. One of the most common effects of mistletoe is to cause the top of the tree to die. We have here another direct relation of mistletoe to forest fires. The accumulation of fallen mistletoe brooms about the bases of larches often insures the death of the tree in case of ground fires even if the fire does not extend to the dry dead brooms still attached to the tree. The formation of burls and "cat faces" by mistletoe on the main trunk may cause extensive windfalls in times of high winds, thus littering the forest floor with a highly inflammable material. At certain stages in their formation, these burls exude large quantities of pitch which is a factor in holding the fire at one point on the trunk, resulting in deep wounds.

The false mistletoes (Razoumofskya) are of much greater importance in the West than in the East. Only one species is known to occur on Eastern conifers and is of importance in but few regions. This species so far as known does not occur in the West. In great contrast to this, practically every Western conifer is attacked by some one of these parasites. Space will not allow of going into detail, but the timber trees most seriously affected are the Lodgepole pine, Yellow pine, Douglas fir, larch, and hemlock. The reason why these parasites have not received greater attention from the practical forester is probably due to the fact that the work of wood-destroying fungi is more directly associated with the destruction of the merchantable parts of the tree, their great abundance, and also because of the conspicuous nature of their fructification. Some species of the false mistletoes are very inconspicuous and their presence is chiefly recognized by the accompanying hypertrophy of trunk or branch. These mistletoes are propagated by means of seeds which are expelled with sufficient force from the seed capsule to carry them several feet. The thin layer of mucilage on the seed causes it to adhere to whatever it strikes. When a lodgment is found on tender unsuberized parts of seedlings or of more mature growth, the young germinating plant penetrates the cortex and bast, and infection results. An elaborate perennial cortical root system results from this infection and from it springs the leafless mistletoe plant. All species of the genus are normally dioecious but staminate and pistillate plants may occur in juxtaposition on the same twig, in fact they often appear to spring from the same cortical stroma. The first primary root (sinker) will penetrate as far into the cambium and cells of the newly formed wood as the tenderness of these tissues will allow, this depending upon the age of the branch infected. The depth to which this primary sinker penetrates at its first elongation is as far as it ever goes. On the other hand, there is in that part of the sinker coinciding with the cambium of the host a zone of meristematic tissue which enables the sinker to elongate at this point, keeping pace with the increasing diameter of the branch. After a time the lateral roots are developed from the primary sinker and may extend for several feet in either direction from the point of original infection. In some species this lateral root system elongates with the branch, keeping pace with the last third or fourth internode. Additional sinkers penetrate the deeper tissues of the bast, springing from the transverse and longitudinal root system, so that eventually a thorough infection of the entire circumference of the branch results. In very young stems the primary sinker follows those sets of cells offering the least resistance. Hence a cross section usually shows the medullary rays occupied by these haustoria.

The degree of parasitism attained by these parasites is far greater than that of the Phoradendrons, or the true mistletoes, which with one or two exceptions have large leafy branches and rarely occur on conifers in America. The total reduction of the leaves to mere bracts, together with a greatly reduced chlorophyll content of the stems, is a first evidence of the class relation of the false mistletoes with their hosts. A recent study made by the writer of the more minute details of the anatomy of the sinkers and horizontal root system of the parasite in relation to the tissues of the host shows quite positively a close union between the two. The phloem of the host is found to be in some species in direct union with the absorbing cells of the parasite. The gradual weakening of young trees under the drain of a heavy infection of mistletoe can hardly be brought about unless a certain part of the organic food materials prepared by the host were not utilized by the parasite. In older growth, suppression may be brought about by the lopping of branches due to the formation of heavy brooms on them and the destruction of the living circumference by the formation of burls on the main trunk. The fact that a great mass of cortical roots often girdling the entire circumference of large forest trees may remain living indefinitely without aerial parts is additional evidence of the parasitic nature of these mistletoes. Usually the different species of the genus Razoumofskya are confined to particular forest trees or to those closely related. Unless the mistletoe seed falls on a host on which it can live, the seed will exhaust its energy in producing a long hypocotyl, but can not penetrate the substratum. This indicates a special adaptation to the particular types of cell structure or chemical constitution of the different hosts. This in itself is significant in the light of the foregoing statements. These are also important points to remember in planning the management of some mixed forests.

Our knowledge of the injurious effects of mistletoes is quite sufficient to show the need of adopting some policy of forest management aimed at reducing the damage caused by those parasites and attendant diseases. It will first be found necessary before any organized attempt is made in this direction to arrange for very effective survey work. The first step then would be to conduct careful surveys of all forests wherever mistletoes are a serious factor in the deterioration of timber. Since it will be found that these parasites follow very distinct predilections as to type of stand, topography, and to a certain extent, climate, the zones of greatest mistletoe infection may be quite readily determined. It will hardly be possible for one or two men to do effective work of this kind by merely going over the forest. The survey should consist of a detailed statement of types, age classes affected, and relation to topography. More effective results could be obtained by carrying the record of mistletoe infection along with the regular yearly reconnaissance as it now being done for certain other classes of defect. Since detailed estimates by types and stands at all elevations are made, it will be possible to indicate very definitely on the field map in colors, shadings, or lines the most severely infected areas. These pathological maps,[3] as they may be termed, would be immediately available when the infected areas came under sale. Of course, this part of the work would have to be done by men who have had instruction and experience in recognizing mistletoe and judging injury. This information is being rapidly gained by the men[4] on the forest. Some mapping of this kind has already been done under the writer's direction by E. E. Hubert of this Laboratory, enough, in fact, to show the value of it. It is planned to carry on the work from year to year until all the great areas of mistletoe infection in District 1 have been mapped.

After the zones of greatest mistletoe infection have been determined, the next step is to devise some means by which a beginning may be made to eradicate them. Unfortunately at the present time conditions are such that no more extensive measures can be adopted than those afforded by free use permits, activities of rangers, and timber sales. It seems that it is entirely possible on some National Forests where mistletoe is abundant to designate only mistletoe-infected trees in free-use privileges. These privileges in the case of mistletoe-infected trees could be made very liberal. The trees could be marked by the ranger during the course of his yearly duties and to a certain extent he could cut such trees for his own use. However, at the present time, it is not possible to man even the more accessible forests with a force of rangers to make a very appreciable headway. The ranger should also be encouraged to make a study of the mistletoe situation, if found necessary, in the region over which he may have control.[5]

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[3] It is a good plan to use this method to graphically show the vertical and horizontal distribution of all serious forest diseases in their relation to type of stand, soil, climate, and topography.

[4] During the past two years over 200 specimens of mistletoe (Razoumofskya), representing all the species of economic importance in the West, have been sent to the Laboratory at Missoula, Mont., for identification.

[5] To facilitate these studies the Laboratory of Forest Pathology, Missoula, Mont., will furnish forms especially prepared for assembling field data on mistletoe. These forms have already been extensively used on several National Forests.

The possibilities of making a beginning in the eradication of mistletoe from which much is to be expected lies in timber sales. In some respects the problems which usually arise in requiring the purchaser to cut every marked tree would not come up in the same way as is often the case when wood-destroying fungi alone are in question. In trees with a portion of the merchantable length decayed by fungi, it is always a question whether or not the tree contains enough merchantable material to bring it under the cutting regulations. To decide this point it is often difficult for the marker, even though with wide experience, to escape complications with the fallers and also with the purchaser. In the case of mistletoe-infected trees, with little or no decay, no such difficulty may exist due to the fact that the amount of damage by the parasite in most cases can be instantly determined by the hypertrophy of branch or trunk. A knowledge of the average or maximum size of the species of tree for the region when growing under normal conditions, together with the fact that mistletoe injury may be safely judged from external appearance, eliminates the danger of leaving undesirable trees of the specified diameter classes on the area. In some regions of heavy mistletoe infection, those species most seriously injured which do not quite attain the regulation trunk diameter designated in the contract, or if they do fall under the diameter class, are so badly burled and broken as to be wholly culled, present a most grotesque and unsightly appearance when left standing on the sales area. This not only may represent a present financial loss, but throwing such trees into the open usually invigorates the parasites to greater activity and the young growth soon to appear is open to widespread infection. The standard of health for the forest in mistletoe-infected regions can never be raised so long as this is practised. A far better plan would be to mark every mistletoe-infected tree above a given diameter and to have these trees cut whether or not they contain merchantable material. The resultant litter, it is true, may be sometimes great, but if the extra cost of lopping and piling the brush is prohibitive, then a clean burn, which will often be necessary when the reproduction is infected, will rid the forest of this trash. The mistletoe, however, will be killed with the cutting of the tree. Frequently it may be quite impossible to impose such restriction on the purchaser because of the large amount of cull material. On the other hand, there may be so few mistletoe-infected trees in a merchantable stand as to cause no inconvenience or loss to the purchaser if he is required to cut all trees marked, whether merchantable or not. A number of regions visited by the writer would fall in this class, but still would represent a serious condition for the future health of the forest if not governed by some such procedure. Management of sales on the basis of requiring the purchaser to cut every marked mistletoe-infected tree, whether merchantable or not, in most regions could only be successfully negotiated where some form of reimbursement was allowed. To determine the most practicable form of reimbursement for both the government and the purchaser is a problem the practical forester has before him. As a first suggestion, cash payment for the time required to fall undesirable mistletoe-infected trees having little or no merchantable content may be considered. The practicability of this would, of course, be determined by the time required to fall trees of varying diameter, which again would be influenced by the ease with which different species could be cut and by the number of mistletoe-infected trees per acre. In regions where serious infection is principally confined to a single species, as in the White pine belt of northern Idaho, a reduction of stumpage price on the basis of all affected species, would be worthy of consideration. The value of this over an equal reduction of stumpage for all species, whether bearing mistletoe or not, is to the effect that the price for White pine, Douglas fir, spruce, cedar, and, in most cases, Yellow pine, would hardly be reduced at all. The only tree affected would be larch, which is in most localities seriously infected by mistletoe. Conditions would, of course, vary as to the number of species affected in the different National Forests. In most cases, however, some one of the more valuable species would escape the reduction. This plan would probably work well enough in regions where the most valuable species is not already carrying, both for itself and its neighbors, the cost of a certain amount of protective work. In some regions where this is being done in the interest of the removal of one or more of the so-called "weed trees" (fir and hemlock), the plan may be varied so as to place mistletoe-infected trees first. It seems that in some cases it may be of more importance to try to reduce the activities of mistletoe on a really valuable species than of the wood-destroying fungus of the weed species. Since the fungus (*Echinodontium tinctorium*) of the firs and hemlocks is not of importance on any of the more valuable species, this may be worthy of consideration. In regions where the firs and hemlocks are both seriously infected with mistletoes and fungi, with no other species carrying mistletoe, the plan would be simple. Such conditions for these species, however, are not common. In regions where all species are so severely infected as to entail a great loss in the quality and quantity of material, the loss in receipts due to the sanitary regulation affecting all the merchantable species could be considered justifiable in view of the needs of the case.

There is something to be gained by negotiating sales wherever possible under the foregoing conditions from the standpoint of the salutary effect it will have on purchasers of government timber. In other words, it is educative. It took some time for the Service to get the purchaser to see the value of, and to practise without murmur, the much needed reforms in the disposal of the débris of a sales area. Now, these conditions are accepted in most cases without protest as a matter of course. This gradual education of timber owners who go into the open market will no doubt cause them to exercise similar precaution in the management of their own holdings.

Mistletoe-infected trees unless infected during late periods of growth, are very often otherwise diseased. Very frequently trees approaching the regulation cutting percentage are left standing when in reality there is considerable merchantable material obtainable. A very large percentage of infected trees in a severely infected region falls far below the amount of material demanded by the cutting regulations. The unfortunate part of it all is these infected trees are left on the area to spread disease through the fungi which they very often carry, to say nothing of the infection of young growth by mistletoe. There can be nothing gained by leaving these near-merchantable trees with the expectation that by the time the next crop is cut something will be realized on them. Those trees infected by fungi will never be any better and, in fact, will be a total loss, while the mistletoe will be stimulated to greater vigor. The immediate felling of all such trees may result, as before stated, in some cases, in obtaining a certain amount of merchantable material heretofore wasted. This would tend to reduce the expense of falling trees having no merchantable content whatever. The most important result would be found in the opportunity given young trees to grow up under better conditions than ever before known for the region.

It has been sufficiently indicated elsewhere that trees severely suppressed by mistletoe are not fit for reseeding the area. In leaving uninfected trees a big advantage is gained in building up the health of the forest. In many cases it will be found that nothing less than clean cutting will be sufficient to eliminate the mistletoe. This also opens up the problem of what to do with the young infected forest growth. Mistletoe attacks all age classes from seedlings to mature trees. A large amount of young stuff when infected, in so far as being a menace to the future health of the forest, is just as serious as the larger diameter classes. When the younger age classes are infected on the main stem, the increment is very early affected and they seldom, if ever, attain a merchantable size. Since the relative cost of handling a tree rapidly increases with decrease in diameter, it is an open question what procedure to follow in ridding the sale areas of this infected material. Clean cutting followed by clean burning may be a drastic method in most cases, but this, however, will be better than taking chances with infected young growth and misshapen and stagheaded trees for reseeding. Furthermore, artificial forestation could be employed.

Naturally a great deal of this work must be considered in the light of an experiment. That it will prove successful under some conditions is shown by what has already been accomplished in some regions. It will mean, of course, that the marker must become thoroughly familiar with the appearance of mistletoe injury and be able to act with judgment under all conditions.

In a work as new as the control of forest tree diseases in the National Forests, it is expected that mistakes will be made. It is often said, however, that he who makes no mistakes never accomplishes anything and it is as true when applied to the furtherance of the principles of forest sanitation as for anything else. Improving the health of the forest is business first and last. It is not a matter of sentiment. When the practical forester and the purchaser get together on forest protection, whether it is protection from fire or protection from fungi and mistletoe, then we may expect a fuller realization of the value of strict sanitary measures.

(It may be of interest to add that the mistletoe trouble extends into Canada as far north as the 54° of latitude at least. In the Pines, Nesbit, Fort à la Corne, Sturgeon and Big River Forest Reserves, the Jack pine is often heavily infested. In the frontispiece we bring examples from the Nesbit Reserve near Prince Albert. The Acting District Inspector, Mr. E. H. Roberts, finds the infection mostly occurring in the pure Jack pine stands, on both young and old trees alike, most noticeable on older trees from 25 years up, and most in open stands. A relation to any particular physical condition of environment was not noted, but fire scars and exposure of tissues by rabbits seem to favor the infection. These sand areas have been kept depleted by fire of any humus cover.—EDITOR.)

SOME CHARACTERISTICS OF SLASH PINE

By Wilbur R. Mattoon[1]

The silvicultural and economic importance of Slash pine (*Pinus caribaea* Morelet) in second-growth Southern forests, although clearly indicated nearly a quarter of a century ago,[2] has somehow quite escaped general recognition among foresters. This is the species formerly called "Cuban" pine (*Pinus heterophylla* (Ell) Sudworth), but now officially designated as above by the United States Forest Service.

Its natural range, occurring within the great Southern pine belt, where the supply of virgin timber has been looked upon as almost unlimited, accounts quite largely for the general lack of information regarding the merits of Slash pine for forest management. Intensive silvicultural studies, starting years ago in the North with White pine, Balsam fir, spruce, and Northern hardwoods, have progressed southward successively to include cottonwood, Yellow poplar, White ash, Shortleaf and Loblolly pines. Recently studies of second growth and yield have been started in the Southern pineries of Longleaf and Slash pines. The above-mentioned species, it will be noted, undoubtedly include the majority of those which, owing to favorable qualities, will furnish the bulk of the future timber supply of Eastern United States. Another reason for the failure of the species to gain general recognition is the difficulty experienced in distinguishing young Slash from young Loblolly and older-aged Slash from Longleaf pine. The first of these is known to be very common among all classes of persons, including those of technical training. Characteristically the young Slash pine of the "old field" is very generally known by that name throughout its range, whether on abandoned fields or cut-over forest lands. Unfortunately the species has passed through a series of many changes in nomenclature which even now is not complete, since botanists differ as to the existence of one or more distinct species of Slash pine.[3]

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[1] Research Department, U. S. Forest Service, Washington, D. C.

[2] Dr. Charles Mohr. Forest Service Bulletin 13, "Timber Pines of the Southern United States."

[3] Sargent, Britton, Sudworth and Shaw recognize but one species, while Harper and Small believe there are two distinct species of Slash pine. The case is similar to that of Bald cypress (*Taxodium distichum*).

Rapid Spread in Second-Growth Forests

Briefly, Slash pine is the predominating tree in the young forest growth over large areas formerly occupied by Longleaf pine. The region extends from southern South Carolina over the lower third of Georgia, extreme southern Alabama and Mississippi, southeast Louisiana, and extensively over Florida. It consists chiefly of poorly drained, sandy flatlands, but continues into the rolling hills of southern Georgia for a distance of 125 miles from salt water. Localities of high, relatively dry hill land, especially a portion of Florida about Tallahassee and the Florida National Forest, form well marked exceptions in the general spread of Slash pine. Because of the uneven distribution of seed trees and the occurrence of annual fires, the stand of young Slash pine is by no means regular or continuous.

Loblolly, present chiefly only in botanical importance, is generally confined closely to alluvial soils along stream courses. The Suwanee River is perhaps its locality of greatest abundance in northern Florida. Commercially, Slash and Loblolly meet in a comparatively well defined line. Botanists[4] have at various times called attention to the widespread advance of Slash pine, yet the fact has remained generally unknown.

Silvicultural Qualities

The silvicultural characteristics of Slash pine which make it a species of high value for forest production under management have been well stated by Dr. Mohr:[5]

"In its dependence on light it is less exacting than either the Longleaf pine or the Loblolly pine. It appears to thrive, from the earliest stage of its development, as well when partially shaded in the open, in this respect resembling the Southern Spruce pine. It is due to these facts, combined with the rapid progress of its growth from the earliest stage, that the Cuban (Slash) pine is gaining the upper hand over the offspring of the light-requiring Longleaf pine, which, on the damp soil of the coast plain, is soon outstripped and

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[4] Engelmann, George, "Revision of the Genus Pinus and Description of Pinus Eliottii," Transactions of the St. Louis Academy of Science, Vol. IV, 1880.

Sargent, C. A. "Manual of Trees of North America," under ***Pinus caribaea,*** p. 19.

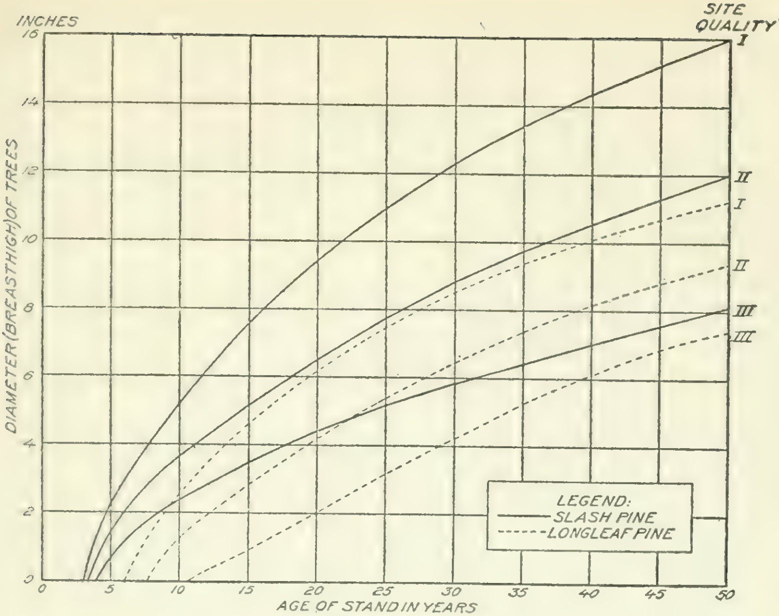
[5] Forest Division, Bulletin No. 13, "Timber Pines of Southern United States."

finally almost completely suppressed by the seedlings of this tree.

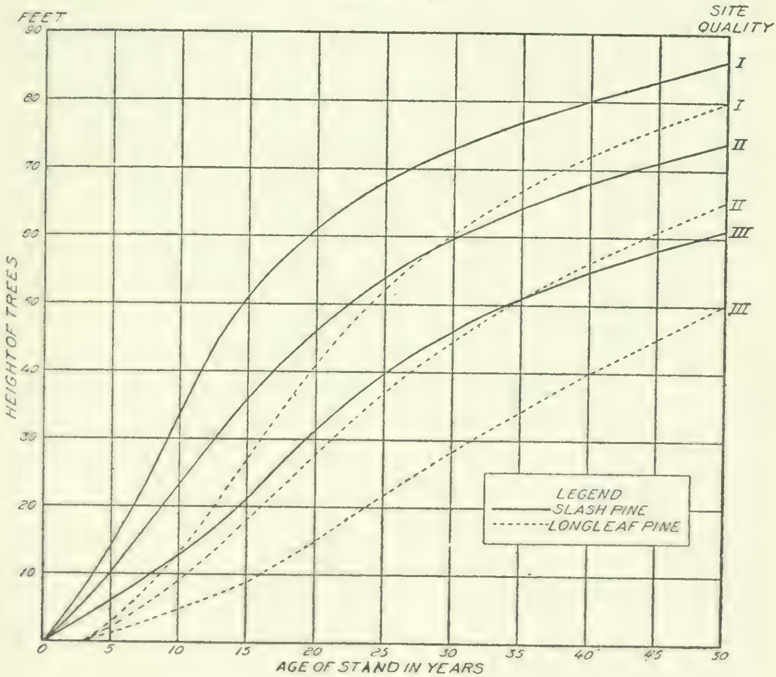
"In the inherent capacity for natural reproduction, or in the advantages for the renewal of its forests by man, the Cuban pine is not surpassed by any other of the species with which it is found associated. This tree commends itself strongly to the tree planter in the coast plain of the lower South. Producing seeds in abundance regularly and with certainty, being less exacting in its demands for direct sunlight, and hence successfully resisting the encroachment of competing species, being less liable to succumb to the destructive agencies of fire on account of its more rapid development in early life, it has greater promise of success than the others. If to this is added the rapid rate of growth, the great value of its timber, being equal to the Longleaf, if not superior, and the abundant yield of its valuable resinous product, it becomes evident that in the reforestation of the low pine lands of the Southern coast regions the Cuban pine is to be preferred to any other, not only within its original boundaries, but as far beyond its range of natural distribution as the climatic requirements of the tree will permit."

The curves of growth, Figure 1, and the derived Tables 1 and 2, although based upon totally inadequate data, are presented here for the purpose of calling attention to the marked difference in growth between Longleaf and Slash pine, with a view of showing the superiority of the latter, and in general the need of further investigation. In respect to height, for example, Slash is seen to make very rapid development for the first 25 years as compared with Longleaf; at 30 to 35 years, on sites poorer than site II, it averages about the same in height as Longleaf on site I and II. Longleaf, however, appears to be more persistent and at 50 years bids fair in a few decades to equal its rival. The average height growth for all trees of the dominant classes of Slash is shown to be greater than that of the predominant trees in Loblolly stands in the central Atlantic States.[6] In diameter growth, Figure 1 clearly indicates that Slash early gets a big lead and retains it quite uniformly throughout the period of years shown. Longleaf evidently has a rather narrow range in rate of growth on different sites, while Slash, in accordance with its wide adaptability to different soils and environment, consistently shows an increasing range in diameter growth with advancing age.

[6] Department of Agriculture Bulletin No. 11, "Forest Management of Loblolly Pine in Delaware, Maryland and Virginia."



(a) *Diameter growth*



(b) *Height growth*

Fig. 1. Comparative growth of average trees in well-stocked Slash and Longleaf pine stands.

TABLE 1.—*Height Growth of Slash and Longleaf Pines in Well-Stocked, Second-Growth Stands*

	Slash pine[7]			Longleaf pine[8]		
Age	*Site:* I	II	III	I	II	III
Years		*Feet*			*Feet*	
5	14	10	6	3	2	1
10	33	23	13	13	9	5
15	51	36	21	27	18	9
20	61	46	31	41	28	15
25	68	54	40	52	37	22
30	73	60	46	60	44	28
35	77	64	51	67	51	34
40	80	68	55	72	56	40
45	83	71	58	76	61	45
50	86	74	61	80	65	50

TABLE 2.—*Diameter Growth of Slash and Longleaf Pines in Well-Stocked, Second-Growth Stands*

	Slash pine[9]			Longleaf pine[10]		
Age	*Site:* I	II	III	I	II	III
Years		*Inches*			*Inches*	
5	2.3	1.5	.8	...	...	...
10	5.2	3.7	2.4	2.6	1.3	...
15	7.5	5.1	3.5	4.6	2.9	.9
20	9.4	6.5	4.4	6.2	4.2	2.0
25	11.0	7.8	5.2	7.5	5.4	3.2
30	12.3	8.8	5.8	8.6	6.4	4.3
35	13.4	9.7	6.4	9.4	7.4	5.3
40	14.4	10.5	7.0	10.1	8.2	6.1
45	15.2	11.3	7.6	10.7	8.8	6.9
50	16.0	12.0	8.1	11.2	9.4	7.4

As compared to Loblolly,[11] the diameters shown for Slash on site I run higher by 40 per cent at 20 years decreasing to 24 per cent at 50 years; they are only little higher for site II, and lower for site III.

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[7] Based on sectional age counts of 18 trees, also average height of 19 sample plots (71 trees), and total height average of 9 trees.

[8] Based on sectional age counts of 12 trees, also average height of 19 sample plots (141 trees), and total height average of 5 trees.

[9] Decade measurements on 14 0.3–5.0 foot stumps of average sample trees 11 to 119 years old.

[10] Decade measurements on 12 0.2–2.4 foot stumps of sample trees 17 to 56 years old.

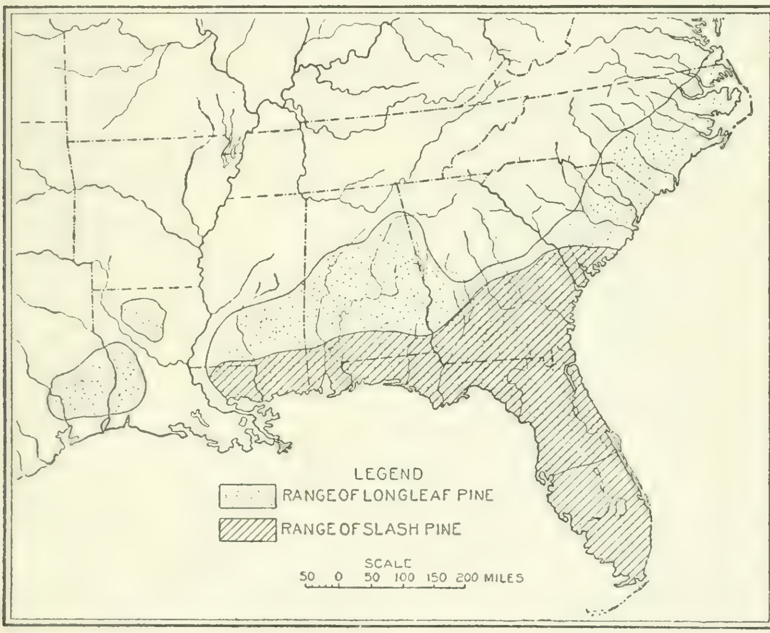
[11] Department of Agriculture Bulletin 11.

[illegible] of Slash pine (about the average tree in 17-year-old stand), [illegible] wide bands of dense, resinous, summer wood even in fast-growing [illegible] 10.7 [illegible]es, height 61.5 feet.)

This is doubtless due to the ability of Slash to tolerate very poor, sandy soils, and also highly acid swamp conditions. The general view concerning the rate of growth of Southern pine forests is based mostly upon that of its most abundant tree, the slow-growing Longleaf pine. While in early life Longleaf grows fairly rapidly in open second-growth stands, it falls markedly below Slash pine in stock density and in both diameter and height growth during a period of 50 years, the probable maximum rotation of future stands under management.

The Wood

The structure of the wood, shown in cross section herewith is such as to give it very high commercial value. Even when



young and fast growing, the tree produces a proportionately wide band of summer wood, very dense and resinous, and sharply demarcated from the spring wood of the same season's growth. The disk here shown—the breasthigh section of a 17-year-old tree, 10.7 inches d. b. h. and 61.5 feet high, is composed of 63 per cent of summer wood—a striking amount for a tree of such rapid growth. Fast-growing Loblolly, in comparison, has relatively much narrower summer wood, grading very gradually into the wider band of spring wood.[12] Table 3 gives the relative physical and mechanical properties of the four important commercial Southern pines, as determined by the Forest Products Laboratory at Madison, Wisconsin. The superiority of Slash over Longleaf in nearly every test will be noted. This gives Slash pine the distinction of producing the heaviest, hardest, and strongest coniferous wood in the United States.[13]

TABLE 3.—*Physical and Mechanical Properties of Slash Pine Compared with the Other Important Commercial Southern Pines*

Quality	*Slash*[14]	*Long-leaf*[15]	*Short-leaf*[16]	*Lob-lolly*[17]
Specific gravity based on volume when oven-dry	.68	.64	.58	.59
Density—weight of wood per cubic foot:				
Kiln dry, pounds	43	40	35	37
Air dry (12 to 15 per cent moisture), pounds	45	42	36	39
Green, pounds	53	48	45	54
Shrinkage in volume from green to oven-dry. Per cent of diameter when green	12.7	12.3	12.6	12.6
Strength in bending. Modulus of rupture. Pounds per sq. in	8,800	8,700	8,000	7,500
Stiffness in bending. Modulus of elasticity. 1,000 lbs. per sq. in	1,630	1,630	1,450	1,380
Toughness. Work to maximum load in bending. Inch-pounds per cu. in	7.9	8.0	8.7	8.0
Crushing strength. Compression parallel to grain. Pounds per sq. in	4,470	4,390	3,810	3,580
Hardness (side) load required to imbed a 0.444 inch ball to one half its diameter. Pounds	630	590	560	450

[12] Based upon detailed studies of the Forest Service in connection with the grading of Southern pine lumber by density rules.

[13] Possibly this may be equally true of all exotic species of conifers.

[14] Figures, except for density, from tests of 5 trees from Florida.

[15] Figures, except for density, from tests of 24 trees from Florida, Mississippi, and Louisiana.

[16] Figures, except for density, from tests of 6 trees from Arkansas and Louisiana.

[17] Figures, except for density, from tests of 10 trees from North and South Carolina and Florida.

PLATE I. THIRTEEN-YEAR-OLD PURE SLASH PINE STAND TAPPED FOR TURPENTINE. 100 TREES PER ACRE, 7 TO 9 INCHES D. B. H., TAPPED IN TOTAL STAND OF 628. HEIGHT ABOUT 40 FEET. (Sandy "pine barrens," Northeast Florida.)

Commercial Value of Young Stands

A few concrete examples of measured stands will serve to illustrate the growth and commercial possibilities of young Slash pine.[18]

A 13-year-old stand,[19] containing 500 trees per acre of the two dominant classes (or a total of 628), averaged 5.7 inches breasthigh diameter and 46 feet in height. There were 172 5-inch trees, 152 6-inch, 84 7-inch, and 20 8-inch trees per acre, yielding 5856 board feet mill scale down to 3½ inches in the top. (Growth and yield data are given in Table 4.) The stand was being worked for turpentine as illustrated in Plate I. About 104 trees per acre, or practically all trees 7 inches and over in diameter, and one face each.[20] A fair value for "gum" in the tree, 10 cents per box for a 3 years' run, gives a gross return of \$10.40 per acre. There had been no protection from fire and the only expense incurred was yearly taxes at the rate of 20 mills on a \$2.50 land valuation. A return of \$10.40 for turpentine rights in 16 years,[21] minus taxes amounting to \$0.83, including interest at 4 per cent, leaves a net profit equal to 4.5 per cent compound interest on the original investment of \$5 per acre for the land. The turpentined trees, which now contained 804 posts per acre, would at the end of 3 years probably contain at least 1,000 posts. Assuming a value of one cent each in the tree,[22] the total returns at the end of 16 years would amount to \$20.40. Deducting taxes for the period, as above, gives a profit of 9 per cent compound interest on the investment in the land. After removing the worked trees, and allowing for a possible 8 per cent additional loss, the stand at 16 years old will contain 496 trees per acre. Under management, however, the tapped trees would not be removed, except as needed for thinnings, but allowed to grow for a period of 3 to 5 years when they could be back-cupped for 3 years. Thus the profit would be increased many times over that derived from the cutting indicated

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[18] Studies conducted in June, 1916, by the writer in company with Mr. C. R. Tillotson.

[19] Columbia County, on typical flat pine barrens sandy soil, 60 miles west of Jacksonville, Fla.

[20] Unfortunately the trees were "boxed" instead of cupped.

[21] Counting to the end of the 3-year turpentine permit.

[22] There is an increasing demand for fenceposts and for sap ties for creosote treatment.

above. At the end of this period the original faces would have about grown over.

Stands showing the effect of protection from fire upon second growth forests are rare in the South. Several such stands of pure Slash and pure Longleaf, however, were located near Glen Saint Mary, Baker County, Florida.[23] According to excellent authority, no fire had occurred during the life of the stands. A layer of humus and leaf-litter from 2 to 4 inches in thickness afforded protection to the underlying very deep, sandy soil. One Slash pine stand made up of two age classes contained 209 trees per acre. Of these, 123 trees per acre, averaging 11 inches d. b. h. (9 to 13-inch classes) and 60 feet in height, were 17.5 years old,[24] and 86 14-year-old trees averaged 5.9 inches in diameter and 47 feet in height. The average annual height growth was 3.4 feet for all the trees, and the average diameter growth for the older age class .76 inches per year since reaching breastheight.[25] The contents of this stand by mill scale taken to 3.5 inches in the top was 10,574 board feet. Since the crown density was .7, it is likely that the stand did not contain the maximum yield for the site by as much as 1,000 to 2,000 board feet. If worked for turpentine according to present methods of tapping, the 146 trees per acre, 7 inches and over in diameter, would take about 160 cups. Located about 1 mile from a turpentine still, the cups in this stand would have been worth about 12 cents for a 3-years lease, or a total of $19.20 per acre. If cut for ties at the present time the stand would yield sixty 6 by 8-inch cross ties, and ninety-two 5 by 6-inch tram ties per acre. At an average stumpage value of 5 cents each, this gives $7.20, or a total return of $26.40 per acre. At the end of 3 years of rapid growth, however, there would be more ties than at present. Deducting the expense for taxes, or 5 cents per year for 19 years[26] at 4 per cent compound interest, and assuming an annual cost for fire protection of 10 cents per year for 16 years, also at 4 per cent compound interest, amounting to $3.82, gives the owner a net

[23] On property owned by the Glen Saint Mary Nursery Company, whose courtesy and cooperation in making studies are hereby acknowledged.

[24] Measurements taken on June 13, 1916, or about middle of the growing season.

[25] 14.5 years growth since reaching breastheight.

[26] Taken to the end of the turpentine lease of 3 years on a stand averaging 16 years old.

profit of over 8 per cent compound interest on the investment of $5 per acre in land. Thus it appears that Slash pine stands, even though understocked from the standpoint of turpentine cups per acre (as in this case) and given complete fire protection, yield very satisfactory returns in less than 20 years.

Young stands should be operated under methods which conserve their productive capacity for crude turpentine, such for example as those used by the French. In this manner they can be profitably worked from the time they reach the age of 15 to 20 years, during a period of 30 to 50 years or more. Under such management the density would be regulated for the development of medium sized trees with thrifty crowns, and necessary thinnings would be brought about by means of heavy and profitable cupping before cutting the timber product. This advantage can hardly be overemphasized in considering the profitableness of growing Slash pine under forest management.

It is very doubtful if any other North American conifer combines silvicultural and economic qualities of an equal value. In addition to prolific seed production, high tolerance, very rapid growth, and adaptability for utilizing the poorest, sandy soils and very poorly drained lands, Slash pine holds the distinction of producing the heaviest and strongest coniferous wood in the country and a larger yield and better grade of crude turpentine than Longleaf pine. Released from its original confinement, under the newly created favorable conditions, the species has spread widely over adjacent lands, showing its inherent ability to adapt itself to a wide range of environment. In the course of the general economic development well under way, several Southern States, particularly Georgia and Florida, have a splendid opportunity for profitably utilizing their hundreds of thousands of acres of poor sandy "barren" lands by acquiring and handling them for turpentine products and timber from second-growth Slash pine stands. The facts acquired thus far point strongly to the profitableness for private capital of this form of investment on low-priced lands.

TABLE 4.—*Examples of Slash Pine Stands of Good Density Showing Growth and Yield*

YIELD PER ACRE[27]

Age	*Trees per Acre*		*Average Height*		*Average Diameter*		*Total Basal Area*		*Solid Measure*[29]		*Yield of Saw Timber Mill Scale*[30]			*Scribner Rule*[31]	*Doyle-Scribner Rule*[31]	*Tree Density*
	Dominant[28]	*Total*	*Dominant*[28] *Feet*	*All Trees Feet*	*Dominant*[28] *Inches*	*All Trees Inches*	*Dominant*[28] *Sq. Ft.*	*All Trees Sq. Ft.*	*With Bark*	*Without Bark*	*5″ and over*	*8″ and over*	*10″ and over*			
10	4,500	7,167	18	16	2.6	2.3	164	204	1,183	717	....	....	....	....	....	1.0[32]
13	500	628	46	43	5.7	5.4	90	99	2,316	1,625	5,856	620	....	1,528	392	.8[33]
15	625	1,150	42	36	5.6	4.4	107	124	2,485	1,735	6,200	550	....	825	150	.7[34]
20	650	1,100	49	44	5.6	4.9	112	134	3,215	2,247	7,550	1,120	....	2,000	510	1.0[35]
20	728	1,378	47	41	6.5	5.3	167	215	4,987	3,569	12,403	6,065	1,480	6,584	1,909	.8[36]
27	420	560	68	66	7.7	7.1	134	153	5,312	3,880	15,170	9,090	690	10,800	3,110	.9[37]

[27] Since Slash pine has the same form factor as Loblolly pine, volume tables in Department Bulletin 11 were used for scaling these trees.

[28] Includes dominant and codominant class.

[29] All trees 3 inches and over. Scaled to top diameter of 1.5 inches inside bark. This and all following tables.

[30] Five and 6-inch trees scaled to 3.5 inches inside bark, all others to 4.5 inches inside bark. Stump height of 1 foot.

[31] All trees 7 inches and over, scaled to 5.5 inches inside bark. Stump height of 1 foot.

[32] Located in Tattnall Co., Ga.

[33] Located in Columbia Co., Fla.

[34] Located in Baker Co., Fla.

[35] Located in Baker Co., Fla.

[36] Located in Jasper Co., S. C.

[37] Located in Columbia Co., Fla.

NATIONAL FOREST ORGANIZATION

By S. W. Wynne[1]

During the past few years very radical and far-reaching changes have taken place in the organization of the working forces of many large industrial concerns. It is natural that these changes should be reflected in the thought of men in the Forest Service who are interested in business management and keep track of progress outside the Service. Mr. Woolsey's excellent article in this volume of the Quarterly puts the matter forth in a definite form, and no doubt his several propositions will bring out the thorough discussion which has been pending for some time. That different men will reach different conclusions with about the same data is just as certain in the Service as it has been with industrial concerns. The extreme difference between District 2 and District 3, at present, indicates how divergent lines of management can proceed from very similar conditions. Which one is right can be determined only by measuring the work accomplished by each and balancing it against the total cost. No common reducing factor has been found to measure the work, and until it is, some other method of determination must be used. If we turn to industry and study the trend of changing methods, it will be seen that large units are displacing small ones. For a time it was held by some organizers that a large operating unit was the first step to low costs. Further experience showed that this did not always work out, in fact, the increase in size sometimes resulted in an increase of cost due to a lessening in the intensity of supervision as against a number of small units with closer attention by the boss. When this condition was studied, it was found that the increase in size was simply a consolidation of similar units without material change in *function*. Increased effectiveness of a single large organization over several small ones resulted only when there was a greatly increased division of labor, or specialization. Conversely, the Taylor type of "functional management" is possible only in a large unit. It would seem that the intense grazing business in District 4 would furnish an excellent chance for larger units, with a grazing specialist to relieve the supervisor of this class of work. The great trouble usually with having a specialist is that the cases requiring his

[1] Forest Supervisor, Sequoia National Forest.

attention are scattered over too much country. In District 4, the concentration of extensive grazing questions should be sufficient to occupy one man's time on a Forest about the size of two of the present ones, without excessive travel. There might be a question of policy here, however, requiring that the grazing work be handled in person by the supervisor.

In order to get the main management systems clearly defined it might be well here to outline them, even at the expense of repeating old material. Different men separate the systems in different manner according to what they conceive to be the principal lines of cleavage.

One of the first divisions into management types was the separation into *traditional*, *transitory* and *functional* systems. The first is simply the old system gradually evolved since men first began working together. As the particular industry enlarged and one man had more than he could do, another man was placed with him to take over half of that line. As more space, tools, etc., were needed, they were added without any definite planning or separation of activities. The transitory type was brought about by the first efforts toward more efficiency. A separation of activities was made, workers were made specialists, and responsibility for each step placed definitely. With the separation of the work of planning from the work of execution, and instruction of the worker *how* to do his work as well as *what* to do, came the functional system. Scientific selection and training of workers, a planning department, and the various bonus systems are parts of the functional type.

A later division of types, resembling the above, is *unsystematized*, *systematized* and *efficiency*. The difference between the first two is largely one of records, with an attempt to correct high costs in the systematized type by periodic paper comparisons. With the setting of *standards* came the efficiency type. Costs were based not on comparisons with what had been done, but on comparison with a standard of accomplishment.

A type division often used is that into *military* and *staff* systems. This division does not seem especially clear, as the staff system in the army is very highly developed. In the words of Prof. Galloway: "The contrast when comparing the staff and military types seems to be the method of exercising control of the business, or execution of orders and commands. The military type is usually a one-man power. The staff type is just the reverse of this. Here the manager is supreme in command, but he is advised by experts at every step."

The action in the military type is like throwing a stone in a pool of water. The initial disturbance radiates out in succeeding waves, the last one gently lapping the shore. It is the military type that has been advocated in some parts of the Government work. The system has sometimes been called "pass-the-buck."

One serious drawback to the staff system is the chance for conflict of authority, which is not possible in the military scheme. However, the military type has so many obvious faults that more than balance the definite authority that it is becoming less used all the time.

In many respects, railroad problems resemble those of the Forest Service, in the great distances involved especially. There have been two radically different systems developed by different roads, the *divisional* type and the *departmental* type. The Division Superintendent, in the words of Mr. Ray Morris in "Railroad Administration," is: "a little king over his domain. He does not solicit traffic nor does he collect or disburse funds, nor is he a lawyer, nor primarily an engineer, but everybody actually employed on the division reports to him on questions of current operation."

Under the department scheme, there is also a separation into divisions, but the division superintendent is *not* in absolute control over all activities. He must take up various questions first with the chief engineer, the superintendent of motive power, the master mechanic, and various other experts. Department, in railroad parlance, refers to a certain group of *functional* operations gathered together under one office. The division superintendent simply operates the trains, and the departments look after track maintenance, bridges, engine repairs, etc. Responsibility is divided and not always clearly defined.

Concerning responsibility, the following is quoted from Mr. Arthur Hale: "They (the men not directly under the division superintendent, as mechanics, division engineers, etc.) should report to the division superintendent everything excepting matters relating to standard designs and methods. It has always been recognized that standard designs must come under the members of the general manager's staff. Where there has been difficulty it can be traced to misunderstanding as to methods of doing work, and the recognition of standard methods should give the staff officers sufficient power as well as plenty to do, for these independent superintendents are sometimes hard to handle. The departmental type will make you splendid trainmasters and engineers in the civil and mechanical branches. The divisional type will give you all round railroad men."

Mr. Woolsey's proposed organization is similar to the divisional type of the railroads, as against the present resemblance to the departmental type. Both systems are represented by prominent and well managed roads and each has its ardent group of supporters. Quoting again from Mr. Hale: "Strength and weakness are best shown in emergencies. On a certain occasion it became necessary to rebuild certain trestles near each other on parallel roads organized differently. The superintendent on the road with the division organization got his carpenters together at once, with all the timber and equipment and simply reported what was done. The superintendent on the road with the department organization could do nothing but report the case to the general manager. He had no control of the carpenters and being Sunday he did not know even where they were. The general manager organized a force composed of his general superintendent, his superintendent of floating equipment and his engineer of bridges and made very good time." What would the case have been in the department system if trestles had been needed on three or four divisions at once?

Quoting Mr. Ray Morris: "The departmental view is that it is economy to have and use the best in all branches of the Service, and that if the mechanical forces do all their work under the supervision of a $10,000 superintendent of motive power, the results will be better than if they do half of it under the supervision of a $2,500 superintendent."

The trouble in the Forest Service is lack of $10,000 places. It might be better to have several $1,500 men doing $2,000 work than to have one $2,500 man in a place requiring $10,000 brain power. A study of railroad management should be more profitable to the Forest Service than a study of shop or factory methods.

The experience of the Sequoia National Forest would tend to show an economy in large units. The Forest area, in 1908, was

3,199,000 acres. This held until July 1, 1910, when it was split into the Kern Forest with 1,938,000 acres and the Sequoia Forest with 1,261,000 acres. On July 1, 1915, after some eliminations, the two were again consolidated, with an area of 2,468,000 acres and a 725-mile boundary line.

The Forest cost for the fiscal year 1910, just prior to the split, was $50,191.00. After the split, costs were as follows for the two units: 1911, $60,852.00; 1912, $60,072.00; 1913, $61,592.00; 1914, $65,869.00.

Following the consolidation, costs became $48,576.00 for 1915, and $43,545.00 for 1916, with an estimate of about $40,000.00 for 1917. Part of this decrease is due to smaller area and a general rise in efficiency as in all District 5. The saving amounts to from $7,000 to $10,000 by dispensing with one set of headquarters. Accomplishment under the two forms of organization is probably fairly comparable, considering some of the former difficulties and the present tendency toward standardization.

The regular administrative and executive force of the Sequoia Forest consists now of Supervisor, Deputy Supervisor, Forest Examiner, and nine district rangers. Protection, improvement, and lands (engineering) are handled by the Supervisor, grazing by the Deputy, and silviculture by the Forest Examiner. This division is the same as that suggested by Woolsey. The difference is that each one of the three men acts in a dual capacity, namely as line and staff. The adviser is expected to transform his advice into action. This entails a lack of clear distinction between departmental manager and staff specialist. There is another difference, due to having fewer men than in the Woolsey system. District rangers are not relieved of the *major* executive work, but are given more of it. It is the intention to relieve them still further of minor executive work, especially bossing ordinary improvement work and similar lines of "physical effort." Labor and construction specialists (line) are easy to get outside the Service, and are often better at this type of work than the ranger. A more effective division of labor is possible also with these minor specialists working along one particular line.

The District ranger is expected not only to "assist the staff executives in the performance of major activities," but also to relieve them of the performance where possible. They are given more important work rather than less important. It is also likely that as fire protection becomes better developed, it will be more fully separated from regular executive lines.

Where one branch of the work becomes too heavy, as in timber sales for instance, it is perfectly possible to assign another man to the organization from the present District organization. This man might be called a staff specialist, but that term is misleading. Staff indicates advice, while in reality he is an executive or line officer. The true staff officer would seem to have his proper place in the District office, as an adviser. Going back to our railroad type, he is an *originator of standard methods and design*. Our local forest specialist then becomes a *line* specialist. He is responsible to the Supervisor for the execution of the work, but carries it out in accordance with the standards and methods of the District staff specialist. Success with this system lies very largely with the ability of the staff specialist to assemble proper methods, uncolored by any strictly local ideas he may have absorbed. It also rests with his complete willingness to change or revise methods as soon as they are shown to be unsatisfactory. The line men must show a similar willingness to stay by the methods until they are so shown. The Service is handicapped in specializing, owing to the fact that it has very few ready-made specialists, but must develop them as it goes. The idea that most of the specialists are potential should be clearly recognized and allowances made in both directions.

The question of more inspection is very important, and probably not satisfactorily solved at present. Before it can be solved, a decision must be reached as to just what should be inspected and how closely. Possibly chiefs of branches can turn more routine matters over to the specialists in their departments and give more attention to field inspection in their own and the other branches. Obviously, silviculture would require different inspection methods from grazing.

Mr. Woolsey's proposition of abolishing the District Offices may possibly work out as a temporary measure of economy, but its chance of as great success as a final economy are not so apparent. His other proposition of making a close study of the organization by a well-balanced committee seems perfectly good business and should be done.

FIRE-SEASON FORECASTS ON A CALIFORNIA FOREST

By R. W. Ayres[1]

One of the chief reasons why each fire season is looked upon without pleasure and with more or less fear is because of the uncertainty of what the summer months have in store. It is true that for certain matters, such as the peak of the fire season, the number of men needed on the suppression force and their length of employment, and the areas of the greatest hazard, we have made long strides towards foretelling what will happen. But still there is left the one all important question: "What kind of a fire season is it going to be?"

The number of fires, the acreage burned and the length of the season belong to the prophet, rather than the forecaster, but there are other questions which have a prospect of being solved by the study of meteorological data. For instance, it is reasonable to suppose that a very wet winter and spring would mean a fire season that would begin late and would not be so intense as a dry one. The summer temperature should be some indication of the character of the fire season. And perhaps the danger from lightning could be determined by weather conditions. Of course, there are only a few years—much too few—to work with, and there may be factors overlooked which contain the key to the problem.

To begin with, it will be assumed that the season which followed the largest precipitation would be the best from a fire protection point of view, and will count the precipitation as beginning with the end of the previous fire season, so none will be lost. That is, for 1911 we will count the rainfall from October, 1910, to June, 1911. Listing the seasons in this way, and leaving out all years previous to 1911, they run as follows:

	Year	
No. 1	1911	42.3 inches
No. 2	1914	38.4 "
No. 3	1915	37.8 "
No. 4	1912	19.6 "
No. 5	1913	17.5 "

This rainfall is taken in Sonora, elevation 1,875 feet, which corresponds to the most dangerous part of the Forest. These

[1]Forest Supervisor, Stanislaus National Forest.

years in the order of their excellence as to precipitation compared to the number of fires are as follows:

	Year		*Best rating as to fires*
No. 1	1911	39 fires	No. 4
No. 2	1914	65 "	No. 3
No. 3	1915	30 "	No. 1
No. 4	1912	23 "	No. 2
No. 5	1913	101 "	No. 5

The only year that acted consistently is 1913; on the other hand, 1912, which has the fewest fires had next to the least rain, and 1914, with next to most rain, had next to most fires.

About lightning, and still using precipitation as a criterion, compare them as to lightning trouble:

	Year	*No. Lightning Fires*	*Relative Position*
No. 1	1911	11	No. 4
No. 2	1914	12	No. 3
No. 3	1915	4	No. 1
No. 4	1912	3	No. 2
No. 5	1913	49	No. 5

Their relative positions here agree exactly with the relative number of fires. So it seems that the number of fires from lightning is in direct proportion to the total fires.

The mean maximum temperature for the same period as the precipitation should affect the season, so they will be listed:

	Year	*Mean Max. Temp.*	*Relative Position*
No. 1	1911	65.3	No. 4
No. 2	1914	66.0	No. 5
No. 3	1915	64.0	No. 3
No. 4	1912	63.7	No. 1
No. 5	1913	63.9	No. 2

Here it is found that the two years which have the smallest precipitation have the coolest weather, and the two with most rain are the warmest. This is the most logical arrangement found so far; but the trouble is that of these two cool years, one had the most fires and the other the least.

Continuing with temperature, if the probable heat of the fire season by the record of the previous nine months could be foretold, it would help; so the average maximum from the previous October to June, with that of the following July to September, inclusive, will be compared. It might be stated here that only maximum temperatures are used, as it is considered that these have a greater effect on the probable hazard by drying out the cover.

	Year	Mean Max. Temp. for Previous 9 Months	Mean Max. Temp. for Fire Season
No. 1	1912	63.7	85.0
No. 2	1913	63.9	98.0
No. 3	1915	64.0	
No. 4	1911	65.3	90.3
No. 5	1914	66.0	88.9

There is not enough difference in the mean maximum temperatures of the summer months to have any effect, and about all there is to say is that dry winters are liable to be the coolest.

If precipitation has no real relation to the number of fires, and if the temperature has no effect, at least a wet winter should mean a fire season that would be late in beginning, or at least late in becoming dangerous. So a table is given showing precipitation for the previous nine months, the number of fires in May, June and July, the acreage burned, and in what ten-day period the season began. A wet winter ought to be a safe basis for making a prophecy, for the condition of the ground in the early season has a marked effect on fires, and to make the table stronger the precipitation in March, April and May, and also the number of clear days in April, May and June will be given to show how much chance the sun had to dry out the ground.

Year	*Precip.*	*Clear Days April, May and June*	*Period Fires Began*	*No. Fires June and July*	*Acreage in June and July*	*Precip. in April and May*
1911	42.3	59	June 1	15	1,264	11.71
1914	38.4	53	June 20	28	114	6.20
1915	37.8	43	July 1	6	6	10.07
1912	19.6	56	May 10	16	2,953	10.65
1913	17.5	61	July 1	8	409	6.43

The two wettest seasons have the smallest acreage in June and July, as compared with the two dryest, which is right. But the number of fires for the two wettest was greater than for the two dryest. The season that had the fewest clear days began late and had the best fire record, but the one which had the most clear days began just as late, and only had two more fires. The year which had the most rain in March, April and May began its season June 1, and burned over 1264 acres, while the year with the next to least rain began a month later and had less fires and one third the acreage.

The amount of snowfall for the various years seems to have an inverse effect on the acreage burned in June and July from what would be expected. The records taken at Lake Eleanor (elevation 4700 feet) show that the largest burned over acreage follows the most snowfall in the late winter and spring, and that years with late snows begin their fire seasons just as early, and in one case earlier than those without them. Particular stress has been laid upon the value of lots of snow and late snows upon the fire season, but this does not seem warranted by the records so far. The three years which have had the greatest snowfall have had the greatest acreage burned over.

There does not seem to be any correlation between any of the known meteorological factors and a fire season, as far as can be ascertained from our present available data. The factors which one would naturally think to be of great influence apparently have none at all, neither late rains or snows, nor precipitation or temperature; and each fire season is an individual which works out its own destiny as it progresses.

The one very important factor of wind cannot be correlated on account of lack of data, and this may turn out to be the key to the results of each season. Wind, however, cannot be predicted far enough in advance to give a line on the coming season; on the other hand, there is no doubt that if wind is the deciding factor in each season, we will very soon be in a much better position to determine the danger by means of the rapidly increasing effectiveness of our cooperation with the weather bureau. This should be extended until each Forest has at least one lookout station fully equipped with all necessary instruments, and with a wireless receiving outfit for getting danger signals from San Francisco.

About the only thing that has been found out by this study is that we cannot tell what the coming year fire season will be like from our present data. There is a chance that a similar study for a large area, such as northern or central California, will show a correlation of meteorological factors from which the main characteristics of a future season can be predicted. But in any case it is probable that we must wait a few years for more detailed data before any very definite conclusions can be drawn.

CONVERSION METHODS—A VISIT TO THE FORESTS OF CHAUX AND FAYE DE LA MONTROND, FRANCE

BY H. R. MACMILLAN[1]

The period of the war is obviously an unsuitable time to visit French forests. All the staff coming within the very elastic limits of military age went on duty at the front at the first outbreak of war. Even many of those too old for active military service were withdrawn from the forest administration to look after transport, supplies and other military necessities. The forests are now in charge of the few men unfit for military service, strengthened by the old guard who have returned from the enjoyment of their pensions. The staff in one conservancy, which consisted in peace times of 20 inspectors had been reduced to 2 inspectors, both well over military age, the guards and subordinate employees had also been reduced by over 90 per cent. Work in the forests is at an absolute standstill; working plans are postponed, excepting where fuel, the work of old men, women and boys, is taken for domestic or industrial purposes, or where the needs of war, which are varied and vast beyond conception, are concentrated on certain forests.

The forest of Chaux is an area of 49,400 acres on the plains east of the Jura mountains. So far as history shows, it has never been otherwise than forest, owned by the royal family or by the State. The name even has remained unchanged for over 700 years.

The coppice stand consists of 50 per cent oak, 20 per cent Blue beech, 10 per cent beech, 10 per cent birch, and 10 per cent alder and poplar. The standards are oak 90 per cent, beech 10 per cent. This forest, an island of inferior soil situated in an agricultural community, though far from being one of the show forests of France, is an excellent example of what forest care should accomplish on similar small, non-agricultural tracts in the more densely settled and industrial regions of Ontario or Quebec. The task was, however, rendered more easy in France than it will be in Canada, by the fact that such non-agricultural areas as Chaux, though they might pass from crown to abbey or noble family, were never broken into small holdings under many ownerships.

[1]Lately Chief, Forest Branch, British Columbia.

Chaux is one of the French forests in which the old rights of user have been settled by awarding to each of the communities bordering the forest, an area in which they carry on their own cutting operations, without payment to the State for the timber, but under supervision of state-appointed, communal-paid officers. There are 29 such communal forests sliced out of the borders of Chaux, averaging in area 600 acres each, and divided into felling series, cut over regularly under a simple coppice system by the villagers and farmers sharing in its ownership.

It is easy to see that a population which thus shares both in the administration and profits of a forest will understand and support a wise and business-like administration of public forest lands in general. The people by using a forest wisely have acquired a forest imagination. The reverse is the case in Canada, where, especially in Eastern Canada, the population is concentrated in deforested area. It seems hopeless to expect people so situated, without any living demonstrations of the profits of wise forest administration before their eyes, to insist upon the proper care and protection for vast public forest areas they have never seen. The establishment and management of forest or well situated tracts of now waste land in the populated portions of Eastern Canada will serve a two-fold purpose in the production of revenue, the supply of timber for domestic and industrial needs, and the teaching of forestry to a population living in a country four fifths of which is fit for forest or nothing.

The staff employed in this small forest must astonish one accustomed to the other end of the forest scale in British Columbia. The central body of State forest and the communal forests, bordering roughly 50,000 acres in all, are administered by the one staff consisting of 5 brigadiers (corresponding to rangers), 6 guards employed solely in the State forest, 12 guards engaged on beats divided between State and communal forest and 2 guards whose beats are entirely within communal forests. All are appointed by the State forest service. Ten of the employees of this small area are furnished with houses and ground for gardens and cattle.

Forest management in France supports as many families per square mile as agriculture in many parts of Canada.

The long and slow progress of the Forest of Chaux to the present system of management is an encouragement to those who may consider progress to be too slow in Canada or the United States. Prior to 1724 this forest was under no regular system of management, except that it was protected against destruction by overcutting. It was then divided into 20 cutting series and managed as coppice under standards on a rotation of 30 years. The necessity for a greater quantity of large timber becoming apparent, and the belief gaining ground that the State should aim to produce high forest rather than coppice, it was decided, in 1766, that 5 felling series would be treated as high forest on a rotation of 100 years. This was not done, however, and the 30-year rotation was maintained. A further attempt was made in 1824 to increase the proportion of high forest by reserving portions of four felling series to stand over through four rotations. It was believed then and for many years after that high forest could be satisfactorily created by clear-cutting the coppice and leaving the standards. The resultant high forest consisted of the standards, seedlings produced from them, and coppice shoots which came up with the seedlings, and in many cases where thinning operations were not carried out, crowded out the seedlings.

The experiment carried out in this manner 100 years ago in the forest of Chaux is not considered to have produced satisfactory results. The seedling growth was not so plentiful as was expected, the coppice growth was particularly vigorous and suppressed many of the seedlings. The resultant forest lost both in productivity and in regenerating power by containing too large a proportion of standards of coppice origin.

French foresters have in recent years devoted much study to the most profitable manner of converting coppice to standards. The system now adopted in such a forest as Chaux, where coppice is being converted to high forest of the same species, is to allow the coppice to grow untouched for the period of one rotation. The effect of this is to weaken the coppice stools and prevent as far as possible the production of another crop of vigorous shoots which would interfere with or suppress the seedlings.

Strong coppice shoots are also produced which may be held over as seed bearers.

At the end of the first period of 30 years the coppice is opened up for a regeneration felling as may be necessary under the local conditions to secure the desired seedling growth. In the beech and oak forests the regeneration fellings are confined chiefly to freeing advance growth or removing the inferior coppice shoots in such a manner as to encourage seed production from either standards or the more advanced coppice shoots. Planting may be undertaken to secure the necessary stock. The usual plan is to complete the establishing of the new stand in this second period of 30 years. The stand then established is thinned and tended for three subsequent periods of 30 years each, by which time the usual rotation of 120 years has been established.

In order that the annual yield of the forest may be kept as nearly constant as possible, the area is usually divided into four series before conversion operations are begun, the conversion of the forest is undertaken one series at a time, series II being started when the regeneration period in series I is completed, the coppice management being kept up in each series until its turn comes for conversion operations.

There are certain forests where it is considered more profitable, not only to convert the forest from coppice to standard, but also to convert the standards from broad-leaf to conifers. An example of this was seen at the small forest of Faye de Montrond on the Jura plateau. This forest was coppice on a 25-year rotation with standards on 120-year rotation, the species being oak, beech, ash, maple. This is being changed to Silver fir high forest for the sake of the greater profits expected. The broad-leaf forest yielded $1.50 per acre per annum; the Silver fir forest is expected to yield $12 per acre per annum. The Silver fir forest is to be managed on a rotation of 120 years. The forest is divided into four felling series, each to be worked over in 30 years. Operations for conversion were begun in 1860. During the following 25 years the coppice was allowed to grow in three of the felling series, but was cut as usual on the other.

The first felling series was taken in hand in 1886, at which date it was covered with coppice 25 years old. The treatment forecast for it at that date provided that it should be gone over three times at 10-year intervals during the period 1886 to 1915, this being accomplished by dividing the block into 10 annual coupes and working over each coupe three times.

The treatment given the block between 1886 and 1895 consisted of cleaning up the area, removing the undergrowth, the poorer coppice shoots and standards, amounting to about 10 per cent of the total. The following year fir and spruce were sown or planted in the openings. The fir was sown several seeds in a spot one or two feet square. Spruce, which is planted, was used only for large openings. The many firs coming up in the seed spots were transplanted during later operations. During the period 1896 to 1905, thinning operations, both to free the spruce and fir already established and to create further openings for sowing and planting were conducted. At this time any failures in the sowing of previous decades were corrected. During the final treatment during the period 1906 to 1915, practically the whole of the remaining broad-leaf stand, excepting vigorous seedlings of valuable species, were removed and the establishment of the coniferous forest completed by final sowing and planting.

While block I, amounting to one quarter of the area of the forest, has been receiving this treatment, blocks II and III have remained in growing coppice which in 1915 will be 55 to 80 years old. During the period 1886 to 1915 improvement fellings were carried out over block II three times, with the intention of leaving in the block at the end of the period only the best of the standards, coppice and seedlings. Enough fir and spruce was introduced after the fellings to form about one quarter of the final stand.

Block III was treated in the same manner as block II, at the same time, with the exception that thinnings in block III were lighter and very little sowing or planting of conifers has yet been done. Block IV was worked as coppice until 8 or 10 years ago. Coppicing was then stopped, and it will be allowed to stand in reserve until ready for the same treatment as has been given blocks II and III.

The forest when visited in 1915 was at the end of the first 30-year period of conversion. The situation in each of the four blocks was:

I. Establishment of coniferous forest completed now in groups, 1 to 30 years old. Broad-leaf trees disappeared except for thrifty seedlings left. Coppice shoots kept cut down and coppice stools dying out.

II. Coppice, 55 to 80 years old. Three improvement fellings have cleared away large proportion of coppice shoots and many standards. Fair number of young fir, spruce present.

III. Coppice, 55 to 80 years old. Small proportion of coppice and standards removed by light improvement fellings and few conifers sown and planted.

IV. Coppice, 8 to 33 years.

The mistake was made in conversion of this forest, of allowing coppice to grow up over too large a proportion of the forest at one time. As a result of this initial error the coppice on block III, and to a certain extent on block II, began to lose its vitality and to thin out before it was reached in the scheme of felling and sowing operations. This was not foreseen in the forest of Faye de Montrond until too late and was then corrected by thinning and planting in blocks II and III some years in advance of the original plan. The consequence will be seen in the final coniferous forest where the age classes will be abnormally distributed, the older trees predominating.

A short visit to a few French forests convinces me that there are now certain regions in Canada where economic conditions are quite as favorable to intensive forest management as in many of the profitable French forests. The real obstacle in Canada is to be found in the public, not in the forests.

PASSING VIEWS OF FORESTRY IN BRITISH SOUTH AFRICA

By H. R. MacMillan[1]

South Africa, of all British dominions, and one might say, of all English-speaking countries, lost least time after the first important settlement, in considering forestry. The Dutch, who were the pioneers over large areas, seem always to have desired to see trees about them. The towns and cities of South Africa, ranging from Cape Town and its oak avenues over 200 years old to the newest crossroads in the veld are clothed with trees in a way that puts to nude disgrace the unblushing blocks on the plains of Canada and the United States. Many of the older South African towns have parks containing an astonishing range of exotic forest species and others have established municipal forest plantations. These parks, arboreta and plantations, even if of no great commercial value, have been of certain assistance during the development of the present progress of forestry in South Africa both by convincing the public of the results possible from forest plantations and by serving as experimental grounds from which foresters may draw valuable deductions regarding the use of various exotic species.

The lesson of the annual timber imports which is kept well before the South African public has induced strong and widespread support for planting trees. The owners of gold, coal and diamond mines, who pay high prices for props, the fruit industry, always in the market for large quantities of cheap box material, the railroads forced to pay about $1.75 each for imported sleepers, the farmers and urban population paying $40 to $50 per thousand feet at the chief centers for common lumber, all support the Government in its forest planting policy. The annual timber importations of South Africa reached, in 1914, over $3,500,000, an average of $3.50 per capita for the white population. The difficulty of the Forest Department has not been so much to secure funds for the carrying out of necessary work as to accomplish the rate of progress demanded by the public without committing errors either in planting or administration of remaining indigenous forest, such as might later lead to hasty condemnation of forest work.

The forester in South Africa must break virgin ground to an

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extent unknown to other forest services. The indigenous forests covering now only half a million acres in a country of 430,000 square miles, are poorly stocked and contain only hardwood species of slow growth, belonging to genera which have never yet been under forest management, and concerning which it has already been learned that natural reproduction is slow of growth and difficult to obtain. The most important forests of the future must be established by the introduction of timber trees from other continents. Rule of thumb methods, carried bodily from other lands, have helped foresters in many new regions—they are of little use in Africa, the country where the forester must rely upon science alone, largely meteorological as well as silvical, in developing his plan of campaign.

Physiography and Climate

The progress and present situation of forestry in South Africa may be more readily understood if a slight digression is made here to outline the climatic and physiographic conditions. A general outline map would show the six broad regions into which South Africa has been divided by the important influences controlling plant growth. The salient features of these types are as follows:

1. *South-west coast.* A desert-like strip, 40 to 60 miles wide, reaching from sea level to the 3,000 foot contour, extending through late German South-west Africa southward along the South Atlantic coast to the Oliphants River. The soil, sandy near the ocean, becomes a mixture of sand and clay inland toward the mountains; the only break in the topography is furnished by low rolling hills. The average annual rainfall over a period of 10 years varied at two stations from 2½ to 4½ inches, 80 per cent falling in the winter six months. The temperature ranges from a minimum of 32° F. to a maximum of 108° F. Vegetation is sparse and trees few, the latter confined to scattered Tamarix, Acacia, Combretum and Euclea, of no economic value.

2. *South coast.* This is another littoral strip, extending about 50 miles wide from the Oliphants River eastward to near Port Elizabeth, a distance of 500 miles. This coastal belt rises in steps by a series of escarpments, to a height of about 3,000 feet. This is a region of winter rains, varying from 40 inches annually near the coast to 20 inches inland. The temperature varies from a

minimum of 26° F. to a maximum of 112° F. Here are found thousands of square miles of brushwood 2 to 8 feet high. Forests occur chiefly, nearly always in small areas, in the moist deep ravines and valleys facing the sea.

The most important areas, now under permanent administration run to a few thousand acres each, grouped chiefly in a district 110 miles long and 10 miles wide. Wild elephants are still found in these forests.

The extremely mixed character of the stand and the problems it presents to the forester are indicated by the genera entering the forest composition in this type: The first and most important is Podocarpus, others are Scolopia, Doryalis, Kiggelaria, Vepris, Ekebergia, Apodytes, Ilex, Gymnosporia, Cassine, Pterocelastrus, Elaeodendron, Scutia, Ptaeroxylon, Rhus, Virgilia, Cunonia, Olivia, Cussonia, Canthium, Curtisia, Burchellia, Rapanea, Sideroxylon, Olea, Nuxia, Chilianthus, Ocotea and Celtis.

3. *South-east.* This coastal belt, marked by summer rains extends, 50 to 100 miles wide northward from Port Elizabeth to Portuguese territory, widening as it goes northward, and reaching from the Indian ocean inland to an elevation of about 3500 feet.

The inland westerly boundary of this region is marked by a north and south mountain range, behind which lies the great continental plateau. The drop from this range to the sea, comprising the type under discussion is neither even nor gradual; the country is very rolling, broken by ridges paralleling the main mountain system, greatly diversified and deeply cut into valleys. The rainfall averages 40 inches near the coast, 20 inches inland. Two-thirds of the precipation falls in the summer months. The temperature varies from a minimum of 21° F. inland, where frost occurs only above 1300 feet elevation, and a minimum of 40° F. at the coast, to a maximum of 110° F. The whole type consists of grassland, savannah and woodland intermingled. The small forest areas, which were originally much larger, amounting now to a total of about 300,000 acres, are found near the coast and include the following genera: Podocarpus, Vepris, Olea, Apodytes, Olivia, Scolopia, Mimusops, Sideroxylon, Ekebergia and Ocotea.

4. *Karroo.* This is the desert bed of an ancient lake, 50 to 75 miles wide from south to north, extending east and west 300 miles, lying 1800 to 2500 feet above sea level, and surrounded by mountain barriers which reach in the north a height of 4,000 to 8,000 feet.

The soil is fertile but water is scarce and the scanty rainfall is carried away rapidly by the many torrential beds which cut the surface. The rainfall has averaged at different points 8 to 14 inches annually, 60 to 75 per cent of which falls in the summer. The temperature varies from a minimum of 20° F. to a maximum of 110° F. There are no trees except scattered *Acacia horrida* along the few river banks.

5. *Upper Region.* Lying directly north of the Karroo is a great region, almost 300 miles square, 3500 to 4,000 feet in elevation, a vast monotonous plain broken only by isolated, flat-topped mountains or rugged hills.

The rainfall here has averaged annually at different points 6 to 27 inches, of which 65 to 75 per cent comes in the summer. Coupled with the absence of rainfall, the range of temperature, together with the sudden changes, is very severe for plant growth. The minimum is 14° F. to 20° F. at different stations and the maximum 97° F. to 112° F. There are a few stunted bushes on sheltered slopes and in the valleys, but absolutely no trees, excepting an occasional *Salix capensis* along the Orange River, which is the chief drainage course for the region.

6. *Kalahari.* There remains the great continental plateau, 3500 to 4,000 feet high, an area of 700,000 square miles comprising almost the whole of Orange River Province, the Transvaal and Bechuanaland, a large portion of the North-western Cape Province, and much territory outside the Union of South Africa. The general slope is westward to the Orange River; a few streams break through eastward to the Indian Ocean. Many mountains rise from the plateau, reaching 6,000 to 10,500 feet.

The rainfall varies from almost nothing in the sandy western boundary districts to 20 inches along the east and southwest and 40 inches on some of the mountain ranges, particularly in the northern Transvaal. Eighty per cent of the precipitation occurs in the summer. The temperature drops to a minimum of 16° F. to 20° F. and rises to 96° F. to 112° F. The changes are very sudden and frosts are dangerous to vegetation in many districts.

The mountains are grass topped. Westward extend hundreds of miles of high veld or grass, which merges into scrubby bush veld and savannah forest. The only important forests are in the limited regions of greater rainfall, covering only a few thousand acres in the ravines and on the slopes lying to the east and southeast of the mountains.

Forest Distribution and Composition

It is not surprising that native forests did not cover large areas in South Africa. By far the greater part of the country, as may be gathered from the descriptions given of the climatic regions, is absolutely treeless. Such forests as do occur are chiefly open, dry-land scrub types, known locally as bush veld or thorn veld. Here acacias predominate. Of the many species occurring, of which only a few, and these only in scattered specimens, possess qualities or reach sizes to give them value for timber may be mentioned as amongst the most useful the wild olive (*Olea verrucosa*), the Karree-boom (*Rhus lancea* and *viminalis*) the Camel thorn (*Acacia giraffae*), Knoppies-doorn (*Acacia pallens*), Aapiesdoorn (*Acacia burkei*), African teak (*Adina galpini*) and Kajatenhout (*Pterocarpus angolensis*).

These scrub forests, occurring as they do in an otherwise bare country, were used extensively from the earliest pioneer days for fencing, fuel, mining timbers, buildings and material for vehicles and implements. The original area could not have exceeded a few million acres. The land on which scrub forests occurred has passed chiefly into private hands or native reservations. The species are slow growing, not virile in reproduction, and so scattered that large areas must be run over to produce sufficient timber even for local uses. The inevitable result has been the destruction of the most important areas of scrub forest in spite of its value to the settlers for shelter, soil protection in a country where erosion is very rapid and destructive, and as a source of small serviceable poles.

About 120,000 acres of scrub forest have been preserved by the Government in forest reservations.

The timber forests were from the earliest days even more limited in area than the scrub forests. The original area was probably between 500,000 and 1,000,000 acres. These patches, rich in species as has been stated, occurred in small areas favored with rainfall, scattered on the slopes and in the ravines of the mountain escarpment which rises 100 miles wide along the northern and eastern African coast. Though the pioneers first penetrated this belt and destroyed much of the forest, they were always looking for more accessible plains where cattle would flourish. The bulk of the population has drifted past the forest areas, otherwise nothing would be left. As it is, few tracts remain which have not been heavily cut over in the past century, almost to the extinction of the principal species. Such small areas of virgin forest as remain owe their salvation to the extremely high cost of moving the comparatively small quantities of valuable timber either to the seaboard or to centers of population.

The original African timber forests contained 108 species, of which a few were very valuable, nearly all slow growing hardwoods, admirably adapted for vehicle construction. Chief among them are Yellow wood (*Podocarpus thunbergii* and *elongata*), constituting three quarters of the stand, Assegai (*Curtisia faginea*), Stinkwood (*Ocotea bullata*) Black ironwood (*Olea laurifolia*), White ironwood (*Toddalia lanceolata*), White pear (*Apodytes dimidiata*), Kamassi-wood (*Gonioma kamassi*), Clanwilliam cedar (*Callitris arborea*), occurring scattered over 200 square miles, Sneezewood (*Ptaeroxylon utile*), and Cape Box (*Buxus macowanii*).

Wherever forests existed wheel-wright and vehicle works were established to supply the wagons so extensively used in South Africa. It is doubtful if any American vehicle woods possessed the strength or toughness of some of the African woods. The selection of the forest for this use, the cutting of mining timbers and railway sleepers, together with repeated fires, and constantly encroaching clearings made by shifting cultivators have sadly reduced the indigenous African forests. About 450,000 acres remain, nearly all cut over and in a state of regeneration, of which about 400,000 acres is in Government forest reservations.

Development of Forestry

An extensive forestry program was under way in Cape Colony and much was actually accomplished long before the Union. Forestry in the other provinces before the Union, and over the whole of the country under the present Union Government, is a direct offshoot of the pioneering days of the old Cape Colony Forest Department. The problem of forest administration first engaged the attention of Cape Colony in 1819 when a Superintendent of Lands and Woods was appointed. This appears to have been similar to what has been so common in Canada, chiefly an office administration, until 1876, when forestry received further recognition by the creation of a Forests and Plantations Department, responsible direct to the Minister. The head office of this department was located at a comparatively inaccessible spot in the midst of the most important Cape Forest area. The pressing need for definite action led in 1881 to the creation of a special separate Forest Department, under charge of a Frenchman, Comte de Vasselot, a student of Nancy who had extensive experience in reforestation in Gascony. His report recommended the passing of a forest law, the establishment of a technical forest department, the demarcation of the indigenous forests to be managed under working plans as permanent forests, and the formation of extensive forest plantations to meet future needs.

D. E. Hutchins, the pioneer of South African forest planting, a man who has done more than any other living forester in the transfer of forest species to new lands and in fighting the cause of forest planting in a treeless country, was transferred from India to the Cape Forest Department in 1883. The native forests were demarcated and set aside under a forest act passed in 1888, modelled upon the 1882 Madras Act. In 1891, following the Indian practice, administration of the Forest Department was divided among four conservators, each reporting directly to the Government on matters affecting his district. This arrangement continued until 1903, when a Chief Conservator was appointed whose responsibilities extended over the whole colony.

The Cape Service grew rapidly; in 1905 the staff included 26 conservators and assistant conservators and 84 European foresters, the latter corresponding somewhat to rangers and guards in North American practice. Several men had been sent to Cooper's Hill for training and a primary forest school had been established in the heart of the Tokai plantations, near Cape Town. Over $3,500,000 had been expended in forest plantations, and the continents of the world had been searched for forest species likely to succeed under Cape conditions.

The other crown colony, Natal, did not make such progress. Rich Yellowwood forest areas, limited in extent, existed in the central part of the Province. As early as 1886, a Cape forester reported; another report was made by a German forester a few years later, but nothing was done. A modification of the Cape Forest Act was put into effect by government regulation, the office of Conservator of Forests was twice created and twice abolished, and very little was accomplished. From 1908 to Union in 1910, forest work was in the hands of the Director of Agriculture. Up to that time a little work had been done in establishing arboreta and plantations. The natives had been given forest rights and had destroyed a large proportion of the valuable indigenous forests.

Forest Departments were established in Orange Free State and the Transvaal under the Agricultural Departments of the Crown Colony Governments in 1903. These departments were staffed with trained men selected from the Cape Service and from Europe. An active start was made in setting aside the few thousand acres of indigenous forest in Transvaal and in establishing arboreta and nurseries preliminary to carrying on an aggressive planting policy. Planting in Orange Free State is extremely difficult. The elevated treeless plains suffer severely from drought, frost and drying winds. The most promising districts are restricted to the Basutoland border where moisture conditions are better.

There is no indigenous forest.

The forest prospects in the Transvaal are better. There are large areas of land along the east slopes forming the eastern boundary that are fit for forest planting. In the north, too, on the mountain ranges, are also areas where conditions are such that forest planting will be successful and profitable.

The indigenous forests are not extensive; they are found on the south and east slopes of the mountains and on the northern escarpment at a height of 4,000 to 6,000 feet where the indigenous Yellow-wood forest reaches its northern limit. Across the Limpopo River from this escarpment begins the low veld with the open, dry, deciduous scrub forest of sub-tropical Rhodesia.

The Union of the four provinces in 1910, carried out on a broader scale than the Union in Canada or Australia, brought under the scope of one Forest Act and one administration the whole of the indigenous and planted forests of South Africa. Forestry thus became the distinctly national question that its importance merits.

Present Organization

The Forest Act, passed in 1913, while consolidating the ordinances of the four provinces follows the previous Cape Act. The chief provisions of the Act are for the reservation and protection, unalienably except by vote of the two Houses of Parliament, of all forest reservations; the acquisition by the Government of land for forest purposes; and the increasing of the timber production of the country by the establishing of plantations. Private plantations may be placed under the Act for purposes of protection, and all trees growing on road sides, if not private or municipal property are placed under the control of the Forest Department.

Forest reservations are, after the Indian system divided into demarcated and undemarcated. No great difference is apparent, except that the demarcated include the more valuable and accessible areas, the boundaries of which are more plainly established, and offences in which are more severely punished.

A sound organization has already been established for carrying on the work. The Forest Service is under the Department of State, and the Chief Conservator is responsible directly to the Minister of Agriculture. The Union is divided into seven conservancies, each in charge of a trained Conservator of fairly long experience, responsible to the Chief Conservator. The Conservancies are divided into districts, each in charge of a District Forest Officer. There are altogether 27 District and Assistant District Forest Officers. The forest planting stations, or small forest areas in each district, are each in charge of Foresters, of whom there are 123.

There has lately been added to the organization an office of Research, the staff consisting at present of one Research officer. The duties of this office are, of course, multifarious, including silvical studies of indigenous forests, recording of the innumerable experiments carried on in planting, finding uses for indigenous and planted woods, coping with insects and diseases, organizing the investigative forces of the whole service and introducing systematic plans of working indigenous forests and plantations. The whole of forestry in South Africa, even more than elsewhere, is experimental, policies and principles must change rapidly according to newly discovered facts. The Research office should soon be largely increased.

Every effort is being made to recruit from properly trained men. A training school established under the Cape Government is carried on by the Union Government. Here men who have passed preliminary examinations and served apprenticeships are given a nine months course, which increases their value for the grade known as "Junior Foresters," to which they are appointed on plantations and forest tracts under administration.

The Assistant District Foresters are now appointed only from men trained at accepted forest schools in Europe or America.

Several South African Rhodes scholars have specialized in forestry at Oxford and later joined the Department. The Union Government has also established two scholarships tenable for three years, each worth £200 annually, to permit two men to study abroad. The regular programme calls for the appointment of two Assistant District Foresters yearly.

One of the chief weaknesses of forest administration, particularly in Canada, is the uncertain future of the trained and other men employed. The lack of a defined salary policy on the part of many governments, and the utter absence of a pension system, is certain to render difficult the holding of the best men. Canadian governments do not attempt to safeguard their interests by providing safe careers for, or offering inducements to, their expert employees. Chiefly as a result of the Crown colony administration in the various African provinces before Union, a definite salary and pension scale has been adopted by law which, by its certain provision for the future, serves as an inducement for the forester to allow his future to rest with the State. What the Government of South Africa has considered it wise to do may be of interest in North America. It should be noted well that in South Africa, a million white people, possessing virtually no forests are engaged in forest planting. Foresters in South Africa on the face of things, can hardly have a high market value outside their present employment. The government desires to attract good men and keep them, therefore offers fair pay and a pension.

The permanent field men, known as foresters, chiefly rangers on the reservations or skilled men in charge of nurseries and plantations, are divided into four grades, receiving the following pay per year:

First grade	£ 84	to	£120
Second "	£120	"	£150
Third "	£150	"	£180
Fourth "	£180	"	£240

The Assistant District foresters receive £180 to £255 annually, and, when they reach the grade of District Forest Officers, rise from £280 to £360. Conservators of whom there are seven, are divided into three classes:

£400	to	£500	3	conservators
£500	"	£600	3	"
£600	"	£700	1	"

The Chief Conservator for the Union is, of course, more highly paid. Throughout the organization a regular annual salary increment is provided. The salaries in many cases are augmented by the use of Government residences or allowances in lieu thereof. Every permanent employee on reaching the retiring age receives a pension.

South Africa, with only a fraction of the population and resources, and a very much less interest at stake, has faced the problem of forest organization in a more statesman-like manner than has any part of Canada, and as a result is building in a more permanent manner and on a sounder basis. The total area of forest reserves in South Africa is about 2,000,000 acres. Only about 400,000 acres of this area is forested. There are 280,000 acres of mountain ground unfit for tree growth, held under forest reservation as a convenient means of retaining under public control areas which might be over-grazed and become crowded if allowed to pass into private hands. Fifty thousand acres of drift sands are included in the forest reserves, as also 200,000 acres of mountain lands producing "buchu," a shrub-producing leaf of medicinal value. The remainder of the area under reserve is made up of waste land, only a small proportion of which is expected to be of ultimate value for afforestation.

Working Plans and Market

The indigenous forests are located chiefly in Cape Province. Ambitious attempts were made in the early days of forest administration to put them under systematic management on a sustained yield basis. Working plans were drawn up and sanctioned which did not work, chiefly because of lack of silvicultural knowledge of the various species, of financial pressure which forced over-cutting in spite of the working plan—a condition not yet remedied—lack of demand for any but the best species in the forest, too few trained officers, and too great a pressure of wood-cutting population seeking the best woods. There was thus created a management system of inverse selection which has gone far to ruin some areas.

Under the present administration a determined effort is being made to overcome these handicaps. Much yet needs to be done before the indigenous forests, which are nearly all very much overworked, can be said to be on the up-grade. A shortage of trained staff still presents an obstacle in the way of learning the silvical habits and requirements of the many species unknown to foresters anywhere. The poor natural reproduction and slow growth of nearly all valuable species intensifies the problem. The existence near some of the most important forests of a population dependent upon timber cutting, whose necessities can only be met by over-cutting has been a sore problem, the solution of which is only now under way.

The policy of the Forest Department is, however, to bring all indigenous forest reservations under permanent management. To this end a systematic study of habits and growth of the different species has been inaugurated and cutting restricted to selection by forest officers. A close supervision is maintained over all cutting operations, and an effort is made to reduce waste in the woods and to encourage natural reproduction. Cutting as well as being restricted to marked trees is kept within assigned areas of each forest each year. Cutting, though regulated, is still probably in excess of the proper quantity. Improvement cuttings have been undertaken in some areas. The indigenous forests at present produce over 900,000 cubic feet of timber annually, chiefly Yellow-wood, Black ironwood and Assegai. The average size of the trees may be judged from the fact that 60,708 trees were cut to produce this quantity of timber. The timber is sold standing, the prices realized being extraordinarily high, having averaged in 1914 to 1915, 9½ cents per cubic foot for Assegai, 15½ cents per cubic foot for Clanwilliam cedar, and 17 cents per cubic foot for Sneezewood. These prices, which are 5 to 10 cents per cubic foot below the previous average, are especially high when it is considered that they represent the average paid for scattered individual trees standing in the forest, and that the logs must be removed miles to a mill or market with crude appliances. As much as 25 cents per cubic foot has been paid for Stinkwood trees 60 miles from a railroad and 6 cents a cubic foot for Yellow-wood 20 to 30 miles from a railroad. Sneezewood fence posts sell for 25 cents per lineal foot standing in the forest. If all the species were marketable, forest management in Africa would be much simplified. Unfortunately only the species fit for sleepers (in a country where sleeper specifications are unduly high), cabinet and vehicle work are used. The The other hardwoods cannot compete, under present methods of logging and utilization, with imported Scandinavian and North

American softwoods and are therefore left to impede the forest. The small area of the forests and the small quantities of the various unused species render the question of extracting them from comparatively inaccessible situations and using them very difficult indeed.

Silvicultural Management

The native tree species of South Africa are strikingly slower in growth than the successful exotics. This fact alone will tend to give the indigenous forests less importance in management than will soon be assumed by the plantations. It has been estimated that no more than 10 to 20 cubic feet per acre per year is the best to be expected from the most promising indigenous forests.

Fire is not a great enemy, the chief trouble in this direction has been from shiftless cultivation encroaching on and causing fires within the reservations. Fire protection, in addition to the patrol of the permanent staff, nearly all of whom have comparatively small areas, has been by planting fire breaks of wattle and by clearing and burning fire lines. The latter policy is considered the more successful. The total area burned over in 1914 to 1915, including plantations, was 212 acres.

An effort has been made to improve the indigenous forests by interplanting with exotic species. Altogether 1,300,000 trees have been so planted on 6600 acres. This work is considered to be experimental, as the results to be obtained from planting rapidly-growing, moisture-demanding species in the indigenous forests are uncertain.

The destruction of forests by the numerous natives cutting saplings for hut poles has been stopped by establishing plantations of exotics to meet this demand.

The area of indigenous forest in South Africa is so small that planting must be relied upon for a large proportion of future requirements. The fact that indigenous species are very hard and dense, being in general unsuitable for common building purposes, are also slow growing, and are in the main only adapted for growth in the more humid portions of the country, has led the foresters in charge of planting work to depend upon exotic species.

Planting was first undertaken in Cape Province. An extensive arboretum was formed, in which trees from all similar regions of the earth were tried, special attention being paid to Mediterranean countries, Australia, Himalayas, Persia, Pacific Coast of North America, Mexico and the Andes. Over 140 species of eucalyptus have been tried and probably well up to 300 species in all from different regions.

The trials are by no means complete, the different combinations of species, soil, climate and exposure have been by no means exhausted. The sketchy manner in which early records were kept reduces the value of many of the experiments. Only recently have systematic studies of past work been undertaken in such a manner as to contribute the maximum of experience. Sufficient has been learned, however, to confirm the Forest Service in the belief, that, although failures may yet be expected, the commercial success of many species has been established. There are in existence now about 64,000 acres of forest plantations, a large area of these consists of plantations of 100 acres to 200 or 300 acres each, containing a large number of plots of different species. These small nuclei, while they have been of great experimental value in demonstrating to the public that trees will grow, and in determining the useful limits of exotic species, cannot be accounted of much commercial value. Many of these plots are also so situated that the stumpage value will be depreciated by transportation costs.

The aim of the Forest Service now is to plant about 10,000 acres per year. Experimental work will still be necessary but planting will in the main be confined to the species already proved satisfactory. The location of the plantations is a serious problem, so as to secure rainfall, productive soil and accessibility. Plantations will chiefly be upon agricultural land near railroads, within 200 miles from the Coast. Each plantation up to the present has contained a great number of species, sometimes 100 or more, each in a small, pure block. Hereafter, plantations are likely to consist of few species. The area for economical administration will be about 5,000 acres at each planting station.

Records furnished by early plantations, as well as the excellent start made by the more recent Forest Department plantations, show that extremely rapid growth may be expected from many of the exotic species in South Africa. Several of the pines thrive exceedingly well in the winter rainfall region of the Cape. *P. insignis* in this district reproduces naturally in profusion and is spreading beyond its original areas. *P. pinaster* and *canariensis* also have been very successful. Forty years ago there were no trees near Grahamstown, one of South Africa's educational centers, since that time *P. insignis* plantations have been established which at 30 years produced 9,000 cubic feet of timber per acre. Shipping timber to the mines from Grahamstown is now an important, and is evidently a permanent, industry.

A plantation of eucalyptus begun after 1876 at Worcester, covering 70 acres, sold at about 32 years for $20,000. *E. diversicolor* at 6 years had produced an average yearly increment of 533 cubic feet per acre, at 13 years this average had risen to 625 cubic feet per acre. *E. saligna* at 18 years had reached a height of 100 feet and averaged an annual growth of 527 cubic feet per acre. English oak (*Q. pedunculata*) thrives in the heavier rainfall regions of some of the Cape Mountain Ranges, and the growth is much more rapid than in Europe. At 21 years one plantation had reached a height of 54 feet, a minimum diameter breast high of 6 inches and had produced 231 cubic feet per acre.

The eucalyptus, nearly 150 species of which have been tried in the inconceivably numerous combinations of climatic, altitude and soil factors in South Africa, have in some instances made marvellous growth. *E. maideni*, in the Transvaal, at 9½ years old (It is significant that in discussing these upstarts the forester in Africa considers half years) was 70 feet in height. A 24-acre plot, 10 years old, yielded from thinnings a gross revenue of $500 and a net revenue of $350. Extensive drift sand planting has been carried out. One area, covering 5100 acres of sea-coast dunes, was planted over a period of 16 years with convict labor at a cost of $325,000. A railroad was built and the sands fixed by distributing over the surface the refuse from the nearby city of Port Elizabeth. The grasses used were *Ehrharta gigantea*, *Psamma arenaria* and *Eragrostis*. *Acacia cyclopia* and *saligna* were planted as soon as the grass established a stable surface, and on the lee slopes *Eucalyptus gomphocephala* and *diversicolor*. The trees have after 14 years grown to a height of 70 feet. Several thousand acres of drifting sand have been reclaimed by forest planting with wattles and pines near Cape Town.

As in India, amongst the earliest commercial forest plantations established in South Africa were those for railway fuel. These were begun in 1876, when all the fuel was being brought from the United Kingdom. When coal was discovered at the

Cape, planting was stopped. Later, in 1902, it was taken up again, this time for sleeper production. South Africa is dependent on outside sources for sleepers for over 11,000 miles of Government line. The railroads, practically all of which are owned and managed by the Union Government, began with a vote for railway sleeper plantations of $50,000. The work was carried on as a separate Railway Forest department for some years. By March, 1915, 20,343 acres had been planted at a cost of $750,385. The average cost of establishing plantations has been about $50 per acre.

The whole work of establishing and managing railway sleeper plantations has been turned over to the Forest Department which receives a specific vote from the Railway Department for this purpose. The annual vote for this purpose before the war was $125,000.

The composition of the plantations for railway sleepers is, eucalyptus 58 per cent, *P. pinaster* 25 per cent, the remainder consists chiefly of acacia, cupressus and Quercus.

The eucalyptus planted are chiefly *pilularis*, *resinifera*, *paniculata*, *saligna* and *sideroxylon*. The eucalyptus grew sufficiently rapidly to make sleepers in a very few years. It is doubtful if when the trees reach sleeper size the wood, in view of the very rapid growth in South Africa, will be sufficiently mature to produce non-splitting durable sleepers. A great deal remains to be learned concerning both the rotation at which eucalyptus should be cut for sleepers, and the best means of producing serviceable sleepers from the many species under trial.

Though the South African Forest Department has succeeded admirably in securing a volume of timber production on many different sites at widely scattered and violently differing regions throughout the Union, an immense variety of technical questions yet await solution. The selection of various species to be grown for special purposes in different parts of the country is fairly well in hand. The experimental work of the past 40 years, during which time over $6,000,000 has been spent by the government on forest planting, has been chiefly directed towards selection of species that under the different combinations of site factors will produce a satisfactory volume of timber. Much attention needs yet to be given to the utilization of many of the species, particularly of eucalyptus. With this problem, is involved that of fixing on the most economic size and situation for the plantation, a rather difficult question when the most profitable ultimate use of the timber is not known.

Where so many species are brought together in a new environment, many of them for the first time under forest management, in a land which does not permit of studying their habits in natural forest, innumerable silvicultural problems arise. An earnest attempt is being made to meet the situation, but the staff is yet too small.

Experimental thinnings are carried on in many plantations, the keen demand for wood enables nearly all thinnings to be made at a profit. Thinnings from *E. polyanthema* at 10 years of age sold at 84 cents per cubic foot on the stump for the manufacture of handles.

Generally speaking, the field of forest management, containing as many posers as could well be brought together under one sky, of selection of species to be grown pure or mixed on temperate to tropic sites, utilization of some 300 species, settlement of policies to be followed in thinnings, fixing cultural regulations and financial rotations, still remains to be conquered by the South African Forest Department.

Nursery practice is excellent. A large number of nurseries have been developed, there being eleven nurseries and nine arboreta in the Transvaal alone. The Forest Department nurseries in addition to supplying plantations (a nursery is established in connection with any plantation of consequence) supply trees for other departments and grow large quantities for cheap sale to the public. Three to four million young trees are sold annually at prices averaging one cent each.

The nursery life of a seedling is very short in South Africa. *P. insignis* is sown in August and planted out permanently in December. In three years from date of seeding the tree is over 20 feet high.

Gasoline tins are used extensively instead of seed beds. The tins are cut in two to make two trays, the seeds are sown in the trays, kept watered, and when planting time comes the trays are carted to the field.

The most extensive forest enterprise in Africa is the growing of Australian wattles for tanbark production. About 300,000 acres of plantations are devoted to this purpose. The species used are chiefly *A. decurrens*, var. *mollis* and *A. decurrens*, var. *normalis*, the Black and Green wattles. The plantations are in Natal and the Transvaal. Agricultural land is used. The plantations, formed at a cost of $10 to $20 per acre, are left until about 7 years old before cutting. At this age the trees are 6 to 8 inches diameter, 40 feet high, and produce one half ton of bark to the acre. The wood also is sold in the fruit growing regions of Natal for $3 per ton, chiefly for crate material and fuel. The market for the wood is leading to an extension of the rotation to 10 years. The annual wood production in a wattle plantation is about 90 cubic feet.

The earliest wattle plantations were started solely for the production of wood, but the bark production has become so important that, in spite of a duty, African wattle bark is being exported to Australia, the home of the species, in quantities exceeding the annual Australian production. The exports of bark in 1914 reached 180,000,000 pounds, valued at $1,430,000.

The management of the plantations is simple. The rubbish is burned after the clear-cutting is complete, a dense crop of seedlings springs up, the land is cultivated to reduce the number of seedlings and the plantation is then left alone for another rotation.

Conclusion

Forestry in South Africa is definitely recognized to be an investment for the future. Nevertheless, although the administration has only something less than half a million acres of heavily culled indigenous forests to work on, and the plantations are only recently formed, many of them being extended arboreta rather than commercial plantations the balance of expenditure over revenue and the stumpage value of free use permits issued is not great.

The statement for the past three years runs:

	1912–13	*1913–14*	*1914–15*
Revenue	£72,718	£55,733	£47,192
Value of free use	£37,976	£26,371	£14,146
Total	£110,694	£82,104	£61,338
Expenditure	£157,833	£149,139	£119,475

Such a favorable financial statement during a period when the Department is undertaking the improvement of indigenous forests and the formation of plantations is possible only, by the working of the indigenous forests (which supplied in 1914 to 1915 about £20,000 of the revenue) at a little higher pressure than can be sustained, by the quick returns from plantations (which supplied in 1914 to 1915 about £24,000 of revenue), and by the very keen demand for timber throughout South Africa even at high prices.

Nearly all timber must be imported. The chief supplies, aside from a certain amount of eucalyptus from Australia for sleepers, railroad and harbor works, are Baltic timbers (*P. excelsa* and *P. sylvestris*) and Douglas fir. The high sea freight and high inland rail freights in Africa raise a permanent protective barrier about the Southern sub-continent that promises well for plantations. The chief market on the Rand pays wholesale for Douglas fir $38 per M feet in periods of lowest prices, and slightly less for Baltic deals. All the smaller timbers suitable for handles, mine lagging, fuel are correspondingly expensive. The prospects for profitable plantations are excellent. The South African public exhibit an intention to grow within the country a large proportion of the timber necessities, amounting in 1914 to 9,000,000 cubic feet, valued at £518,000, which is now imported.

FORESTRY IN INDIA FROM A CANADIAN POINT OF VIEW

By H. R. MacMillan[1]

The first shock to a Canadian traveling in India is the wooded state of the country. One expects that hundreds of millions of people warring through thousands of years and finally under a century of peace crowding agriculturally 300 to 600 to the square mile would have produced a denuded land. Such is not the case—except in the arid Indus valley—the whole land, viewed from a railway carriage, appears forested, and even the Ganges plain with its agricultural half thousand to the square mile is so dotted with trees as to appear at a distance of less than a mile an unbroken wall of forest. The temperament which leaves trees to grow, in groves, rows and scattered throughout the most valuable fields without even the protection of the fence row, which saves a few trees in America, must have been an important factor in leaving any forests for the British to administer in India.

The forest area of British India now stands at about 336,000 square miles, or 31.1 per cent of the total land area. Though the forest cannot all be considered as productive timber land, or even as wooded land, as will be explained later, the proportion of actual forest must to a Westerner appear very large, especially when the age, history and population of the country are considered.

The large proportionate area of forest is explained by three or four conditions wherein India differs fundamentally from American conditions, which act as brakes on forest destruction in India.

Recent Canadian experience to the contrary, the Indian is not an emigrant. The strongest human tendency in Canada and the United States has been to move west along the parallels of latitude and destroy forest. The native North American has not waited either for pressure of population upon the land or for a market for the timber in the virgin Western forests to furnish the stimulus for the Western movement of population. The Indian, the direct antithesis of this man, even when the agricultural population has reached 600 to the square mile; has not felt impelled to leave his ancestral paddy field and move a few hundred miles to

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another part of his native province or to another province of India, even though bountiful paddy fields have already been proved there, settled government established and railroads laid down for easy transport.

The Indian will assuredly cut down the forest bordering his field and village if allowed, but he will not migrate to attack a new forest area. Nearly every province contains a fair proportion of forest, some of it seemingly on good agricultural land and only a hundred miles or so from districts so densely populated that to use Kipling's description of Canton you feel that if you knocked a corner off a house it would bleed. Other provinces, rich beyond dreams, in the capacity for growth of myriad crops, such as Assam and Burma, lying in the direct line between the hordes of China and the swarms of India to this day cry aloud for population and all through the past have suffered little or no forest destruction. A large proportion of the forest wealth of India is in these two provinces. If they are omitted the forest in India sinks to 21 per cent of the land area. One should be permitted to dream a moment what would be the situation in North America today if we had possessed only a little of the Indian's characteristic of pausing to make each acre fertile before passing on to denude another. We should have been still somewhere East of the Appalachians and the beaver would not yet have been driven out of Canadian rivers to take refuge in the folds of the flag.

Forest Distribution and Ownership

The proportion of forest area in various provinces is given below:

Province	*Area of Province*	*Area of State Forest*	*Per cent of Forest in Land Area*	*Population per Square Mile,* 1911
Burma	224,854	141,443	62.9	44
Assam	48,915	22,782	46.6	139
Central Province	99,876	19,684	19.7	139
Madras	142,402	19,665	13.8	291
Bombay	123,316	12,242	9.9	159
Bengal	78,875	10,612	13.5	577
Punjab	96,650	8,314	8.6	207
United Provinces	106,773	4,193	3.9	440
Behar and Orissa	83,673	2,785	3.4	415
Andamans	3,143	2,209	70.3	8
Baluchistan	54,228	785	1.4	8
Coorg	1,582	520	32.9	111
Northwest Frontiers	13,184	236	1.8	166
Ajmer	2,767	142	5.1	181
British India	1,079,638	245,612	22.7%	226

This table includes only the State forests. The proportion of forest to land area would be slightly increased by the inclusion of privately owned forests.

The population had risen to about 150 to the square mile before a forest service or any forest protection beyond arbitrary reservation of royal trees for reserve purposes was established.

Another reason for the proportion of forest remaining in India lies in the extremely persistent character of plant and tree growth. Except for the coniferous forests of the Himalayas, which constitute a very small proportion of Indian forests, the species are not readily inflammable and though injured by fire are not wiped out as is so frequently the case in Canada. Forests near villages hacked over from time immemorial for village and industrial use still persist because of the tenacious character of tree life in India, due partly to coppice and partly to a general ability common to many tree species in India, of preserving a little life under an unlimited amount of persecution and springing up again the moment persecution is relieved.

These devastated areas, though bearing only a little scrub and not recognizable to the Westerner as forests, were because of the high price of timbers and the low earning power of the Indian worth more per square mile than many a heavy virgin Canadian forest. They were gathered up everywhere by the early administrators, even down to scattered blocks of a square mile or so, constituted State forests, and go to swell the total area.

The nature of the land ownership made simple the assembling by the State of all non-agricultural or wooded tracts large and small. The Mogul emperors and their predecessors had established and maintained that all land belonged to the emperor. The user paid as annual rent one-third of the crop. Royal trees, teak, sal and sandal wood were reserved to the emperor and might not be cut, thus forest lands did not pass out of the hands of the central authority. All land remained the property of the emperor. The British, on establishing government after the fall of Mogul and other lesser kingdoms, gave to each man the land to which he could show title established by use. So few were the private estates extending over woodland, even in a country where timber is very valuable, that to the present time only 77,000 square miles of forest are in private ownership. Even small areas of a few acres of scrub or rocky ridges belong to the State, there being no private individual who can show title to it.

The Forest Service in India is spared one of the most difficult problems in Eastern America, the bringing of non-agricultural lands, now divided amongst hundreds or thousands of small owners, under one control for forest management. There is no doubt, however, that if the Indian Forest Service had been faced with this problem in such a country, say, as Southern Ontario, they would have solved it quickly. Though the average Indian forester will not admit it, being progressive in spirit, ambitious for his profession, and having much larger schemes yet in hand, which he maintains will pay the State 10 or 20 per cent on the investment, the various Indian governments have in 50 years been trained by the foresters to consider their forests as estates, and to vote money for expenditure on improvements where it is shown by the Forest Service that such expenditure will be returned with interest. It is possible that there is a tendency, under the growing influence of democracy in India, to assent to forest investments a little more readily when they are sugared by being hitched to schemes of development than when they are purely for forest improvement, but the fact remains that the forests are to the Indian governments assets upon which each year the financial powers are being educated, by business arguments only, to spend an increasing proportion of the revenue. Further reference will be made to this point.

Organization

The public forests in India are in nearly all provinces divided into three classes, reserved, protected and unclassed. The division, which in some ways gives confusion to outsiders, arises from the system of civil government. Throughout British India the country is divided into administrative units, known as civil divisions. Each division is in charge of a member of the famous Indian Civil Service, who as Commissioner or Collector governs the district and is head of the local organization. The Commissioners, who in early days were active heads of forest work in their districts as well as of all other work, now occupy themselves chiefly with magistrative duties and are concerned only with forest administration when the latter affects the rights or daily life of the population. The administration of the country may now be said to be divided, the land in use is administered by the Collector; the land not used, or not capable of being used at the present time, is public forest land and is administered by the Forest Service.

It is this public forest land which is represented by the 245,612 square miles under the administration of the Forest Service. As we understand the term, it is *all* reserved land, in that it cannot be withdrawn and put to any other use without the consent of the Forest Service. The Indian term "reserved" applies, however, only to the forest areas which have been brought under definite, and, from our standpoint, intensive management. The reserved forests cover only 96,297 square miles, a small proportion of the total State forest. The rights of user, which are inevitable in a country like India, have been clearly recorded, have been kept to a minimum and in many instances have been commuted by cash payment. The increase in area of reserved forests is very slow, only 1736 square miles since 1909. The additions to reserved forest are chiefly in Burma, where more future additions may be expected. The great contrast in conditions in various provinces in India is borne out by the deforestation since 1909 of 2237 square miles of forest in the Central Provinces where timber is in great demand, and on the other hand, the existence of so much forest land in Burma, a thousand miles away, that even a paternal government thinks it hardly worth while yet to reserve it.

The policy in India with respect to deforesting reserved forests may be stated thus: "that application of the soil must generally be preferred which will support the largest numbers in proportion to the area," therefore, as population increases these few forests upon which permanent cultivation can be established without harm to neighboring lands must disappear. Working plans are in effect in reserved forests only.

"Protected" forests rank after reserved forests. These are the forests in which certain valuable trees only are under care and protection by the Forest Service and in which villagers and others may cut other species under permit from local forest officers. Protected forests are not recognized in all provinces and cover only 8390 square miles in the whole of India. They are usually merely halted on the way to reservation until local rights of user can be defined and settled or commuted or until arrangements can be made to survey and care for them as reserved forests.

The most important class from the standpoint of area are the unclassed forests covering 140,925 square miles.

These forests include the whole area in British India, which not being in use by the population for agriculture, does not come under the direct administration of the Revenue Department (as administration by the Commissioner is known), and, therefore, must be under the administration of the Forest Service. Much of this land is not forest and may never be—it includes river estuaries, grass lands and various waste tracts, for which no use is found at present, but which may sometime be planted to forest or reclaimed for agriculture. Much of it, on the other hand, particularly in Assam and Burma, which between them contain 133,000 square miles of the unclassed forests, consists of heavy, mixed hardwood forests which will be moved up to the reserved class by the time a demand is felt for the timber.

The creation of reserved forests has been largely governed by the utter absence of timber in the region, or, in districts where forest lands are plentiful, by the presence of teak, sal or deodar. Areas of heavy forest not containing these species are still unclassed and may be cut, almost destructively one might say, under permit or trader's license from the Forest Service and with very little supervision from the Forest Service. The opinion may be hazarded that there are now fairly large areas which should be made "reserved" in Assam and Burma, but which are not, because a large enough staff cannot be secured to bring their management up to "reserved" forest standards, and because, partly due to shortage in staff, Indian silviculture still revolves around teak, sal and deodar.

A curious policy exists when fixing the boundary of a reserved forest, of leaving on the outside a strip of forest for the use of the local public. Forest thus left remains unclassed or protected, usually the former, and is rapidly destroyed by unregulated use. Just why such unclassed forests are left, and what will be done when their destruction is complete, is not evident.

Standards are higher in India than in Canada. Reserved forests seem to be created in India only when the government is committed to supporting an adequate staff and scheme of improvement and management.

The great differences in the problems of government arising in the various provinces of India, evident in other questions as well as in the administration of the forests, together with the growth of local legislative councils, has resulted in the rapid development of a policy of decentralization in forest affairs.

The only forest organization common to the whole of India now is the Inspector General of Forests, the Imperial Forest Service staff, the Forest Board, and the Forest Research Institute and College at Dehra Dun. The Imperial Government, while retaining a certain directing control over forest policy in India and to a certain extent serving as a means of maintaining an organization for correlating work in the various provinces, does not administer in any way any forest lands. All the executive work of forest administration is in the hands of the various provinces.

The broad path of duty for the province is laid out in the Imperial Forest code, the staff to be used is selected by the Imperial Government, the form of organization and numbers of staff are decided by the Imperial Government, and until recently, all the higher promotions have been made upon the advice of the Imperial Government. The work carried on by the province is subject to inspection and criticism by the Imperial Government, which also furnishes in the Forest Board, Research Institute, and School a body of advice and control serving to maintain forest work in the different provinces at a common level. There seems to have been little left for the provinces to do but execute Imperial Government policies with Imperial Government tools, but there is an indication now that the powers of the provincial officers are being increased.

The foundation of forestry in India is the Forest code, the first edition of which was issued in 1877 and the seventh and latest in 1913. This code will well repay reading by any forester. It establishes the basis upon which the staff is recruited and promoted, defines the forest policy for India and lays down the general rules for the management and working of the forests. The making of reports and keeping of accounts are also standardized by the code. It follows, since the code must be accepted as issued by all provincial governments excepting the Presidencies of Bombay and Madras, that forest administration, while varying in execution, energy and initiative in the various provinces, must throughout India proceed along the same lines. The Presidencies of Bombay and Madras being of earlier origin than the Supreme Government of India, maintain a certain independence; they, therefore, do not accept the code as an order as it comes from the Imperial Government, but with very few changes re-enact it for themselves.

The powers of the central government, which thus fixes a uniform forest policy and a uniform organization for its administration throughout India, while leaving the executive work to the provinces, are naturally much greater than the central powers of government in Canada or the United States.

Personnel

The personnel of the Forest Service in India is divided into three watertight compartments, the Imperial Forest Service, the Provincial Forest Service and the Subordinate Forest Service. The driving power, initiative, supervision and inspiration of forest work depend almost wholly upon the Imperial Service, now numbering 237.

The Imperial Service is recruited from the United Kingdom where probationers, 19 to 22 years of age, are taken in at the rate of about 20 yearly, after having taken prescribed degrees in Natural Sciences. The probationers during two years' study under the direction of an officer detailed in England as the Director of Indian Forest Studies, are required to take forest degrees at the Universities of Oxford, Cambridge, Dublin or Edinburgh, and to pursue assigned field studies on the continent. Only two or three men are now left in the Forest Service in India who prepared at Nancy. The probationers receive $600 yearly during their two years of preparation.

The period of training completed, the men are appointed to the position of assistant conservators at $126 per month. Salary increases are fixed and dependable at the rate of $160 per year for 8 years, $200 per year for 12 years, bringing the pay to $5,000 per year in the twentieth year of service. Thereafter salary increments depend upon promotion to various grades of the service. The full strength of the Imperial Service, or cadre as it is known in India, in 1915 stood at:

1 Inspector General	$10,600
1 Assistant Inspector General	Variable
2 Chief Conservators of Provinces	8,600
22 Conservators (in three grades) 1st	7,600
2nd	6,800
3rd	6,000

187 Deputy and Assistant Conservators, whose pay, as stated above, depends upon the length of service. The staff of the

Research Institute is included in the statement above. The rates of pay given are in many cases further supplemented by small local allowances.

Foresters in North America will be rendered still more envious by the knowledge that the members of the Indian Forest Service receive after 20 years' service pensions roughly equivalent to one-sixtieth of the average pay for each year served.

A man entering the Indian Forest Service expects to spend his life in the service and does so. It remains to be seen whether it will be possible for a man to do so in North America on the scale of reward and under the condition of uncertainty of the future now existing.

One result of the crystalization of the Indian Forest Service is that promotions from grade to grade are determined chiefly by seniority. A man expects to be made a Conservator when about twenty-two years in the service. Naturally where seniority is one of the guiding principles in promotion, the effect is to a great extent to dull initiative.

The only members of the Imperial Forest staff paid by the Government of India are the Inspector General, Assistant Inspector General, Officers of the Research Institute, Chief Conservators and Conservators. The remainder are paid by the provinces in which they serve. The Indian government pays all pensions, however, and for this reason must sanction the staff employed in each province. The effect of this arrangement is an inevitable understaffing of the organization; the head of the Forest Service in any province must persuade first his provincial government, then the Indian government to sanction an increase of staff. The chances are against him.

Promotions to the grades of conservator and chief conservator have always been made by the Inspector General who has felt himself free to draw upon the whole service to fill a vacancy in any province. This power of the Inspector General has, however, apparently been somewhat reduced in recent years. The provincial governments have exhibited a tendency to override the recommendations of the Inspector General and promote one of the men already serving in the province.

The Provincial Service consists chiefly of men born in India, selected from the subordinate services of the various provinces and given a two years' training at the Imperial Government Forest School at Dehra Dun.

The appointment and promotion of men in the Provincial services rests with the Provincial Governments, except that the number and the scale of pay is fixed by the Imperial Government. Men of the Provincial Service when appointed usually act as assistants to Imperial Service men, but later may be promoted to take charge of districts. Their pay rises from $1,000 per year at entrance to $2200 after 16 years' service and may reach $3400, with pensions. The Provincial Service now numbers 227, the Subordinate service includes the rangers, deputy rangers, foresters, guards and various other classes of employees. The number exceeds 20,000.

Schools exist in nearly every province now for giving forest training to rangers and guards, either in vernacular or in both English and vernacular. It may be very difficult to teach forestry to natives who not only know nothing about it, but whose language contains no equivalent either for scientific or forest terms. This, however, is one of the many little jobs taken on by the Indian Forest Service. The training given the subordinate staff gives them a general idea of the principles underlying their work, but cannot give them energy, ambition or initiative, or make them dependable. One of the greatest difficulties of forest administration in India is the supervision of the subordinate staff to prevent an utter break down of the machine. That the few men in the Imperial Forest Service, with the materials at hand, have accomplished so much in the way of forest administration in India is nothing short of a marvel.

The unit of forest administration in India is the Division. The forest Divisions, for convenience in administration, usually coincide in boundaries with the civil districts. There are over 250 civil districts in India, and 166 forest Divisions. Divisions are very large in provinces like Burma where the population is comparatively sparse. Burma divisions reach a maximum area of over 16,000 square miles of forest and 141,108 square miles of forest is divided amongst 31 Divisions. Where population is densest, and the forests more intensely worked, as in the United Provinces, 13,258 square miles of forest is divided into fifteen Divisions.

The officer in charge of a Division may be an Imperial Officer, in which case he will grade as Assistant or Deputy Conservator, or he may be a Provincial Service man, in which case he will grade as an Extra Assistant or Extra Deputy Conservator, according to his length of service. In any case he is the executive officer in charge of all forests under the Forest Service in his Division, whether reserved, protected or unclassed. Many Divisions contain no reserved forest. The Divisional Forest Officer, as the various grades of men in charge of Divisions are known for convenience, rarely have trained assistants. The Imperial Forest Service man goes in charge of a Division almost as soon as appointed, and the staff available, of a grade to be useful as trained assistants, is too small to supply assistants excepting in a few very busy or very important districts.

The small Divisions, as compared with administrative units in Canada or the United States, the lack of trained assistants, and the necessity of giving an incredible amount of close constant personal supervision to the native staff result in the Divisional Forest Officer in India spending fully half his time actually in his forest. Although there appear to be reports, forms and accounts without number, covering every little transaction, these do not tie the forester to his office. Mail carriers only cost about eight cents a day and the office follows the forester to the field. The result is that Indian foresters retain their keenness for field work and maintain their forest eyes. On the other hand, in North America the size of the administrative units, the impossibility of having even urgent office work sent to the field tends too rapidly to make office men of foresters. Either a man is kept continually on field work involving a great amount of hardship and sickens on the profession, or is transferred to executive work at an early stage and thenceforth sees too many papers and too few trees.

Canadian foresters have no monopoly of hardships. The men in India who go cheerfully to their annual spell of fever, who feed an iniquitous variety of insects, and in a shade temperature of 115° do their field work in a forest that offers no shade, all the while furnishing energy not only for themselves but for the whole subordinate staff, must rank as the heroes of forestry. This is not for a few years only in the beginning. In India, the wholesome tradition prevails, that while a man is in service, which is for 25 years if he survives the climate, he must do his annual three to six months "tour" of the forest or forests under his charge. They all look forward to it.

Divisions are grouped for administrative purposes into working circles, comprising (except in isolated instances) three to eleven Divisions each. There are in India 28 working circles, of which five, consisting of provinces containing but little forest, include only one Division each. Working circles never cross provincial boundaries. Each working circle, excepting the five noted, is in charge of a Conservator.

The Conservator, while paid and to a great extent selected by the Government of India, is directly responsible to the Provincial Government in carrying out the Forest Code. Originally there was but one Conservator in each province. As the work intensified and the staff increased, the supervision necessary became too much for one Conservator. The principle, which appears unnatural, was then followed of dividing the province into two, and finally into as many as four Working Circles, each in charge of a Conservator directly responsible to the local government, and entirely independent of the other Conservators in his province. There was no controlling correlating influence governing the different working circles, and the local government soon found itself with as many separate forest departments on its hands as there were Circles in the province. The policy was then inaugurated in Burma, followed in United Provinces and Central Provinces and now recently sanctioned for Bombay and recommended for Madras, of appointing a Chief Conservator for the Province, who would be in full charge of the work in the Province and with whom alone the Provincial Government would take up questions of forest administration.

The Chief Conservator is hampered by being without assistance other than native office staff. The influence of his office is measured by the amount of work he can personally accomplish. He does not reach the position until late in life, and can only occupy it on an average of 6 or 8 years before the 55-year limit retires him from India. It being a one-man office, there must be a violent break in ideas and policy each time a new man enters the position. It seems that a stronger organization, that would make for more continuity of policy, would have been developed if a form of specialist organization had been built up when the work in the province became too great for one unaided Conservator. The work could have been classified into three or four broad divisions and an Assistant Conservator appointed for each class of work who would supervise this work over the whole Province.

It comes as a shock to a forester accustomed only to the type of organization common in the developing Forest Services of the United States and Canada, to find how small a headquarters staff exists in India. There is no headquarters staff in India, and there are no specialists. The areas, both of the Divisions and the Working Circles, are small compared to corresponding areas in America. The Service is much older than any in America, has worn deep channels of procedure, developed fixed ideas and contains a large proportion of experienced men. The fact remains, however, that the time of the men, from Assistant Conservators to Chief Conservators, is so taken up with routine office duties and routine field inspection, that, though they are on the average keener and better trained foresters than we have on the whole in America, they have not the time to develop as rapidly as should be the necessary knowledge of the silviculture and utilization of their forests.

The growth of Provincial autonomy in forest administration was accompanied by discussion of the abolition of the office of Inspector General of Forests. It was wisely decided to retain the office as general adviser to the Government of India on forest policy. The Inspector General has direct charge of the Imperial Forest Research Institute and College and performs a valuable service in advising with the Chief Conservators and Conservators regarding Provincial forest policy. Reference has been made to his decreasing power over appointments.

The appointment of Chief Conservators has theoretically limited the power of the Inspector General in its most important field, the supervision of working plans. Formerly all preliminary reports on working plans were sent by the Conservator of the Circle in which the plan was being made, for the Inspector General's opinion and instructions before the plan was proceeded with, and the plan itself was sent up for acceptance by the Inspector General before it was adopted by the local government. Now this procedure follows only where the office of Chief Conservator does not exist, and there is evident a tendency to still further limit the actual power of the Inspector General in this direction. The regular and constant inspection trips made by the Inspector General, by arrangement with or at the invitation of the local government, are of great influence in stimulating improvements, particularly in the extension and revision of working plans. The reports made by the Inspector General as a result of such trips are submitted by the Government of India, to whom they are addressed, to the local government concerned, and though the latter is in no way bound to act upon the recommendation of the Inspector General such a course usually follows.

Research

The work of forest research, which in the diversified forests of India involves many more problems than in America, is under the direction of the Inspector General. The administrative and executive organization of the Forest Service not providing for any silviculture or other research work, this also remains exclusively with the central organization. The Forest Research Institute at Dehra Dun embraces therefore a wider range of subjects than is attempted either at Madison or McGill. The work of the institute is grouped under five heads, Silviculture, Zoology, Botany, Economy, and Chemistry. The staff in each department consists of one man only, excepting for one assistant in Economy. The staff in the two most important departments, Silviculture and Economy, are recruited from Divisional Forest officers who possess only the ordinary forest training. Men are assigned to the Research Institute for short terms rather than appointed to it for sufficient periods to enable them to plan and carry out effective work.

The field for forest research work in India is probably the greatest in the world. There are already hundreds of products and by-products profitably extracted from the Indian forests; there remain many thousands of square miles of accessible forest awaiting development when problems of utilization and seasoning have been settled. Grasses and bamboos also exist in vast volume over wide tracts of land under forest administration. Silviculture is yet confined to three or four species, and everything is yet to learn concerning the silviculture of scores of valuable species. The Silviculturist and Economist at Dehra Dun, facing these problems without assistance, are attempting ropes of sea sand. Much valuable work has been done, buildings have been erected, now devoted to museum space which would house both the Madison and McGill Laboratories, but of the facilities and staff for doing original work on the problems awaiting solution in Indian forests there are none.

The most important duty of the Economist is to find markets for Indian forest produce, and to find in Indian forests substitutes for imported articles. An effort is made to co-operate with firms in India or the United Kingdom in conducting all tests on a commercial scale. There is a bold disregard of trifles about the work which is inspiring. Typical instances are the departmental working of the turpentine forests, and the building of distillation plants to put the refined article on the market, or the taking of a departmental contract for the creosoting of 1,000,000 sleepers. This broad conception and freedom combined with the laboratories and staff, which sooner or later will come, will put the Research Institute in an enviable position.

A Forest Board exists, consisting of the Inspector General of Forests, President of the Research Institute, Chief Conservators, and one Conservator from each Province where there is no Chief Conservator. The Board meets once in three years at Dehra Dun, outlines the three-year program of research work, and discusses questions affecting administration throughout India. The resolutions of the Board are submitted to the various Governments concerned and are frequently made effective by Government orders.

The inability of the Research Institute to overtake the urgent problems demanding solution has led to talk of establishing Provincial Research Institutes. As such Provincial Institutes would almost certainly be understaffed, no great improvement could be expected. The true solution lies in increasing the personnel of the central Institute, by appointing men, not trained in general forestry, but specialists in the various branches of the work.

Administration

The Indian Forest Service, not having to woo the ear of a variable democracy, has not maintained a propaganda, therefore they do not confuse works written about with works accomplished, therefore if you wish to see what they have accomplished you look, not into their reports and speeches, but into their forests. The best answer to the pessimist, who feels discouraged about the situation in Canada, is found in the result now to be seen in Indian forests of half a century's work on the part of a small band of foresters whose numbers have only recently passed the 200 mark.

Before discussing the work, the financial policy of the Indian Governments, which make the work possible, must be noted. Twenty-five years ago the annual revenue from Indian forests was $5,101,000 and the government sanctioned the expenditure for forest purposes of $2,430,000 or 47 per cent of the total revenue. Under wise administration and an absolute veto of methods of spoliation, revenue has constantly risen. It was $11,100,000 in 1914 and the actual expenditure for that year was $5,252,000 or 48 per cent of the total. Indian governments differ in two respects from Canadian governments in their attitude towards forest finance, they do not push their yearly financial demands upon the forest beyond the true forest yield, and they devote practically half of each year's revenue to the improvement of the forest. Further, half the forest revenue under non-political administration in India and on a wage scale of 15 to 30 cents per day for labor goes much further than it would in Canada in forest protection and improvement. Nevertheless the economic outlook would be different in Canada today if one-half the forest revenue had been expended on the important forest areas during the last half century, as has been the case in India.

The development of a reserved forest area in India proceeds uninterruptedly through the stages of settlement of rights, survey, boundary demarcation, roads, trails and buildings, protection and working plans. So far as these phases of administration go, the reserved forests only need be considered, the other forests, while surveyed, are only to a limited extent provided with buildings and communications and defined boundaries. Fire protection is not usually extended reserved forests and practically no working plans exist outside reserved forests.

The settlement of rights acquired by neighboring villagers over public forest land was the price paid by the Indian Forest Service for the acquisition of the land. The settlement of these rights, usually accomplished by cash payments, or, as in France, by grants of lands upon which holders of rights are concentrated, is confined chiefly to reserved forests. The general policy is to undertake only the extinction of rights interfering with the working of the forest. The area upon which such rights are settled now averages about 800 square miles per year, and the average cost has been during five years $4.13 per square mile.

Forest surveys have not presented the same difficulties in India as will be met in many parts of Canada. The Survey of India has done magnificent work in the survey of the whole of India. There was a period, however, when surveys in forest regions were not proceeding sufficiently rapidly and a survey branch was maintained by the Forest Service under direct supervision of the Inspector General. The branch was later transferred to the Survey of India and now forms the Forest Surveys Branch in that department, charged with all forest surveys and map publications Indian forests, according to their value and the intensity of working are surveyed on three scales, one two and four inches to the mile. During the past five years the annual area surveyed has been 184 square miles on the one-inch scale, 872 on the two-inch, and five on the four-inch. The extremely low labor rates in India enable survey costs to be kept down even in very difficult country. Nearly all the work connected with surveying and mapping is done by trained Indians. The cost in 1913 to 1914 varied from $5.30 to $18.70 per square mile for one-inch and two-inch-scale work. There are still small areas under working plans which are not surveyed.

The establishment of plainly marked boundaries is an important point in a country where the inhabitants believe only what they see and see only what they can't overlook. It also fits in with the official British passion in India for permanent structures. Boundaries are extremely well defined by broad, cleared lines, mounds and stone pillars. The total length of boundaries of reserved forests is now 165,051 miles of which only 3185 yet require demarcation. The cost per mile of new boundary is about $10. The work could not be done in America for $100.

The responsibilities of the Indian Forest Service with respect to communications and buildings are rendered distinctive both by the climate and the system of exploitation. European officers could not spend half the year, as they do in India, camping in the jungle supervising field work were no rest houses provided. As it is, only a sound man can live through 20 years of heat, wet, fever and bad water.

Excepting in some districts where the natural conditions make tent life reasonable during the working seasons, bungalows or shelters are built at convenient halting points. An excellent building can be put up for $400 to $700. The total expenditure in new buildings varies between $150,000 to $190,000 annually.

The yearly repair bill is half the cost of new construction. The Indian will not build a road to take timber out; he would rather go without the timber. The Forest Service, if it is to sell the timber, excepting in the isolated instances where large companies are working, must first build the road. Roads built for extraction, inspection paths and trails, which are very numerous and the travel routes of the native tribes living in many of the forests render Indian forests very accessible indeed, at least as judged by Canadian standards. The yearly expenditure on roads is from $145,000 to $263,000, of which about two-thirds is for new construction. Forest engineering is an important part of the training for both the rangers and men of the Provincial Service. It is doubtful if, as at present trained, the average forester in North America could produce as creditable an engineering showing as results from the daily work of the Indian Forest Service. It is also doubtful if the foresters now trained in the forest schools of Great Britain will do as well in this respect as those who came from Cooper's Hill.

There are few if any points of resemblance between forest protection in India and America. Protection against trespass is more of a problem in India than fire protection.

The total number of breaches of forest regulations in India in 1913 to 1914 was 94,390, classified as follows:

Timber trespass	50,899
Grazing trespass	33,938
Injury by fire	4,012
Others	5,541

The density and lack of morality of the population, the difficulty of detection, and to a certain extent the fact that protection against trespass is largely in the hands of Indian members of the service renders the preservation of the forest against the population exceedingly difficult. Not even the settlement of rights by grants of forest land in which villagers are free to cut, the leaving of strips of forest outside the reserved boundaries, the granting of free use of forest produce and grazing valued at $2,500,000 yearly serves to stem the tide of trespassers. The convictions secured against offenders, 174,084 persons convicted in the 83,064 convictions secured out of the 84,170 cases settled in 1914 to 1915, should discourage offenders, but evidently does not. It is easy to see that when almost 100,000 trespass cases yearly, all involving the untangling of the marvellous trail of the expert Indian witness, come before 200 odd forest officers, a discouraging proportion of their time must be spent in contemplation of files.

Fire protection, on the other hand, is a simpler matter than in America. The area for which fire protection was provided has never been great in India, as areas go either in Canada or the United States. At the most, protection extends over about 50,000 square miles, all or nearly all reserved forest. Except in grass areas, which so far as possible are burned in a safe season by forest officers as a measure of protection, Indian forests do not burn readily. Large fires are rare, record fires being those of Madras, covering 16,000 and 7,000 acres each respectively. Such fires as occur in Canada, would if in India, call for special investigation by a Committee of the British House of Commons. The measures of fire protection are chiefly wide fire lines both around and through the forests. These fire lines are regularly swept. Patrols are also maintained at a cost each of about 10 cents per day. Villages near the forest are in a measure made responsible for the fire protection of the forest in their neighborhood by being made to fight fire without pay or by threats of withdrawal of their rights if destructive fires occur.

The causes of fires in India were in 1913 to 1914:

	Number	*Area Square Miles*
Unknown	2,038	724
Originating outside forest	431	426
Malice	690	359
Carelessness of outsiders	1,278	333
Department fire protection measures (back firing)	319	148
Total	4,756	1,990

The organization of telephone systems and lookouts, if adopted in India as now developed in the Pacific Northwest, should reduce the average area per fire. The small areas under protection and the low labor costs in India would render such improvement feasible. Perhaps, however, a telephone with a native at the far end of it would prove no convenience.

The loss by fire each year is 3.5 to 5.7 per cent of the area protected. Considering the small area under protection this proportion is high. It is explained by the dense population and the subordinate staff. The cost of fire protection, in spite of the low labor rates, is high, varying as it does from $1.30 per square mile in the Punjab to $15.00 per square mile in Burma.

An interesting statement of the fire protection situation in India is given in the following table:

Province	*Area under Protection Square Miles*	*Per cent Reserves under Protection*	*Per cent Protected Area Burned*	*Cost of Protection per Square Mile*
Madras	15,481	82.1	7.1	7.10
Central Provinces	11,409	58.	1.5	3.00
Bombay	10,032	84.6	3.9	2.10
Burma	4,548	16.6	3.3	15.00
United Provinces	3,210	77.9	2.6	....
Behar and Orissa	1,689	97.8	.5	....
Assam	1,440	32.9	4.	....
Punjab	1,060	49.	.9	1.36
Bengal	719	14.8	1.3	....
Coorg	157	30.	1.9	....
Ajmer	141	99.3	...	....
Northwest Frontier	85	36.	...	....

The controversy which has raged in India concerning the advisability of preventing fires on certain forest types is settling into the generally accepted decision that fire must be used as a silvicultural agent both in the moist teak forest of Burma and the pure sal forest of Eastern Bengal and Assam. These types if protected form fire are overrun, the teak with bamboos and the sal with evergreen species to such an extent that natural reproduction is impeded or extinguished and the valuable type is superseded by an almost valueless type which has benefited too much by freedom from fire.

Working Plans

The Indian forest code provides that for every reserved forest an annual plan of operations must be drawn fixing the quantity of timber to be cut within limits which will secure the maintenance and improvement of the forest. This plan of operation which is a temporary measure to prevent spoilation of the forest before a working plan is completed outlines all works of any nature to be undertaken in the forest. The policy is that a working plan should be in existence before a reserved forest is exploited. This policy, chiefly through the lack of the officers necessary to put it into effect, has not received universal observance. The responsibility for working plans has varied from time to time, and at present no particular office is charged with working plans. In 1872, a separate

Working Plans office, consisting of one Conservator and two assistant Conservators, was constituted as a branch of the Inspector General's office, the Inspector General arranged with the various local Governments for work to be undertaken in the provinces. Surveys were so necessary before plans could be undertaken that working plans were held in abeyance and the office became a forest surveys office.

Working plans remained largely a matter of the personal accomplishment of the Inspector General who drew up rough schemes as he toured various forests. Special working plans officers were appointed in 1880 in the United Provinces, Burma and Punjab. Another change was made in 1882 before these officers had an opportunity to accomplish anything, when an Imperial Working Plans Office was constituted, presided over by a special officer working under the direction of the Inspector General. The idea was that the plans would be made in the various provinces by local officers and would be supervised and checked by the Imperial office. In 1884, they introduced another change, the working plans officer became the Assistant Inspector General, all working plans were sent to the Inspector General's office for checking and approval. This arrangement continued until 1906.

A Superintendent of Working Plans was then appointed at Dehra Dun, who was made responsible for the maintenance of the required standard in working plans. This officer, however, was soon made Silviculturist, charged single-handed with the investigation of Indian silvicultural problems. Obviously working plans suffered.

The pendulum then swung back to the Inspector General, who with the abolition of the Working Plans Superintendent in 1911 was made examiner of working plans in provinces where there were no Chief Conservators. The Inspector General may also bring to the notice of Local Government defects in existing working plans, but may not issue instructions.

Under the regime of the present Inspector General who has selected as his assistant the previous Silviculturist at Dehra Dun there has been a renewed concentration on working plans. A difficulty which still exists is the lack of officers to prepare the plans, even where the necessity of plans is recognized by the local governments. As has already been pointed out there are absolutely no forest officers in the provinces excepting the number necessary to actually fill the positions of Chief Conservators, Conservators and Divisional Forest Officers, with a very few green assistants. Only rarely can an experienced man be spared from his executive duties to prepare working plans. Too often the working plan falls to the inexperienced assistant. Certain provinces are now seeking authority from the Imperial Government for the creation of a special post of Working Plans Officer in order that more time and care may be given to plans in the future.

Altogether, plans are in effect over 53,926 square miles in India. Plans are already needed for an additional 33,000 square miles, but cannot be prepared for lack of staff.

Silvicultural Operations

Plans have first been made for the wrecked forests of Central India, for the teak of Southern India, the deodar of the Himalayas, the sal of northern India and Assam, and the teak of Burma. Other areas which the poor development of forest transport renders inaccessible must within a few years be opened up by railroad and will then require working plans. The methods of treatment provided by the working plans in force is shown by the following tabie which gives the area of forest under each system, excluding Bombay Presidency:

Method	*Area Square Miles*
Selection with improvement fellings	16,664
Improvement fellings	9,487
Coppice with standards	5,269
Simple coppice	377
Clear fellings by compartments	204
Uniform system	150
Group system	95
	32,246

The selection system as practised in India is not the selection system of Europe. It is a method of working the high forests, particularly of deodar and teak, which prevents clear-cutting and the immediate extinction of the valuable species by limiting operations to mature trees. The forest is worked over periodically, usually every 30 years for teak. The improvement of the forest is sought by periodic improvement fellings the aim of which is to destroy creepers, free young teak, and, if possible, encourage teak regeneration. The impracticability of covering the whole forest sufficiently often with improvement fellings to effectively increase teak reproduction and thus increase the proportion of teak, has lead to a search for some system which would make possible concentrated regeneration fellings. The importance of settling upon some such system is obvious as teak occurs only in two or three mature trees per acre in a forest which is probably composed of 80 per cent other species, not removed at the time of the cutting of the teak. Working teak under the present selection method is therefore attended by two disadvantages, the proportion of teak is not increased and may possibly be decreased by the continuance of what is really inverse selection, and the forest is only being one fifth worked, the other four fifths of the capital standing idle. No wood less valuable than teak, would permit such a costly system of management.

The present method of selection working with teak really represents a triumph for forestry. By means of the regulation it provided, the teak forests of india have been saved. Timber worth $50 to $60 per M in the log, and nearly all of it accessible at logging costs not exceeding $30 to $40 per M would not have been left long standing in a territory as new as Burma if the selection system had not been courageously applied to all lands. As it is, the proportion of teak has not suffered greatly, if at all in half a century of operations, and the Forest Service in control of the situation is now on the ground with increased experience to study possible improvements. Two systems under trial are the Shelterwood Compartment system, known in India as the Uniform system and the French Quartier Bleu system.

The introduction of the Shelterwood Compartment system will probably be facilitated when conditions make it possible to utilize several of the species occurring with teak. A small area of forest is now being worked on this system in Burma where all species excepting teak must be cut and left to rot.

The conditions under which forests are worked by improvement fellings are much the same as described for the selection system. The one is applied to a forest in comparatively good natural condition containing mature trees, the other is applied to forests hacked and burned over in the past and now being brought to a natural state. Here again the Forest Service did all that probably could be done at the time, restricted to the inferior trees, the cutting of timber which the population demanded, worked the forest over regularly and directed the improvement cuttings in such a manner that the volume in the forest increased and the young trees of valuable species benefited.

The time has probably come in places where the working of these forests could be elaborated so as to concentrate the workings in order to increase the regeneration of valuable species. The method now practiced will produce a natural forest, the demand is now that an attempt be made to produce a normal forest.

Very large areas of wrecked forests were taken over by the Forest Service in districts where the demand for small wood was great, which could only be regenerated and managed by the coppice system. Where the population is dense, it is the policy of the Forest Service to seek to produce the small wood best suited to the needs of the Indian. This object is well met by the coppice system.

The improvement of forest management in India will require much study of the silvicultrual needs of the important species. It is difficult to see how this can be accomplished without extensive additions to staff. The policy of the Indian Forest Service with regard to control of working in the forest contains many lessons for Canada. In areas where it was evident that a continuance of existing working methods would result in forest destruction they courageously imposed at once practicable measures, which prevented the extermination either of the forest area or of any particularly valuable species in it. They did this even where great loss of present revenue resulted, as in the case of teak, the cost of logging of which has undoubtedly been greatly increased to the companies by the abolition of clear cutting and the substitution of a system of selection cutting which restricts the amount taken from a square mile to one quarter or one fifth of the stand. They have fortunately not had to face a situation now existing over large areas of the Pacific Northwest where the financial condition of the timber industry seemingly permits of no increase in logging costs.

The costs of making working plans in India varies enormously in different Divisions and Provinces, the annual reports for 1913 to 1914 show it to have ranged from $5.00 to $1.24 per square mile.

There are without doubt areas in Canada now, particularly on prairies and possibly in Eastern Canada where economic conditions make the introduction of regular methods of forest working quite as possible as it was in India.

Considering the other problems in hand, the Indian Forest Service has by adding a little each year developed a very large area of forest plantations. Altogether there are now about 200,000 acres of planted forest, of which 56,000 are ordinary plantations made by the department and 144,000 acres are "taungyas" made in temporary clearings by forest tribes. The expenditures on plantations is $60,000 to $125,000 yearly. There is a tendency to do less planting now, excepting in the Punjab, even though plantations have proved financially successful, because of the impossibility of securing staff and appropriations enough to guarantee the necessary care. The species chiefly planted are teak, sissu, babul, deodar, eucalpytus and casuarina. Over one half the plantations are in Burma, almost one quarter in Madras.

Financial Aspects

The outturn of Indian forests is constantly increasing. The total outturn of wood in 1913 to 1914 was 294,643,000 cubic feet, in addition to minor produce valued at $3,600,000. The average outturn per mile on the various classes of forest is:

	Cubic Feet Wood	*Minor Produce*
Reserved forests	1,931	$28.30
Protected forests	3,174	$53.65
Unclassed forests	582	$ 3.00

The possibilities of forest production in India have been by no means reached, the stock in the reserved forests is constantly increasing, there are large areas at present commercially inaccessible which will eventually add greatly to the annual production. In this, India, with its 320,000,000 people the home of a dense population for thousands of years, presents a strange contrast to Canada. That this should be so, is very greatly due to the happy arrival of foresters in India, slightly in advance of what we in America understand as "the development of the country."

Very little idea of the character of the outturn of the forests may be gained by a comparison of the quantities of lumber and fuel. Utilization is such in India that very small stuff is classified as timber, such as is used for native house poles mending carts or making ploughs.

The relative quantities of each for 1913 to 1914 were:

Timber	97,225,170 cubic feet
Fuel	197,418,153 " "

The densely populated areas practise as intense forest utilization as is possible anywhere in the world, taking the grass as well as the twigs.

Departmental working of the forests though gradually decreasing is still important. Contractors in the employ of the Forest Service or laborers working on the piece work system took out in 1913 to 1914 over 7,500,000 cubic feet of timber, 13,500,000 cubic feet of fuel, and $240,000 worth of bamboos and minor produce. The system of departmental working involves a great burden on the staff, coming between them and their other duties, and for this reason it is gradually being discontinued except in new districts where because of the lack of initiative in India private individuals would be slow to act, or where departmental logging is advisable to operate as a check both on the cost of taking out timber and, in the case of teak in Burma, as a controlling influence on the market price.

The teak logging operations of the Forest Service in Burma must rank amongst the most profitable in the world. The average net profits were in 1914 $40 per M feet board measure on logs delivered in Rangoon.

Though Indian stumpage rates appear high as a rule, considering the earning power of the population, the stumpage on teak is low compared to the profit of taking it out. If Government operations may be taken as a criterion, the private company logging teak makes a profit on the logs alone of about $22 per M after paying stumpage of about $16.50 per M. There is a large profit to be added from the sawmills run by the logging companies.

The grazing problems have been continuously difficult. India is densely populated with cattle, buffaloes, goats and sheep, for which grazing must be found, and which in many instances interferes with natural regeneration. Altogether 14,500,000 animals grazed in the forests in 1913 to 1914. The grazing is regulated so as to close forests against injurious cattle during the regenerative period.

CHINA'S FOREST LAWS

By Forsythe Sherfesee[1]

On January 15, 1916, the Chinese Forest Service was formally inaugurated as an annex to the Ministry of Agriculture and Commerce. In the history of forestry this date will be taken as marking the first real beginning of modern forestry in China. It is true that, as will be shown, there had been for several years certain efforts in the cause of reforestation; some of them instigated by private individuals, some by educational organizations or institutions, some by the provinces and some by the Central Government at Peking, and the cumulative effect of these projects was of undoubted importance; but the significance of the movement which was launched in January of this year lies in the fact that it marks the decision of the Central Chinese Government definitely to adopt an active, extensive policy of reforestation and of forest protection and management, and at least its intention to proceed along the line of a definite scientific policy in accomplishing certain clearly defined ends. It means that hereafter it is intended that all efforts and individual projects shall be shaped in accordance with a uniform policy so far as it is within the power or influence of the Central Government to do; and, best of all, that an effort is being made to gather together a personnel and to establish an organization which will put accomplishment within the realm of practicability.

Soon after the Republic of China was organized there was created a Ministry called "The Ministry of Agriculture and Forestry" and at the same time there was brought into existence a so-called Department of Forestry in the Ministry. This was in August of 1912. The Department lasted two years, but it seems to have merely existed without a definite, clearly defined policy, a driving force or correlation of efforts. A nursery had been established in a portion of the spacious grounds of the Temple of Heaven in the southern city of Peking; also an office called the "Bureau of Forestry for Kirin Province" (Kirin being one of the three Manchurian provinces) had been established with headquarters at the City of Kirin, the chief of the bureau reporting to

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the Ministry of Agriculture and Forestry in Peking. It appears that the Department of Forestry in the Ministry was supposed to exercise some sort of supervision over the acts of the branch bureau (although it was not designated as a "branch") in Kirin, but it is very probable that such supervision was far more nominal than real. Also, during these early years of the Republic there was some forestry work carried on in, or by a few of, the provinces. In 1914, the Ministry of Agriculture and Forestry was combined with the Ministry of Industry and Commerce to form the present Ministry of Agriculture and Commerce. At the same time the Department of Forestry was combined with the Department of Agriculture under the name of the Department of Agriculture and Forestry, and this nominal organization (nominal at least so far as an active forest policy was concerned) lasted for about two years, or until January, 1916, when as stated above, the Forest Service was inaugurated as a separate entity in the Ministry.

Even earlier, under the Manchus, there was a so-called "Board of Agriculture, Industry and Commerce" which had issued a simple set of rules encouraging people to plant trees, but the practical result was so small as to be negligible. Under the early Manchu emperors (Tsing dynasty) and under the immediately preceding Chinese dynasties there may have been some official recognition of the harmful effects of deforestation and some efforts to curb its extension, but all that there is to judge by are a few occasional and indefinite references scattered in books of the different periods, and such references seem to be more concerned with literary effect than with historical accuracy.

With this short and possibly inaccurate introduction, I propose to give a free translation of the Forest Laws or Mandates (which have the force of law) issued since the inauguration of the Republic, together with a translation of the memorial from Chow-Tzi-chi, then Minister of Agriculture and Commerce, requesting authority to establish a Chinese National Forest Service, the reply of Yuan-Shi-kai (at that time Emperor-Elect) and certain regulations issued thereunder. It is necessary to state, however, that up to the present time the laws appear to have remained quiet upon the statute books, and that little effort has been made to take advantage of their provisions or to comply with the restrictions they impose.

The first legal document I have been able to find is dated August 8, 1914, and is entitled:

"Regulations Governing the Granting of Concessions in the National Forests in Manchuria."[2]

Art. 1. With the exception of those portions reserved by the Government, concessions in the national forests in Manchuria may be granted in accordance with the following rules, such grants to be limited to the timber contained therein.

Art. 2. The right to request such concessions is limited to Chinese individuals or to corporations organized under Chinese law. International agreements previously made under special rules or conditions shall be effective up to their time of expiration.

Art. 3. In case any forest tract previously granted may be considered by the Ministry of Agriculture and Commerce to be necessary for reservation as either a protection forest or for public use, the concession may be cancelled, but the cancellation must not in any way injure the interests of the concessionaire. The rules governing the details of such cancellation shall be drawn up by the Ministry of Agriculture and Commerce in a separate form.

Art. 4. The applicant for a concession shall first present to the Bureau of Forestry a formal request for the investigation and survey (of the tract in question) and the said Bureau shall recommend such request to the Ministry of Agriculture and Commerce for consideration and approval; or else the applicant may present such a request for investigation and survey to any Magistrate or to any forest office, whereupon the official of the office in question shall submit recommendations to the Ministry of Agriculture and Commerce through the corresponding Tao-yin[3] and the Governor of the Province.

Art. 5. Such request shall contain the following information:

1. The name, native province, residence and age of the applicant.
2. The amount of capital he proposes to invest.
3. A statement of the boundaries and area of the forest tract, together with a map and description.
4. A list of the species, number, lengths and sizes of trees (or logs) he proposes to cut.
5. A plan for cutting.
6. Logging equipment.
7. Sawing equipment.

Art. 6. If the application is made by a corporation, it shall contain, in addition to the items specified in Article 5, the following additional information:

1. The names, native places, residence, occupations and ages of the originators and managers of the corporation.
2. Regulations and rules of the corporation.

Art. 7. At the time of presenting the application, the applicant shall pay the following amounts to cover the expenses of investigation and survey; to wit, for every 10 square li (a li is slightly more than one-third of an English mile) \$100.00, Chinese Currency,[4] and one dollar for every additional square li. If the Bureau of Forestry or the Magistrate after investigation and survey should report to the Ministry of Agriculture and Commerce that it is inadvisable to grant the forest tract requested, one half of the sum paid for investigation and survey shall be refunded to the applicant.

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[2] The author is fully aware of the ambiguity of the phrasing in many of the passages which follow. He has considered it safer, however, to content himself with as close a translation as it has been possible to secure, rather than to try to increase its intelligibility by coloring it with his own opinion of its real meaning.

[3] A Tao-yin is an official of intermediate rank and authority between the Governor of the Province and the Magistrates of the various districts or Hsien. Thus a Tao-yin has supervision over several magistrates, but is subject to the authority of the Governor of the Province. Author.

[4] The exchange value of the Chinese dollar varies within fairly wide limits; but for convenience it may be considered about equal to or slightly less than fifty cents, United States currency.

Art. 8. If the concession is granted by the Ministry of Agriculture and Commerce, a certificate shall be given to the applicant by the Ministry, upon receipt of which the applicant shall pay to the Ministry the sum of $50.00. The maximum term for such concession shall be twenty (20) years, but a yearly inspection shall be made, for which a charge of $10.00 shall be paid by the concessionaire.

Art. 9. At the time of receiving the certificate of concession, the concessionaire shall deposit $200.00 for each 10 square li embraced within his concession.

Art. 10. Upon taking any logs from the forest to their destination, the concessionaire shall render a report to the local Government office for inspection, showing a list of the number, species, sizes and lengths of the logs.

Art. 11. When the logs are sold, the concessionaire shall, in addition to the payment of regular taxes, pay stumpage charges at the rate of 8% of the selling price.

Art. 12. The area applied for under a single concession shall not exceed 200 square li.

Art. 13. If the concessionaire should wish to transfer his concession to a third party, such application shall, in accordance with provisions of Article 4, be referred to the Ministry of Agriculture and Commerce, for consideration and approval, and a charge of $50.00 shall be paid to the Ministry for such transfer. At the time that such transfer becomes effective the guaranty deposit shall also be transferred. The concession thus transferred shall be effective only during the period remaining under the original grant.

Art. 14. If after logging, the concessionaire should wish to apply for the land itself for agriculture, in accordance with the law governing the granting of government lands for agriculture, he may do so by making application to the Government, provided that the local Government office does not consider that the land in question is unsuited for agricultural purposes.

Art. 15. At the time of cutting two or three trees shall be left on each mo[5] of land. Such trees left shall be more than one foot in diameter and shall be of good quality.

Art. 16. The concessionaire shall be held responsible for the proper preservation of boundary marks, and of any ancient works or monuments within the limits of his concession.

Art. 17. Within six months from the date of the promulgation of these regulations, the certificates previously issued by other Government offices shall be presented to the Ministry of Agriculture and Commerce to be exchanged for certificates of the Ministry of Agriculture and Commerce. After the expiration of this six month period, all such certificates issued by other Government offices shall be void.

Art. 18. The above regulations shall become effective from the date of their promulgation (August 8, 1914).

THE FOREST LAW

(Promulgated November 3, 1914)

CHAPTER I

General

Art. 1. The management and control of the forests owned by the Government, by the public[6] or by private individuals shall be in accordance with this

Art. 2. Forests which have not yet passed into private ownership, and which should legally be considered the property of the Government, shall be classified as Government owned forests.

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[5] A mo is equal to about one sixth of an English acre.

[6] For example, local associations, monasteries and other public institutions.

law, unless otherwise provided for by other laws or mandates.

Art. 3. The Government owned forests, in addition to those which have been under the direct control of the Ministry of Agriculture and Commerce, may be entrusted to the local official organs for management.

Art. 4. All Government owned forests falling under any of the following classes must be under the direct control of the Ministry of Agriculture and Commerce.

1. Forests affecting the sources of rivers and streams.
2. Forests situated within two or more provinces.
3. Those which are connected with diplomatic cases.

Art. 5. Should the Ministry of Agriculture and Commerce deem it absolutely necessary for the development of Government owned forests, it may purchase forests owned by the public or by individuals at an adequate price.

CHAPTER II

Reserved Forests

Art. 6. Under any of the following conditions the Ministry of Agriculture and Commerce or the local high administrative official may convert any forests, whether owned by the Government, by the public or by an individual, into a reserved forest:

1. For protection against floods.
2. For the maintenance of the source of streams.
3. For public sanitation.
4. For use as a landmark for navigation.
5. For the convenience of fishing enterprises.
6. As wind and sand breaks.

Art. 7. When any public or private forest is converted into a reserved forest, a petition may be sent to the Ministry of Agriculture and Commerce, claiming any proper indemnity for the loss incurred.

Art. 8. The procedure for the management and control of the reserved forests, which have been entrusted by the Ministry of Agriculture and Commerce to local officials, shall be fixed by Instructional Mandates of the President.

Art. 9. Orders of reservation may be cancelled when the Ministry of Agriculture and Commerce or the local high administrative official no longer think such reservation necessary.

Art. 10. Without the permission of the local officials, no one shall be permitted to fell trees in reserved forests and no combustible material may be brought into such forests.

Art. 11. The provisions of Articles 7, 8 and 10 shall also apply to forests hallowed by ancient traditions or containing renowned scenery.

CHAPTER III

Encouragement

Art. 12. Should any individual or individuals wish to apply for any idle Government-owned hill-land for the purposes of growing forests, the land applied for shall be granted without charge. Such applicant must be a citizen of the Chinese Republic.

Art. 13. The idle Government hill-land applied for for reforestation shall not exceed an area of 100 square li. When the applicant's operations have extended over this entire area, he may apply for an additional area.

Art. 14. The applicant for such idle Government-owned hill-land shall deposit as cash security an amount between \$20.00 and \$100.00 for every ten square li, the exact amount being fixed by the Ministry of Agriculture and Commerce, or the local chief administrative official. For this purpose an area of less than 10 square li shall be reckoned as equal to 10 square li. If, after a period of five years has elapsed, the local controlling official should find that the enterprise has succeeded, the cash security may be returned to the applicant, together with interest computed at between 3 and 5 per cent.

Art. 15. If within the period of one year, no attempt has been made to work the portion of the idle Government-owned hill-land granted as above provided, the land shall revert to the Government and the cash security shall be forfeited; but this shall not apply in case such failure is due to natural calamities or to any other causes over which the applicant has no control, provided that the sanction of the local official for the delay has been obtained.

Art. 16. When such idle Government-owned hill-land is applied for for reclamation, such land shall be exempt from taxes for a period between 5 and 30 years, the length of the period being fixed by the Ministry of Agriculture and Commerce or the chief local administrative official.

Art. 17. The details of the regulations for rewarding and encouraging persons who shall have achieved success in reforestation shall be fixed by Instructional Mandates of the President.

CHAPTER IV

Supervision

Art. 18. If desirable for public benefit, the local officials may forbid or restrict cultivation in forested areas owned by the public or by individuals.

Art. 19. Should the owner of public or private land begin to fell trees in other than the usual manner or in case he should overcut or abuse the same, the local official may restrict or warn him.

Art. 20. The controlling local official is authorized to fix a date before which the public or individual owners of idle hill-land may be compelled to plant trees thereon.

CHAPTER V

Punishment

Art. 21. Any one who steals any produce of the forest shall be considered a thief, and shall be punished with a limited imprisonment of the fifth grade with hard labor or by a fine not exceeding double the value of the products stolen.

Art. 22. Any forest thief who commits theft under any of the following circumstances shall be liable to punishment with limited imprisonment of the fourth grade or lower, together with a fine not exceeding double the value of the products stolen:

1. Theft committed in a reserved forest.
2. Theft committed by a person who has been entrusted by officials or by contracts with any responsibility for protecting the forest.

Art. 23. Any person who accepts as gift, transports, stores, purchases, or sells on commission goods which he knows to have been stolen by forest thieves shall be liable to punishment in accordance with the provisions set forth in Articles 21 and 22.

Art. 24. Any one who sets fire to forest not his own property shall be liable to punishment in accordance with provisions of Article 188 of the Criminal Code.

Art. 25. Any one who sets fire to his own forest shall be liable to punishment with limited imprisonment of the fifth grade, with hard labor or with a fine not exceeding one hundred dollars. Should such fires set on his own forest injure the property of others, he shall be liable to punishment in accordance with the provisions set forth in Article 189 of the Criminal Code.

Art. 26. Should any person use another's forest as pasture for his cattle or horses, without previously obtaining the approval of the owner, he shall be fined not less than one dollar nor more than thirty dollars.

Art. 27. Should any person damage or remove boundary or other forest marks, he shall be fined an amount not less than two dollars nor more than fifty dollars.

Art. 28. Should any person injure the young trees in another's forest, he shall be fined not less than two dollars nor more than one hundred dollars.

Art. 29. Should any person violate the provisions contained in Art. 10 by felling timber or by bringing combustible material into the forest, he shall be fined not less than one dollar nor more than thirty dollars.

Art. 30. Should any person violate the provisions contained in Art. 18 by cultivating in a reserved forest, he shall be fined not less than two dollars nor more than fifty dollars.

CHAPTER VI

Additionals

Art. 31. The detailed regulations for the enforcement of this law shall be fixed by Instructional Mandate of the President.

Art. 32. This law shall become effective from the date of its promulgation (November 3, 1914).

In accordance with the provisions of Art. 31 of the above Forest Law, the President promulgated on June 30, 1915, the following regulations for its enforcement.

DETAILED REGULATIONS ENFORCING THE FOREST LAW

Promulgated June 30, 1915

Art. 1. Within six months after these Detailed Regulations became effective, every owner of public or private forests shall report to the District Magistrate, the details concerning the locations, dimensions and descriptions of the forest he owns. The District Magistrate shall transmit the same through the Tao-yin and the highest local administrative official to the Ministry of Agriculture and Commerce for registration. If a single forest is situated in two or three districts (hsien) reports should be submitted separately.

Art. 2. Within three months after these regulations become effective, all changes in ownership of public or private forests and the suspension or extension of enterprises conducted therein shall be reported according to the provisions in the article immediately preceding.

Art. 3. When it is desired to entrust the management of a government owned forest to a local official as provided for in Art. 3 of the Forest Law, the area shall be first inspected by the Ministry of Agriculture and Commerce.

Art. 4. When the management of a forest has been entrusted by the Ministry of Agriculture and Commerce to the highest local administrative official, the corresponding District Magistrate shall, during the first month of each year, submit to the highest local official a detailed report for the past year. This shall be forwarded through the Tao-yin to the Ministry of Agriculture and Commerce. Separate reports should be submitted in the case of any special occurrence.

Art. 5. The Ministry of Agriculture and Commerce may order such changes in management as it considers desirable.

Art. 6. The District Magistrate shall be held responsible for the protection of all government owned forests within his jurisdiction, and in case of his transfer all such property shall be included in his accounts. Each Magistrate shall report on the condition of the government owned forests, which report shall be sent through the Tao-yin to the highest local official, who in his turn, shall report to the Ministry of Agriculture and Commerce.

Art. 7. When ownership of public or private forests is transferred to the Government, the compensation paid shall be in accordance with the current market rate of the land and forest concerned.

Art. 8. In case there is any loss or damage when a forest is sold, according to the provisions in the preceding article, the former owner must submit a petition to the District Magistrate, who shall transmit it to the highest local administrative official to be forwarded to the Ministry of Agriculture and Commerce.

Art. 9. If after the ownership of a portion of a public or private forest is transferred to the Government, the original owner should consider it necessary for the Government to take the rest, he may submit a petition setting forth his reasons to the District Magistrate who shall transmit it to the highest local administrative official to be forwarded to the Ministry of Agriculture and Commerce, for investigation and corresponding action.

Art. 10. In addition to the notification sent to the owner, the transfer of ownership of such forest shall be published for general information, after which the former owner shall lose all claims to ownership.

Art. 11. Should any complication arise in connection with the forest transferred to the Government, the original owner shall be responsible for proper settlement; and if he fails to do so before the expiration of a fixed period, the District Magistrate shall settle the case for him, all expenses to be deducted from the proceeds of the sale of the forest.

Art. 12. When a declaration of "reserved" forest is made or cancelled as provided for in Arts. 6 and 9 of the Forest Law the Ministry of Agriculture and Commerce or the highest local administrative official shall inform the owner of the reasons therefor, and shall notify the public in due form. If such a decision is made by the highest local administrative official, it shall be transmitted to the Ministry of Agriculture and Commerce for registration.

Art. 13. In case a portion of a forest is declared to be reserved, or the former declaration is cancelled, a map indicating the location of the forest shall accompany such report or proclamation.

Art. 14. When a petition is lodged for compensation as provided for in Art. 7 of these regulations, the petitioner shall give a detailed estimate of the loss incurred, which shall be reckoned up to the date of publication of a public notice, prohibiting all free cutting within the forest.

Art. 15. If the ownership of a reserved forest is transferred or if such forest suffers any change in appearance or condition, a report shall be made to the District Magistrate who shall transmit it through the Tao-yin to the Ministry of Agriculture and Commerce for registration.

Art. 16. When a person applies for public owned forest land for purposes of reforestation, as provided for in Art. 12 of the Forest Law, he shall prepare an application containing the following particulars and send it to the District Magistrate who shall transmit it through the Tao-yin to the highest local administrative official to be forwarded to the Ministry of Agriculture and Commerce for approval:

1. The name, age, native home, present address and occupation of the applicant. If the applicant is a corporation there shall be given the name and address of the corporation and the name, age, native province, present address and profession of its manager or representative.
2. The amount of money he expects to invest in reforestation.
3. The location and dimension of the land applied for.
4. The four boundaries of the tract. If only a portion of the tract is applied for, the specific location within the tract shall be noted.

In addition to such application, the applicant shall submit a statement of his plans, together with a map of the area applied for.

Art. 17. In the case of an application for extension of area according to the provisions made in part 2 of Art. 13 of the Forest Law, such extension shall not exceed 100 square li.

Art. 18. If after an order has been received to plant trees as provided for in Art. 20 of the Forest Law, the person concerned fails to comply with the same, the District Magistrate shall proceed in accordance with clause 1 of Article 2 of the Law Enforcing Administrative Measures.

Art. 19. The local high administrative officials referred to in these regulations are the Governors of the Provinces, Lieutenant Generals of the Special Administrative areas and the Governor of the Metropolitan Prefecture.

Art. 20. These detailed regulations shall become effective from the date of their promulgation (June 30, 1915).

REGULATIONS ENCOURAGING REFORESTATION

Promulgated, June 30, 1915

Art. 1. Those who have achieved success in planting forests shall be rewarded according to the following regulations:

Art. 2. When a petition is submitted for encouragement, it shall contain the following particulars and be forwarded to the highest local administrative official to be submitted to the Ministry of Agriculture and Commerce for consideration:

1. The name and address of the person or company deserving of encouragement.
2. Location of the forest.
3. Dimension and area of the forest.
4. Description and number of the trees.
5. Important plans of the enterprise.
6. The number of years which have elapsed since planting.

Art. 3. When a petition is made in accordance with the preceding article, it shall be accompanied by photographs of the forest and by specimens of the timber produced.

Art. 4. When an area of more than 200 mo of land has been reforested for a period of more than five years, a fourth class medal shall be awarded.

Art. 5. When an area of more than 400 mo has been reforested for a period of more than five years, a third class medal shall be awarded.

Art. 6. When an area of more than 700 mo has been reforested for a period of more than five years, a second class medal shall be awarded.

Art. 7. When an area of more than 1,000 mo has been reforested for a period of more than five years, a first class medal shall be awarded.

Art. 8. When an area of more than 3,000 mo has been reforested for a period of more than five years, the Ministry of Agriculture and Commerce shall request the President to give a special reward.

Art. 9. When reforestation work is conducted which affects international trade or furnishes material for the construction of ships, railroads and other important purposes, subsidies may be granted according to the dimension of the forest and the number of trees planted, if the Ministry of Agriculture and Commerce considers such a course necessary.

Art. 10. The Ministry of Agriculture and Commerce shall publish in the Official Gazette awards made in accordance with the provisions contained in these regulations.

Art. 11. These regulations shall come into force from the date of their promulgation (June 30, 1915).

On December 22, 1915, Mr. Chow-Tzi-chi, Minister of Agriculture and Commerce, presented the following petition to Yuan-shi-kai, at that time Emperor-Elect:

"As the Ministry of Agriculture and Commerce intends to organize a "National Forest Service," it begs leave respectfully to submit the following regulations and estimates to His Imperial Majesty for His Holy Perusal:

"Three thousand years ago during the Yü Dynasty, an officer named Pe Yi was sent out by the Emperor to take charge of herbaceous and woody plants throughout the country. In the office of Sz Tie (an official administrative organ) there was also in existence a department of forestry and hunting. These two facts clearly indicate that in order to develop the forests of the country there must be a special organ to take charge of them. Inasmuch as all countries both in the East and in the West realize the importance of forest conservation, they have taken progressive steps towards its maintenance and upkeep because reforestation betters the economic condition of the people and increases the wealth of the nation, and the annual revenue from forestry is so large that it forms a considerable percentage of the national income. When we consider the wide extent of our territory and the rich forests in our border provinces, it will be seen that an early establishment of a Forest Service cannot fail to benefit the country. It is also a great pity to see mountains and hills lying idle and not utilized: therefore it is necessary to take immediate steps to devise means and regulations to develop these natural resources. It is the duty of this Ministry to conserve the forests. In the former Ministry of Agriculture and Forestry there was in existence a separate Department of Forestry until the Ministry was merged with the Ministry of Commerce and Industry, at which time the Department of Forestry was also merged into the Department of Agriculture under the name of Department of Agriculture and Forestry. Since then the duties of the Department have increased as the work has multiplied, and it is, therefore, difficult for it to render efficient service and to produce good results. Furthermore, forestry work in different provinces is under the charge of the Division of Industry in which there is no man who devotes his complete attention to forestry; and there are also no technically trained foresters. Upon careful consideration the Ministry has reached the conviction that unless a special organ is established in the Ministry and unless districts are marked out with special commissioners to take charge of them, it is impossible to lay responsibility anywhere and to expect progress of any kind. Therefore, taking everything into consideration, this Ministry has definitely decided to organize a Forest Service to carry out forestry work throughout China, appointing the Vice-Minister to act as Director-General, and two technical foresters being proposed as co-directors. For the remaining staff of the Forest Service, there are other members in the Ministry who have graduated from eastern and western universities where they received technical training in forestry. These will be placed in accordance with their ability and qualifications: and for the present each province will be made a forest district, to each of which a Provincial Forest Commissioner will be appointed. Provincial Forest Commissioners will be recommended to His Majesty jointly by the Minister and the Governors of the provinces concerned. The Central Government will bear the administrative expenses of the Forest Service, but the expenses of the Provincial Forest Commissioners and of their reforestation work in the districts (hsien) must be borne by each province and district and charged to the provincial annual administrative expenditure. By so doing responsibilities are clearly placed. Technical men at different places will be working jointly and abundant results will be achieved. The expenses will be borne separately and this will make them lighter to bear. The Ministry believes that such an arrangement cannot fail of good results. The Ministry has carefully drawn up regulations in 16 articles governing the organization of the Forest Service and also its budget for the coming year, and hereby respectfully submits them to His Majesty for His Holy Perusal. If the plan is approved, the Ministry will humbly follow it out, and will notify the Ministry of Finance and the Governor of each province that they should act accordingly. As soon as the Central Government shall have rectified and graded the official system, the Ministry will immediately submit a petition for the necessary change of the present Department of Agriculture and Forestry.

Respectfully submitted,

CHOW-TSZ-CHI,
Ministry of Agriculture and Commerce."

The sixteen regulations referred to above were submitted in a separate but accompanying document which reads as follows:

"The Ministry of Agriculture and Commerce hereby respectfully submits the following 'Regulations' to His Majesty for His Holy Perusal:

"Art. 1. The Ministry of Agriculture and Commerce intends to organize a 'National Forest Service' as an annex to the said Ministry. Said Service shall administer the forestry affairs of the whole country according to the Forest Law and its Detailed Regulations.

"Art. 2. The staff of the National Forest Service shall be composed of one Director-General and two Co-Directors. The Vice-Minister of the Ministry shall be ex-officio Director-General. Other officers shall be appointed by the Central Government. The three directors shall manage the affairs of the Service in accordance with instructions from the Minister. The Forest Service shall also maintain technical foresters who are to be appointed from among those who have obtained the required knowledge and experience in forestry.

"Art. 3. The provincial administrative centers shall temporarily serve as forest stations. When necessary to meet the demands of the work, the Forest Service may, with the approval of the Minister, establish additional forest stations.

"Art. 4. A technical forester shall be appointed and assigned to every large forest station. It shall be the duty of such an official to carry out the instructions of the Ministry and of the Civil Governor of the Province.

"Art. 5. When no forest stations have been designated the Forest Service may, after due investigation of local conditions and with the approval of the Ministry, draw up a working plan and put it into execution.

"Art. 6. A candidate for the position of Provincial Forest Commissioner shall be one who has knowledge of forestry and who is well versed in administrative work. The Ministry and the Governor of the Province shall jointly submit a petition (to his Majesty) for appointment.

"Art. 7. The Forest Service shall enumerate the duties of the Forest Commissioners and draw up regulations for their work, which shall be put into execution after approval by the Ministry.

"Art. 8. The expenses of the Provincial Forest Commissioners shall be included in the budgets of the respective provinces.

"Art. 9. Each district (hsien) shall annually provide a sum of more than $200.00 to be expended for encouraging reforestation.

"Art. 10. The Forest Service shall cooperate in and increase the collection of forest taxes, and shall recommend regulations looking to the improvement of the law governing forest taxation and the administration thereof.

"Art. 11. The Ministry shall decide upon the number of divisions to be created in the Forest Service and shall fix the duties of each. The number of officers shall be governed and limited by the annual budget.

"Art. 12. The Forest Service may increase the number of temporary employees whenever necessary.

"Art. 13. The Ministry shall draw up rules for the guidance and government of the officers and employees of the Forest Service.

"Art. 14. The Forest Service shall formulate rules and regulations for the various divisions for the approval of the Ministry.

"Art. 15. If it should be found that these regulations are incomplete the Ministry may rectify them from time to time and memorialize for approval.

"Art. 16. The above regulations shall become effective when sanctioned."

On January 3, 1916, the Council of State promulgated the following reply to the petition quoted above. The reply in full reads as follows:

"The Council of State has received the following Imperial Mandate, which is hereby promulgated: (January 3, 1916).

"The Ministry of Agriculture and Commerce has requested permission to create a National Forest Service in the said Ministry to have special control over the woods and forests of the whole country. This suggestion is in line with the practice of the Ancients when special officers were appointed to supervise the work of the woodsmen in felling trees in order to protect such as were useful for working materials. In both Eastern and Western countries, there are departments of forestry which supervise the timber resources. The benefits accruing therefrom are very extensive.

"China is a large country rich in natural products. The border provinces contain abundant woods and forests and in the interior provinces there are many places which produce timber, the only trouble being that no pains have been taken to protect them, nor has the Government done anything towards that end. The consequence is that lands once forested have through neglect become bare and barren. A knowledge of the disasters due thereto was not, however, obtained in a day or a night. It was not until the science of forestry was taken up in addition to the study of agriculture that the conditions became popularly understood and that merchants began forming companies for obtaining and transporting lumber. It is, however, necessary that the Government should make a beginning by taking steps properly to organize the work; to appoint officers to take charge of the various districts—to appoint rangers or forest police; and to investigate and map the areas suitable for reforestation. In a word there should be a spirit of earnestness in drawing up plans and regulations in order to direct the common people towards the path of progress along such lines.

"The proposal of the Ministry, therefore, that a National Forest Service should be created in the said Ministry is hereby approved, such Forest Service to have control over the woods and forests of the whole country. Each province shall be considered a forest district which shall be placed under an officer to be appointed by the Central Government at the joint recommendation of the Ministry and the Civil Governor of the Province. The expenses of this tentative plan shall be defrayed in accordance with the temporary regulations. The aim of the work shall be the encouragement of the study of forestry and the protection of whatever may tend to benefit the people.

"The said Ministry is ordered to submit reports from time to time upon progress made in order that it may be put upon record."

With the promulgation of this Mandate the Forest Service was definitely established and the formal opening took place as stated above, on January 15, 1916. Subsequent developments, in particular the organization of the Forest Service into divisions, will be dealt with separately in a later paper.

THE SIGNIFICANCE OF CERTAIN VARIATIONS IN THE ANATOMICAL STRUCTURE OF WOOD

By R. P. Prichard[1] and I. W. Bailey[2]

In the following pages are summarized the results of one of a series of investigations that have been undertaken at the Bussey Institution in the study of plant tissues and cells, their comparative structure, relative conservatism, and behavior under the influences of various modifying factors. The investigation deals with the variation in size of the principal woody elements (fibers and vessel-segments) in various parts of the stem of a single species, the common Shagbark hickory, *Carya ovata* (Mill) K. Koch.

Tables and Other Data

Specimens of wood were secured from three different trees, a mature virgin-forest tree from West Virginia, a second-growth tree of seedling origin from eastern Massachusetts, and a sprout-hardwood from near Syracuse, New York. Sections of the selected trees were cut at various heights from the ground. Blocks were cut radially from each section, and chips were taken from every fifth ring. These chips were macerated by treating with a 5 per cent solution of equal parts of chromic and nitric acid, and the cells were separated by shaking with water and glass beads. Measurements were made with a micrometer eyepiece, 50 of fiber lengths and 20 of vessel-segment lengths. To obtain the diameters of the vessels microscopic slides were made from different portions of each section, and measurements were taken from these slides with a micrometer eyepiece.

The results are shown in the following tables and diagram:

Length of Fibers at Different Ages of a Tree

Table I.—*Carya ovata* (sprout), 60 annual rings, cross section 1 foot from the ground. Specimen from near Syracuse, New York.

Annual Rings	Fiber Lengths Millimeters Max.	Min.	Ave.
5	1.34	.62	.89
10	1.60	.80	1.11
15	1.66	.56	1.21

Table II.—*Carya ovata* (seedling), 65 annual rings, cross section 2 feet from the ground. Specimen from near Boston, Massachusetts.

Annual Rings	Fiber Lengths Millimeters Max.	Min.	Ave.
1	.98	.54	.73
5	1.10	.66	.90
10	1.30	.66	1.02

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20	1.64	.70	1.28	15	1.48	.78	1.10
25	1.70	.74	1.32	20	1.40	.78	1.12
30	1.70	.72	1.23	25	1.42	.90	1.12
35	1.64	.72	1.32	30	1.48	.96	1.21
40	1.62	.62	1.27	35	1.60	1.04	1.29
45	1.88	.56	1.33	40	1.64	.96	1.24
50	1.80	.86	1.39	45	1.48	.86	1.20
55	1.92	.96	1.48	50	1.50	.94	1.18
60	1.80	.96	1.34	55	1.52	.94	1.18
				60	1.60	.96	1.22
				65	1.52	1.04	1.26

TABLE III.—*Carya ovata* (seedling), 255 annual rings, cross section 2 feet from the ground. Specimen from West Virginia

	Fiber Lengths Millimeters		
Annual Rings	*Max.*	*Min.*	*Ave.*
5	1.28	.49	.82
10	1.25	.67	.96
15	1.23	.97	1.03
20	1.24	.77	1.05
25	1.48	.98	1.17
30	1.41	.96	1.12
35	1.45	.51	1.03
40	1.33	.86	1.12
45	1.35	.70	1.14
50	1.35	.74	1.11
55	1.38	.60	1.07
60	1.42	.66	1.06
65	1.44	.69	1.13
70	1.41	.82	1.08
75	1.48	.89	1.18
80	1.76	.89	1.11
85	1.44	.62	1.12
90	1.54	.96	1.17
95	1.42	.60	1.19
100	1.55	.80	1.19
105	1.54	.73	1.10
110	1.48	.87	1.19
115	1.45	1.01	1.22
120	1.57	.94	1.19
125	1.18	.86	1.02
130	1.46	.89	1.06
135	1.53	.98	1.20
140	1.57	.73	1.15
145	1.58	.78	1.22
150	1.44	.88	1.18
155	1.50	1.05	1.24
160	1.52	1.10	1.28
165	1.59	1.09	1.32
170	1.54	1.06	1.28
175	1.48	1.00	1.19
180	1.59	.82	1.22
185	1.50	.85	1.30
190	1.86	.85	1.12
195	1.44	.83	1.17
200	1.44	.90	1.06
205	1.52	.98	1.15
210	1.33	.83	1.05

Annual Rings	*Fiber Lengths Millimeters* *Max.*	*Min.*	*Ave.*
215	1.56	1.03	1.19
220	1.36	.75	1.01
225	1.56	1.04	1.28
230	1.42	1.01	1.23
235	1.65	.90	1.19
240	1.37	.76	1.10
245	1.48	1.02	1.13
250	1.51	.90	1.17
255	1.45	.95	1.16

Length of Vessel-Segments at Different Ages of a Tree

Table IV.—*Carya ovata* (seedling) 65 annual rings, cross section 2 feet from the ground. Specimen from Boston, Massachusetts.

Annual Rings	*Vessel-Segment Lengths Millimeters* *Max.*	*Min.*	*Ave.*
1	.30	.24	.27
5	.42	.28	.36
10	.54	.32	.39
15	.46	.28	.38
20	.42	.36	.40
25	.48	.42	.43
30	.44	.36	.40
35	.48	.38	.42
40	.52	.42	.44
45	.60	.30	.44
50	.54	.36	.45
55	.62	.40	.45
60	.56	.44	.52
65	.58	.40	.49

Table V.—*Carya ovata* (seedling), 255 annual rings, cross section 2 feet from the ground. Specimen from West Virginia.

Annual Rings	*Vessel-Segment Lengths Millimeters Ave.*
1	0.12
10	0.33
20	0.37
35	0.38
60	0.40
85	0.39
110	0.44
135	0.41
160	0.40
185	0.42
210	0.41
235	0.42
255	0.44

Effect of Age and Position in Vertical Axis on the Length of Fibers and Vessel-Segments

Table VI.—*Carya ovata*, same specimen as table II. Average length of fibers in millimeters

Annual Rings

Distance from ground. Sec.	1 yr.	5 yr.	10 yr.	15 yr.	20 yr.	25 yr.	30 yr.	35 yr.	40 yr.	45 yr.	50 yr.	55 yr.	60 yr.	65 yr.
2 ft.	.73	.90	1.02	1.10	1.12	1.12	1.21	1.29	1.24	1.20	1.18	1.18	1.22	1.26
10 ft.	....	.68	.96	.99	1.06	1.11	1.06	1.08	1.07	1.05	1.06	1.16	1.10	1.06
19 ft.	....	....	.70	.78	.87	.96	1.00	1.09	1.09	1.00	1.05	1.03	1.06	1.09
29 ft.	....	....	....	....	74	.88	.96	.98	1.01	1.07	1.04	1.06	1.08	1.09
38 ft.	....	....	....	....	....	.69	.90	.93	.97	1.05	1.10	1.03	1.03	1.06
46 ft.	....	....	....	....	....	....	....	.95	.95	.94	.88	.91	.89	.97

TABLE VII.—*Carya ovata*, same specimen as table IV. Average length of vessel-segments in millimeters

Annual Rings

Distance from ground. Sec.	1 yr.	5 yr.	10 yr.	15 yr.	20 yr.	25 yr.	30 yr.	35 yr.	40 yr.	45 yr.	50 yr.	55 yr.	60 yr.	65 yr.
2 ft.	.27	.36	.39	.38	.40	.43	.40	.42	.44	.44	.45	.45	.52	.49
10 ft.	....	.35	.43	.42	.45	.46	.48	.44	.44	.50	.48	.48	.55	.53
19 ft.	....	....	....	.40	.39	.45	.48	.48	.49	.47	.48	.51	.51	.53
29 ft.	....	....	....	....	.36	.41	.41	.43	.44	.48	.48	.47	.50	.48
38 ft.	....	....	....	....	....	.39	.41	.41	.47	.44	.47	.47	.47	.41
46 ft.	....	....	....	....	....	....	....	....	.42	.42	.46	.44	.44	.43

DIAMETER OF VESSELS AT DIFFERENT AGES OF A TREE

TABLE VIII.—*Carya ovata*, same specimen as table IV. Large vessels.

Annual Rings	*Diameter Vessels, Millimeters* *Max.*	*Min.*	*Ave.*
Section 2 feet from ground			
2–5	0.24	0.20	0.21
29–37	0.41	0.29	0.33
57–65	0.41	0.31	0.37
Section 19 feet from ground			
19–27	0.38	0.28	0.33
47–55	0.42	0.36	0.38
Section 46 feet from ground			
0–8	0.24	0.14	0.18
28–36	0.38	0.27	0.33

TABLE IX.—*Carya ovata*, same specimen as table III. Large vessels. Section 2 feet from ground.

Annual Rings	*Diameter Millimeters Ave.*
1–2	0.06
10	0.18
20–85	0.22
85–160	0.26
160–260	0.33

DISCUSSION AND CONCLUSIONS

A. Size of tracheary elements in different parts of a tree.

In 1872 Sanio[3] published the results of a detailed study of the variations in size of the tracheids in Scotch pine. From his observations upon the conditions in this plant, he deduced a number of conclusions in regard to the variation in size of the tracheary elements in conifers. The first of these says: In the stem and branches the tracheids everywhere increase from within outwards, throughout a number of annual rings, until they have attained a definite size, which then remains constant for the following annual rings.

[3] Sanio, Karl, Ueber die Grösse der Holzzellen bei der gemeinen Kiefer (*Pinus silvestris* L.). Jahrb. Wiss. Bot., Vol. VIII, pp. 401–420, 1872.

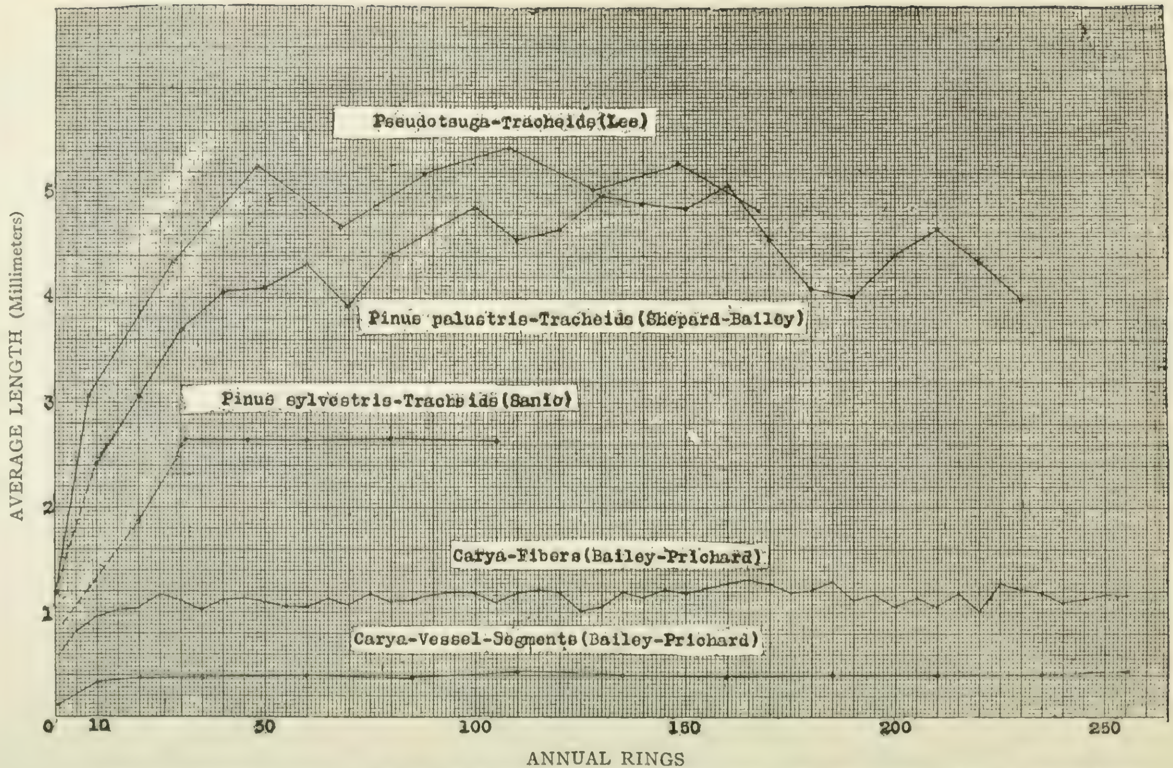

FIG. 1—Diagrammatic representation of the variations of average tracheid, fiber, and vessel-segment lengths in succeeding annual rings of a tree.

In a paper published in 1914 Shepard[4] and one of the writers questioned the general applicability of Sanio's first law, since no constant tracheid length could be found in *Abies concolor* Lindl. and Gord., *Pinus strobus* L., *P. palustris* Mill., *Picea rubens* Sarg., and *Tsuga canadensis* Carr. In the investigated specimens of these species, the tracheids increased rapidly in size for a number of years (30–60), and in succeeding years no constant length was attained. On the contrary, the dimensions were subject to pronounced fluctuations of varying magnitude and duration. Sanio's curve for a basal section of a 105-year-old specimen of Scotch pine and that of Shepard and Bailey for a similar section of a 230-year-old specimen of Longleaf pine are given in figure 1. More recently the results of Shepard and Bailey have been corroborated by Miss Gerry,[5] who has made a very detailed study of Longleaf pine and Douglas fir.

In his study of arborescent and shrubby Dicotyledons, Sanio[6] reached very different results in regard to the variation in the size of the xylem elements in these plants from those which he had previously published in regard to the conifers. His measurements show that the fibers increase in length in succeeding annual rings in *Caragana arborescens*, *Sophora japonica*, *Sarothamnus scoparius* *Acacia longifolia*, *Carpinus Betulus*, *Quercus pedunculata*, *Cornus sanquinea*, *Rhamnus cathartica*, and *Ficus elastica*. The length of the fibers remained constant, however, in *Mahonia aquifolium* and *Berberis vulgaris*, as did that of the vessel-segments in these species and in his species of Ficus, Caragana, Sarothamnus, Acacia, and Sophora. In only one species, *Quercus pedunculata*, did Sanio secure material from a specimen of sufficient size or maturity to afford results comparable to those secured from his study of Scotch pine. Furthermore, his limited number of measurements were confined to the earliest and last formed rings, and, therefore, afford no evidence in regard to the behavior of the elements at intermediate stages in the development of the plants.

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[4] Shepard, H. B., and Bailey, I. W. Some observations on the variation in length of coniferous fibers. Proc. Soc. Am. Foresters, Vol. IX, No. 4, 1914.

[5] Gerry, Eloise. A comparison of tracheid dimensions in Longleaf pine and Douglas fir, with data on the strength and length, mean diameter and thickness of wall of the tracheids. Science, Vol. XLIII, No. 1106, p. 360.

[6] Sanio, Karl. Anatomie der gemeinen Kiefer (*Pinus silvestris* L.) II. Jahrb. Wiss. Bot., Vol. IX, pp. 50–126.

The results secured by the writers, in their study of fibers and vessel-segments in hickory, are, accordingly, of interest as affording a possible clue to the variations of these xylem elements in the development of arborescent Dicotyledons, and the comparative behavior of representatives of the Angiosperms and Gymnosperms. As is shown graphically in figure 1, fiber length, in *Carya ovata*, increases rapidly for a number of years (20–25), and does not become constant in succeeding years. It is subject to regular cyclic variations such as occur in the tracheid length of all conifers investigated, except the material of *Pinus sylvestris* examined by Sanio. The increase in length is, however, less rapid, the maximum length attained is considerably shorter, and the cyclic variations are less marked than in conifers. The length of the vessel-segments increases rapidly for a few years, but appears to remain nearly constant during the later stages of the tree's development.[7] The diameter of the vessels, on the contrary, increases considerably during this period.

A survey of all the evidence at hand indicates that in the development of the stem of Coniferæ and many large perennial Dicotyledons there is a period, in the early stages of the plant's life history, during which the woody elements increase in size comparatively rapidly. The duration of this period and the rate of increase during the period vary more or less in different groups of plants, in different specimens of the same species, and at different heights in the stem of a single individual. Furthermore, different types of xylem elements, *e. g.*, tracheids, libriform fibers, and vessel-segments, behave very differently.

One of the writers,[8] working in collaboration with Mr. W. W. Tupper, has made a study of the length of the xylem elements in the secondary wood of a large number of Gymnosperms and Angiosperms. This investigation has shown that, in comparable mature material, the tracheids of the former group of plants are, on the average, more than twice as long as the tracheids, fiber-tracheids, libriform-fibers, and vessel-segments of the Dicotyledons. The tentative assumption may be made, accordingly, that the curves in figure 1 are, in a general way, indicative of the differ-

[7] The fluctuations in the curve are but slightly greater than the probable deviations of the means of twenty measurements.

[8] Tupper, W. W., and Bailey, I. W. Some observations upon the secondary xylems of Gymnosperms and Angiosperms. Science, XLIII, No. 115, p. 323, March, 1916.

ences between Coniferæ and Dicotyledons. Furthermore, the fact that certain primitive types of arborescent Ranales, which do not possess vessels, resemble the conifers in the structure, size, and general variability of their tracheids, suggests that the shortening of the xylem elements in Dicotyledons has been associated in some manner with the evolution of vessels.

The evidence at hand indicates, also, that the size of tracheids, fiber-tracheids, libriform-fibers, and vessel-segments fluctuates more or less during the later stages of the development of a tree, and that the size of the elements in any given annual ring is not constant, but varies at different heights in the stem.

Associated with such variations in the size of the xylem elements are concomitant changes in the shape, structure, and arrangement of the elements, and their mechanical properties.

B. The significance of these variations in the identification of the timbers of commerce.

The fact that xylem or wood is not a homogeneous material, comparable to iron or steel, but is extremely variable even in different parts of a single tree, has not been fully appreciated by most investigators who have interested themselves in the problems of the classification and identification of plant tissues. In the majority of cases, a very limited amount of material, often a single small specimen of each species, has been studied in detail and used in constructing keys for distinguishing the woods of different plants. Such keys are obviously subject to grave errors, since the material of each species examined may give no indication of the structural variations which occur within the species. For example, in the endeavor to secure authentically identified specimens, the investigator has frequently been led to refer to herbarium material. This is a particularly dangerous proceeding, since the wood of twigs is usually very different from that of the outer layers of the bole of a large tree.

It is evident, accordingly, that, in endeavoring to secure satisfactory criteria for distinguishing different woods, the investigator must examine sufficient material of each species to be certain of the limits of variability of each diagnostic character.

There appears to be good reason for believing that the study of the variability of the different elements of the xylem in different groups of plants, and of the factors which produce or control this variability, should lead ultimately to the establishment of guiding general principles of much value in the identification and classification of woody tissues. Such investigations should, in addition, throw considerable light upon the properties of wood, and upon the variations in anatomical and chemical structure which produce them.

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DOUGLAS FIR FIBER, WITH SPECIAL REFERENCE TO LENGTH

By H. N. Lee,[1] A.M., and E. M. Smith[1]

Sanio in 1867 investigated (*6*) the variation in size of the tracheids in Scotch pine (*Pinus sylvestris* L.), and deduced five general laws:

1. In the cross-section of a stem or branch the tracheids increase in size for a certain number of annual rings from the pith until a maximum is reached, after which the size remains constant.

2. The final constant size in the stem varies at different distances from the ground, first increasing till a maximum is reached and then decreasing toward the top.

(*a*) The tracheids in a given annual ring increase in size from the ground upwards until a certain maximum is reached and then decrease toward the top.

The other laws have to do with the fibers of the branches and roots.

As a result of their study on pine, fir, spruce and hemlock, Shepard and Bailey (*1* and *2*), reach the following conclusions:

1. No constant maximum length of tracheids occurs.

(*a*) The length rapidly increases, in a given cross-section of the stem, for the first 25 to 50 years, then there is a marked decrease in length for about a decade which in turn is followed by an increase. In the only old material studied there was a maximum at 160 years followed by a comparatively rapid decrease.

2. Sanio's second law holds for *Picea rubra*.

(*a*) The maximum tracheid length occurs higher from the ground in rings nearer the bark.

3. There is no relation between the width of annual ring and the length of the tracheids.

4. The tracheids in "rotholz" are shorter than those in "sugholz" of the same annual ring.

5. There is so much variation in the length of tracheids that this feature is not a safe method to use in identification of wood.

After an extended study on White pine, Loblolly pine, Long-

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[1] Forest Products Laboratories of Canada.

leaf pine and Douglas fir, Miss Gerry (*3*) comes to the following conclusions:

1. In any cross-section the fibers nearest the pith are shorter, there is a gradual (irregular) increase in length from the first annual ring outward.

(*a*) No constant length is found.

2. In 26 specimens taken at from 2½ to 3 inches from the pith at four-foot intervals from butt to top there was a gradual increase in length for about two thirds the height of the tree.

3. No direct relation between length of fiber and strength could be determined.

(*a*) From butt to top specific gravity and strength decreased but average fiber length increased.

(*b*) Late wood was found to be about twice as strong as early wood, although fiber was some 12 per cent shorter.

(*c*) In "rothholz" the wood is stronger but fiber length shorter than in normal wood.

4. General range of variation in fiber length is not greater within the species than in the individual tree.

5. Longest fibers are in the earliest spring wood, shortest in last layers of late wood.

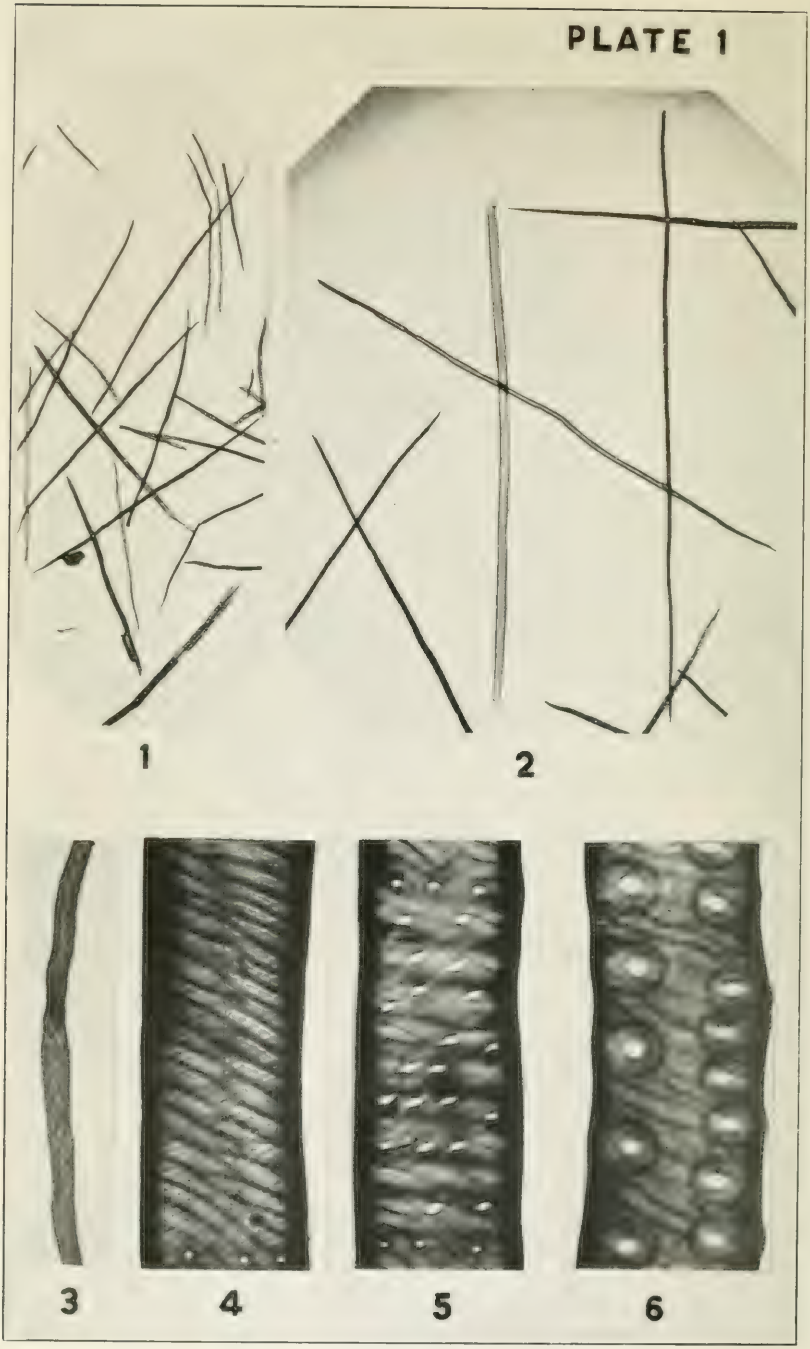
6. Root fibers have length equal to or greater than stem fibers.

Mell (*4*) states the following:

1. The average length of tracheids increases within the plane perpendicular to the axis from the center outwards until the tree reaches its maximum height growth, after which it remains quite constant.

2. The average length of tracheids increases from base until a maximum is reached, after which it decreases toward the top.

3. The length of Douglas fir fiber, based on measurements from different parts of trunk and branches, is: average 2.68 *mm*, maximum 3.30 *mm*, minimum 1.82 *mm*.



Douglas Fir Fibers.
Description *see* footnote on opposite page.

Microscopic Characteristics of Fiber[2]

As is shown in Plate 1, Figure 2,[3] which includes one spring, one intermediate and one summer fiber, the average tracheids of Douglas fir are roughly one hundred times as long as they are broad, and are more or less pointed at the ends. In length there is much variation, depending on the position of the fiber in the tree. In the wood formed around the pith the fibers are less than one third as long as the average, as may be seen from comparison of Figures 1 and 2, Plate 1, in which are shown mature and first annual ring fibers on the same scale of magnification (*see also* Tables and Curves). According to studies made by Miss Gerry (*3*) the fibers in the early or springwood of any given annual ring are longer than those in the late or summerwood. Our measurements show no great difference in the average length of the fibers of the springwood and those of the summerwood. There is, however, an indication that the fiber of the summerwood is slightly longer, as may be seen in Table IV and as is illustrated in Plate 1, Figure 1. The shortest fibers of the summerwood are those last formed, in the springwood the location of the minimum fiber appears to be more irregular. According to Penhallow (*5*, p. 360), in width the tracheids of Douglas fir are about .03 *mm* in early wood, and .027 *mm* tangentially or .018 *mm* radially in late wood. The actual walls are about .0024 *mm* thick in the springwood and .0084 *mm* thick in the summerwood, *i. e.*, they are some three times as thick in the late as in the early wood. We have made no special study of the thickness of the walls.

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[2] The terms fiber and tracheid are used interchangeably throughout this discussion.

[3] Description of Plate 1.

Fig. 1.—Fiber from the first annual ring of Douglas fir, shipment 2, tree 1, disc X. Stain nigrosin, mounted in balsam. x 20.

Fig. 2.—One springwood, one summerwood, and one intermediate Douglas fir fiber from ring 152 years from pith, shipment 2, tree 1, disc B. Stain Haidenhain's haematoxylin, mounted in glycerin jelly. x 20.

Fig. 3.—"Rotholz" fiber, showing spiral striations, from same mount as figure 1. x 100.

Fig. 4.—Part of single springwood fiber of Douglas fir, shipment 2, tree 1, disc F, last annual ring, showing the characteristic tertiary spiral thickenings. Stain nigrosin, mounted in balsam. x 285.

Fig. 5.—Another part of same fiber as shown in figure 4, showing the crossing-field of the ray. Note the three smaller marginal pits at both the top and the bottom of the group of larger pits. x 285.

Fig. 6.—Another part of the same fiber as shown in figure 4, showing bordered pits. x 285.

Photomicrographs by Mr. W. B. Stokes, Forest Products Laboratories of Canada, Montreal.

One of the most marked characteristics of the tracheids of Douglas fir is the presence of spiral thickenings on the inner surface of the fiber. From 1 to 4 of these spirals, or tertiary thickenings, may show in a single tracheid. They are practically always prominent in the springwood, running at a mean angle of about 80 degrees (Fig. 4), but are usually absent or vestigial in the summerwood. The only other coniferous tree growing in Canada, the tracheids of which normally have spiral thickenings, is the yew (*Taxus*) of the Pacific coast, and in this the spirals occur in both the spring and summer tracheids. Furthermore, the pits marking the crossing-field of the ray cells are different in the two genera and in the wood as a whole; Douglas fir is easily distinguished from yew because the former has and the latter has not resin canals.

Although we are not dealing specially with the ray cells which occasionally show with the fibers, as may be seen in the very shortest cells in Plate 1, Figure 1, we must consider the pits or openings which occur in the tracheids where they come in contact with ray cells. Since the rays are from 1 to 15 cells high and the tracheids have, in the late wood, from 1 to 3, and in the early wood up to 7 pits per each cell, it follows that the fiber will show from 1 to 15 sets of openings, containing up to 7 pits in each set, representing the crossing-field of the ray. The openings are divided into two classes, those leading into the central cells of the ray and those leading into the marginal cells. The difference between these two kinds of pits is not always easy to distinguish on a single fiber, but in general it may be said that the marginal openings are smaller, more rounded and with a wider border than the central openings; in fact, the latter are often extended into quite distinct slits. Plate 1, Figure 5, shows very clearly the difference between the three marginal bordered pits at both the top and the bottom of the slit-shaped, slightly bordered central pits.

The circular marks surrounded by a circular border are the pits which occur in Douglas fir tracheids, as in all coniferous woods, forming openings from one fiber to the next. These bordered pits, as they are called, are always confined to the radial walls except in the late wood, where they occur on the tangential walls. In Figure 2, Plate 1, the bordered pits may be barely seen and Figure 6 shows them under much higher magnification.

Specialized collections of cells with an open space between them known as a resin canal, are found more or less commonly in the wood. The cells forming the wall of the resin canal are different in structure from the ordinary tracheids and usually are shorter. As a result, an extremely short fiber may rarely be found in any annual ring but could not be considered as a real minimum of the tracheids of that ring. Resin canals also appear in certain of the rays, but are not considered at all in this discussion.

Under exceptional conditions, apparently when the wood is compressed as it is forming, the fibers develop remarkably heavy walls. Because of the reddish color this type of wood has been named "rotholz." The single tracheid from such an area may be recognized by the spiral striations (not to be confused with the tertiary, spiral thickenings referred to above), which appear to represent the method in which the walls of the tracheid are formed. (Plate 1, Fig. 3.) The pits in such a tracheid usually exhibit long, slit-like openings, and the walls themselves seem often to be spirally split. According to Shepard and Bailey (*1*) and Miss Gerry (*3*) the fibers are shorter in the "rotholz" than in the same annual ring where "rotholz" does not occur. We measured one case in which the fibers in the "rotholz" averaged to be 3.3 *mm* long, while those in the "zugholz" of the same ring were 4.51 *mm*. Since this agrees with condition found in various woods by other investigators, we made no further determinations. It may be noted here that spring tracheids occurring in "rotholz" ordinarily do not show the typical spiral thickenings which occur in the normal fiber.

Material

All measurements included in this study were made on Douglas fir trees from British Columbia, one set being referred to as shipment 2, the other as shipment 3. In referring to trees the shipment number and tree number will be stated, thus 2-1 means shipment 2, tree number 1, and 3-10 means shipment 3, tree number 10, etc. The following data is taken from the collector's notes.

Shipment 2, taken as typical of the so-called Coast type, came from Abottsford, B. C.; 100 feet above sea level; soil high class agricultural type, a well drained sandy-clay loam 4 feet deep underlaid with gravel; rainfall about 60 inches per year, the stand of timber was close, 75 per cent Douglas fir, 22 per cent hemlock and 3 per cent cedar, timber cut from 60 to 70 M feet, board measure, per acre. Tree 1 was dominant, about 190 years old, originated from seed, was 195 feet in height, bole 141 feet clear, butt slightly swollen. Tree 5 was 176 years old, 182 feet in height, 137 feet clear.

Shipment 3 is taken as typical of the so-called Mountain fir, came from Golden, B. C., about 4,000 feet above sea level; soil coarse and gritty with fair amount of clay 12 inches deep, underlaid with gravel below which is bed rock of schist; average precipitation about 18 inches per year; extremes of temperature occur; the stand of timber was 80 to 85 per cent Engelmann spruce, then in order of frequency, Douglas fir, hemlock, cedar and Lodgepole pine. The Douglas fir trees were dominant. Tree 8, was about 180 years old, was 99 feet in height, bole 32 feet clear. Tree 10, about 270 years old, originated from seed, was 157 feet in height with bole 63 feet clear, was grown on a 30 per cent slope.

From 2-1 the chief measurements were made, twenty discs, including complete cross-sections of the tree, were cut out at stump height, 2 feet from the ground, and then at intervals of 8 feet, these discs being referred to as A, B, etc., as is shown in Figure 1. From each of the other trees examined but one disc was taken, these being at the following heights from the ground, 2-5 at 19 feet, 3-8 at 19 feet and 3-10 at 19 feet. With these latter discs the cross-section of 2-1, 18 feet from the ground, is compared.

Method of Preparation

Preliminary data, including soundness, measurements of total diameter, sapwood, rate of growth along radius from which fibers were measured, number of annual rings, etc., were made by visual inspection, after which samples were removed along a certain radius at intervals of every twenty annual rings from the periphery inwards, including the first and last year's growth. Figure 1 shows diagramatically the manner in which the chips were removed, each dot in the diagram representing the point from which the sample was taken. Each chip removed in this manner was given a number which indicates directly the multiple of 20 it is from the periphery, thus 2-1-D-O means shipment 2, tree 1, disc D, last annual ring, 2-1-D-5 indicates 100 annual rings from the periphery, and 2-1-F-5 refers to the same annual ring as the last but, being in disc F, is 8 feet higher in the log. In general the shipment and tree number are stated separately in the tables and figure and only the disc and ring designations are given in direct conjunction with the measurements. For example in Figure 1, which refers to shipment 2, tree 1, only, the disc designations are given on the left of the diagram and the ring designations at the lower end of the dotted line which marks the course of the particular ring throughout the length of the tree. The chips each included radially one complete year's growth and were about three fourths of an inch long and wide and, of course, the thickness of the annual ring. Each of these samples was split along the plane of the rays into chips with comparatively square ends and thus prepared the set from each annual ring was put into a one-ounce, wide-mouthed bottle filled with an aqueous solution of equal parts of 8 per cent nitric and 8 per cent chromic acids. The outer layers of the chips usually separated into the constituent fibers after not more than three days' treatment, but if not, were treated with fresh acid and heated to not over 50° *C*. Chips having become sufficiently macerated were removed from acid fluid and stored first in distilled water, and secondly in a dilute alcohol solution.

Method of Examination

For examination radial slices were removed from one or more chips and the constituent fibers carefully separated out with needles on a glass slide, great care being taken not to break the fibers. The slides thus prepared were placed on a microscope fitted with an eye-piece micrometer and objective of such power that the fibers might be measured directly in millimeters. The adjustment of the microscope was carefully checked, before each slide was measured, with a standard stage micrometer to see that the adjustment had not been accidentally changed. Thus arranged, 50 measurements were made from each chip, the fibers being measured without any special choice, except that care was taken not to measure always the longest or the shortest fiber.

Results of Examination

Twenty discs, including measurements of 171 annual rings of shipment 2, tree 1, a typical example of coast Douglas fir, were examined. Disc A, the butt end, was two feet from the ground, contained 177 annual rings and was 37.75 inches in diameter, while 2-1-L, the top of the log, was 154 feet from the ground, contained

88 annual rings and was 11.5 inches in diameter. Measurements between the butt and the top of the log are given in Table I. The heartwood was in general clear and sound, but sapstain and other forms of fungous attack were common in the sapwood.

The sapwood averaged about 40 *mm*, or $1^9/_{16}$ inches, in thickness, and contained about 40 annual rings. It showed, in general, the slowest growth of any part of the tree. In fact it appeared that the growth was rapid up to from 30 to 40 years from the pith and then gradually decreased in the direction of the periphery. (Table III and Fig. 3.) As is illustrated in Figure 1,[3] showing a graphical reconstruction of the tree, the diameter at the butt is wide in proportion to the rest of the tree; from the butt to about 30 feet from the ground the decrease in diameter is rapid, from 30 to 90 feet is relatively slow, and from 90 feet to the top, 154 feet from ground, is increasingly rapid. Table III summarises the measurements of the extent of each 20 annual rings along the actual radius from which were taken chips for fiber measurements. Since a mean radius was not always selected, a slight discrepancy appears if a comparison is made, using as figures the average diameter and total number of rings as stated, as a basis for determining the rate of growth in diameter. In Figure 1 some allowance had to be made for the fact that a mean radius was not always chosen in making the measurements. The rate of growth for the complete radius at different heights, Table III, as shown by comparing the averages for different discs, reveals no marked change except an increase at the butt end. The average of all appears to be 1.96 *mm*, per year, for discs A and B, 2.6 *mm*, and for the remainder 1.9 *mm*. These figures represent the radial increment. Taking the average figures by rings, however, there appears a marked difference, the rate of growth being more than five times as great near the pith as it is near the periphery with the change between the two as listed in Table III and shown graphically in Figure 3 and also on the left-hand side of Figure I. Curiously enough the average fiber length in the last annual ring is about five times as great as in the first annual ring. Figure 3 also shows the average length of fiber by rings and it will readily be seen that the indication is that increased growth in diameter produces a shorter fiber. The broken line is drawn through points plotted from average figures omitting

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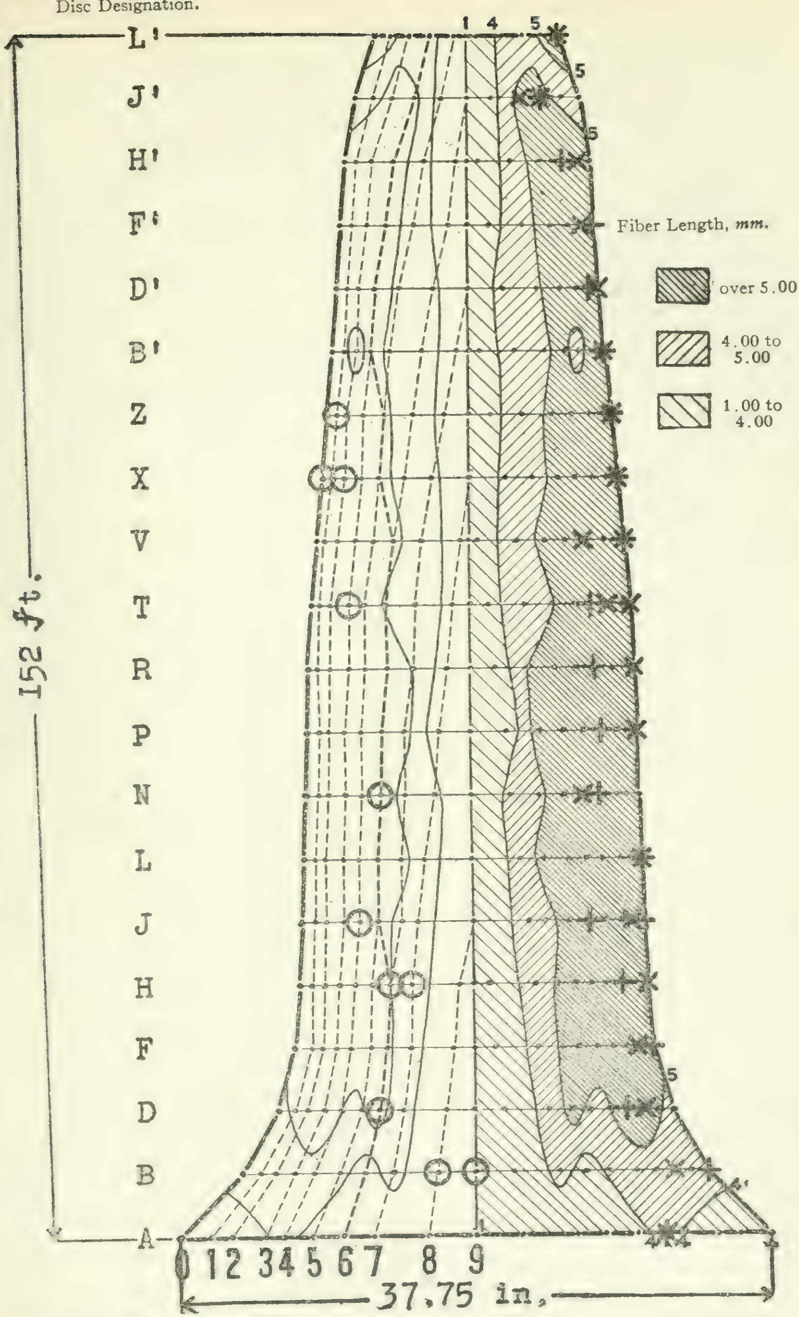
[3] To exactly locate the position in tree of any ring measured refer to Figure 1.



Annual Ring Designation.
Intervals 20 Years.
× indicates location of maximum fiber in disc.
+ indicates point of longest average fiber in disc.
O indicates point of longest average fiber in ring.
- - - indicates limit of wood over about 50 years from pith.

FIG. 1.—DIAGRAM OF LONGITUDINAL SECTION OF SHIP. 2, TREE 1, SHOWING LOCATION OF DISCS AND OF POINTS WHERE FIBERS WERE MEASURED.

TABLE I

Average fiber length, mm

Disc Designation	Annual Rings, Age in Years	Dif. in Age, Years	Diameter, Inches	Radial Increment mm.	Height From Ground Feet	Annual Ring Designation										Fiber Length, Disc Averages	Disc Averages, Mature Wood
						0	1	2	3	4	5	6	7	8	9		
L′	88	9	11.5	1.8	154	5.17	5.07	4.96	4.37	2.74	0.99					3.88	4.89
J′	97	8	14.5	2.0	146	4.21	4.87	5.14	5.00	3.73	1.00					3.99	4.80
H′	105	7	15.5	2.0	138	5.08	5.05	5.20	5.13	4.53	2.30	1.04				4.04	5.11
F′	112	5	17.0	1.8	130	5.92	5.88	5.71	5.08	4.68	2.89	0.87				4.43	5.64
D′	117	8	18.0	1.8	122	5.66	5.81	5.56	5.11	4.70	4.03	0.94				4.54	5.53
B′	125	9	19.0	1.9	114	5.36	5.32	4.90	5.22	4.71	4.11	1.95	0.90			4.36 4.06	5.20
Z	134	7	20.0	1.5	106	6.11	6.03	5.17	5.43	5.05	4.46	3.18	1.06			4.56	5.55
X	141	2	20.75	1.8	98	6.31	5.52	6.17	5.23	5.10	4.14	4.18	1.20	1.08		4.71 4.32	5.66
V	143	4	21.0	1.9	90	5.79	5.69	5.49	5.62	5.29	5.38	4.69	2.27	0.92		4.57	5.54
T	147	4	21.5	2.0	82	5.91	5.31	5.66	6.08	5.33	4.80	4.89	3.30	1.12		4.71	5.51
R	151	2	23.0	2.0	74	5.56	5.55	5.73	5.84	5.34	5.07	5.15	3.43	1.07		4.74	5.51
P	153	1	23.5	2.0	66	5.61	5.56	5.54	5.91	5.20	5.20	5.02	3.85	0.91		4.75	5.50
N	154	4	24.0	1.9	58	5.35	5.82	5.56	6.04	5.99	5.75	4.81	4.49	1.29		5.01	5.75
L	158	2	24.0	2.0	50	6.09	5.92	5.55	5.80	5.31	5.06	5.06	4.42	1.11		4.92	5.62
J	160	2	25.0	2.1	42	6.07	5.94	5.87	5.78	6.07	5.42	4.99	4.15	1.28		5.06	5.85
H	162	3	25.5	1.7	34	6.01	6.02	6.05	5.85	5.60	5.34	5.26	4.50	2.66	0.91	4.82	5.73
F	165	3	27.0	1.9	26	5.97	5.70	5.25	5.50	5.39	5.11	5.12	4.10	2.57	1.09	4.58	5.43
D	168	4	27.5	2.0	18	4.84	5.29	5.04	5.43	5.19	4.68	5.26	4.33	3.07	1.19	4.43	5.10
B	172	5	31.25	2.3	10	4.98	4.41	4.71	4.23	4.77	4.76	3.97	4.38	3.52	1.29	4.10	4.54
A	177	0	36.75	2.9	2	3.56	3.25	3.20	3.66	4.63	3.61	3.67	3.13	2.99	1.15	3.28	3.65
Average fiber length, by rings.						5.47	5.40	5.32	5.31	4.96	4.20	3.89	3.30	1.81	1.12	4.46	
Average mature fiber, by rings.						5.47	5.40	5.32	5.31	5.30	5.01	4.65					5.21

TABLE II

Minimum and maximum fiber, mm. Ship. 2, tree 1

Disc Designation	*Annual Ring Designation*									
	0	1	2	3	4	5	6	7	8	9
L′	3.30	3.70	3.82	3.20	3.06	0.60				
	6.28	6.22	5.50	5.14	3.50	1.32				
J′	2.60	4.10	3.90	3.10	2.80	0.70				
	5.20	5.70	6.10	6.10	4.70	1.30				
H′	3.10	3.70	3.70	3.10	3.00	1.70	0.60			
	6.10	6.60	6.10	6.10	5.30	3.10	1.40			
F′	5.00	3.00	5.00	3.30	3.10	1.88	0.34			
	6.80	6.85	6.45	5.96	5.94	3.62	1.50			
D′	3.11	3.36	3.18	3.52	3.10	2.04	0.44			
	7.30	7.28	6.58	6.08	5.76	6.04	1.94			
B′	4.02	4.10	2.60	3.58	3.42	3.12	0.82	0.36		
	7.42	6.42	7.32	6.60	5.62	4.98	2.74	1.50		
Z	4.38	3.00	3.68	4.42	3.56	2.30	1.56	0.48		
	7.47	7.20	6.42	6.42	6.30	5.20	4.02	1.72		
X	4.10	3.60	4.70	4.10	3.50	2.70	3.00	0.80	0.70	
	7.20	6.90	7.10	6.70	6.20	4.90	5.20	1.60	1.50	
V	3.90	4.14	3.80	3.50	4.00	4.00	3.07	0.96	0.50	
	7.00	6.65	6.80	7.00	6.20	6.20	5.50	2.76	1.40	
T	3.30	2.70	3.50	4.50	3.30	3.60	3.60	2.20	0.70	
	7.10	6.40	7.10	7.00	6.50	6.00	5.80	3.90	1.50	
R	3.10	3.20	3.60	3.70	3.90	3.50	3.00	2.20	0.50	
	7.60	7.00	6.70	7.10	6.40	6.85	6.10	4.20	1.60	
P	2.00	3.66	3.54	4.80	3.98	3.68	3.82	2.90	0.40	
	7.58	7.10	7.08	7.34	6.70	6.44	6.04	4.98	1.52	
N	3.90	3.30	3.30	3.90	3.90	4.30	3.30	3.10	0.70	
	7.30	7.40	7.10	7.20	7.60	6.30	5.70	5.00	1.80	
L	4.72	3.62	3.60	3.96	4.00	3.00	3.62	2.16	0.45	
	7.12	6.98	7.00	7.10	6.50	6.48	6.02	4.90	1.80	
J	4.24	4.14	4.02	4.64	3.60	4.02	3.40	2.72	0.56	
	7.70	8.12	7.20	6.58	7.02	6.45	6.78	5.56	2.02	
H	3.78	4.50	4.98	4.08	5.02	4.08	4.08	3.20	1.56	0.28
	7.40	6.92	7.04	7.16	6.52	6.48	6.72	5.80	3.50	1.36
F	5.10	3.88	3.32	3.06	4.38	3.36	3.62	3.16	1.62	0.50
	6.56	8.60	6.32	6.58	6.38	6.72	6.18	5.96	3.40	1.90
D	1.29	4.48	2.75	4.40	3.44	3.10	3.65	3.12	1.80	0.35
	6.42	6.64	7.37	6.55	7.11	6.78	6.24	5.55	4.15	2.25
B	1.97	2.75	2.74	3.40	3.19	3.43	2.80	3.20	2.05	0.84
	5.97	6.31	6.51	5.21	5.76	5.89	5.55	5.71	4.50	1.95
A	2.09	1.80	2.16	2.44	3.14	2.30	2.30	1.26	1.76	0.60
	4.72	4.79	4.28	5.50	5.62	5.90	5.02	3.86	3.68	1.70
Average	6.74	6.80	6.60	6.47	6.08	5.30	4.91	4.20	2.49	1.83
	3.45	3.53	3.59	3.73	3.51	2.87	2.61	2.12	1.02	0.51

Average of all, maximum..... 5.14
minimum..... 2.69

Average of highest maximum.. 7.14
and lowest minimum of each disc..................... 0.53

any measurements made inside the heavier line extending from 6 to 3 in Figure 1, *i. e.*, omitting fiber under approximately 50 annual rings from the pith. This curve cannot be taken as an absolutely correct interpretation, however, since in every cross-section the shorter fibers occur in the rings near the pith without regard to the width of the rings. Measurements must be made on very old trees to definitely establish any relation between rate of growth in diameter and fiber length in rings more than 50 years from the pith.

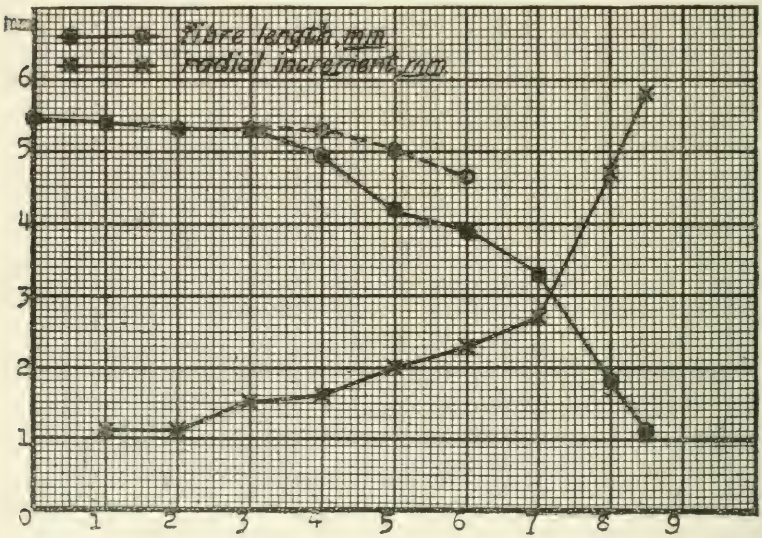


FIG. 3.—ANNUAL RING DESIGNATION.

Douglas fir. Ship. 2, tree 1. Curves showing average rate of growth in radius and fiber length, by rings. The broken line is made from measurements excluding fiber under 50 years from pith.

From Figure 2 there appears to be a relation between growth in height and length of fiber. The curve of height growth is plotted by taking the difference in age between successive discs of 8 feet apart, beginning with disc A. This, of course, means that a greater difference indicates slower growth in height. At the butt the average difference up to 34 feet from the ground is almost 4; from 34 feet up to 98 feet the difference averages 2.7; while from 98 feet to the top disc the average difference is more than 7. Up to 34 feet, therefore, it seems that the tree was growing in height at a medium rate, from 34 to 98 feet at a rapid rate, and from 98 to 154 feet it was growing more and more slowly in height. The dot-dash line in the curve indicates the reciprocal of the rate of growth in height. Comparing this condition with the average fiber length at various heights, it will be seen (Fig. 2), that the fiber length is short at the butt end, but increases to a maximum at 42 feet from the ground; from 42 feet to the top there is a steady decrease which is, apparently, more rapid after about 90 feet from the ground. While it appears from this that the more rapid the growth in height the longer will be the fiber, it must be taken into account that the fiber measured at any particular height from the ground may have been formed long after the growth in height had passed this point. Here again further determinations must be made before the relation between fiber length and growth in height can be positively established, although the indication is that the greater the latter the greater will be the former.

In the tree as a whole the fibers in the first year's growth, *i. e.*, in the annual ring surrounding the pith, show the shortest figures for length. From the first year to about 50 years (*see* Figs. 4, 5 and 6 as average examples), the increase in the length of fiber is very rapid each year, but after the fiftieth ring from the pith the length in any given cross-section seems to be comparatively constant. In some cases the rings nearer the bark show a slight increase of decrease. Comparing the average of all measurements made in each annual ring, as stated in Table I and as illustrated in Figure 3, it is found that there is apparently a very rapid increase up to about 100 years from the pith, and then a constant slight increase in the length of the fibers to the periphery. The true condition is shown better in the curve which includes only mature wood, *i. e.*, over about 50 years from the pith, than in the general curve of all figures, since the data from which this general curve was obtained when averaged gives too much weight on the short fibers in the disc containing the lesser number of annual rings. The method of choosing points for measurement as shown in Figure 1 explains the reason for this. In the curve of mature wood it is seen that the fiber reached very nearly its full length at 50 years, rather than 100 years from the pith, and the increase to the periphery is constant but small and growing smaller till in the very outermost rings it is practically nil.

The final average of all fibers measured is 4.46 *mm*, the average

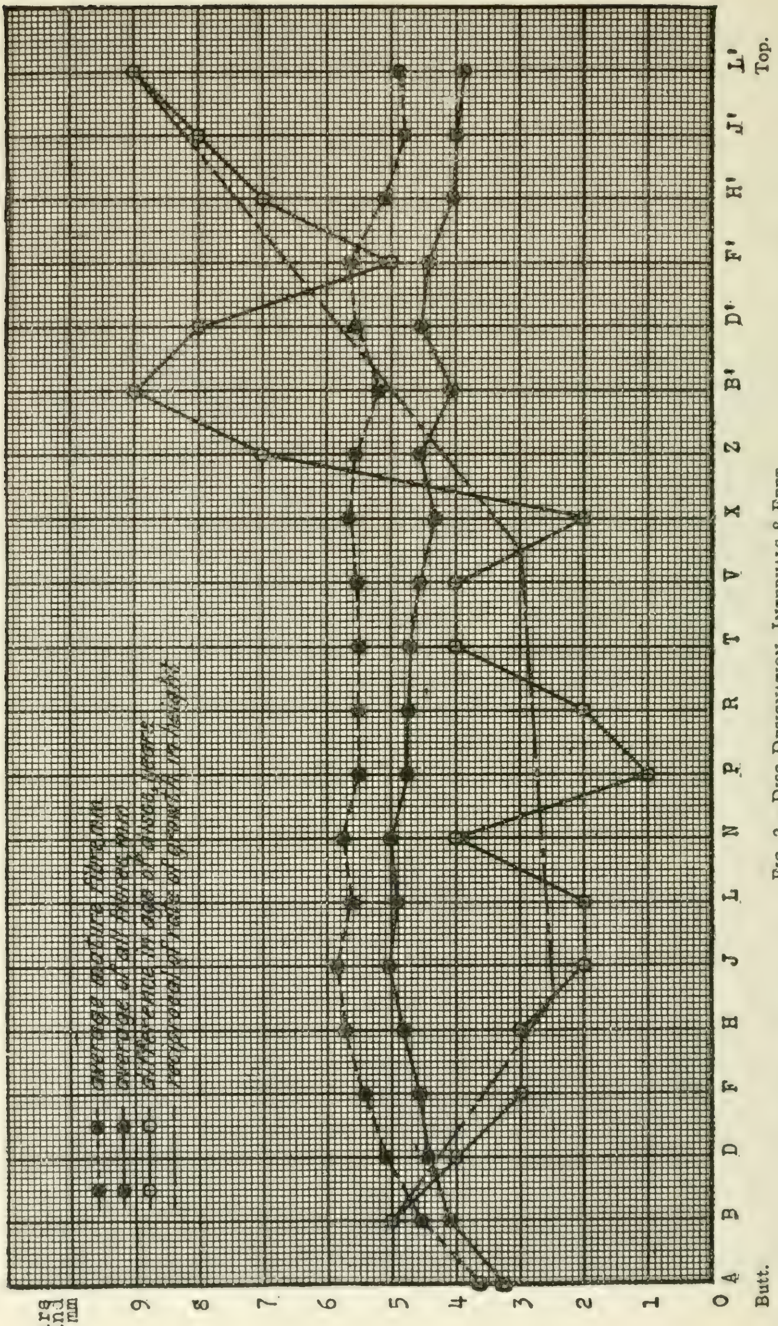


FIG. 2.—DISC DESIGNATION, INTERVALS 8 FEET.

Douglas fir. Ship 2, tree 1. Curves showing average fiber length by discs and rate of growth in height.

maximum is 7.26 *mm*, and average minimum (always in the first annual ring), 0.51 *mm*. Table 1 gives concisely the averages for each 50 measurements taken throughout the tree as well as the averages by discs and by rings. Since the rings were cut out every 20 annual rings from the periphery toward the pith, the first annual ring varies from one to 19 years from the next ring measured. As a result in two cases (discs X and B′) there is a measurement in an annual ring very close to the pith as well as the first annual ring and the former figures are omitted in making the higher average in those cases where two are stated. The average omitting this extra short measurement is probably more nearly the actual average to be compared with the averages of other rings.

Table II shows the maximum and minimum fibers as found in the discs at different heights from the ground; also as found in the various annual rings and the averages for the latter. The maximum, 8.60 *mm*, for the tree, was in the twentieth annual ring from the bark, or 145 years from the pith, at a height of 26 feet from the ground. As is shown by X in Figure 1, the maximum fiber of the respective discs occurred in the annual ring nearest the bark in 11 cases in the twentieth ring from the bark in 4 cases, the fortieth ring from the bark in 4 cases, in the sixtieth from the bark in 2 cases, and in the eightieth in 2 cases, the other rings no cases. In disc J′ at 146 feet from the ground a maximum was found in both the fortieth and sixtieth rings from the periphery, in disc V at 90 feet from ground in the last and sixtieth rings, and in disc T in the last and the fortieth rings. It will readily be seen that the annual rings last formed have the longest fibers. The curve of average maximum fibers (Fig. 7), is much like the curve for the average of all fibers or the curve for any one annual ring, *i. e.*, showing a sharp increase nearer the pith and then a more gradual increase practically to the last annual ring. The increase in this case is, however, much more marked than is the case in Figures 3, 4, 5 and 6, showing average for all fibers and typical curves at various heights. The minimum fiber always occurs in the annual ring first formed and the curve for minimum fiber lengths in the different rings is much the same as the maximum, except that there appears to be a distinct, though small, decrease in the average minimum in the annual rings after about 100 from the pith.

As has already been stated, the fiber in the first annual ring formed at any height is extremely short, averaging 1.12 *mm*.

TABLE III

Width of each 20 successive rings with average radial increment in mm. Ship. 2, tree 1

Disc Designation	Annual Ring Designation									Total Radius	Average Increment
	1	2	3	4	5	6	7	8	9		
L′	29	29	36	42	20					156	
	1.4	1.4	1.8	2.1	2.5						1.8
J′	33	32	38	49	48					200	
	1.6	1.6	1.9	2.4	2.8						2.0
H′	22	26	33	48	59	18				206	
	1.1	1.3	1.6	2.4	2.9	3.6					2.0
F′	23	24	32	43	49	32				203	
	1.1	1.2	1.6	2.1	2.4	2.6					1.8
D′	18	20	27	36	59	46				206	
	0.9	1.0	1.3	1.8	2.9	2.3					1.8
B′	1.7	19	29	38	57	67	16			243	
	0.8	0.9	1.4	1.9	2.8	3.3	3.2				1.9
Z	17	19	24	27	45	50	28			210	
	0.8	0.9	1.2	1.3	2.2	2.5	2.0				1.5
X	20	21	28	28	39	48	68	3		255	
	1.0	1.0	1.4	1.4	1.9	2.4	3.4	3.0			1.8
V	22	24	30	33	35	46	73	14		277	
	1.1	1.2	1.5	1.6	1.7	2.3	3.6	4.6			1.9
T	19	22	32	28	34	46	70	36		287	
	0.9	1.1	1.6	1.4	1.7	2.3	3.5	5.1			2.0
R	20	21	33	29	37	47	61	58		306	
	1.0	1.0	1.6	1.4	1.8	2.3	3.0	5.2			2.0
P	18	19	26	22	33	42	70	83		313	
	0.9	0.9	1.3	1.1	1.6	2.1	3.5	6.3			2.0
N	22	20	30	28	31	41	46	80		298	
	1.1	1.0	1.5	1.4	1.5	2.0	2.3	5.7			1.9
L	21	21	30	29	31	45	49	97		323	
	1.0	1.0	1.5	1.4	1.5	2.2	2.4	5.4			2.0
J	21	21	30	30	30	43	47	115		337	
	1.0	1.0	1.5	1.5	1.5	2.1	2.3	5.7			2.1
H	18	21	23	24	27	26	36	82	24	281	
	0.9	1.0	1.1	1.2	1.3	1.3	1.8	4.1	12.0		1.7
F	22	20	23	27	31	31	42	78	35	309	
	1.1	1.0	1.1	1.3	1.5	1.5	2.1	3.9	7.0		1.9
D	22	21	28	30	33	32	41	73	51	331	
	1.1	1.0	1.4	1.5	1.6	1.6	2.0	3.6	6.3		2.0
B	32	27	34	30	40	43	44	75	70	395	
	1.6	1.3	1.7	1.5	2.0	2.1	2.2	3.7	5.8		2.3
A	47	35	56	31	49	55	63	93	79	508	
	2.3	1.7	2.8	1.5	2.4	2.7	3.1	4.6	4.6		2.9
Average Increment	1.1	1.1	1.5	1.6	2.0	2.3	2.7	4.7	5.8		

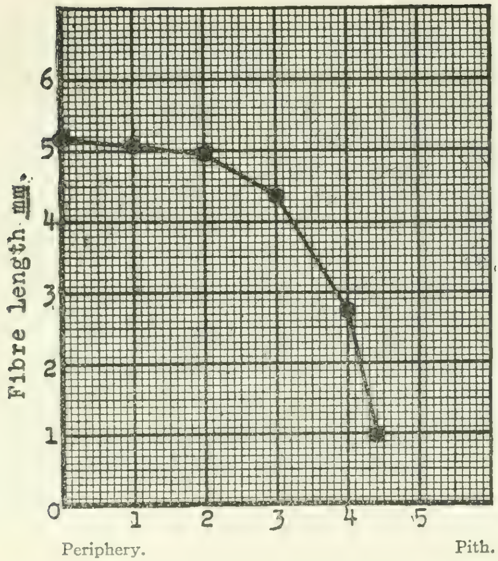


FIG. 4.—ANNUAL RING DESIGNATION.

Douglas fir. Ship. 2, tree 1, disc L'. Curve showing average fiber length by rings, at 154 feet from ground.

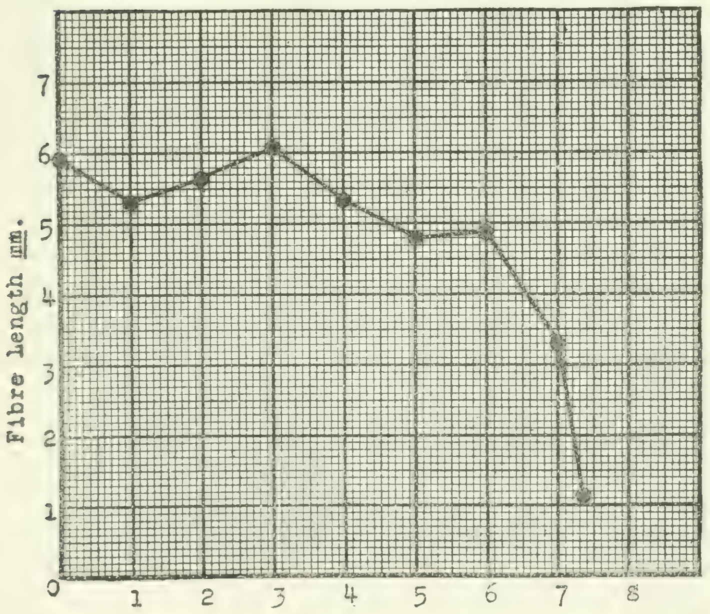


FIG. 5.—ANNUAL RING DESIGNATION.

Douglas fir. Ship 2, tree 1, disc T. Curve showing average fiber length by rings, at 82 feet from ground.

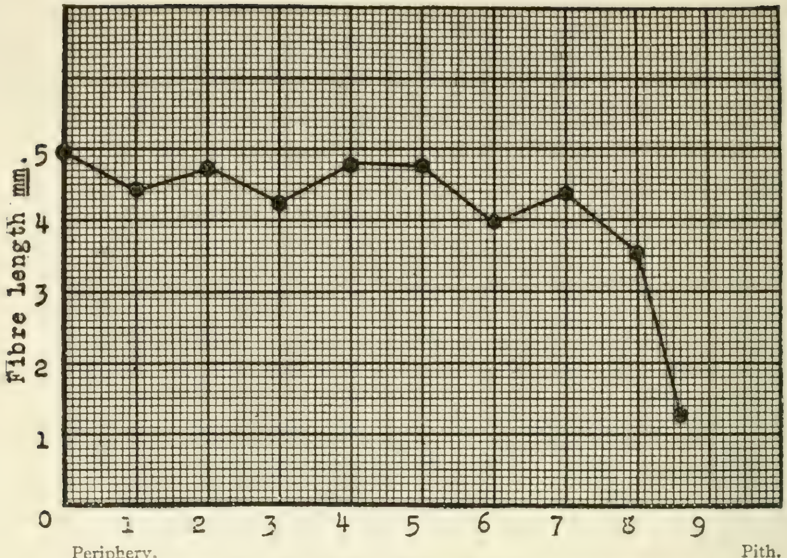


Fig. 6.—Annual Ring Designation.

Douglas fir. Ship. 2, tree 1, disc B. Curve showing average fiber length by rings, at 10 feet from ground.

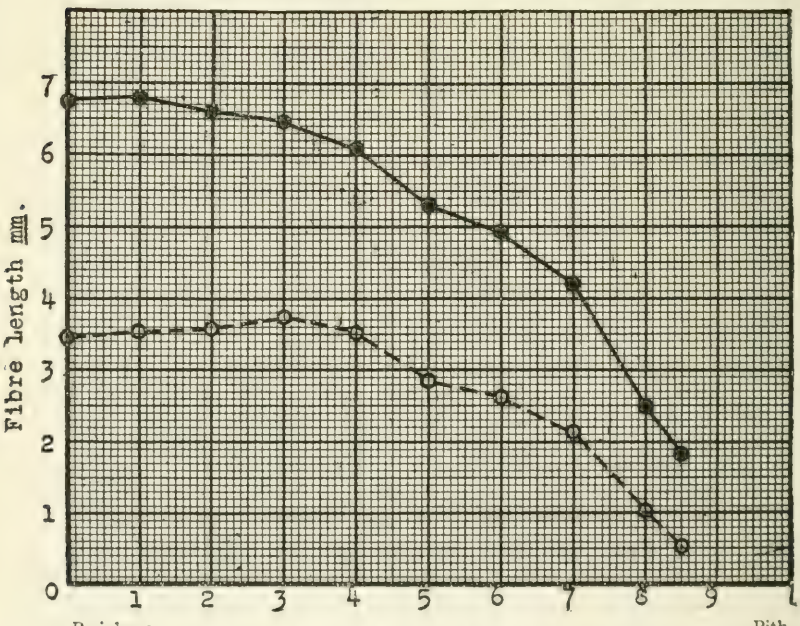


Fig. 7.—Annual Ring Designation.

Douglas fir. Ship. 2, tree 1. Curve showing average maximum and average minimum fiber length, by rings.

The length rapidly increases to about 4 *mm* until about 50 rings are added and thereafter increases very slowly, if at all. Contrary to the conclusions of Bailey and Shepard referred to above, we find no marked decrease after about 50 years from the pith, although this condition does sometimes occur. Considering only that wood over 50 years from the pith, both the individual rings measured and the average of all, show, in general, the fiber length to be longest at 42 feet from the ground and gradually decreasing from that point toward the top and the butt. (*See* Fig. 2.) Thus it would appear that the fibers in the top and butt logs would be shorter than those of the main trunk between these two. Excepting for the wood up to 40 feet from the ground, it appears that the older the wood the longer will be the fiber, and it might almost be stated that as a general rule a log having a great number of annual rings could be expected to show longer fibers than a similar log having few annual rings.

Table IV shows the location in summer or springwood of each annual ring of the maximum, minimum and of the average longer fiber. Of the 112 rings in which these were determined, as is shown at the end of the table, the maximum fiber was in the summerwood in 96 rings, in the springwood in 16 rings; the minimum fiber was in the summerwood in 35 rings and in the springwood in 77 rings; the average of all fibers was longer in the summerwood in 62 rings, longer in the springwood in 8 rings, and equal in both spring and summerwood in 42 rings. It would, therefore, appear that the fiber of the summerwood is longer than that of the springwood in this particular tree, but it would not be safe to state this as being the general condition, especially as contrary results, as mentioned above, have been found by other investigators.

The average longer fiber in the respective discs occurs, as is shown by + in Figure 1, in the last annual ring in ten instances, in the twentieth ring from the periphery in one instance, in the fortieth ring in three cases, in the sixtieth ring in five cases, and in the eightieth ring in two cases. In disc J at 42 feet from the ground the average fiber at 80 rings from the periphery was the same as in the last annual ring. Beyond the fact that the average longest fiber occurs most frequently near the periphery, but that this condition does not occur constantly, there seems to be no chance for any general conclusions in regard to the location of the average longer fiber in the discs at different heights from the

TABLE IV.—*Position in annual rings of maximum, minimum and average longer fiber. Ship. 2, tree 1.*

Annual Ring Designation

	0	1	2	3	4	5	6	7	8	*Totals*
Maximum...	13sr 2sp	13sr 2sp	12sr 3sp	14sr 1sp	10sr 5sp	11sr 3sp	11sr 0sp	8sr 0sp	4sr 0sp	96sr 16sp
Minimum....	7sr 8sp	2sr 13sp	5sr 10sp	6sr 9sp	5sr 10sp	5sr 9sp	4sr 7sp	1sr 7sp	0sr 4sp	35sr 77sp
Average longer	8sr 1sp 6 =	5sr 1sp 9 =	5sr 2sp 8 =	10sr 1sp 4 =	10sr 0sp 5 =	7sr 2sp 5 =	7sr 1sp 3 =	7sr 0sp 1 =	3sr 0sp 1 =	62sr 8sp 42 =

sp = springwood.
sr = summerwood.
= indicates the measurement in springwood and summerwood to be equal.

ground. Inspection of the location of the average longest fiber in the different rings, as shown by 0 in Figure 1, shows quite positively that the longer fiber in the annual ring tends to be near the ground in the rings first formed but to be farther from the pith and higher from the ground in rings formed later. This agrees with Bailey's modification of Sanio's law, *i. e.*, that the longer tracheid length occurs higher from the ground in the rings nearer the bark.

A comparison of the length of fiber with strength values seems to indicate no relation except that both these factors tend to increase rapidly up to a certain distance from the pith and then vary irregularly within comparatively narrow limits toward the periphery, both tending to increase slightly. However, the fact that the butt gives in general the highest and the top the lowest strength values rather indicates that the fiber length is not correlated with strength, since the fiber length is low in both these regions. It, therefore, appears that no marked relation exists between strength and fiber length in the vertical direction, although there may be a relation in the horizontal direction.[4]

TABLE V—*Average length of fiber in discs from trees* 2–5 *and* 2–1 *from Coast and* 3–8 *and* 3–10 *from Mountain Region of British Columbia.*

Tree	Height from Ground	Annual Ring-approximate[5]										
		Pith	10	30	50	70	90	110	130	150	170	Average
2–5 Coast	19	1.18	2.99	4.06	3.92	3.99	4.62	3.78	4.10	3.48	2.89	3.44
2–1 Coast	18	1.19	3.07	4.33	5.26	4.68	5.19	5.43	5.04	5.29	4.84	4.43
3–8 Mountain	19	1.13	2.24	3.06	3.56	3.30	3.85	3.66	3.70	....	....	3.06
3–10 Mountain	19	1.10	3.43	3.93	4.41	4.51	4.70	5.17	4.81	4.98	4.76	4.18

[4] For complete discussion of strength values of Ship. 2, tree 1, see "The Mechanical and Physical Properties of Canadian Douglas Fir." R. W. Sterns, Dominion Forestry Branch Bulletin No. 59.

[5] In choosing annual rings the last was taken and then every twentieth, going toward the pith. Since the exact number of annual rings was not 170, the number of annual rings between the pith and the next ring removed was variable being 8 for 2–5, 8 for 2–1, 20 for 3–8 and 9 for 3–10. *See* Figure 1 or method followed.

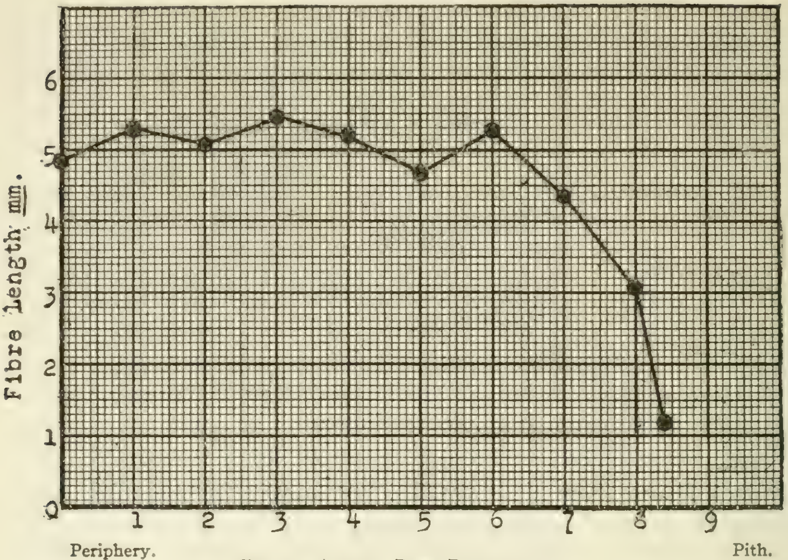


FIG. 8.—ANNUAL RING DESIGNATION.

Douglas fir. Ship. 2, tree 1, disc D. Curve showing average fiber length by rings, at 18 feet from ground.

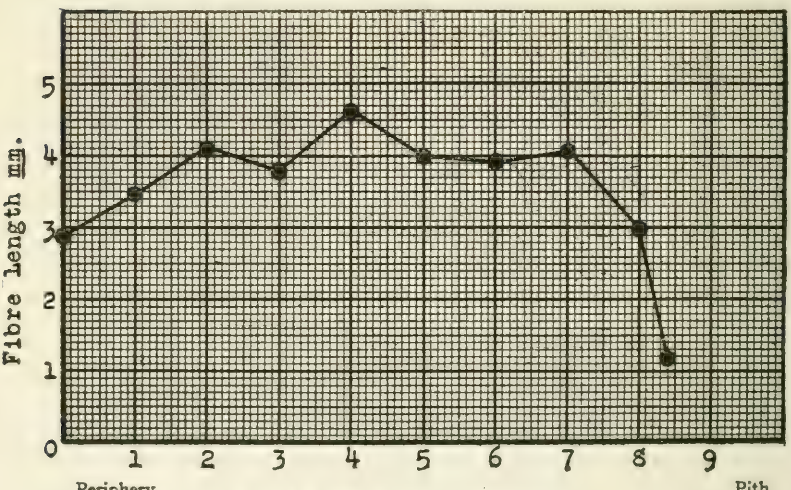


FIG. 9.—ANNUAL RING DESIGNATION.

Douglas fir. Ship. 2, tree 5. Curve showing average fiber length by rings, at 19 feet from ground.

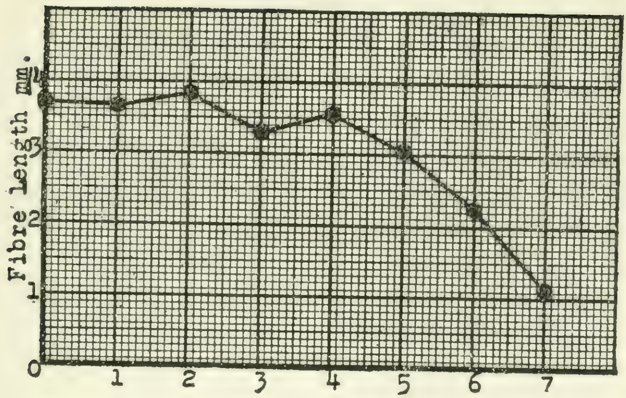


FIG. 10.

Douglas fir. Ship. 3, tree 8. Curves showing average fiber length by rings, at 19 feet from ground.

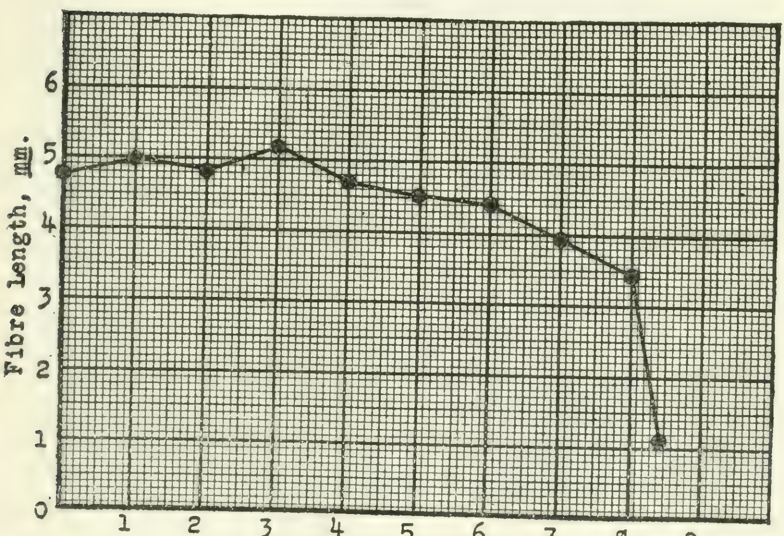


FIG. 11.—ANNUAL RING DESIGNATION.

Douglas fir. Ship. 3, tree 10. Curve showing average fiber length by rings, at 19 feet from ground.

Results of examination of one disc each of 4 trees, two being typical coast Douglas fir and two being the mountain form, are recorded in Table V and Figures 8, 9, 10, 11. A disc of tree 5 of shipment 2 taken at 19 feet from the ground gave 3.49 *mm*, as an average fiber length of 500 measurements made from ten annual rings. Comparing this with the average for tree 1 of the same shipment, *i. e.*, from the coastal region, at 18 feet from the ground, we find this latter tree gives an average of 4.43 *mm* for the same number of measurements. The indication from this is that the fiber length as stated for shipment 2, tree 1 is possibly above the general average for all trees of the coastal region of British Columbia. Both trees at the height from the ground given show a marked increase in fiber length up to 60 years from the pith followed by increases and decreases within comparatively narrow limits until near the periphery, when a marked decrease occurs. As is shown above, this decrease near the periphery does not hold throughout a complete tree. The discs of shipment 3 from the mountain region of British Columbia taken from trees 8 and 10 at 19 feet from the ground give average measurements of 3.06 *mm* and 4.18 *mm* respectively. The disc from tree 8 (Fig. 8), contained only 140 annual rings and fiber, shows an increase in length practically up to the periphery, but tree 10 (Fig. 9) with 169 annual rings shows a decrease near the periphery. In both, as is the case in all discs measured, the increase up to about 50 years is very rapid but is followed by irregular, small increases or decreases. Comparing the coastal forms with both the mountain forms it appears that the former produces a somewhat longer fiber.

Summary

1. Measurements of 8550 tracheids at 171 points in a single Douglas fir tree showed the average fiber length to be 4.46 *mm*, the maximum fiber 8.60 *mm*, and the minimum 0.34 *mm*.

2. The length of the tracheids increases rapidly up to about 50 years from the pith, after which there are comparatively small and irregular increases or decreases, with an average slight increase toward the periphery.

a. The most marked decrease near the periphery occurs near the butt.

3. The average fiber length increases up to somewhat less than one third the height measured and then gradually decreases.

4. The tracheids in a given annual ring increase in size from the ground upwards until a maximum is reached and then decrease to the top.

a. The maximum length occurs higher from the ground in the rings nearer the bark.

b. The annual rings last formed give the longest average fiber.

5. Measurements indicate that a greater growth in diameter may be correlated with a shorter tracheid.

6. A greater growth in height appears to be correlated with a longer tracheid.

7. The tracheids in "rotholz" are shorter than those in "zugholz" of the same annual ring.

8. Fiber length appears, in tree measured, to be somewhat longer in the summerwood than in the springwood.

9. Both fiber length and strength increase rapidly from the pith outwards to a certain point, after which comparatively small increases and decreases occur irregularly. No definite relation at various height in tree could be established.

10. Douglas fir from the coast region of British Columbia appears to produce a fiber averaging slightly longer than that growing in the mountains.

Further studies are being conducted on spruce and pine and it is hoped that comparisons with the data herein given will lead to more definite establishment of certain of the conclusions stated above.

Literature Cited

(1) Variation in length of coniferous fibers. Shepard, H. B., and Bailey, I. W. Proc. Soc. Amer. For. *9*:4, Oct., 1914.

(2) Sanio's laws for variation in size of coniferous tracheids. Bailey, I. W., and Shepard, Bot. Gaz. *60*, 1, July, 1915.

(3) Gerry, E. Fiber measurement studies: length variations, where they occur and their relation to the strength and uses of wood. Science Vol. 61, No. 1048, page 179, 1915.

(4) Mell, C. D. The length of tracheids in the wood of cone-bearing trees. Paper Trade Journal, 15 June, 1911, p. 52.

(5) Penhallow, D. P. Anatomy of Gymnosperms, Boston, 1907.

(6) Sanio, K. Jahrbücher d. Wiss. Botanik, Vol. VIII, p. 401, 1867.

THE ECONOMIC WOODS OF HAWAII

By Vaughan MacCaughey[1]

The Hawaiian Archipelago is remarkable in its geographic and biologic isolation, and in the highly endemic character of its fauna and flora. Thereis no other land mass, of equal area, on the planet, so remote from continental regions as is Hawaii. The islands lie in the North Pacific Ocean, 2100 miles west of San Francisco, and just within the tropics. The archipelago consists of over twenty islands, extending from the great volcanic island of Hawaii in the south-east, for a distance of two thousand miles to tiny Ocean Island in the north-west. Only eight of these are inhabited; the remainder are minute coral rings, sand islands, and barren volcanic rocks, with a combined area of less than twelve square miles. The eight large islands—Hawaii, Maui, Oahu, Kauai, Molokai, Lanai, Niihau, and Kahoolawe, in order of size—have a combined area of 6,454 square miles. Hawaii, the largest island of the group, has an area as great as that of all the others combined.

These eight islands are, or were, all heavily forested in their interior, mountainous districts. Within historic time there has been extensive deforestation, and two of the smaller islands, Lanai and Kahoolawe, have been stripped by goats and cattle of practically all their forest mantle. The forest is composed largely of peculiar, endemic species, and presents many striking contrasts to the familiar mainland forests. There is no other region in the world with so large a percentage of endemic plant species as Hawaii, and the great majority of these are perennial, woody, and arborescent. A lumberman from Georgia, from Michigan, or from the Puget Sound country would find in our Hawaiian forests not a single familiar tree, not a single conifer, and but few species that even faintly resemble those of the continental forests of the United States.[2]

The lowland climate of Hawaii is mild and equable throughout the year, with an average of about 75° F. and extremes of 60° and 85°. There is a drop of about four degrees for every thousand feet ascent; the high mountains of Maui and Hawaii (8,000-13,825

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[2] MacCaughey, V. The Forests of the Hawaiian Islands. Plant World, vol. 20, 1916, pp. 162–166; 2 figs.

Teaching dendrology in the Hawaiian Islands. F. Q., vol. XIV, pp. 46-9.

feet), have snow and ice, which occurs nowhere else in the archipelago. The trade winds from the northeast blow almost continuously throughout the year, and create marked windward and leeward regions, as the main axis of the islands lies athwart these winds. The trade winds are heavily water-laden, and the precipitation resulting from their contact with the mountains is extremely large, in some regions amounting to 400-500 inches. The native forest reaches its finest development in the rainy zone, although there are some tall species that inhabit the barren lava-flows and other zerophytic regions.

The chief ecologic zones are as follows:

1. Littoral. a. Humid Littoral; windward.
   b. Arid Littoral; leeward.
2. Lowlands. up to 1,000-1500 feet. Humid and Arid Sections, depending upon relation of topography to trade winds, and distance from interior mountains.
3. The Forest Zone. a. The Lower Forest; 1,000-2,000 feet; Humid and Arid Sections.
   b. The Middle Forest; 1800-5,000 feet; variable, with Humid and Arid Sections.
   c. The Upper Forest; 5,000-9,000 feet; restricted to the high mountains of Maui and Hawaii.
4. The Summit Regions. a. Summit Deserts; 9,000-14,000 feet; high mountains of Maui and Hawaii.
   b. Summit Bogs; peaks rising into the cloud belt; 4,000-6,000 feet.

The tree of first rank as a commercial asset in Hawaii is the *ohia lehua*, (*Metrosideros polymorpha* Gaud.). This is the most abundant tree in our forests, and forms the largest pure stands. It, and other closely related species, also occur in the island of the South Pacific. It grows at all elevations from sea-level up to 9,000 feet, and in every ecologic habitat, from raw new arid lava, flows to the perpetually water-saturated summit bogs. The *ohia* is exceedingly variable in growth form and foliar characters, and the botanic status of its numerous sub-species and varieties is still unsettled. Many of the South Sea forms that have been described as species are probably only varieties of *polymorpha*. This species has been divided into a number of sections, or sub-divisions, which are as intricate and baffling as those of Craetagus or Quercus. This species is evidently in a condition of organic inequilibrium and incipient evolution. Many of the New Zealand forms are climbing or decumbent lianas.

In the Hawaiian summit bogs the *ohia* is a stunted creeper, scarcely rising above the mosses and sedges of the swamp. In the great jungle-forests of puna and Olaa, Hawaii, it is a stately tree, rising to over a hundred feet in height. In the latter regions it is straight-trunked and high-crowned, an excellent form for lumbering. In recent years several local companies have undertaken the commercial exploitation of these great *ohia* forests, and large quantities of the lumber have been exported, as well as utilized locally. The wood is strong, tough, fine grained, dark red, and very durable. Its one defect is that it requires very careful drying in order to prevent warping and checking, to which it is very susceptible. In laying *ohia* flooring great care must be exercised in fastening the boards properly in place, otherwise they twist and check.

The *ohia* wood has come into prominence for flooring, paving blocks, railroad ties, bridge timbers, and other uses in which durability is of especial importance. In its mechanical and structural properties *ohia* rivals the best oak, although it cannot be obtained in as large sizes, as its trunk is relatively slender. Occasionally boles of three to four feet in diameter are obtained, but these are uncommon, and the average diameter of the trunk is about two feet. The engineering testing laboratories of the College of Hawaii were used, a few years ago, for a thorough examination of the *ohia*, and the results of an extensive series of tests were very satisfactory. It is to be noted that the *ohia lehua* is a slow-growing tree, and upon the consummation of the present epoch of exploitation, unless conservative principles of forestry soon be rigorously applied, the supply will be practically exhausted for a considerable period.

Second only to the *lehua* in abundance and importance is the *koa* (*Acacia koa* Gray). It is the finest tree in the Hawaiian forests, and is endemic.[3] In the lower forest the *koa* usually grows as a large spreading tree, with a thick, stocky trunk, sometimes

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[3] MacCaughey, V. The Woods of Hawaii. Scientific American Supplement, vol. 81, 1916, No. 2098, pp. 184–85, 5 figs.

seven or eight feet in diameter, and long horizontal branches. Under these conditions the crown is a beautiful symmetrical dome, rising from the ground to a height of forty feet. In the dense rain-forest, particularly in the island of Hawaii, the *koa* has an entirely different growth-form. The trunk is very tall, straight, and unbranched to a height of forty feet above the forest floor. A relatively small crown is developed at the summit of this beautiful gray column. The bark may be either smooth or very scaly. In early times the "big *koa*" was abundant, and many trees attained heights of eighty or ninety feet. These largest trees were used by the natives for their war-canoes and huge carved idols, and later by the whites for structural timber and cabinet wood, so that today there are few of these veterans standing.

The *koa* foliage is thin and diffuse, and crowded at the ends of the branches. The interior of the tree is bare, and one can readily see the entire framework through the spotty and diaphanous superficial drapery of foliage. The juvenile foliage, both in the seedlings and in the young twigs of old trees, is the typical bipinnate mimosoid leaf, with twelve to fifteen pairs of crowded leaflets. The true leaves, however, rapidly pass into the phyllodia; the petioles become expanded, flattened, and sickle-shaped. The mature phyllodium is four to six inches long and half an inch wide, thin coriaceous, very smooth, and longitudinally striate with fine parallel veins. The floral peduncles are solitary or clustered in the axils; each bears a globular head of minute, closely packed white florets. The pod is flat, brown, four inches long, with about a dozen dark brown seeds.

The range of the *koa* is considerable—from near sea-level up to 5,500 feet—and from hydrophytic to semi-arid habitats. It possesses marked adaptability, but reaches its finest development and largest stands in mesophytic-hydrophytic districts. Although its thin canopy of phyllodia indicates zerophytic adaptations, it is not a tree of the strictly arid lands, and grows with evidence reluctance under desert conditions.

The *koa* timber is undoubtedly the most valuable wood which the islands now possess. It is typically a rich golden brown, varying through a series of tints and grains, from a straight-grained, rather commonplace "piney" yellow, through to a very handsome, distinctive, dark mahogany-red, curly-grained type. This latter is the rarest and most highly prized, and is the kind used in the manufacture of *ukuleles*, (Hawaiian guitars), and fine cabinet work and furniture. The wood is of about the same hardness as oak, and is not difficult to work. In the early days it was used for common structural purposes, and for interior finish, but is now too scarce for such uses. Several local companies have from time to time exploited the *koa*, under the name of Hawaiian "Mahogany," particularly on the island of Hawaii, where the choicest timber occurs. In the vicinity of the crater Kilauea are the remains of the old camps and lumber mills.

Of much greater seriousness than human exploitation have been the ravages of wild goats, cattle, and insect pests. The goats, cattle, and other wild live stock have done irreparable and incalculable damage to all the forests, and the magnificent *koa* groves have suffered with the rest. Hawaii's carelessness and ignorance in allowing wild live stock to roam and multiply unchecked in all her forests for over a hundred years, has heaped up for her a heavy penalty of ruined woodlands. Moreover, when the Hawaiian forest has once been ravaged and despoiled, it is exceedingly difficult to restore the primitive conditions, as foreign undergrowth has taken possession of the land, and inhibits natural reforestation. In many places where formerly existed splendid groves of big *koa*, there is today nothing but a dreary tangle of naked dead and decaying timber. The goats and cattle devour the seedlings, and kill the young trees. There are a number of lepidopterous larvae, mostly Scotorythra, which feed upon the leaves and often defoliate the tree. Several coleopterous borers—ex. Aegosomus—riddle the wood with their tunnels. When decay has once set in, the tree is attacked by a variety of bracket and wood-destroying fungi, which complete the ruin and destroy the tree.

The tree of third rank in our woodlands is the cosmopolitan *kukui*, (*Aleurites moluccana* L. Willd.), popularly known as the candle-nut tree.[4] It inhabits the lowlands and lower forest zone, up to 2,200 feet elevation in moist and mesophytic districts. It will not stand prolonged drought, and the groves which at present occur in semi-arid regions are the vanishing remnants of what was once a humid forest. The *kukui* is abundant in the South Pacific and in many tropical countries.

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[4] MacCaughey, V. The Kukui Forests of Hawaii. Paradise of the Pacific Magazine, 1911, pp. 19–24, 6 figs.

Like the *koa*, with which it is often associated, the *kukui* has several growth forms. When not crowded for room it has a short thick trunk, with many large, horizontal crooked branches, supporting a beautiful dome of silvery-green foliage, that begins almost at the ground and rises to a height of thirty or forty feet. The lower branches are often prostrate on the ground, supported by curious elbow-like angles. This is the common form in the lower forest and the shallow ravines. In the narrow gorges and valley-heads the tree is frequently fifty to eighty feet tall, with a smooth straight bole, and a high, compact crown.

The leaves of young trees and branches are large, dark green, and digitately five to seven-lobed, somewhat like those of our mainland Planatus. The mature foliage is small, ovate, and clad with silvery-gray woolly tomentum. This gives the *kukui* crown a characteristic silvery aspect, recognizable at a great distance, and readily distinguishing it from any other Hawaiian tree. The flowers are dioecious, in loose, terminal, cymose corymbs. The fruit is globular, fleshy coriaceous, 1½–2 inches in diameter, with one or two large, hard-shelled, oily nuts.

These nuts constitute the commercial value of the tree. The ancient Hawaiians, and other native peoples, used the nuts for illumination, either stringing the oily kernels on fiber and burning them like a candle—hence the name candle-nut—or expressing the oil by pounding the kernels, and burning it in open stone saucer-like lamps, with a bit of fiber for a wick. The *kukui* oil is very similar to the "wood oil" of China and other parts of Asia, which is obtained from another species of Aleurites. It possesses certain drying properties which make it excellent for fine paints, lacquers, and varnishes. It is also used in soap-making, as a wood preservative, and in medicine.

At various times in the history of Hawaii there have been commercial attempts to establish a local *kukui* oil industry. In monarchical days the annual exports amounted to ten thousand gallons, but the industry lapsed with shifting political and economic conditions. In 1915, a new corporation, the Hawaiian Kukui Oil Company, was organized with a capitalization of $25,000. The machinery for separating the kernels from the shells and husks, and for expressing the oil, is comparatively simple and inexpensive.

The company estimates a total available *kukui* acreage of about fifteen thousand acres. Conservatively assuming eighty trees to the acre, and two hundred pounds of nuts per tree, this gives an annual yield of eight tons per acre. Reducing this estimate to five tons per acre the annual crop is 75,000 tons. Considering 50,000 tons as the available crop, the extracted oil would amount to 2,375,000 gallons, having a conservative wholesale value of at least $1,187,500. Inasmuch as the importation of Chinese wood-oil into the United States in a single year amounts to nearly six million gallons, and as a single New York firm could have placed orders for an additional 500,000 gallons, had it been available, the market prospects for the Hawaiian *kukui* oil seem very auspicious.

The wood is white, soft, coarse-grained, brittle, and lacking in durability. It has no commercial value save as firewood, and as fuel is of low grade. The wood decays easily, and the trees are attacked by various boring insects, notably the longicorn beetle Aegosoma.

Another important oil-yielding tree is the *kamani*, (*Calophyllum inophyllum* L.). It is widely distributed throughout tropical Asia and Polynesia, and is everywhere valued for its oil and wood. It is distinctly a littoral species, like the *milo*, and was also brought by the first Hawaiians from the South Pacific. It is often fifty or sixty feet high, with a trunk of two to three feet in diameter, and a domed crown of heavy, dark green, glossy foliage. The fragrant, creamy-white flowers are in showy axillary racemes. The fruit is 1½–2 inches in diameter, with a hard rind and a very oily nut. In India, Fiji, and other regions the oil is of considerable commercial importance, and like the *kukui* oil, is used for a variety of purposes. The wood is as hard as oak, close grained, and reddish brown in color. In ancient Hawaii it was used chiefly for the carved wooden bowls or *umeke;* in other countries it is utilized for timber, in shipbuilding, and for fine cabinet work. The day will undoubtedly come when this valuable oil tree will be handled as a forest crop, under scientific management.

The leguminous mesquite, *Prosopis juliflora*, an introduced tree, has become the dominant lowland tree in many regions, and has proven to be of great economic importance. It thrives in semi-arid regions where other trees are scarce, and ameliorates the poor soil upon which it grows. Its height is twenty to forty feet, with a wide-spreading crown, gnarled, fluted trunk, and small, pinnate foliage. The first seed was brought from Mexico in 1837 by Father Bachelot, founder of the Roman Catholic Mission. The nutritious pods are relished by live stock, and cattle have been largely responsible for the wide dissemination of the tree on the ranchlands and lowland plains. There are now over 60,000 acres of mesquite or algaroba forest in the islands. Land formerly considered worthless has been transformed by this valuable tree into useful pasture land. The tree—called *kiawe* by the natives—bears profuse crops of yellow, nutritious pods. These mature during the summer months, and are harvested as a regular crop. The pods are picked up from beneath the trees, and placed in gunny sacks for transportation and storage. The pod is filled with a sweet gummy pulp, which surrounds the small, exceedingly hard seeds. The seeds, like those of all legumes, contain a high percentage of valuable food materials, but are so hard-walled that cattle cannot crack them. A milling device was perfected in Honolulu a few years ago, by means of which the pods and seeds are thoroughly crushed and macerated, and reduced to a readily digestible condition. This is sold as "algaroba bean meal" and is mixed with other less concentrated feeding stuffs. It is an important local product.

The flowers are fragrant and very nectiferous, and constitute an important honey supply. The *kiawe* bee pasturage is reckoned as of the finest quality, and due to the prolonged flowering period, yields unusually large quantities of honey. Apiaries have been established throughout the *kiawe* belt on all the islands, but notably on Oahu and Molokai. The latter island is reputed to be one of the greatest honey-exporting districts in the world. *Kiawe* honey is very sweet, and of excellent keeping qualities.

The wood is dark reddish brown, with yellow sapwood; rather coarse grained, and very crooked and irregular. It is never sawn into boards, because of these distinctive irregularities, but is used for fence posts, and chiefly for firewood. It is the common fuel wood of Honolulu, and commands high prices. Owing to the ravages of an exotic locust borer, the *kiawe's* usefulness for fence posts has been seriously impaired. The *kiawe* is commonly used as a shade tree, in Honolulu as well as in the country districts. When bountifully irrigated it assumes stately proportions, ascends to a height of sixty or eighty feet, and rivals in beauty and dignity the elms of England and the Eastern States.

At this point may be mentioned a number of other foreign trees, which have been introduced and are now well established, and whose woods are used in various ways. The monkey-pod, *Pithecolobium samang*, is valued locally for ship timbers in the construction of the Japanese sampans, and for cabinet work. The ironwood, *Casuarina equisetifolia*, the beef-wood, *Grevillea robusta*, and the gums, *Eucalyptus* spp., all from the South Pacific, are extensively planted along plantation roadways, and are used for posts, flume timbers, etc. The wood of two fruit trees, the mango, *Mangifera indica*, and the bread-fruit, *Artocarpus incisa*, is often used for *poi*-boards, house timbers, firewood, etc. The Orientals make large quantities of charcoal from the guava, *Psidium guayava*, which in many lowland regions forms extensive "chaparral" thickets.

A very hardy endemic tree, with a wide range of adaptability a to elevation and habitat, and of considerable economic value, is the *mamane*, (*Sophora chrysophylla* Seem.). This is a legume, fifteen to forty feet tall, with a trunk of ten to twenty-four inches in diameter. The pinnate leaves are five or six inches long, with six to ten pairs of leaflets. At high altitude these, and other parts of the plant, are covered with silvery or golden pubescence. The bright yellow flowers are clustered in pendulous axillary and terminal racemes; the pods are four to five inches long, quadrangular, and deeply constricted between the seeds.

The *mamani* occurs on all the islands save Oahu and Molokai. There is no explanation for this remarkable hiatus in its range. It grows from sea-level to ten thousand feet elevation; on the lowlands it is always a shrub, and attains its best development at an elevation of about 5,000 feet, on the slopes of Mauna Loa. The most extensive belts of *mamani* occur on this and on the other high mountains of Hawaii—Mauna Kea and Hu-ala-lai. According to Rock the very numerous wild cattle and horses of Mauna Kea "live almost exclusively on the young leafy shoots of the *mamani* during the dry season, when there is no grass available."

The *mamani* wood is very hard, and unusually durable in contact with the soil. It makes excellent fence posts, and is generally used by the ranchmen of Hawaii for that purpose. The high altitudes of the best groves has prevented the commercial exploitation of the *mamani*, but there is little question as to the valuable properties of the wood. There is considerable evidence to show that many fine groves at the lower levels—5,000-6,000 feet—have been destroyed by lava flows in relatively recent geologic time.

"The sandalwood (*Santalus freycinetianum* Gaud.) is a name to conjure with in Hawaii. In old monarchical days the sandalwood forests were the treasury houses of the kings. Sandalwood was ready money, and was recklessly squandered, so that there is now very little sandalwood of commercial size."[5] There are four species of native sandalwood in Hawaii—*S. freycinetianum*, characteristic of xerophytic regions on all the islands; *S. ellipticum*, Gaud., confined to Oahu and Kauai, at elevations of 600–1,500 feet; *S. pyrularium* Gray, restricted to Kauai, at elevations of 3,000–4,000 feet; and *S. Haleakalae* Hillebd., occurring only on the slopes of Hale-a-ka-la, at elevations of 2,600–9,000 feet.

In olden times the sandalwood—native name *ili-ahi*—often attained heights of sixty to eighty feet, with trunks two to three feet in diameter. The secretions of the fragrant oil increase with age, so that the older trees are very much more valuable than the young ones. Today it is difficult to find a sandalwood over thirty-five feet high, and in most places they are small trees or shrubs.

The sandalwood is semi-parasitic in its feeding habits, and in its seedling stages seems to be very dependent upon its haustorial connections with the roots of other trees. No one has as yet successfully germinated the seeds of the Hawaiian sandalwoods, and this difficulty is apparently connected with the semi-parasitic habit. One of its chief associates in the lower forest is the *koa*, (*Acacia koa*), and it is likely that the young sandalwood tree derives a portion of its sustenance from the *koa*.

In the "sandalwood days"—1790 to 1820—the tree was shamelessly exploited. The cargoes were sent to China, and the Chinese designation for the Hawaiian Islands was Tan-Shan, literally "the fragrant mountains." Although the prices received by the Hawaiian chiefs for the wood were ridiculously small as compared with the actual value of the product, in the height of the period the income amounted to several hundred thousand dollars annually. This extravagant exploitation came to a speedy termination, the supply was exhausted, and today there is little

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[5] See The Woods of Hawaii, MacCaughey, Scientific American Supplement, loc. cit.

commercial sandalwood in the islands. Under the present excellent system of forest conservation by the Territorial government, this valuable tree should again become an economic asset.

With the decline of the true sandalwood the false sandalwood, *Myoporum Sandwicense* (DC.) Gray, was cut and shipped in its stead. This tree, called *naio* by the natives, is very common, growing at all elevations from sea-level up to ten thousand feet. It prefers arid leeward regions, and the high mountains of Maui and Hawaii. The finest stands occur on East Maui, at an elevation of about 2,500 feet; here trees of fifty to sixty feet, with trunks of 30 to 36 inches, are still fairly common. The glossy leaves are crowded at the ends of the branches; the small, fragrant white or pink flowers are borne in axillary clusters. The wood is rather soft, fine grained, and dark yellowish green in color; upon drying it becomes fragrant, like the true sandalwood.

Just as the Chinese prized the sandalwood for its fragrance, so was the *mokihana* beloved of the Hawaiians. This is a small, slender tree, (*Pelea anisata* Mann), endemic to the island of Kauai. The trunk is eight to ten inches in diameter; the tree is fifteen to twenty feet in height. The wood and all parts of the tree possesses a strong aromatic anise odor, very pleasant and fragrant, and one of the favorite perfumes of the old-time Hawaiians. The pretty little brown capsules, half an inch in diameter, were strung into odorous *leis* or garlands; the crushed twigs were laid amongst the *tapas* stored in the calabashes, like the sweet lavender of our grandmothers, to impart its delightful odor to the clothing.

The *moki-hana* is plentiful in the Kauai rain-forests, at elevations between three- and four-thousand feet. Another species—*Pelea pseudo-anisata* Rock—is plentiful in the rain-forests of the Kohala Mountains, Hawaii, at elevations of four- to five-thousand feet. This species is more odoriferous than *anisata*, and has larger capsules, some two inches in diameter. There are twenty-two other species of *pelea* in the Hawaiian forests, but only the two specified are of economic interest. A technical study of the *moki-hana* oil is being conducted in the chemical laboratories of the College of Hawaii, Honululu, in order to determine its commercial possibilities.

The "mountain apple" tree, or *ohia ai*, was introduced by the primitive Hawaiians, and now is abundant in the humid valleys and ravines. It forms pure stands, some of which cover areas of several hundred acres. This tree (*Jambosa malaccensis* (L.), P.DC.) is cosmopolitan, and occurs throughout the Pacific. It is thirty to sixty feet in height, with a straight, smooth-barked trunk, and handsome, dark green, glossy foliage. The flowers are pompons of showy magenta stamens, and produce juicy, crimson, obovate fruit, the size of a small pear. During the fruiting season, generally in mid-summer, the fruit is common in the Honolulu markets. The wood was used by the natives for their house and temple timbers, and for idols; it has not been used to any extent by foreigners.

A highly laticiferous tree of possible commercial value is the *koko*, (*Euphorbia lorifolia* Gray, Hillebd.). The native name *koko* means "blood" and refers to the latex. This is a small endemic tree of twenty or twenty-five feet, with a trunk of eight or ten inches, which on old trees is encrusted with fissured protuberances. It occurs on Molokai, Lanai, Maui, and Hawaii, at elevations of two- to four-thousand feet, in zerophytic habitats. A variety, *gracilis*, is restricted to the semi-arid waste-lands on the slopes of Mount Hu-ala-lai, on Hawaii, at an elevation of three thousand feet. This variety, which is estimated to occupy about five thousand acres, has a very copious flow of latex, and has been investigated by the Hawaii Agricultural Experiment Station as a possible source of rubber and chicle. The favorable reports and the considerable acreage involved may lead to the commercial utilization of this tree.

Among the comparatively few Hawaiian trees which attain large stature is the *a'e*, *Sapindus saponaria* L. It rises to a height of sixty or eighty feet, with a straight, buttressed trunk, often six feet in diameter. In no other part of the world does this tree reach such a large size as in Hawaii. The bark flakes off in large thick irregular plates or scales, exposing the smooth young bark beneath. The wood is white and soft; it is not utilized by the natives, nor is the tree of sufficient abundance to be of special commercial importance. The leaves are pinnate, and deciduous; the small, yellowish flowers are in hairy terminal panicles, and produce round black berries. The saponaceous qualities of the fruit are well known, and utilized by natives in all lands where the tree occurs. In Hawaii the *a'e* occupies the middle forest zone, at an elevation of about four thousand feet. A second species, *S. oahuensis* Hillebd., is a small endemic tree, twenty to thirty feet, distributed throughout the leeward lower forests of Kauai and Oahu.

The *wili-wili*, (*Erythrina monosperma* Gaud.), is a soft-wooded leguminous tree of the lowlands. It has a short, stocky trunk, and a squat spreading crown of stiff, gnarled branches. The bark is smooth, thin, and of a peculiar leathery yellow-brown color, with scattering conical prickles. The foliage is sparse, three-foliate, and crowded at the ends of the branches. This is one of our few deciduous trees. The flowers are dull red or creamy-yellow, in showy axillary racemes; these appear after the spring rains, before or with the new leaves. The pod is two to three inches long, with one or several bright scarlet beans. The *wili-wili* is strongly zerophytic, and inhabits the arid lowlands up to an elevation of 1500 feet. The tree is fairly common, although it is solitary and scattered, and does not form groves or pure stands. The wood is white, very soft and grainless, and of remarkable buoyancy. The natives formerly used it for the outrigger of their canoes, for which purpose its lightness, which is equal to that of cork, admirably fitted it. The trees are easily grown, and the buoyant wood should come to be of some economic value.

A very soft-wooded liliaceous tree, that is also plentiful in the arid and semi-arid lowlands, is the *hala-pepe*, *Dracaena aurea* Mann. It is twenty to thirty-five feet high, with a profusion of erect, stiff, naked branches, each of which, like the *hala*, is crowned with a large rosette of long pointed, ribbon-like leaves. The bark is light gray and smooth; the wood is exceedingly soft and brittle, white with reddish brown streakings. The tree is common on the barren leeward stretches of the various islands. On Kauai, near Waimea, it forms extensive, almost pure, stands. It is also plentiful in the vicinity of Honolulu. In the days of ancient Hawaii the wood was used commonly for idols, because of the ease with which it could be carved.

Another tree of interest because of the remarkable lightness and softness of its wood, although not of economic importance, is the *papala*, *Charpentiera obovata* Gaud. This small tree is fifteen to thirty-five feet in height, with thick, glossy, dark green foliage and smooth thin, light-brown bark. The tree lives in the lower forest zone, and up to four thousand feet, on all the islands, in both humid and semi-arid regions. The natives formerly used the wood for torches, as it burned with great brilliancy. One of the noteworthy ancient nocturnal sports consisted in throwing great numbers of these buoyant, flaming firebrands from high precipices overlooking the sea. These exhibitions were very spectacular in character and, before the introduction of gun powder, were the Hawaiian's nearest approach to fireworks.

The ***nene-leau*** or Hawaiian sumach, is a small, tough-wooded tree, formerly much used by the planters in the construction of their primitive ox-plows. In later years these have been almost wholly supplanted by imported implements. The wood is soft, coarse grained, and of grayish yellow color. The trunk is eight to twelve inches in diameter, and ten to fifteen feet high. The leaves are pinnate, and bright green; the flowers small, yellowish, in showy dense terminal panicles, which are clad with rusty tomentum. This sumach (*Rhus semi-alata* Murray var. *sandwicensis* Engler) is endemic; it grows in the lowlands and lower forests, up to two thousand feet elevation, in isolated clumps. Its numerous root-sprouts sometimes form very dense clumps.

A soft, white wood, occasionally used by the natives for making saddle frames, is obtained from the *kawau, Ilex sandwicensis* (Endl.) Loes. This is a beautiful tree of twenty to forty feet, with a bole of ten to twelve inches. It chiefly inhabits the rain-forests. The dark green coriaceous foliage is quite handsome; the small white flowers occur in axillary cymose panicles. There are a number of other tree species, some of them attaining considerable size, that are all characterized by soft, weak, white or yellowish wood, which have not been used by the natives or foreigners. Among these may be specified the *poola, Claoxylon sandwicense* Mull.-Arg.; *Tetraplasandra meiandra* Hillebd. Harms.; *ohe, Reynoldsia sandwicensis* Gray; *ohe-ohe, Pterotropia*, three species; Cheirodendron, two species; *aiea, Nothocestrum breviflorum* Gray, and *N. latifolium* Gray. This list is sufficient to indicate that the tropical and subtropical forests contain many soft-wooded trees, in addition to the more commonly known hardwood species.

Two Hawaiian trees were known as *kauila*, and their exceedingly hard, heavy wood was extensively used by the natives for their spears, war clubs, beaters, and similar implements. One, *Colubrina oppositifolia* Brongn., is endemic, and confined to the Kona district of Hawaii. Its height is twenty-five to thirty-five feet, with a trunk of ten to fourteen inches. The wood is fine grained, tough, and dark red. The other species, with somewhat softer wood, *Alphitonia excelsa* Reiss, is a tall tree, often eighty feet in height, and with a trunk of eighteen to twenty-four inches diameter. It occurs in the arid leeward districts of all the islands, to an elevation of 3,200 feet. The wood is like that of Colubrina, but is marked with conspicuous black streaks. This species is not endemic, but is plentitiful in the islands of the South Pacific.

A common hardwood tree is the *lama*, *Maba sandwicensis* A.DC., or Hawaiian ebony. The wood is dense, fine-grained, and rich reddish brown. It was formerly used for idols, temples, and house timbers. The tree is twenty to forty feet in height, and occurs in the humid and semi-arid lower forests on all the islands.

The Hawaiian olive, *pua* (*Osmanthus sandwicensis* Gray, Knobl.), is also common, but is restricted chiefly to the arid leeward districts. It is a dominant tree on many of the Hawaiian lava-flows. Its height is thirty to sixty feet, in old trees the trunk is frequently thirty to thirty-six inches in diameter. The wood is exceedingly hard and heavy, fine textured and durable; it is dark brown with blackish streaks, and takes an excellent polish. The Hawaiians formerly used the wood for their implements.

A comparatively scarce endemic tree, of economic value, is the *uhi-uhi*, *Mezoneurum Kauaiense* Mann, Hillebd. It is a legume, sub-family Caesalpinioideae, and grows to a height of twenty-five or thirty feet, with a trunk of ten or twelve inches. The smooth leaves are abruptly pinnate with one to five pairs of pinnae, each with four to eight pairs of leaflets; the leaflets are about 1½ inches long. The dark purple red flowers are arranged in showy terminal racemes, which appear in early spring. The thin flat pod is 3½ x 2 inches, with a broad wing along one margin; the young pods are pink and showy. *Uhi-uhi* wood is very heavy, fine grained, hard, and durable; in color dark chocolate brown, almost black. It was used by the natives for fishing sinkers, as it is much heavier than water, and easier to drill than stone. This tree occurs in restricted localities on Kauia, Oahu, Maui, and Hawaii, and is too scarce to be of present commercial value.

We have several species of the endemic genus Bobea which become large trees—thirty to thirty-five feet—and were formerly valued by the natives for their yellow wood. The Bobeas are widely scattered on the various islands, chiefly in the rain-forests, although also inhabiting the zerophytic districts. The bright yellow wood was used for the gunwales of the outrigger canoes, and afforded a pleasing contrast with the dark body of the vessel.

One of the very tough, close-grained woods of Hawaii is the *ai-ai Pseudomorus Brunoniana* Endl. Bureau. The tree is twenty-five to thirty-five feet high, with a trunk of twelve to eighteen inches, laticiferous, and with mulberry-like foliage. It is semi-zerophytic in habitat, and occurs on all the large islands of the group. The *ai-ai* is Australian in origin, and was there used extensively by the natives for their boomerangs, owing to the remarkable toughness and hardness of the wood.

The endemic *ke-ahi*, *Chrysophyllum Polynesicum* Hillebd., is common in the zerophytic leeward districts. Considerable mixed stands occur on East Maui, Molokai, and Lanai. The wood is very hard and durable, but does not appear to have been used by the natives. The tree is twenty-five to forty feet high; the young leaves and inflorescence are covered with a golden-brown tomenum.

The Hawaiian ironwood, *hao*, (*Rauwolfia sandwicensis* A.DC.), is a fairly common laticiferous tree, occupying arid leeward lowlands on all the islands, at about two thousand feet elevation. It is often a mere shrub, but under favorable conditions becomes a tree of twenty feet, with a trunk of six to twelve inches. The wood is dark yellow, fairly strong, close grained, and very durable. Its native name, *hao* or iron, refers to the latter property. The *holei Ochrosia sandwicensis* Gray, resembles the *hao* in color and other properties. From the bark and roots the natives formerly extracted a bright yellow dye-stuff.

A very beautiful native wood, extensively used for turned wooden bowls, *umeke*, is the *milo*, *Thespesia populnea* L. Corr. The rich golden-brown color and variegated grain of the *milo* wood, and its beautiful polish, give it high value as a cabinet wood. The tree was brought by the ancient Hawaiians from their South Pacific home, and was abundantly planted around their beach settlements. It grows to a height of twenty-five to forty feet, with a trunk of eighteen to twenty-six inches. It seeds freely and is now thoroughly established along the strand. The *kou*, *Cordia subcordata* Lam., was another easily carved, beautifully grained wood which the natives prized for bowls and other vessels. It was brought from the South Seas, where it is plentiful. It was formerly common along Hawaiian shores, but is now quite rare. The beautiful orange flowers are arranged in showy panicles.

The *kolea* (*Suttonia lessertiana* A.DC. Mez) yields a beautiful cabinet wood. It is of medium hardness, easily worked, of a rich pink color mottled with darker, with a showy grain, and taking a high polish. The sap is brilliant red. The *kolea* is quite variable in stature and habitat; the finest trees occur in the three- to four-thousand-foot zone, and here they reach a height of fifty to sixty feet, with a trunk of twelve to twenty-five inches. It grows both in the rain-forest and in semi-arid regions. There are eleven endemic Suttonias in the Hawaiian Archipelago; most of these are shrubs or small trees.

The genus Xanthoxylum has seven Hawaiian representatives; three of these, *Kauaiense* Gray *Mauiense* Mann, and *dipetalum* Mann, attain sufficient stature, (twenty to forty feet), to rank as trees of economic importance; the others are small trees and shrubs. The bark is acid aromatic; the leaves three- to seven-foliate, and dotted with pellucid oil-glands. When crushed, the leaves emit an aromatic, soapy odor. The species enumerated above show preference for zerophytic leeward regions, usually at elevations of 2,500 to 4,000 feet. In these districts, on ancient lava-flows and waste-lands, the trees develop smooth boles twenty-five to thirty feet high and eighteen to thirty inches through. The wood is hard, close grained, yellow, and bitter to the taste. The ancient Hawaiians used the wood for making the *tapa* "anvils," upon which the strips of macerated *mamake* or *wauke* bark were pounded together, forming the bark cloth or *tapa*.

The wood of the *hame* tree (*Antidesma platyphyllum* Mann) is fine grained, dark reddish brown, and of considerable hardness. It can be beautifully polished, and were it sufficiently abundant would make an excellent cabinet wood. It was used by the natives for their *olona* "anvils," which were similar in structure and function to the *tapa* anvils. The *olona*, a tall straggling shrub, was a very important fiber plant, from which material for the best fish-lines and nets was derived. The macerated bark was beaten on a *hame* log, to soften and separate the fiber. The *hame* occurs on all the islands, at elevations of from 1,500 to 3,000 feet, on both wet and dry habitats. The tree attains a height of twenty to thirty feet, with a trunk of twelve to fifteen inches. The scant, sparsely-branching crown is covered with shining, bright green foliage, and in mid-summer is loaded with axillary panicles of dark red, juicy berries. The red juice was used by the natives for dyeing *tapa*.

The *mamaki* tree, *Pipturus ablidus* Gray, has very hardy durable wood that darkens from light reddish to dark brown upon cutting.

The tree is exceedingly variable in stature and foliar characters; it is commonly a small shrub, but in favorable localities becomes a tree of twenty-five feet. It is found on all the islands at elevations of 1,500 to 4,000 feet, in regions of moderate rainfall. The light brown bark is richly provided with strong fibers, and this part of the tree was of great value to the primitive Hawaiians. From it the finest *tapa* or bark cloth was produced. The modern *tapa* of Samoa is made from a species of Pipturus.

The *hau*, *Hibiscus tileaceus* L., a cosmopolitan littoral species, abounds on Hawaiian beaches and lowlands. The long curved branches were used in conjunction with the *wili-wili*, in the construction of the outrigger for the Polynesian canoe. The plentiful tough bast of the bark was commonly utilized for certain kinds of rough cordage and heavy *tapas*. Nowadays the Oriental farmers pollard the trees, and use the bark from the long, wand-like branches for tying up rice bags, bunches of bananas, and other produce. Along the beaches the tree is frequently pruned to form a wide spreading arbor or *lanai*.

Another native cordage plant, the *akia* (*Wikstroemia oahuensis* (Gray) Rock), is a shrub or small tree, growing on the lowlands and in the rain-forest. The bark is very fibrous, tough, and black in color. The fiber was prepared and used in the same way as the *hau* and the *oloná*. Hawaii has seven or eight endemic species of *akia*, which were used both for their fiber, and also for their narcotic property, by means of which fish were stupefied and caught.

One of the most valuable trees of the Pacific Ocean is the *hala*, *Pandanus odoratissimus* L. It is widely distributed throughout southern Asia, the Indian Archipelago, and the islands of the Pacific, and was doubtless brought to Hawaii by the early human migrants from their southern home. The tree is easily recognized by its abundant large prop- or stilt-roots, which form a cluster four to six feet high around its base. The naked trunk and branches are densely covered with conspicuous leaf-scars and prickly lenticels; the glossy, spiny-margined, ribband-like foliage is crowded to the ends of the branches in wind-tossed rosettes. The trees are unisexual; the male trees bear very fragrant compound spadices pendulous from the center of leaf-whorls; the female trees bear spadices erect and solitary in the leaf-whorls, and surrounded by showy white bracts. When mature, the fruit reaches a diameter of six to eight inches, orange-red, and somewhat resembling a pineapple. The *hala* is abundant in many parts of the Hawaiian lowlands. It rarely occurs at an elevation exceeding two thousand feet, and is commonly associated with the *koa* and *kukui*. Occasionally, as along the Nahiku coast of Maui, and the Puna coast of Hawaii, it forms pure stands of considerable area. The great majority of the trees are female; male trees are rare. This is probably due to persistent selection by the ancient Hawaiians, as the fruit-producing trees were the most valuable. The situation is analogous to that of the date palm and the papaia tree.

The long fibrous leaves were the most valuable part of the plant, and from them, when properly dried and prepared, were woven the house mattings, sails for the double sailing canoes, and a variety of other woven products. The drupes contain nutritious starchy material, and constitute an important item of diet on many of the low coral islands of the Pacific. The hard, glossy, orange colored ends of the drupes are cut and cleaned by the Hawaiians and strung into beautiful fragrant garlands. The drupes become fibrous upon drying, and were formerly used as little brushes for applying the various dyes to the *tapa* cloth. The female trees have a soft, fibrous interior, although the outer shell is hard; the stems of the male trees are solid throughout. The closely packed and intertwined fibro-vascular bundles give the wood a distinctive and beautiful grain, and *hala* wood is used for a variety of ornamental purposes in fine cabinet work. Occasionally the pithy stems of the female trees are cleaned and used for water-pipes.

Of the great palm family, so intimately associated with tropical life and industries, but two genera are native to Hawaii. Pritchardia, with perhaps a dozen species of fan palms—the botanic status of these is still a matter of question—is endemic. *Cocos nucifera*, the well-known coco-palm, was probably introduced by the first Hawaiians, and is now thoroughly established on the lowlands and beaches. The multitudinous economic uses of the coco palm are so well known that they require no cataloging here. The Pritchardias occur mainly in the rain-forest and along exposed humid summit ridges. They are scattered, are usually solitary or in small clumps, and constitute a very minor element in the forest. They occasionally attain considerable height, forty or fifty feet, but are customarily of short or even dwarf stature. The Hawaiians sometimes used the fleshy fruits as food, and wove fans and hats from the delicate fibrous, young leaves, which they collected before the leaf-blade had expanded. No economic uses are known for the wood or trunk, which is like that of other palms in structure.

The tree-ferns constitute a beautiful and important element in many of our Hawaiian forests. There are two species—*Cibotium Menziesii*, the *hapu i' i' i* or larger tree-fern, and *C. Chamissoi*, the *hapu* or lesser tree-fern. Chamisso's tree-fern is abundant on all the islands in the lower and middle forest zones. Its trunk is twelve to fifteen feet high, at its maximum growth; ordinarily it is not more than five or six feet. Menzies' tree-fern becomes much larger than the other, and often attains truly magnificent proportions, the trunk of twenty to twenty-five feet, and the beautiful crown of wide-spreading fronds carrying the total height up to nearly forty feet. This species occurs on all the islands at elevations of from two- to six-thousand feet, but reaches its finest development, both as to stature and area, on the island of Hawaii. In the dense humid jungle-forests, which lie along the entire windward side of Hawaii, from the Kohala Mountains in the north along the middle slopes of Mauna Kea and Mauna Loa, and south into the districts of Hiloa and Puna, the *hapu i'i'i* is abundant. It luxuriates in the humid shade of the *lehua*, and forms extensive pure stands of undercover. The tall slender *lehuas* rise to eighty or one hundred feet, the tree-ferns form an unbroken canopy below them, at an elevation of thirty or forty feet.

The tree-ferns are not valuable as timber, for their soft, spongy trunks are weak and easily crushed. However, the trunks are often cut into lengths, like cordwood, and used in the construction of corduroy roads and trails through the soggy jungle country. Frequently these fern billets are piled into fences—the buds sprout and the fence is draped with its own greenery. Although the outer rind of the tree-fern trunk is hard and fibrous, owing to the abundance of old leaf-bases, and extremely plentiful, appressed aerial roots, the large central interior portion is starchy. This was formerly used by the natives, in times of scarcity, for food. They thoroughly baked or roasted the stems, to prepare the starch for eating. Nowadays this material is used chiefly as food for swine, in the vicinity of the crater Kilauea, where the numerous steam cracks furnish free fuel for the baking of the fern stems.

The greatest value of the tree-ferns is their aesthetic value. They are among the crowning glories of Hawaii's beautiful jungle forests. Although seriously decimated and threatened with extinction in recent years, owing to the encroachments of wild goats, cattle, woodchoppers, etc. upon the native forest, there is at present a strong public sentiment demanding the adequate protection of these unique and spectacular plants. A bill has recent passed Congress which provides for the establishment of a national park on the slopes of Mauna Loa and Kilauea, and including a large area in which these magnificent ferns are abundant.

In conclusion, it should be emphasized that the great value of the Hawaiian forests is as watershed, and their usefulness as conservors of rainfall vastly outweighs the value of their timber.

CURRENT LITERATURE

Studies in Tolerance of New England Forest Trees. III. Discontinuous Light in Forests. By G. P. Burns. Bulletin 193, University of Vermont and State Agricultural College. Burlington, Vt. 1915. Pp. 23.

This interesting bulletin exhibits the hopelessness of the attempts to investigate the scientific basis of tolerance and intolerance by the methods hitherto pursued, namely of measuring the light intensities in the forest with its discontinuous shade and bringing them into relation with seedling development, and it describes a new departure in method, namely by growing seedlings under a devised habitat with continuous shade.

Like many inventions, the idea is not entirely new, for many years ago Borggreve in the garden of the Academy at Münden instituted such experiment, to disprove his predecessor, Heyer's philosopy of tolerance, albeit in a much cruder and unscientific form.

At the outset we must take issue with the author's statement in the introduction, repeated in the conclusion, that "the word 'tolerance' should be stricken from the vocabulary of forestry students unless to it can be accorded a more comprehensive definition. It is taken generally to express a light relationship, but really it expresses not a light relationship, but the total relationship of a tree to all factors of the habitat." Nor is it true that "if the trees are developing slowly, they are 'intolerant;' if they are developing rapidly, they are 'tolerant.' "

If the reviewer may presume to speak for the profession, foresters mean only a light relationship and nothing more when they speak of intolerant or light-needing species and tolerant or shade-enduring species, expressing thereby differences in the amount or intensity of light required for satisfactory development. That the development, and even the light requirement itself, is influenced by other factors of the habitat or site is perfectly recognized and does not by any means exclude the influence of light until this is disproved.

Nor is the slow or rapid development (of the seedling?) the only criterion by which the forester recognizes relative light requirements. The character of the foliage, the inability of foliage to survive in the interior of the crown, the ready loss of lower branches, etc., are signs of intolerance. For more detail we would advise the author, as he is interested in the subject, to refer to Gustav Heyer's classical little volume, *Das Verhalten der Waldbäume zu Licht und Schatten*, which for the first time systematically developed the theory, and on which is built up the whole philosophy of our silvicultural methods.

Until disproved, foresters will be well advised not to give up their notions of light influence. The only notable attempt to disprove it was made by a forester, Fricke, who believed to have demonstrated root competition to be responsible for what was charged to light influence. (*See* F. Q., vol. II, pp. 226-30, where also our comment is to be found.)

The author cites the work of various investigators to determine, with more precision than general observation can ever expect to attain, the question of light required. He details his own work on the same lines and comes to the conclusion that "a study of the foregoing tables soon convinces one that the present methods of determining light values in the forest are unsatisfactory. Too little attention has been paid to the fact that the so-called shade is a discontinuous shade and a constantly changing factor. The variations in light intensity due to clouds, the impossibility of making equal exposures in repeated readings, the variability of the forest cover thus requiring the operator to choose a 'typical station for the forest under consideration,' and the habit of reading only on bright days about noon; all these make for inaccuracy and emphasize the difficulty, if not impossibility, of determining the relation of forest trees to light by a 'study in the forests.'"

The method the author has started on, to secure a controllable shade condition consists (if we understand it correctly—it is not very clearly described) of a series of nested frames covered with cheese cloth, and some dyed black, a smaller or larger number being superimposed to vary light intensities, which latter are standardized for various combinations by means of a photometer. Under these frames seedlings are grown. The only trouble is, which the author recognizes in a footnote, that these frames have a decided influence upon all other factors of this habitat, and it looks doubtful to us whether it will be possible to control or even measure them.

The first two bulletins of the series by the author were reviewed in F. Q., XIII, p. 525. B. E. F.

Forest Pathology in Forest Regulation. By E. P. Meinecke. Bulletin 275, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 63.

In this highly interesting, although somewhat diffuse, study the author attempts to place on a high plane the importance of forest pathology in influencing forest management, and especially influencing the determination of a rotation and felling cycle.

The study can be divided into four sections: an introduction which points out the difficulties still besetting the attempts at introducing forestry methods and the lack of definite basis for such methods; an elaboration in detail of methods of investigation in forest pathological direction; an actual study of the pathology of *Abies concolor* as a sample rather than with the expectation of securing final results; the application of the knowledge secured in this particular study to the problems of forest management.

We consider this an important and thoughtful attempt to link practical issues with scientific investigation, even if we do not feel inclined to go the whole way with the author. Much as we believe in the need of a thoroughly reliable basis for our forestry practice, if the sectioning and careful study of 160 trees of one species in one locality cannot be considered a sufficient basis for determining even for that locality proper action, we must despair of ever coming to conclusions. "The amount of work to be done is enormous," the author says; we fear it is too enormous, and meanwhile, the practical world does not want to wait, and will preferably rely on rough judgment in solving its problems.

We cannot get away from the thought, at which the author hints in some place, that forest pathology in the virgin forest progresses differently from forest pathology in the cut and reproduced forest, hence what the study of the first develops may not repeat itself in the managed forest. Just the same experience applies to the study of increment under the two conditions.

In the introduction the author points out the difference between our virgin forest and the managed European forest as an argument for the impracticability of applying European methods. But the forest conditions there were not so very different from ours, when these methods were being first developed. The author is right, that even in scientific Germany forest management practically is still based on empiricism and judgment—even in determining rotation and felling cycle—instead of applying the theories which scientific inquiry has shown to be superior. The explanation is simple; forestry in the last analysis is business, and practical business considerations often bar the use of better methods—the same considerations which prevent the Forest Service from practising "sound silviculture!"

There is much more in this bulletin that we would like to discuss controversially, but we have perhaps said enough to stimulate every forester to read the pamphlet itself, and realize that the attitude of the author at least is the correct one. The proper sanitation of our forests is as important as their regeneration.

B. E. F.

Second Biennial Report, The State Forester of Kentucky, 1915. Published by Direction of the State Board of Forestry. Frankfort, Ky. Pp. 140.

This report deserves more than the mere listing under *Other Current Literature*, which was given it on its appearance. The report is also particularly interesting as coming from a hardwood State, especially for two longer articles which form the bulk of the volume.

The State Forester's (J. E. Barton) portion consists of a well stated, matter of fact report of his doings and recommendations for further action on the part of the State Board of Forestry and the Legislature. Education by addresses, bulletins and other publicity agencies, forest fire protection by wardens, State nurseries, growing mainly hardwood trees for free distribution, a small experimental forest, and action to enable the Weeks Law, to purchase National Forests in the State, are discussed in a businesslike manner.

From a short article by M. H. Foerster, the forester of the Consolidation Coal Company, we learn that this company "became the pioneer in the practice of forestry in this part of the State (Eastern Kentucky)" on its 24,000 acres of timberland, which is to furnish increasing requirements of mine timber. "The ideal type of forest for mining purposes, the author states, is a full, even-aged stand of young pole timber which will reproduce itself naturally after the end of each rotation." So far, the activities have been confined to secure protection against fire and the running of hogs and cattle, with less wasteful use.

A long, carefully prepared and fully illustrated article on the locust borer, by H. Garman, acquaints us, incidentally, with the existence of a number of commercial plantations of Black locust in the State, aggregating some 300 acres, all more or less attacked by the borer. The close relation between the damage by the larvae in the trees and the abundance of goldenrod, on which the beetles feed, was established. Destruction of the goldenrod or spraying with arsenate of lead, also spraying of the trees in September, when the beetle emerges from them, is suggested as remedy.

The article on marketing of woodlot products in Kentucky, by W. D. Sterrett, which occupies half the volume, is particularly praiseworthy for the thoroughness and comprehensiveness of procedure. As regards woodlot conditions, the State is divided into five regions in which economic usefulness of the woodlot, sizes, kinds, qualities of trees, and markets differ. The distribution of cut among the various species in these different sections is given in table 1; the consumption of wood-using industries and proportion of supply from woodlots in table 2; a full directory of concerns, with addresses of wood-using firms, classified into 13 uses, covers 15 pages (part of this erroneously referred in the index to Tennessee!). The use of different species (17 kinds) by different industries is discussed in detail with prices for different assortments, species by species, with reasons of favoring this or that assortment; price being given for various grades of lumber as well as logs.

In a chapter on "How to increase profits from woodlot sales," there are discussed methods of sale; scaling and grading logs and bolts; estimating standing timber; knowledge of markets; costs and profits; contracts and supervision; and cooperation. In the tabulations accompanying this chapter, tables 8 to 11 are of special interest and, as far as we know, novel. Tables 8 and 9 are volume tables in board feet, the first lumped for *any* hardwood trees over 75 years old, the second for *any* coniferous trees over 75 years old, in each case with correction factors for different species and diameters. Apparently the basic hardwood table is that for Yellow poplar, the basic conifer table that for White pine.

This is a bold innovation and seemingly based on slim data, but we believe for the purpose in hand—a rough estimate—perhaps satisfactory.

Table 10 gives the contents in cubic feet and number of cubic feet per cord of *any* hardwood trees of different diameter and height; also bark per cents for given species.

Table 11 is also of novel character, giving contents in cubic feet and number of cubic feet per cord in the *tops* (above merchantable log contents) of hardwood trees.

A series of tabulations of costs—low, high, and average—in exploitation for logs, for lumber, for ties, for poles and piles, and a half dozen other uses is most useful for calculating profits, as well as the tabulation of freight rates on lumber and green logs, cordwood, piling, of various species and sizes.

Ten rules are given for procedure by farmers to secure the best return from his woodlot sales, which are all self-evident, simple and practical. A brief discussion of how to prevent the deterioration of cut woodlot products finishes this highly interesting work.

We consider this a most valuable contribution to the practical literature of forestry, and only regret that we are without the means to critically analyze the novel features mentioned. The total absence of any silvicultural discussion or advice is perhaps reprehensible; but this was clearly outside the field of the inquiry

B. E. F.

Structural Timber Hand Book on Pacific Coast Woods. By O. P. M. Goss, assisted by C. Heinmiller. The West Coast Lumbermen's Association. Seattle, Wash. 1916. Pp. 289.

"The purpose of this book is to present information relative to structural timber which will be useful to engineers, architects, and contractors. Particular attention has been given to Pacific Coast species.

"There have been published from time to time by the U. S. Forest Service and other organizations data showing the strength and durability of Pacific Coast timber. In writing this book, an effort has been made to collect such of these data as are up to date and to present them in a concise form for general use.

"Most of the tabular matter refers to Douglas fir. Tables show the safe total loads and corresponding deflections for rectangular beams of various sizes, ranging from 2 by 4 to 20 by 30 feet. The number of pounds per board foot of lumber, supported by beams, is also shown, which will assist in effecting economical designs. Tables have been computed which show the safe loads on beams limited by the horizontal shearing stress. Other tables show safe total loads on columns of various sizes and still other tables give the maximum spans for mill and laminated floors, board measure for various dimensions and lengths, and board measure and weight for unit lengths of Douglas fir dimension timber.

"Data and figures are given on timber frame-brick mill buildings, showing costs, insurance rates, and details of construction. Standard formulas for computing stresses covering the usual practical conditions are given. A grading rule for securing structural timbers of high strength is also included.

"A considerable amount of data is presented on the creosoting of Douglas fir lumber in various forms, such as bridge stringers, mine timbers, piling, ties, bridge caps, paving blocks, silo staves, and other forms. Space is devoted to wooden silos and Red cedar shingles. Kiln drying lumber is briefly discussed as well as other subjects of interest to the consumer of wood."

Instructions for the Scaling and Measurement of National Forest Timber. U. S. Dept. of Agriculture. Contribution from the Forest Service. Washington, D. C. Revised July, 1916. Pp. 94.

The revised scaling instructions are of wide interest because they set a standard of excellence towards which all scalers should work, whether in public or private employ. The exact scaling enforced by the Forest Service under the Scribner Decimal C rule is a step towards decreasing inaccuracy in local scaling methods and towards narrowing the number of log rules in current use. The revised edition has been rearranged and is more logically classified. For example on pages 9-10 under "Defects in the log which reduce the scale" the duplication found in the first edition has been corrected.

Due emphasis is made that scaling is for quantity rather than quality of material and "not in relation to any particular grades of lumber it will produce" because the unit will be more stable, and the basis less subject to individual judgment. The definition of merchantable logs (p. 11-12) will be of value in standardizing the use of volume tables in government estimating. Under "The Log Rule" (p. 13) it would be interesting if the manual had explained how the Scribner Decimal C Rule as originally published was extended to secure board foot contents on larger logs. Especial emphasis is placed on throwing the one half inch diameters to the lowest inch when scaling. "If . . . the average diameter is 35½ inches—the log is scaled as a 35-inch log." It has never been clear to the reviewer why a 35½-inch log should not be scaled as a 36-inch log with just as much reason as a 35, or better still, why it should not be scaled 35 one time and 36 the next on a give and take principle. The rules for interior defects are excellent (p. 18), and should be of value even to experienced scalers now that empirical methods are giving way to exact practice. Possibly it might have been well to emphasize the difference between curve allowance in a butt log, as compared with the other logs in the tree, on the ground that curves in butt logs (while rare) cannot be allowed for in varying log lengths.

Under "check scaling" a summary of the scale by the original scaler and by the check scaler is still required, as it should be. But even more emphasis might have been made that a difference between the two scales is not a basis for changing the original scale. There is some question as to whether the original scaler should even be informed of the difference percent. On account of the peculiar psychology of scaling better results may be secured by merely correcting errors in scaling with reference to single logs rather than on the basis whether the scaler averages higher or lower than the check scaler.

On p. 66 a very complete converting factor table is given which will be of value for statistical purposes, even if individual figures may be questioned. The log grading rules (pp. 92-93) are worthy of study, although the reviewer, prefers names for different log classes rather than numbers. Is not the classification *clear*, *shop*, *rough*, preferable to Number 1, 2, 3? This naming of log grades is followed in the example given on p. 94.

It is understood that the original manual was written by E. H. Clapp, who should be complimented on the excellence of the presentation of the data.

According to the Forest Service:

"The 1916 edition contains no radical changes from that of 1915. It was found, however, that the text could be considerably clarified by reconstruction and rearrangement, and the procedure in some respects was changed. The more important changes made are given below, reference being made to the 1915 text:

Scaling Logs

"The present policy of scaling quantity of sound material rather than quality of material in the log is more strongly emphasized; also that overrun is considered a factor in appraisals and not in scaling.

In making deductions for defects in the log, provision is made that the sound material must be of at least the minimum length of product manufactured from the species in standard milling practice in the region and at least four inches wide.

An exception to the requirement that all logs over 16 feet will be scaled as two or more logs was extended to 17 and 18 foot mining timbers on the Black Hills Forest.

Some changes relating to procedure were made in the instructions for measuring, numbering, and stamping logs.

A change was found necessary in the rule of thumb given for center or circular rot on p. 19. Also, in applying the cull tables for defect, a slight allowance in excess of the dimensions bounding the actual defect is provided for.

No deduction was made previously for curve or sweep in logs over 16 feet long. The revised instructions provide that deductions will be made for curve or sweep in logs of any length to the extent that material in them cannot be used for boards of the minimum length utilized in the milling practice of the region.

A uniform percentage allowance of difference between check scale and original scale was changed to a graduated standard depending upon the percentage of defect in the log."

T. S. W., Jr.

The Naval Stores Industry. By A. W. Schorger and H. S. Betts. Bulletin 229, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 58.

One hears a great deal nowadays about the progressiveness of American business men; but when one considers the increased yield from the use of cups in lieu of the old-fashioned boxes, it is surprising that less than a third of the operators have adopted the more modern, and less destructive, cup system. To obtain a keener insight into the relative advantages of cups and boxes, it would have been more conclusive, to be sure, if Schorger and

Betts had given the relative cost of the box and cup systems, in addition to the data presented in Tables 9 to 13. Granting the reputed financial advantage of using the cups, why is it that the turpentine operators in Alabama use cups on but 8 per cent of the trees, while, even in Texas, but 49 per cent of the resin is secured by cupping? They show, unquestionably, a better yield from the use of cups, but what is the relative expense in working, and for installation—and the resulting *net* profits? It is unfortunate that Bulletin 229 does not answer this question. The bulletin is remarkable in its excellent description of methods, machinery, and in its accumulation of data which must prove of value to the turpentine operator. It appears, however, somewhat weak in the presentation and description of French tapping methods, and in the results of the experiments undertaken by the Forest Service during the past 10 years. As the authors admit, there is much to be answered; some of the most important questions cover problems which the operator must know and understand before he will make the effort to revolutionize the antiquated methods of the past half century. For example, in Table 14, page 25, the results of different methods of chipping are given. These figures, however, are disappointing, since the results are not based on a fixed factor, or unit of comparison (as, for example, per square inch of face for trees of different sizes, soils, and varying producing capacities). The results are of interest, but by no means conclusive, simply because the experiments were not scientifically planned and elaborated. (See footnote p. 35 of bulletin.)

Beginning on p. 32, the authors review the French methods of collecting gum. A French forester might question the exactness of some of the data presented. For example, take the statement: "The forest rotation varies from 60 to 75 years." The authors should have stated that rotations higher than 75 years, however, are frequently met in the Landes; *e. g.*, in the Forest of Mimizan it is 80 years; it is also 80 years in the Forest of Saint-Julien-en-Born. It is hardly correct to say that the French "lop" the lower branches, since they are more properly described as *pruned.* "The wood resin rights are sold for a period of 5 years," to be sure, but also for periods of 4 years, as is indicated in the translation given on p. 34, fourth paragraph, where the official instructions state: ". . . if the tapping period is for four years." As a matter of fact the French have (officially) abandoned the fifth year of tapping because of the following objections: (1) Difficulty of chipping the face when it is over 3 meters (9.8 feet) in height. (2) This high face (which is often too deep because of the difficulty of accurate chipping) heals poorly or very slowly. (3) An important part of the bole is damaged by a high face. For these reasons the French have reduced the tapping period from 5 to 4 years. This fact was evidently not known to Betts and Schorger; however, the oversight is a natural one because it is a recent change, although it has been under consideration for some time. The modern dimensions for the faces are as follows:

	Width		*Height*	
Year	*(Centimeters)*	*(Inches)*	*(Centimeters)*	*(Inches)*
1	9	3.5	60	23.6
2	9	3.5	60	23.6
3	8	3.1	75	29.5
4	7 to 6	(2.75) (2.36)	95	37.4
			2.90 meters.	9.5 feet.

With the former fifth year system in vogue, the total height was 3.70 metres (12.1 feet) before 1904; 3.40 metres (11.1 feet) from 1904 to 1909; and 3.20 metres (10.4 feet) since 1910. The authors failed to bring this information out. Such a tendency to a shorter face is of vital interest.

This reduction of the length of the tapping period will mean the revision of working plans *after the war*. The regeneration by clear cutting will be every 4 years instead of 5 years as formerly. The cycle for thinnings will also be reduced from 5 to 4 years. In the future the cleanings will be made earlier after regeneration, since experience has shown the inconvenience of waiting for 5, 6, or 7 years as was formerly the case. Such points as these are of keen interest, yet they do not appear in the bulletin.

Plate IX would have been much clearer if, besides numbering the tools alluded to in the text, the French names had also been given, secured from an exact source. The correct French names for this plate are cited in the paragraph which follows. Apparently the text does not allude to the instrument labelled number "2" in this plate. The correct explanation of Plate IX, figures 1 to 5 inclusive (furnished me personally by Conservateur De Lapasee of Bordeaux), is as follows:

1. (*Barrasquit d'espourga.*) Used by the tappers to bark the pine that is to be tapped. This preliminary operation is made at the beginning of each working year by scraping the bark from the top down in order to get rid of the hard dry pieces of outer bark. This enables the chipping of the soft inner bark and sapwood without dulling the instruments. This area barked is 30 to 35 centimeters (11.8 to 13.7 inches) wider and 10 to 15 centimeters (3.9 to 5.9 inches) higher than the proposed face. Usually the first year's barking is made with an ordinary chopping ax. The second year they use either the ax or the "barrasquit" with a short handle. The third and fourth year the "barrasquit d'espourga" is used; the length of the handle is governed by the height of the face. A very similar local instrument is called the "barrasquit de barrasque," only it is used for removing the scrape.

2. (*Palette* or *palinette.*) A sort of flat trowel used for removing the soft gum from the pots. The handle is about the length of an ordinary gardener's trowel. The gum is collected in an "escouarte," a wooden pail or box, holding about 20 litres (5.2 gallons) and is used for carrying the gum to the collection tanks or barrels. These hold 230 to 350 litres (60.7 to 92.4 gallons), and are sunk in the ground and protected by a wooden cover to prevent evaporation.

3. (*Hapchot*, new model called "*bridon*"). This is the chipping axe, and is used for cutting thin slivers of wood from the face (when it is freshened). It is swung from right to left with a downward motion. The left hand is placed uppermost against the iron of the instrument. The length of the handle varies with the height of the face the first, second, and third years, but for the fourth and fifth year (fifth year now generally abandoned) the operative must use a crude sort of ladder formed of a notched pole with the "rasclet" described under "4."

4. (*Rasclet.*) The curved end of the instrument (the right side of figure 4, plate IX) is for chipping high faces during the fourth and fifth years of working the trees. The straight end (left of figure) is used for cutting into inclined faces (because of leaning trees) where it is necessary to insert a piece of wood to prevent the resin from dripping to the ground.

5. (*Pousse-crampon* or *place-crampon.*) This is for inserting the gutter above the cup. The gutter is embedded about 1 centimetre (.4 inch) into the wood by two or three blows of a

wooden mallet applied to the "place-crampon" which holds the gutter (*crampon*).

On p. 34, the authors give what purports to be the latest turpentine specifications issued by the French Government. As a matter of fact, the Government has issued a more recent circular than that of 1909, namely, one approved by the Secretary of Agriculture, May 17, 1912. Essentially they are the same, but it would have been more exact to quote from the latest "Cahier des Charges." As already explained, an important change has been made in the national methods in the Landes which is not alluded to by the authors.

As a footnote to p. 35, the authors give a "Comparison of Yields of Crude Gum per Inch of Width of Face, French and American Methods." This data might have been of especial interest if it had been presented in clearer fashion; to the reviewer the tables in the footnotes are far from clear. It is well known that trees of different sizes will yield different amounts of gum per inch of face; therefore, without this measurement known, the value of these tables, even if they had been clearly presented, is more or less minimized.

The experiments of tapping Western Yellow pine in Arizona within the Coconino Forest are specially interesting, but it would have made the data of greater value if the local climatic and topographic conditions of the stand tapped had been fully described. What was the altitude? What is the length of growing season? Are the conditions average for the Western Yellow pine belt? As a matter of fact, the writer happens to know personally that the experiments were conducted at the Fort Valley Experiment Station, where climatic conditions are unusually rigorous, much more so than obtains in the average Western Yellow pine stand in Arizona. What would have been the result of these experiments (especially as regards yield and length of season) if timber had been tapped at a slightly lower elevation where the climate was not so severe, on a general southerly exposure. An important point, however, which should have been emphasized in analyzing the advisability of tapping a Western Yellow pine stand is the possible danger of wholesale tapping operations on a species which has to make such a fight for existence. This would apply particularly if trees were tapped on the lower, warmer situations, and, of course, must be considered silviculturally before the advisability of tapping such stands can be granted. The tapping of Corsican (*Pinus laricio*) pine in Corsica was not a success silviculturally. What would the danger from insect or fungus attacks amount to in Arizona or New Mexico? The writers seem to be somewhat in doubt as to the future success of Western turpentine operations, for, on p. 46, they state: "The commercial success of turpentine operations in the Southwest will be doubtful until tried on a commercial scale," but, a few lines farther on, they say: ". . . make it reasonable to suppose that turpentine operations in the large tracts of virgin pine timber in the West will in time be justified."

The data on evaporation from cups (p. 47), comparison of yields from north and south faces, effect of temperature on weekly yield of gum, rate of flow during week, are of great interest and value.

A careful study of this bulletin, as well as of French works on turpentining, shows that there is much scientific investigation to be done before the best methods of turpentining operations are definitely known. To be conclusive, these experiments must be upon a scientific basis instead of being based on the hit-or-miss methods used in the past. *Such investigations are urgently needed.*

The main difference between tapping methods in France and America seems to be in the width and annual increase in height of the face. In the United States, the first streak cannot begin higher than 10 inches above the ground. In France, it can be anywhere above the root swelling. In America, the maximum depth of streak is .5 inch; in France it is approximately .4 inch. In America, in Federal tapping operations no tree less than 10 inches can be tapped and trees 16 inches and over can have two faces, while trees 10 to 16 inches can have but one face. In France, the minimum diameter of tree tapped on State forests (unless to be removed in thinnings) is 13 inches and the number of faces is specially designated by the Waters and Forests Agent. In the United States, the face can be 12 to 14 inches wide with no specified decrease in width as the face proceeds up the tree. In France (according to the former system as described by authors), the width is 3.5 to 2.4 inches, decreasing each year as the distance above the ground increases. The maximum height increase per year in the United States is 16 inches, while in France the face can be lengthened 24 to 26 inches, and even up to 39 inches in case of four-year tappings. (See table of revised dimensions in this review.) Such marked differences need scientific investigation before the American forester will be satisfied that he is recommending the proper system.

T. S. W. Jr.

Carrying Capacity of Grazing Ranges in Southern Arizona. By E. O. Wooton. Bulletin 367, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 40.

The Bureau of Plant Industry has been carrying on for some eleven years a study of range conditions on a fenced range in southern Arizona, on an area known as the Santa Rita Range Reserve, located near Tucson, Arizona, having altitudes ranging from 2800 to 5500 feet. This publication has for its object the presentation of the results of this study.

The study of carrying capacity is of unusual interest to federal forest officers, since it represents a method diametrically opposed to that used in National Forest administration. So far as understood, this experiment was based on the premise that in order to get a stock range to come back it was necessary to fence it, thereby absolutely controlling at all seasons the number of stock using it; whereas the plan followed on the National Forests is based on the idea that a range can be brought back by a system of rotation and deferred grazing.

This latter method is the only one considered practicable for the range conditions as they exist on the National Forests. Complete fencing of stock ranges and allowing complete rest for considerable periods has not yet been shown to be feasible on the extensive areas within the National Forests.

As stated by the author, the objects of the experiments carried on on the Santa Rita Range Reserve were:

1. To demonstrate that under proper treatment rundown and overstocked ranges will recover. A statement of fact that was very much doubted by stockmen when the experiments were begun.
2. To ascertain how long a time is necessary to get appreciable and complete recovery, and what methods of management will produce such results.
3. To carry on reseeding and introduction experiments in the hope of increasing the total quantity of feed.

4. To measure as accurately as possible the carrying capacity of a known representative area.

The results of the first three of the above studies have already appeared in Bulletins 67, 117 and 177 of the Bureau of Plant Industry, and this publication, therefore, deals only with the last query, although the results of the other three studies are summarized in this volume.

The method followed in the capacity study was:

1. To cut everything growing on small areas (quadrats), and from the weights of the dry material collected to calculate the total productivity in terms of pounds of forage per acre. These were collected for a period of 9 years, from which a figure of 1160 pounds per acre was obtained as the approximate value of the average total annual productivity.

This method was supplemented by data from hay cuttings on an area of 492½ acres, which gave an average amount of hay per acre of 640 pounds.

The results are summarized as follows:

A map was prepared showing the approximate distribution of the different forage plant associations of the area. Four main plant associations are found, the six-weeks grass, the black grama, the crowfoot grama, and the needlegrass associations. "From the quadrat measurements the approximate productivity of each association is obtained. From these figures and the areas of each association, a weighted average expression representing the average productivity of the whole Reserve is derived. This number, 1100 pounds per acre, is closely comparable with that obtained as the average of the quadrat measurements alone (1160 pounds). Assuming the value of 1100 pounds per acre as an average total productivity and 50 per cent of that amount as maintenance capacity for the range, then, if the average animal eats the equivalent of 30 pounds of dry feed per day he will need 11,000 pounds in a year, and it will take 10 acres of land to furnish that amount at full productivity, and will take 20 acres of land at maintenance capacity. Thus we have an average value for carrying capacity equal to 20 acres per head per year, or 32 head per section" (640 acres).

The above figures are of interest, since they show a much higher carrying capacity for this fenced area of semi-desert range than is figured on the average unfenced National Forest range having practically similar plant associations, which is about 35 acres per head, according to forest officers.

In this connection it may be noted that this range reserve has, within the past year, been turned over by the Bureau of Plant Industry to the Forest Service, which is conducting further grazing and range studies on it, which should produce additional valuable data.

J. D. G.

Forest Products of Canada, 1914, 1915: Pulpwood; Poles and Cross-Ties; Lumber, Lath and Shingles. Bulletins 54, 55, 56, 58B. Dominion Forestry Branch. Ottawa, Canada. 1915 and 1916. Pp. 18, 15, 62, 12.

The improvement in methods of collecting statistics has one serious drawback in their use; it prevents useful direct comparison with former years, which is the main object of statistical inquiry. In the present report on lumber, the completeness of the figures for Quebec and British Columbia—and the report accentuates it—is inimical to comparison with former years. No attempt is made in any year to ascertain the degree of completeness of the data, and no attempt to discuss with that knowledge present and past conditions; they are simply set in juxtaposition. Since no statement as regards the actual completeness is made, it may be assumed that the totals are understatements.

The total cut of lumber for Canada remains slightly below 4 billion feet b. m., at a value of 60 million dollars, to which a little over 5 million is to be added for lath and shingles. Over 93 per cent is coniferous lumber, 84 per cent of which is furnished by five species, spruce (without species distinction) furnishing by far the largest cut (36.5%), White pine (16.9%) and Douglas fir (15.3%) sharing almost equally second rank, hemlock (8.5%) and fir (6.5%), the last two together representing nearly the same as the Douglas fir. In the small cut of hardwoods (6.8%), birch and maple play the largest rôle, with basswood, elm and poplar together making a second.

In enumerating the species cut into lumber, the office still suggests the presence of *Betula lenta* and *populifolia*. The occurrence of the former in Canada is altogether doubtful, and neither it nor the latter, we venture to say, would be lumber trees.

As regards provinces, Ontario is still the largest producer in value, its large White pine cut accounting for the difference in average value per M feet ($18.89) as against Quebec with a somewhat larger cut, mostly spruce, but average value of only $15.60. British Columbia comes a close third in quantity, but, with an average price of only $11.45, comes in value to only a little over one half of what Ontario produces and about the same as New Brunswick and Nova Scotia together produce.

Comparisons with the previous year are vitiated for the reason above stated, except perhaps in prices, which have decreased from $17.24 to $15.30, as an average over the whole Dominion. Only in New Brunswick and Nova Scotia is a slight increase noticeable in cut as well as price.

As regards prices for different species, the greatest slump was experienced by White pine, a drop from $27.28 to $20.29. This slump occurred, however, mainly in Ontario. No explanation is given. Perhaps a larger cut of poor grades may explain this, or else competition in the market with American importations.

For the pulpwood situation we have the data for an additional year, 1915. The growth of this industry during the last 8 years is phenomenal, the pulpwood production for home use rising from nearly 500,000 cords to almost three times that amount in 1915, and in value to more than three times or around 9.5 million dollars, the average price (at what place not stated, probably at mill) having risen from $6 to $6.71. In addition, nearly one million cords was exported to the United States, making the total cut 2,355,550 cords value at $15,590,330.

Quebec furnishes half, and Ontario a little over one third this output, the latter at a considerably higher value, namely $7.92 as against $6.06 for Quebec supplies.

Spruce is, of course, the largest contributor, with 71 per cent, but fir at only a slightly reduced price in 1914 ($6.58 as against $6.70) and a more reduced price in 1915 ($5.84 as against $7.07 for spruce) furnishes nearly 22 per cent, hemlock, Jack pine and poplar, and other species contributing negligible quantities. Jack pine, however, of which large areas exist, is found suitable for sulphate or Kraft pulp.

Details are given by provinces, species and processes, with diagrams, the mechanical process producing over three times the tonnage that sulphite produced.

A map indicates the location and a list gives in part the names of the 56 mills operating and the 12 not operating.

The export of pulpwood declined somewhat below the previous year, but was still 40.3 per cent of the total production; altogether the total rise in exports of pulpwood for the last 8 years was not great, but while the wood pulp export also decreased under the previous year in amount, in value it increased due to considerably higher price ($25.48 as against $20.87). The United States take, of course, the largest proportion of these exports, the proportion in export of wood pulp having grown to over 87 per cent.

The bulletin on poles and cross-ties is based on data from 381 purchasing firms. The total of poles for all uses in 1914 had fallen considerably, nearly to one half the purchases for 1913, showing differently from the pulp situation the influence of the war. Continuous reduction in pole purchases are, however, noticeable since 1910, when over 780,000 poles figures, as against 283,184 in 1914, the price being slightly advanced over the previous year to $2.33, or $660,262 altogether. Cedar forms 85 per cent of the output.

The purchase of cross-ties was practically the same in the last three years, and considerably larger than in 1910 and 1911, not quite 20 million at an average value of 45 cents, Jack pine and cedar furnishing the bulk (over one half); tamarack, Douglas fir, hemlock, Western larch and spruce in almost equal quantities, one third of the consumption.

B. E. F.

Hypoderma deformans, an Undescribed Needle Fungus of Western Yellow Pine. By J. R. Weir. Reprint from Journal of Agricultural Research, U. S. Department of Agriculture, vol. vi, no. 8. Washington, D. C. May 22, 1916. Pp. 277–88.

Dr. Weir names and describes this new, and apparently widespread, disease and its results. It is distributed throughout the northwestern United States and Western Canada; its distribution southward is still unknown. It is readily recognized by the foliage, first yellowing, then browning in patches, beginning at the tips, or by the formation of witches' brooms. It attacks all age classes and kills seedlings. In mature trees it probably influences increment, but does not otherwise prove detrimental and affected trees should be marked for removal in cuttings, to reduce the infection, burning the infected brush, and if need be lopping and burning infected parts of younger trees.

B. E. F.

Third Annual Conference of the Woods Department, Berlin Mills Company. Berlin, N. H. November, 1915. Pp. 37.

Contains a short paper with illustrations on the use of kraft paper; a paper on rot fungi; one on hardwood estimating, logging, manufacture, grading, concluding with five points to be observed in a successful hardwood operation; a short paper on the development of mechanical log haulers; and one on pulpwood loading and receiving.

We are still hoping for an account of results in the woods from the application of forestry methods.

Annual Report of the Director of Forestry of the Philippine Islands for the Fiscal Year Ended December 31, 1915. By W. F. Sherfesee. Department of the Interior. Manila, P. I. 1916. Pp. 91.

This report chronicles several changes in Bureau affairs during the year. Among these is an amendment to the forest law, effective July 29, 1915, requiring the manifesting of all timber in the round, due allowance being made for defects. The custom for some years previous was to measure the sawed product and add a recharge of 15 per cent for loss in sawing. This practice was not satisfactory because lumbermen were wasteful and used only the best part of the log. Some opposition developed to the change due both to the added cost per thousand and to an increase in the sum charged for stumpage. Coming at a time of depression in the lumber market, it caused considerable opposition.

Another law of interest relates to the separation of the Forest School from the College of Agriculture, making the former a separate institution.

The year was marked by the formation of the Philippine Manufacturers' Association, the object of which is to bring the lumber interests into closer touch.

Provision was made during 1915 for the employment of two government lumber inspectors. Because of the lack of grading rules and poor inspection, many export cargoes of lumber were unsatisfactory to buyers. It is proposed that the government inspectors shall not only inspect outgoing shipments and certify the grades, but also will train natives for inspection work.

The relative importance of the various activities of the Bureau are well shown in the distribution of expense in field work.

	Cost *Per cent*
Licenses	41.16
Public Land Examination under Homestead Law	21.61
Caingins	6.44
Commercial forests	3.25
Botanical Collection	1.51
Sundays and Holidays	10.51
Leave	2.65
Reconnaissance	2.06

Administrative activities, especially license (timber sale) work was paramount, followed by homestead examinations.

The Bureau showed a slight loss in revenue over the year 1914, due to unfavorable market conditions. However, the expenditures of the Bureau were only 64 per cent of the receipts. The Bureau from the first year of administration has been self-supporting, the expenses during this period averaging 57.3 per cent of the receipts.

R. C. B.

Fomes Officinalis—A timber-destroying fungus. (Summary of a paper to be published in the Transactions of the Canadian Institute, 1917.) By J. H. Faull.

1. Historically, *Fomes officinalis* occupied an important place in medicine, dating back to Dioscorides, and is still officially recognized in Austria and France. It was also used for various purposes, including the preparation of yeast for breadmaking by the early settlers in Ontario and Quebec, and known to them as the

"Pineapple Fungus,"[1] though this is the first botanical record of its occurrence in those areas. The first record in America appears to have been not earlier than 1886.[2] There is some evidence that the Indians knew it and made use of it medicinally.

2. The active principle is a resinous substance, Agaricin; this, with other resins, constitutes up to 70 per cent of the dry weight of the fruiting body.

3. The resins are secreted in the form of amorphous granules, to some extent on the mycelium, but in much greater abundance on the hyphae of the sporophore.

4. Chlamydospores appear in cultures. They also occur on the sporophore, but in both cases are different from those produced by *Polyporus sulphureus*.

5. Quélet and certain other European systematists have assumed that *Fomes officinalis* is a variety of *Polyporus sulphureus*, or specifically very close to it. They are very distinct species, however, differing in many respects: (1) Size and branching of hyphae; (2) Form, longevity and content of sporophore; (3) Structure of sporophore; (4) Size of spores; (5) Distinct differences in cultural characters.

6. *Fomes officinalis* is the cause of a red heart rot of conifers, characterized by a removal of the cellulose, by a fracturing of the wood into rectangular masses, and the formation of mycelial sheets in the crevices. Histologically, the effects are similar to those caused by *Polyporus Schweinitzii*. It occurs on living and dead timber, and belongs to the group commonly regarded as wound parasites. The losses occasioned by it in some areas are extensive. It occurs throughout Ontario and Quebec on *Pinus strobus*, and has been reported from Michigan on the same host.

7. *Fomes officinalis* is known to occur on the following hosts:

Europe and Asia:

Larix europaea, *L. sibirica*.

America:

Abies concolor, *A. magnifica*, *A. grandis*.
Larix occidentalis, *L. laricina*.
Picea Engelmanni, *P. sitchensis*.

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[1] *Pineapple tree*—An old English name, now obsolete, for a pine tree or a coniferous tree; *pineapple* originally meant a pine cone.

[2] Specimens in the Museum of the Royal Botanic Gardens, Kew, were collected by Dr. D. Lyall in British Columbia about 1860.

Pinus lambertiana, P. murrayana, P. ponderosa, P. Jeffreyi, P. strobus, P. monticola.
Pseudotsuga taxifolia.
Tsuga heterophylla, T. mertensiana.

8. In America *Fomes officinalis* is reported from:
   Canada:
   British Columbia, Ontario, Quebec.
   United States:
   Arizona, California, Oregon, Washington, Montana, Nevada, Idaho, Wisconsin, Michigan.

OTHER CURRENT LITERATURE

Forests of Porto Rico. By L. S. Murphy. Bulletin 354, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 99.

The Preservative Treatment of Farm Timbers. By G. M. Hunt. Farmers' Bulletin 744, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 32.

Dixie National Forest (*Nevada, Utah, Arizona*). A Proclamation by the President of the United States Restoring Certain Areas to the Public Lands. Washington, D. C. May 10, 1916. Pp. 2; map.

Bridger National Forest (*Wyoming*). A Proclamation by the President of the United States, Transferring Certain Lands from the Washakie National Forest to the Bridger National Forest. Washington, D. C. June 30, 1916. P. 1; map.

Washakie National Forest (*Wyoming*). A Proclamation by the President of the United States, Transferring Certain Lands from the Bonneville National Forest to the Washakie National Forest. Washington, D. C. June 30, 1916. P. 1; map.

Contents and Index to Bulletin 94, *Bureau of Entomology. Insects Injurious to Forests and Forest Products.* U. S. Department of Agriculture. Washington, D. C. 1916. Pp. ix, 87–95.

How to Attract Birds in Northwestern United States. By W. L. McAtee. Farmers' Bulletin 760, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 11.

Game Laws for 1916. By T. S. Palmer, W. F. Bancroft, and F. L. Earnshaw. Farmers' Bulletin 774, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 64.

Laws Relating to Fur-Bearing Animals, 1916. By D. E. Lantz. Farmers' Bulletin 783, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 28.

Second Annual Report of Bird Counts in the United States, with Discussion of Results. By W. W. Cooke. Bulletin 396, U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 20.

National Parks Portfolio. Department of the Interior. Washington, D. C. 1916.

Contains the following pamphlets: Introduction; the Yellowstone National Park; Yosemite; the Sequoia National Park; the Grand Canyon; Mount Rainier National Park; Crater Lake National Park; the Rocky Mountain National Park; the Mesa Verde National Park; Glacier National Park.

The Grazing Industry of the Bluegrass Region. By L. Carrier. Bulletin 397, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1916. Pp. 18.

Proceedings of the Society of American Foresters. Volume XI, Number 3. Washington, D. C. July, 1916. Pp. 271–368.

Contains: Recreational Use of Public Forests in New England, by A. Chamberlain; The Use of the New York State Forests for Public Recreation, by G. D. Pratt; Use of the Southern Appalachian Forests for Recreation, by J. S. Holmes; Use of the National Forests of the West for Public Recreation, by E. A. Sherman; Hylobius Pales as a Factor in the Reproduction of Conifers in New England, by E. E. Carter; The Growing Stock as a Criterion of Normality, by A. B. Recknagel; Hewn-Tie Versus Saw-Timber Rotations, by C. F. Korstian; Forest Taxation as a Factor in Forest Management, by G. W. Hutton and E. E. Harpham; Scientific Notes and Comments; Reviews.

Proceedings of the Society of American Foresters. Volume XI, Number 4. Washington, D. C. October, 1916. Pp. 369–497.

Contains: South American Forests, by H. M. Curran; Forest Problems and Economic Development in South America, by R. Zon; Utilization and Round-Edge Lumber, by R. T. Fisher; The Natural Root Grafting of Conifers, by H. S. Newins; Slash Pine—An Important Second-Growth Tree, by W. R. Mattoon; Comparative Test of the Klaussner and Forest Service Standard

Hypsometers, by D. K. Noyes; Dollars and Sense, by D. Bruce; Comment, by F. E. Olmsted; Evaporation and Soil Moisture in Relation to Plant Succession, by C. F. Korstian; Silvical Notes on Western Larch, by J. A. Larsen; Silvical Notes and Comments: What about Sites, by A. B. Recknagel; The Effect of Wind, by C. G. Bates; Silviculture and Grazing Combined; Comparative Value of Burlap and Pine Needles as a Mulch; A Russian National Conservation Commission; Reviews.

Metric System in Export Trade. Report to International High Commission. By S. W. Stratton. Senate Document 241, 64th Congress, 1st Session. Washington, D. C. 1916. Pp. 78.

A Catalogue of the Flora of Isle Royale, Lake Superior. By W. S. Cooper. Reprinted from Sixteenth Report Michigan Academy of Science. Pp. 109–31.

Forestry and the Farm Woodlot. By J. E. Barton. Circular 5, Frankfort, Ky. Pp. 4.

The Forests of the Future—Second Growth. By W. W. Ashe. Address Delivered at the Southern Forestry Congress, Held at Asheville, N. C., July 11–15, 1916. Reprinted from Southern Lumberman. Nashville, Tenn. August 5, 1916. Pp. 12.

Creosoted Wood Block Paving. By W. Buehler. Technical Letter No. 1, National Lumber Manufacturers' Association. Chicago, Ill. May, 1916. Pp. 4.

The Extent of the Woodlot in the New England States. By W. P. Wharton. Society for Protection of New Hampshire Forests. 1916. Pp. 7.

Plantae Wilsoneanae, an Enumeration of the Woody Plants Collected in Western China for the Arnold Arboretum of Harvard University during the Years 1907, 1908, *and* 1910 *by E. H. Wilson.* Edited by C. P. Sargent. Vol. iii, pt. 1, issued May 8, 1916; pt. 2 issued August 31, 1916. The University Press, Cambridge, Mass. Pp. 419.

Report of the Station Botanist, 1915. By G. P. Clinton. Being Part VI of the Annual Report of the Connecticut Agricultural Experiment Station. New Haven, Conn. 1916. Pp. 421-539.

The Keene Forest. Prepared by J. W. Toumey and R.C. Hawley. Bulletin 4, Yale Forest School. Yale University. New Haven, Conn. 1916. Pp. 25.

Lumbermen's Safety First, First Aid Manual. By J. E. Sparks and E. H. T. Foster. Associated Press, New York. Pp. 69.

Robert Hartig (1830-1901). By E. P. Meinecke. Reprinted from Phytopathology, vol. 5, no. 1, February, 1915, pp. 3. Baltimore, Md.

Peridermium Harknessii and Cronartium Quercuum. By E. P. Meinecke. Reprinted from Phytopathology, vol. 6, no. 3, June, 1916, pp. 225-40. Baltimore, Md.

Plant Successions in the Mount Robson Region, British Columbia. By W. S. Cooper. Reprinted from the Plant World, vol. 19, no. 8, August, 1916, pp. 211-38. Baltimore, Md.

Report of the Dominion Entomologist for the Year Ending March 31, 1915. By C. G. Hewitt. Department of Agriculture. Ottawa, Canada. 1915. Pp. 40.

Seventh Annual Report of the Commission of Conservation of Canada, 1916. Ottawa, Canada. 1916. Pp. 283.

Contains the following addresses of interest to foresters: Fire Protection and Fire Prevention, by F. H. Wentworth; Fire Protection from the Private Timber Owner's Viewpoint, by Ellwood Wilson; Report of the Committee on Forests, by Clyde Leavitt; Silvicultural Problems on Forest Reserves, by B. E. Fernow; Museums as Aids to Forestry, by H. I. Smith; Fire Protection in Dominion Parks, by J. B. Harkin; Report of the Committee on Lands, by F. C. Nunnick; Water and Water-power Problems by A. V. White; Fire Prevention, by J. G. Smith; Report of the Committee on Waters and Water-powers, by L. G. Denis; Appendix III; Fire Waste Facts and Figures.

Travelling Exhibit at Prairie Fairs. Markets Bulletin 22, Forest Branch, Department of Lands. Victoria, B. C. 1916. Pp. 281-90.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iii, pt. 7 (pt. xxvii of the Complete Work). Government of the State of New South Wales. Sydney, N. S. W. 1916. Pp. 125-55; pls. 112-5.

I. Timbers of British North Borneo. II. Minor Forest Products and Jungle Produce. By F. W. Foxworthy. Bulletin 1, Department of Forestry of British North Borneo. Sandakan, B. N. B. 1916. Pp. 67.

Administration Report of the Forest Circles in the Bombay Presidency for the Year 1914-15. Bombay, India. 1916. Pp. 180+4

Notes on the Burma Myrobolans or "Panga" Fruits as a Tanning Material. By Puran Singh. Forestry Bulletin 32. Calcutta, India. 1916. Pp. 5.

Notes on the Economic Uses of Rosha Grass, Cymbopogon Martini, by R. S. Pearson, and *Note on the Constants of Geranium Oil,* by Puran Singh. The Indian Forest Records, vol. v, pt. vii. Calcutta, India. April, 1916. Pp. 50.

Rapport Department Suisse de l'Intérieur sur sa Gestion en 1915. Pp. 18. Date and place of publication not given.

PERIODICAL LITERATURE

[The slimness of this department is due to the absence of all German forestry literature, owing to interference with mails by Great Britain.]

FOREST GEOGRAPHY AND DESCRIPTION

South American Forest Conditions

In a paper, read before the Pan-American Scientific Congress in January, Mr. R. Zon has brought together from various sources information regarding forest conditions in South America.

This article confirms what we have known all along, albeit with more detail and certainty, that in spite of the extensive woodland cover, estimated at 38 per cent, varying from State to State between 15 and 80 per cent, desirable wood supplies of the continent are scanty and unavailable for various reasons, among them the nature and distribution of the species, a matter which can not be helped, and inaccessibility, which may in time be overcome.

The total forest area is stated as 1924 million acres, but taking Chili alone with 38 million acres only about 5 million are commercial forest, 6 million may furnish poles and stakes, 9 million are pasture forest and 18.5 million fuelwood.

The species are mostly very heavy and hard woods, mostly of value only as finishing wood and distributed in a manner that, if any one species were to be logged, a very large acreage would have to be hunted over to secure volume, making logging cost prohibitory except for most valuable material. It is stated that to secure the one million tons of quebracho wood consumed or exported annually from Argentina, 500,000 acres must be logged over.

The importations from the United States, Canada and Europe, chiefly pine and spruce, softwoods, into Argentina amount to 80 per cent of her wood consumption, into Brazil 40 per cent, into Chili 55 per cent.

So far only two conifers (*Araucaria brasiliensis*, the Paraná pine, and *A. imbricata*, the Chilian pine); Spanish cedar (*Cedrela odorata* and several other species, *cedro*); quebracho, noted for its tannin contents, and greenheart (*Nectandria rodioei*), associated with mora (*Dimorphandra mora*), noted for its teredo-proof quality, hence useful in ship and dock building, are commercially exploited. The distribution of these species leads to the recognition of seven forest types and the construction of a map, locating the same, about one third of the total forest area being occupied by types containing the above species.

The Parana pine forest region, which is being exploited, is located in the southeastern portion of Brazil, cutting sometimes as much as 20 M feet to the acre. The Antarctic beech region, which contains the Chilian pine, also some larch and cedar, is located along water courses in Western Patagonia, on the slopes of the Andes.

The hardwoods, in which quebracho forms the commercially important species, are found chiefly in northern Argentina with an estimated area of 84 million acres and a stand of 168 million tons.

Greenheart, with mora, is located in the river forests of British Guina over a range of 154 million acres.

The mahogany region is located, with 54 million acres, along the northwest coast, and finally the tropical and subtropical hardwoods, with 1200 billion acres, occupying the largest area, are occupying the Amazon watershed, the balance being non-forested or brush areas.

In 1912, the export of forest products, including copaiva, tolu and quillaya bark, amounted to $9,282,625, while the importation of wood and manufacture amounted to around 32 million dollars.

In spite of the vast extent of the forest area the author says: "not only quebracho, but many other valuable species of trees with which the forests abound are in danger of extinction (when their use has been found out?) in the not very distant future as the result of inadequate forestry laws."

To find out the character and uses of the many hardwood species with a view to export is a primary task; the softwoods are so limited as to require reservation for home consumption.

South American Timber Resources and Their Relation to the World's Timber Supply. The Geographical Review, October, 1916, pp. 256–66.

South American Lumber Markets

Additional information on forest conditions of South America may be gleaned from the report of R. E. Simmons, special agent of the Department of Commerce, which is mainly devoted to a discussion of market conditions.

The distinguishing feature of the lumber trade of the Pacific Coast countries is the supremacy of the North American product; only in the Chilian port of Puntas Arenas is European lumber in demand; 99 per cent of the importation into Chili and over 80 per cent of that into Peru are from the United States, a very large proportion of the consumption being imported. Much of the more accessible forest, it appears, has already been cut for lumber or cleared for farming. The *roble*, the so-called Chilian oak, the cheapest and most abundant native wood, besides its weight, is most troublesome to season in the rainy latitudes of Southern Chili. The Chilian pine (Araucaria) seems to be mainly esteemed for the seed, like our Pinion pine; otherwise fit mainly for pulpwood.

Ecuador seems the only State without regular importation of foreign timber, the home industry being highly protected.

The lumber industry based on the Paraná pine in Brazil was rendered possible by the building of the Paraná railroad and by the fact that these araucaria forests occur in extensive pure stands. It is carried on largely by North American lumbermen.

Venezuela, in spite of its extensive forest area, imports 45 per cent of the lumber consumption, mostly Southern Yellow pine, which in the La Plata district goes by the name of Riga pine, from its resemblance to the Russian Scotch pine, which it has replaced.

Special Agents Series 112 and 117, Bureau of Foreign and Domestic Commerce, Washington, D. C. 1916.

BOTANY AND ZOOLOGY

Incompatibility of Oak and Olive Trees

As bearing on the important theory of toxic effects of one species of trees on others in mixture, Petri's investigation of the common knowledge that olive trees are generally stunted in their growth when in the vicinity of oakwoods may be cited.

In a series of pot cultures, in which olive and oak seedlings were grown at 10 *cm* intervals, the one-year-old oak roots in contact with olive roots showed the existence of small brown zones in correspondence with which the primary cortex was in an advanced state of decay, and vesicles originating in the deep strata of the cortical parenchyma were discovered.

Character of mycelium and vesicles correspond exactly to those of the endotrophic mycorrhizae of the olive—a weak parasitism occurring on a dying tissue. The one-year-old olive roots showed no trace of the infection.

The author concludes, that the failure of the olive trees in the neighborhood of oaks is probably caused merely by the oaks having impoverished the soil or by the eventual decay of the root due to development of Dematrophora in the soil remains. "The theory of any injurious action due to the mycelium of the diseased oak roots may be totally discarded."

Atti della Reale Academia dei Lincei, vol. xxiv, Rome, 1915, pp. 536–9.

Asphyxiating Gas and Vegetation

According to F. Doe, an excellent opportunity to study the effect of asphyxiating gas on French forests is offered in the Canton of Verzy, to the east of Rheims and to the north of Chalons. According to Doe, the gas was launched October 19 and 20, 1915. Blown by a high wind the heavy gas extended quickly over an area exceeding 10 miles from the place where it was started. The vineyards were not permanently injured, nor was cauliflower or turnips, but lettuce and most ornamental plants suffered severely. In the forests, the oak, beech, birch and hornbeam were not damaged, but the leaves of Scotch pine turned yellow, exactly as if the forest had been burned over. Apparently, the damage reported by Doe was very much the same as if there had been a large smelter in the neighborhood.

T. S. W., Jr.

Revue des Eaux et Forêts, July 1, 1916, pp. 192–5.

Causes of Tree Form

Continuing his discussion on the processes of diameter development (the first part briefed on pp. 325–7 of this volume), Dr. Jaccard, of the Swiss Plant-Physiological Institute, discusses the physiological reasons for winter rest. He refers to Klebs' experiments, who could artificially produce in a given plant either continuous growth or growth interrupted by periods of rest, by varying the supply of mineral salts and light intensity at the disposal of the plant. The functions of various mineral salts as determined by Hansteen and others are explained, from which it appears that calcium, to which certain amounts of potash and magnesium salts are added, is the most important factor in forming cell walls and also in enabling roots to take up minerals by chemical reactions (not simply by osmosis). Hence the importance of lime in soils. The necessity of an active water circulation to carry away chemical products so as to permit further chemical production is accentuated.

Water circulation is reduced not only by dryness of soil, but by decrease in temperature and reduction of light intensity and light duration. The fall of leaves and final rest of vegetative functions is simply explained by the change in exterior conditions.

The species with leathery, thick-skinned leaves (conifers) can inhibit their functions or resume them at any time without change in form, because a small water supply suffices for them. The water-needing species, on the other hand, respond to a longer withdrawal of water by loss of the assimilating organs and only a decided change of exterior conditions, especially a lengthening of light influence, causes new formation of foliage. By influencing these exterior conditions within narrow limits at any season without any period of rest a continuation of growth can be secured. There is no "need of rest" where assimilating organs are renewed, and not as in the animal used up. Plants die from hunger and thirst, animals from age, being used up.

Under the caption, "The specific form of the tree as product of diameter growth," the author combats Metzger's theory of the wind as determining factor of the form and structure, namely such as offers the greatest resistance with the smallest amount of material. Elsewhere, the author believes to have proved that "the stem of an old spruce in timber forest, in which the dying of the crown basis takes place as the tip grows, corresponds to a shaft of equal *conductivity for water*, and not to one of equal resistance (to bending) for its whole length." Every stem shows varying resistance to bending at different heights, as shown by calculations. The big trees, if sound, show in proportion to their crown development a much greater resistance than younger, thinner stems. Trees work with surpluses and use much more material for the building up of their stems than resistance to the ordinary wind pressure requires; and in extraordinary storms they, too, succumb, so that their claimed inherited structure through selection is of no advantage to them. The author then adds arguments demolishing Metzger's theory. He believes to have proved that a bending force according to its intensity produces quite varying reactions; even where no bending due to exterior pressure exists, increased increment takes place, as on the concave places of a branch or root; if the shaft were the product of wind pressure, then the tree form would have to vary from locality to locality, like the local winds; trees would rarely have concentric form and regular structure; either the form is the mechanical product of the present wind direction, when there would be no inheritance effect; or the present form is the result of natural selection and inheritance, when there would not be reaction to present winds. The author, then, brings forward his theory that the form is a result of conditions of nutrition and especially of water conduction.

Since air and light (diffuse, which is the important part in assimilation) surround the crown symmetrically, hence the shaft must assume a symmetrical radial structure (just as in sea anemones, corals, etc., which live surrounded by equal feeding chances on all sides). In the horizontal branches gravity produces eccentricity.

To secure uninterrupted water conduction a conduction layer is required which is in proportion to the transpiring organs, such a layer is represented by the area of the vessels and tracheids of the last three or four annual rings at any cross section.

To preserve equality of conducting area, it would be necessary to have an increasing ring width towards the crown on account of the decreasing circumference. Assuming that this conducting area will be proportional to the ring area, the author calculated the form which a spruce would have to assume to become a *shaft of equal water conductivity*, and found very satisfactory agreement with actual forms.

A figure illustrates the method of calculating and the resulting form, also showing that Metzger's theory will not hold.

Microscopic investigations of the last rings of several spruces and firs show a minimum of ring area at a height several meters above ground, and from this point an increase of ring areas toward base and crown. A relative thickening of the shaft above the lowest dry branches was also found a common occurrence, evidently to compensate the reduction of the conducting area due to the dead branch knots. An experiment with inserted glass rods, interrupting the living wood area produced the same result.

The mechanical theory of the root collar is denied and a physiological explanation substituted, namely the retardation of the transpiration stream due to change of direction which requires an increased conducting area.

The author does not claim that water conduction is the only influence on stem form and admits that mechanical influences may cooperate, but much more complicated ones, than have hitherto been assumed. For instance, the author could differentiate compression and tension influences on diameter growth at night from those in the day time, and show that the reaction to bending is different in different trees.

The anatomy is always different on the pressure side from that on the tension side, sometimes suppressing formation of vessels, and of wood fibers, the cambium making only parenchymatic cells.

The author concludes that many of the phenomena of life which hitherto have been supposed to be adaptations are mostly direct reactions to present influences; especially the structure and anatomy of vegetative organs are directly depending on conditions of nutrition.

Was wissen wir vom Dickenwachstum der Bäume? Schweizerische Zeitschrift für Forstwesen, May-June, 1916, pp. 104–17.

SOIL, WATER AND CLIMATE

Forest Influences

In a most painstaking analysis of the problems which confront the water works engineer by the variations in precipitation, replete with a mass of detail, tabulations, maps, curves, and all the means of making for sound argument, Mr. Carl Peter Birkinbine, son of the well known, late, lamented John Birkinbine, also incidentally alludes to the relation of forest cover to precipitation and run-off, and in the subsequent discussion was induced to use the following language: "As to the matter of precipitation and run-off being affected by deforestation and agricultural development, the point brought out in regard to precipitation includes two separate ideas. One that the different temperature conditions between forest and open land may alter the character of the precipitation, that is from rain to snow or *vice versa*. In this connection there has recently been published a paper claiming a different depth of snow fall for forested areas from that for open ground; although as the effects of ground temperature, ground moisture and wind are to be considered, the conclusions of the paper are not yet definite. It has also been claimed that land under cultivation permits higher evaporation from the soil, thus extending the area of condensation, although this would need to cover a large area to be appreciable.

"It is true that a former high official of the Weather Bureau strongly stated that deforestation did not affect the run-off, but I do not accept this as a general statement. Records of stream flow both maximum and minimum, the visible signs of erosion on bare ground, the slow melting of snow in shaded areas, the reduction of intensity offered by leaves and branches during severe downpours, the greater porosity of forest humus and the fact that it does not freeze deep, and the more uneven and obstructed floor of the forest as compared to bare hill or field, cannot fail to have the effect of stabilizing run-off, and this view is generally shared by those who have studied the records and conditions, especially in this country where deforestation generally clears the ground of all growth."

Variations in Precipitation as Affecting Water Works Engineering. Reprint from the Journal of the American Water Works Association, vol. 3, no. 1. March, 1916, pp. 103.

MENSURATION, FINANCE AND MANAGEMENT

Assortment Tables

The most extensive and important investigation by Flury on the assortments or grade relations in spurce, fir and beech is of special interest for the methods of investigation. A discussion of the principles and systems of grading in vogue in Switzerland, Germany and France is followed by an analysis of grade or size relations in the single stem, then of whole stands in general, and finally of pure, even-aged, normally stocked stands. Twenty tables and three graphic illustrations are the result of the measurements and bring the basis for this discussion.

The object of assortment, or graded yield tables, is two-fold, namely to enable the estimate and division of the volume of a stand into its main assortments, saw logs, building material, poles, fuelwood, as a basis for value calculations, and second, for single stems or groups of stems, to determine the available assortments in volume and length of stem in the annual yield.

For entire stands so far only one assortment table of limited character exists (Dr. Wimmer's on the beech; *see* F.Q., xiii, 555), and a few dealing with single stems; these are based not on general, but specific, local grades. For workwood, length and diameter (or, in France, circumference) either at top, or at middle, and for sawlogs in South Germany and Austria, or the contents of the piece, as in North Germany, furnish the basis for classification; the greatest variety of assortments is found in Switzerland.

To meet the widest number of requirements the author bases his assortments on top diameters (with bark) of 42 (17 inch), 32, 24, 18, 15, 12 and 7 *cm* (3-inch). The tables consider only timberwood (over 7 *cm*) and do not attempt grading of fuelwood or brushwood. The author at the outset accentuates that such tables are only aids to estimate the assortments in actual stands, giving maximum average values, which in actuality in single individuals are often not attained, due to crookedness, unsoundness, etc.

The basis of the tables is furnished by the sectioning in 2-meter lengths of trees selected after the Urich method in pure, more or less even-aged stands in medium density, also some selection forest material. Some 3125 spruce, 1307 fir, and 2284 beech were involved, in 5 to 7 height classes differing by 5*m*, and in 2-*cm* diameter classes. The contents of each piece was expressed in per cent of the total tree volume (timberwood), and it was soon found that while, of course, the absolute contents of the same diameter class showed great variation with varying height, *they always showed the same percentic relation to the timberwood volume*, which discovery facilitates greatly the construction and use of the tables. E.g., in a group of spruce trees of 40 *cm* (16 inch) d.b.h. the piece with top diameter of 24 *cm* for all heights of trees represents 82 per cent of the total volume, and so for the top diameters:

32, 24, 18, 15, 12 *cm*.
47, 82, 94, 96.8 98.4 *per cent*.

By multiplying these percents with the timberwood volume, the absolute volume of the assortment is found.

Practically the same relation, with different figures, to be sure, is found in fir and beech; thus in fir for a 50 *cm* tree the pieces with top diameters 42 32 24 18 15 12 7 *cm*
represent 28.9 81.8 94.7 97.9 98.9 99.7 100 *per cent* of the timberwood volume of the tree, no matter what height. In other words, with the same d.b.h. the shorter stem gives percentically as much of certain sizes as the longer stem. This is true within an error of 1 to 2 per cent, rarely over 2 per cent. Only in the first (largest) class are the differences somewhat greater.

The author explains this peculiar relation by reference to the behavior of form factors and by the fact that in proportion as the shorter stem is less in volume than the longer, the assortment contents decrease, but the percentic relation remains the same. The tables, of course, represent average values, and hence in the single case considerable differences may occur. Spruces of the hill country and of the mountains did not show enough difference to make different tables necessary, nor did mixed forest show an influence on this percentic relation. But the influence of specific shaft form differences may make itself felt in very tapering and very cylindrical stems. Schiffel's form quotient is declared of no value in this connection because the diameter at half the height is practically too cumbersome to ascertain, and practical use of the tables is their object. The author, to aid in judging the form, gives in the tables the average diameter at 5*m*, which in the given case can be either judged or measured by calipers on poles or otherwise, furnishing judgment whether the tree is more or less deviating from the normal form. There is also given a correction table which, to make allowance for the form, reduces the d.b.h. by given amounts for different diameter classes, when the corresponding assortments are found under the reduced diameters. Since, however, these tables like any other volume tables are not to be used for estimating of individual trees, but only of groups, errors of 8 to 12 per cent, which might occur in individual cases, do not vitiate the use of the table without making allowance for form differences.

A special, extended investigation into the difference of ascertaining the volume by 2-meter sections and by use of the middle diameter and full length showed that the latter measurement gave, as a rule, too small results, except with a top diameter of 7 *cm*, in which case it may sometimes be too low. With increasing stem diameter the error becomes larger, and with increasing top diameter also. Differences in spruce vary from 0 to −2.5 per cent for a 20 *cm* b.h.d. and 12 *cm* top diameter, and down to −8.5 per cent for a 60 *cm* b.h.d. and 42 *cm* top diameter. The butt section with its root collar influences especially the higher result of the sectioning method. The different species show differences in this comparison: the full-bodied fir compared with the spruce shows a more rapid increase of volume based on middle diameter, still more so the beech, so that, *e.g.*, for the 18 *cm* top diameter the latter volume may be even larger than that obtained by sectioning.

To avoid practical difficulties in the use of the tables, these, instead of giving the volumes determined by sectioning, bring the assortment volumes determined by middle diameter and length percentically to the timberwood volume; but the basic timberwood volumes are those derived from sectioning.

To gain an insight into results when a long piece is cut into shorter pieces and measured by middle diameters, a table shows the percentic relation between the measurements by 2 *m* sectioning and by 6 *m* sections for the various top diameters and breast high diameters. This shows differences of 1.5 to 8.5 per cent for spruce (6 *m* measurement below 2 *m* sectioning), for fir between 1 and 8 per cent; for beech between +1.3 and −4.5 per cent.

The complete tables for single stems then are constructed, with the following headings, in columns: column 1 gives b.h.d. and diameters at 5 *m* corresponding to different height classes in column 2; column 3 gives timberwood contents of stem for each height class; columns 4 to 9 give in bold face type, in single line, the assortment per cents for different top diameters and underneath in ordinary type their actual volumes for each height class; columns 10 to 16 give lengths and middle diameters of assortments related to top diameters and corresponding to height classes; the middle diameters are given only for the highest and lowest height class, the differences being so small that the intermediate figures can be readily interpolated; the last column gives the length of timberwood, the useful portion, or merchantable length as a per cent of total height. Certain portions of the stem, varying from 4 to 8 *m* in length for various top diameters, had to be neglected, *e.g.*, in the 34 *cm* class of spruce no entry is made for the 32 *cm* top assortment, because it is too short.

An example of the use of the table may make the arrangement clearer: A spruce of 48 *cm* (19 inch) b.d.h. and 28–30 *m* (100 feet) height is to be estimated. In the appropriate column the timber-wood content is found to be 2.23 *fm*. If 32 *cm* (13 inch) is assumed as the proper sawlog diameter, the content of the log is found to be 1.56 *fm* and the length 13.3 *m;* the balance may be cut for building timber or pole at 15 *cm* top diameter; by inspecting proper columns the contents are found to be .62 *fm* and the length $23.8-13.3=10.5$ *m*. If, however, it is determined that it is more advantageous to hold out the whole stem to a 18 *cm* top diameter, it will be found to have a length of 22.4 *m* and furnish 2.14 *fm*.

Test measurements in clear-cutting areas, in selection forest fellings, and in areas thinned in different degrees are tabulated, showing divergences between the tables and actual measurements.

In the first case, for the grades of 12 to 32 *cm* results were satisfactory, only the 42 *cm* assortment (butt log) showed more frequent and greater differences. By using, however, the allowances for unusual taper conditions errors could be reduced to $-.6$ to $+1$.

No influence of thinnings could be determined, but the author admits the basic material to be insufficient. The somewhat scanty data from selection forest shows that the trees in the selection forest are stouter in their lower section. The assortment per cents of the trees over 60 *cm* d.b.h. correspond to stems 2–4 *cm* less in diameter of the tables; the 30–60 *cm* trees are more full-bodied than the trees of the tables.

The determination of assortment relations of entire stands, also based on even-aged timber forest, requires the knowledge of the total volume of the stand and the stem numbers in diameter and height classes. It is well known that two or more stands of the same total volume may differ considerably in assortments, due to the distribution of stem classes or individual composition, especially as regards sawlog contents. For convenience the author divides the stem numbers into larger (b.h.d.) size classes, each of which furnishes a main assortment, thus: over 50 *cm*, stout wood; 37–50 *cm*, ordinary saw logs; 27–36 *cm*, building timber; 19–26 *cm*, telegraph poles; 13–18 *cm*, scaffolding, telephone poles; 7–12 *cm*, smaller poles of all kinds. Usually a stand furnishes only three, sometimes only two, rarely four of these dimensions. The volume of each size class and height class being known, the question is what assortment volumes does a certain number of stems of each of the size classes furnish.

In investigating the material collected for the single tree tables the interesting discovery was made, that just as there is a percentic relation between timberwood volume and assortment, so *there is a percentic relation between total basal area and the volume of each size class, and similarly the assortment contents*, at least in the timber forest. In selection forest the basal area per cent in the lower stem classes is 2–4 per cent higher in the upper classes, 2–4 per cent lower than the volume per cent; in the middle classes, however, the percentages are alike.

Thus for the size class 37–50 *cm* of spruce the percentages of different assortments based on top diameters 32 24 18 15 12 7 *cm*
are for all height classes 57 84 93 96 98 100 %
For incomplete size classes the percentages will, of course, have to be reduced, guided by the single tree assortment tables.

The completed stand assortment tables requiring properly less accuracy, are simpler than the single tree tables. There are only five size classes; the height classification is based on 5 *m* differences and only the percentage of the assortments, with their length for different height classes, is given.

The following example shows the procedure: A stand of spruce, with few firs intermixed, gave a content of 5210 *fm*. From experience of a neighboring felling the amount of fuelwood is ascertained as 25 per cent = 1303 *fm*, requiring, therefore, 3907 *fm* to be assorted or graded. The following tabulation taken from the tables can be made use of to show possibilities:

Assortment Volumes

Top Diameters: / *Percentages:*		32 / 57		24 / 84		18 / 93		15 / 96		12 / 98	
Size Class cm	*Timber Wood fm*	*Vol.*	*Length*	*Vol.*	*Length*	*Vol.*	*Length*	*Vol.*	*Length*	*Vol.*	*Length*
38–50	890	507	11	748	19	828	23	854	24	872	26
28–36	1821	....	......	1093	11	1602	17	1712	20	1766	22
20–26	1063	....	......	....	....	648	11	872	15	978	17
16–18	133	....	......	....	....	....	......	....	....	90	11

From this we can choose according to local usage, say,
Saw timber, top diameter 32 *cm*, from 38–50 *cm* class .... 507 *fm*
Building material, top diameter 18 *cm*, from 38–50 *cm* class 828–507 321

Building material, top diameter 18 *cm*, from 28–36 *cm* class 828–507	1602
	1923
Poles, top diameter 15 *cm*	872
top diameter 12 *cm*, from 16–18 *cm* class	90
	962
Workwood	3392
Pulpwood (balance)	515
	3907

Test measurements prove satisfactory for the top diameters 12–32 *cm;* only again for the 42 *cm* class errors, in spruce at least, are considerable, but, the author states, such an assortment would rarely be made for a whole stand, only for a few stem groups.

Finally, the author constructs normal assortment yield tables for pure, even-aged, normally stocked stands, with the aid of the percentic basal area relation; one set of tables showing the percentic distribution from period to period (20 years) for 5 site classes in the 6 size classes as made above, and another set showing the distribution in detail from 4 to 4 *cm*, b.h.d. Diagrams also are used to exhibit this percentic distribution of size classes at different ages.

While the common stand assortment tables are to be used for estimating contents of stands in practical work, these normal assortment tables are to be used for static and financial calculations.

The author expresses the hope that the ready adaptability of these tables will lead to their use not only in the practice of utilization, but on the field of organization. "The exhibit and valuation of the stock capital of a management class, in size and assortment classes; the determination of an economic rotation based on calculations; the influence of thinning practice on volume and value yield are questions which can be convincingly and clearly answered only by paying attention to assortment volumes and assortment values."

We call special attention to this fruitful investigation!

Mitteilungen der Schweizerischen Centralanstalt für das forstliche Versuchswesen, xi Volume, 2 Heft, pp. 153–272.

Cost of Growing Timber

Professor B. P. Kirkland discusses in detail the elements of forest finance calculation with special reference to conditions and values of the Pacific Northwest, more especially the cost of growing timber to different forest owners, the object being to show that the required interest rate rules the possibilities of profit, or of engaging in forestry business.

As regards land values, he claims that the optimism of the West will insist on high land values. Leaving out the real farm lands at $10 to $50 as unavailable, he gives values of $10, $5 and $2 for three site qualities. Planting cost, he thinks can be kept down to $5 per acre if advantage is taken of existing volunteer growth. Cost of administration and protection, which Kellogg and Ziegler in a similar discussion placed at 5 cents, the author raises to 20 cents as more reasonable. The matter of taxes is somewhat complicated, as values of a growing crop change. For site I up to the 20th year the soil alone may be taxed at 1 per cent, or 10 cents an acre, the next decade, owing to increased value of the crop, this is doubled, the next decade trebled. From the 41st to 50th year a volume of 20,000 feet b. m. at $3 and the land at $10 brings the tax up to 70 cents per acre, and the following decade the value is figured at $290, the annual tax at 1 per cent being $2.90. For II site, two thirds, and for III site, one third of these values are prescribed.

Difference in ownership affects taxes; public ownership, federal, State, municipal, though not directly paying taxes, is charged in lieu of taxes with 25 per cent of the gross income, after the precedent of the National Forests handing over to the States this amount.

Interest charges vary even more widely than taxes. Without argument, except that these are rates at which owners can borrow or lend, the author proposes the following interest charges:

	Per cent
Federal Government	3
State "	4
Municipalities	4.5
Large Corporations	4.5–5
Moderate-sized Corporations	6
Small Corporations and Individuals	7

As regards rotation, or length of time for calculations, the author claims to have found that 60 years give "the highest profits from the use of the soil for private forestry, while 80 to 100 years is more profitable for government forestry, working with lower interest rates."

The product of different sites varies more than is usually realized. An extensive study by the Forest Service, unpublished, brings out the fact that in Western Washington and Oregon, for a 60-year rotation in Douglas fir, site I may be credited with 44 M, site II with 32 M (75%), and site III with 16.5 M feet (nearly 40% of site I).

In six tables, the costs for various conditions and ownerships properly calculated are given, item by item, and in three tables the possible reductions from costs due to thinnings are figured for the three sites. All calculations are for Douglas fir.

We can give only the totals, which for the six ownership classes, as above, run per M feet:

Site I	3.37	5.92	7.85	9.91	16.17	26.80
Site II	3.61	6.16	8.05	9.87	16.0	26.31
Site III	5.80	9.64	12.45	14.01	22.77	37.50

The strange phenomenon that the cost on II site differs only slightly from that on I site, and with high interest rates is even less, is explained by the much lessened interest charge on the lower soil value, so that costs are more reduced than yield, while on III site, in spite of reduced cost on low soil values, the great decrease in yield brings the cost far above the other sites. Natural regeneration is here suggested as a way out (on sites on which natural regeneration is probably difficult to manage? Rev.)

Thinnings—and there is "very little doubt that all thinnings from young stands originated now or hereafter may be utilized because even now demands for pulpwood, ties, and mine timbers are capable of using all this type of timber within easy reach of transportation"—figure in quantity in the same proportionate relation as the main yields (11:8:4), but the values, owing to smaller sizes on the lower sites, will be less; the total amounts on site II being assumed as one half, on site III as one third of that on site I. But the saving on cost due to thinnings per M feet figures:

Site	I	62	75	79	87	102	123 *cents*
"	II	42	50	55	59	71	85 "
"	III	55	65	70	77	91	109 "

All the figures used are believed to be fair averages, but in specific cases may be enormously modified. Probably much land already stocked with young growth could be bought at the rates specified for the empty acre, saving the cost of stocking; and as every dollar saved in the start means from \$5 to \$50 at the end, according to the interest rate, the possibilities of profit are greatly increased. Other conditions modifying costs are cited.

The position of different owners with reference to forestry business are then discussed, the advantage of large corporations being specially accentuated, and the small owner, except possibly for the small woodlot, is properly discouraged.

In discussing taxes as an element in cost of production, the author shows by an example that they do not play the important rôle which many foresters ascribe to them misled to it by a false averaging of the general property tax over the entire time of production instead of the gradually increasing tax rate on value, when they appear as rather a minor charge. A deferred yield tax might be substituted, but that yield tax must be less than the 25 per cent of the gross yield paid by the National Forests, which is much larger than the accumulating tax as figured in the tables. Since, however, a yield tax is based upon the conception of intermittent management, the author will none of it. The fallacy that the State can practice forestry without paying taxes, at least indirectly, is exposed.

The author comes to the conclusion that "owners who must pay or can get high interest rates for the use of capital cannot wisely undertake the production of timber as an investment," hence mainly Nation, State, possibly municipalities, or possibly under certain conditions, large corporations must be relied upon. State and federal responsibility is argued and even additions to National Forests by purchase.

A special section brings the comparative cost of growing new as compared with hoarding old timber under a financial test. Under the assumption that with a 5 per cent interest rate, the cost of growing timber on site II is \$9.87, and allowing 3 cents for taxes and protection of old timber, the cost of holding old timber is calculated at 57 cents, while the present value of the cost of growing is 53 cents, so that "even if the timber were given to a corporation to be held 60 years, it would be cheaper to grow it than to take the old timber as a present."

There are on the National Forests large areas of mature and over-mature timber which could be sold for $1 per M feet or more, tending rather to decrease in volume from the 40 to 50 M they contain. Figuring soil at $10, protection and administration at 20 cents, stumpage at $1, the cost of holding for 60 years would be $7.93 per M, to compare with $3.36 (*see* table above) for producing the same amount of timber.

The summary of the very interesting exposé is given in the following six paragraphs:

1. The chief cost of producing timber is the interest on the capital involved.
2. It follows from (1) that the interest rate under which the forest owner works, to a large extent determines the cost of producing timber to the owner concerned.
3. Taxes, though important, are a minor cost as compared with interest charges.
4. The costs of production under high interest rates are so great as to bar forest production to those owners who cannot secure money at a rate not much, if any, higher than 5 per cent.
5. This makes forest production at a profit possible only to the federal government, the State, the municipality and the larger corporation, and those owners exceptionally situated as to the ownership of land for other purposes, such as mining, in connection with farming, etc.
6. Since the federal government is already practising forestry so far as its resources make practical at present, the large corporation is not likely to become interested under present conditions, and the municipality can engage only to a limited extent; there is little hope of introducing forest practice in adequate manner except through the State.

The Cost of Growing Timber in the Pacific Northwest, as Related to the Interest Rates Available to Various Forest Owners. Forest Club Annual, University of Washington. Seattle, Wash., 1915. Pp. 23.

Errors in Using Middle Diameters

For more than 150 years the practice in the European wood trade has been to measure contents of logs by the use of the middle diameter, and Huber's formula, $(v=\frac{\pi}{4}d^2l)$ has since 1822 been accepted to express the volume. The accuracy of the formula has been again and again tested, with varying results, due probably to failure in classifying diameter classes or to confining the investigation to certain stands and overlooking that shaft form varies from stand to stand.

Comparing with volume determinations by 2 *m* sections, Flury found the following deviations by employing the Huber formula.

Average of	*Sawlogs Top Dia.* 12 *Inch*	*Building Timber Top Dia.* 10 *Inch*	*Timberwood Top Dia.* 3 *Inch*
576 Spruces	—3.6%	—2.4%	— .5%
158 Firs	—2.3	— .6%	—3.1%
479 Beech	—1.6	.....	—3.2%

The errors are still greater, if as Flury has done (in *Mitteilungen der schweizerischen forstlichen Versuchsanstalt*, vol. XI, 1916) reference is made to tree diameter classes. Thus in spruce of 24 inch d.b.h. with a top diameter of 17 inch, the error percent is as high as —8.5, scaling down with a 3 inch top diameter to —1.8 per cent.

Burger adds a less extensive series of measurements, relating it to varying log lengths, and formulates the results of these various investigations as follows:

1. The cubing of middle diameter and length almost always furnishes too small (negative) results;
2. The error percent decreases with increasing length;
3. Positive differences can occur;
4. The deviations from the true volume are greatest (in spruce) with a log length of 6 to 8 *m* from the stump;
5. A remarkable fact is that the maximum of the error curve (not the maximum deviation) occurs not with the timberwood diameter (3 inch), but a few meters lower.

The explanation of this last point is to be found in the fact that the influence of the diameter, especially in long pieces, is of more import than the lengths, especially when the diameter falls into the portion of the tree, where there is a rapid diameter decrease, when one centimeter decrease offsets 2–3 *m* in length.

The author modifies two statements in Udo Müller's *Holzmesskunde*. Müller states that "the accuracy of Huber's formula increases, the smaller the length of the log compared with the length of the whole tree, so that 3-5 *m* logs are measured very accurately, the more so the more they belong to the middle of the tree." This does not hold good when the region of the root collar is included.

The statement of Müller, that "trees of all species which have continuously grown in dense stand are full-bodied, and hence will invariably be cubed too high," is not so generally correct, if sawlogs (not whole trees) and material up to 9 inch top diameter is involved.

Ueber Kubierung der Stämme aus Länge und Mittenstärke. Schweizerische Zeitschrift für Forstwesen, July-August, 1916, pp. 151–7.

UTILIZATION, MARKET AND TECHNOLOGY

Wood Prices in Prussia

Just to nail down information of price conditions before the war, for comparison with conditions after the war, we abstract from *Silva* figures published in March, 1914. The year was not a boom year, but an improvement over the preceding years, 10 per cent and more over the year 1913 resulting in many wood auctions. The results of some 20 auctions in February and March in different parts of the Kingdom and detailed for coniferous workwood are given. These prices refer to logs and building timber, cut, lying in the woods—they are therefore log prices—and there are usually four grades involved which rely on size or contents of the piece for classification.

In translating mark per festmeter into cents per cubic foot, the approximate reduction factor of 2/30 has been used.

Assortment	I	II	III	IV	
Pine	20.6–21.8	15.4–18.7	10.6–15.0	8.8–12.4	*cents per*
Spruce and Fir	17.6–19.5	16.5–17.6	13.5–16.0	11.0–15.0	*cu. ft.*

Some lower sizes of spruce sold for less than 11 cents. In translating these figures into price per M feet, each assortment would have to be debited with a different loss per cent. Assuming this per cent as 25 for the largest to 40 for the smallest sizes, would make the average about 33 per cent which is about a usual assumption. That is to say 110, 120, 128, 140 cubic feet of the respective assortments would be required to make 1 M feet. We would find then that the highest log prices were for pine just about $24 and the lowest a little over $12, for spruce and fir the figures are $21.50 and a little over $15.

Attempting to secure a translation into prices of stumpage, we must deduct first logging expense which we may assume to approximate 2.5 cents per cubic foot in the average, and a proportion of different assortments in the cut, which for lack of more definite information we may assume to be 10, 20, 30, 40 per cent respectively for the four grades.

In this way we come to an average stumpage value of $14 per M feet for pine and about $21 for spruce; prices which in some sections we have reached and exceeded in our country, at least for White pine. It is interesting to note that all grades of spruce except the largest bring higher prices than pine, the competition for pulpwood of the smaller sizes being probably the explanation.

Silva, March, 1914.

POLITICS, EDUCATION AND LEGISLATION

Early Forestry Education

In a longer article, based upon official sources, Dr. Diekel, in great detail, gives insight into the beginnings of forestry education in Prussia. It is of interest not only historically in showing how crude even organization still was in the middle of the eighteenth century, but also in the similarity to our own development in the United States. The first specifically and separate forest department was organized as a branch of the General Direction in 1770.

The first educational venture was a detail by the Prussian Government of a single man in 1767 to Hans Dietrich von Zanthier, who was the manager of the forests of the Count von Stolberg-Wernigerode in the Harz Mountains, and had evidently secured a wide reputation for his successful silviculture. This detail of the Referendar Koch curiously enough was only for a few weeks, but on Zanthier's representation that a half year was necessary to secure a thorough knowledge of forestry, his detail was extended to nine months and finally to a year. Two other such details were made, apparently without any payment to v. Zanthier. The result of his work, however, was so satisfactory and became so well known, that Zanthier's became a "celebrated forest school, from which issued many, later grown great foresters, of whom Prussia could boast."

We find the counterpart of this movement in Dr. Schenck's master-school at Biltmore.

About the same time another phase in educational lines developed, when J. G. Gleditsch, a botanist of note, in 1770, at the Academy of Science in Berlin (later University of Berlin) was installed as professor of forestry, and especially of forest botany, in connection with the mining school. The students, as is evidenced from several lists extant, consisted in part of officials in the forest department and other departmental clerks. A number of reports on his work exist, which show that the number of students remained small, partly because the young men had learned "that without knowledge of forestry and without examinations they could secure positions in the royal camera service." His lecture course consisted of three lectures a week for a year, covering the "theoretical and practical part of forestry science and forest management." For this he received 100 Thaler ($73). Appparently the number of students became less and less, the list of 1779 showing only five. So poverty stricken was the poor professor and poorly treated that he had to petition the King for "three heaps of pine fuelwood" to warm his auditorium.

For a volume on the "Systematic Introduction into the Newer Forest Science Derived from Its Peculiar Physico-Economic Causes," he received a gratuity of 100 Thaler.

After his death in 1786, a physician, Prof. Mayer, or Meier was appointed as successor. His "short" plan of the courses on forest science, or curriculum, covers six closely printed pages, classified under 10 main headings, in which utilization occupies the lion's share.

Die Anfänge des forstwissenschaftlichen Unterrichts in Preussen. Zeitschrift für Forst-und Jagdwesen, January, February, pp. 12–30, 49–72.

STATISTICS AND HISTORY

British Forestry

Conditions of British forestry appear from a review of a book on the subject by E. P. Stebbing not so roseate as the enthusiastic author is inclined to consider them. We quote the reviewer verbatim: "It will be with some surprise that foresters will read of the "powerful help" rendered to British Forestry by the Development Commission. "During the six years of its existence," we are informed, "It has enthusiastically taken up the forestry question." Those six years of enthusiasm have not, however, produced very much unless it be some assistance to forestry education. Mr. Stebbing can only point to some four areas in England as embodying the results of the Commission's activity, and even these do not bear close investigation. There is Liverpool, whose afforestation scheme at Lake Vyrnwy was commenced many years before the Commission came into existence; the Manchester watershed, where the funds were provided by the Corporation, and where planting has been in progress for fully 20 years; there is Birmingham, which, we are told, has a "magnificent *unplanted* area;" Leeds is "contemplating" action; while Scotland, in spite of frequent demands, has only been given some 600 acres on the Talla catchment area. It is hinted, however, that the outbreak of war interfered with several schemes which were hatching."

Quarterly Journal of Forestry, October, 1916, pp. 288–92.

OTHER PERIODICAL LITERATURE

Science, XLIV, 1916,—

The Interdependence of Forest Conservation and Forestry Education. Pp. 327–37.

American Lumberman, 1916,—

War-Time Uses of Forest Products. P. 1.

Canadian Forestry Journal, XII, 1916,—

The Forests of Serbia. Pp. 608–10.
Forest Fire Damage from Coast to Coast. Pp. 732–3.
Fire Situation on the Prairies. P. 733.
Fire Season in British Columbia. Pp. 734–5.
Fire Situation on Railway Lines. Pp. 736–7.

These four short articles taken together give a summary of the fire situation in the Dominion of Canada for the season 1916.

Nipigon Forest Reserve—Ontario's Oasis of Real Protection. Pp. 756–8.

An account of work which might well be emulated in other districts throughout the Province.

Pulp and Paper Magazine of Canada, XIV, 1916,—

The Use of Bark for Paper Specialties. Pp. 333–5.

An account of experimental work carried on at the Forest Products Laboratory, Madison, Wis.

Canada Lumberman and Woodworker, 36, 1916,—

Steam Logging by the Aerial Method. Pp. 30–2.

Canadian Engineer, 31, 1916,—

Proposed Specifications for Douglas Fir Bridge and Trestle Timbers. Pp. 57–60.

Gives definitions, general requirements, and requirements for various individual parts of a bridge. This paper was presented to the American Society for Testing Materials for discussion, amendment and possible adoption at the next annual meeting.

The Treatment of Wood Paving Blocks. Pp. 335–9.

The author brings forward the contention, in contrast to the belief previously held, that the treatment of the blocks is a more vital consideration than the properties of the preservative.

The Agricultural Gazette of New South Wales, XXVII, 1916,—

Forest Longicorn Beetles and their Parasites. Pp. 561–7.

Gives information regarding the genus Phoracantha beetles, which work great destruction to the eucalyptus, the most typical tree of the Australian flora.

Skogsvårds Föreningens Tidskrift, XIV, September-October, 1916,—

Contains on 384 pages the detail reports of the work of the various provincial conservation boards (Läns Landstingsområde) for the year 1915, there being 23 such Boards.

Boletin de Bosques, Pesca i Caza, III, 1915—

Contains observations on the behavior of various species of trees planted in Chile.

Mr. Theodore S. Woolsey, Jr., writes us:

"Quite a few professional foresters have mistaken my meaning in an article published in *American Lumberman* in 1916, entitled "Can National Forests be made Self Supporting?" This misunderstanding was due to a number of poorly worded sentences from which it might be inferred that I thought the Forest Service was not increasing the grazing fees simply because it was playing politics. The meaning which I intended to express was that the National Administration and Congress would not permit the Department of Agriculture or the Forest Service to raise these fees because of the difficulty of convincing Western stock men and voters that it was a fair increase. The "politics" referred to was *outside the Forest Service* rather than within; at the same time I felt the Service, itself, had not been aggressive enough in fighting for an increase in the past. I do not impugn the motives of the Forester. It is well known that the Forester is in favor of increasing the grazing fees, but that he has not hit, as yet, upon the proper ways and means for accomplishing this purpose. Some of his subordinates in grazing may, on the other hand, doubt the advisability of an increase—however, this is beside the point that leads me to make this statement."

Every publisher is in a quandary about the sudden rise of prices for newsprint paper, and Trade Commissions on both sides of the line are investigating the reason. And there does not seem to be a limit to paper prices reached, for according to the Secretary of the Newsprint Manufacturing Association, the indications are that after January 1, 1917, the price of wood pulp will be practically double, and of chemical even three to four times what it was a year before.

In answer to a circular letter from the Commission at Washington, some startling statements regarding pulpwood supplies are made in a letter by Mr. Frank J. D. Barnjum, President of a number of timberland, lumber and pulpwood companies, to the Federal Trade Commission. We have been privileged to see, and have permission to divulge, its important contents.

Mr. Barnjum, having for years dealt in New England timberlands and having lately made a close canvass from township to township through parts of Maine, and having canvassed the situation in New York, comes to the conclusion that the exhaustion of pulpwood supplies in the two chief pulp and paper-producing States is responsible for the high price of paper.

The following statements lend color to this assertion. Of the 976,200 cords of pulpwood used last year in New York, 60 per cent was imported from Canada; the cost at mill being $14 per cord for peeled and $16 for rossed wood. Forty-one mills in that State, using 367,000 cords, are without their own stumpage, and 27 mills, using 350,000 cords, will be in that condition in one to three years, depending then on the open market.

On the Androscoggin River in Maine there is claimed to be only sufficient standing wood to last the mills on that river, unless drawing supplies from elsewhere, for only about two and one half years.

On the Kennebec River, which is credited with a stand of 8,400,000 cords, last season's cut was 600,000 cords, indicating 14 years' supply for such a cut.

On the Penobscot River, of 1,200,000 acres on the west branch nearly 90 per cent is owned by one company; the east branch is credited with an average of 5 cords or total of 3,500,000 cords to be divided up among a number of smaller mills.

Taking the report of the Forest Commissioner of Maine for 1902, which claimed for Maine a little over 21 billion feet of standing supplies, and deducting what has been cut since, namely 10 billion feet, there is only about 15 years' supply left for such a cut.

In a private letter Mr. Barnjum adds: "Regarding the predictions made by the Washington forestry authorities (Senate Document No. 40, Fifty-fifth Congress, 1898), that the timber in the East would be exhausted in fifteen to twenty years, if you deduct the amount of importations from Canada, these predictions were absolutely correct, as there has been sufficient imported from that source to just extend our supply a matter of about fifteen years, which is just about the supply that we have left. . . . I marvel at the accuracy of Dr. Fernow's figures!"

As regards importations from Canada, Mr. Barnjum is not hopeful, for "Canada has no more timber than she needs for her own development," and it is likely that export duties will be enacted; besides, much of the pulpwood is unfavorably located.

"One of the best mills in Canada today is obtaining a wood supply on a two-years' drive" and others are not certain of a sufficient supply for many years.

The Dominion of Canada is out on the same inquiry: the cause of high price for newsprint paper.

The question of growth is also gone into, and quite properly dismissed as having hardly any bearing on the question of present prices, net growth being a negligible quantity if occurring at all. Altogether the situation of pulpwood supplies appears decidedly appalling.

In connection with the above we note that at a hearing before the Dominions Royal Commission lately Mr. Ellwood Wilson, Forester of the Laurentide Paper Company working in Quebec, is reported as having made a statement that unless more vigorous efforts are made to protect pulpwood lands from fire, the supply in the St. Lawrence Valley will be exhausted within 15 years, at present rate of consumption.

In this connection also we may quote from a paper read by Prof. P. S. Lovejoy, of the University of Michigan, on pulpwood supplies before the Paper and Pulp Association.

He asserted that we did not know now within 25 per cent what our stand of saw timber is for any given region or State. [This would be, indeed, close enough!] Mr. Lovejoy urged the need of systematically growing pulpwood material which for an annual consumption of 5 million cords (we are already using 6 million) in a 50-year rotation may be secured from 100,000 to 200,000 acres each year, or, say, a reserve of only 5,000,000 acres, if the 100,000 acres to be cut can be made to produce at the rate of one cord per acre per year.

There are, of course, other conditions besides the waning wood-pulp supplies that tend to increase paper prices, increased demand and the disturbed market conditions and increased prices of commodities going into paper making, as well as lack of labor and transportation due to the war.

According to the Swedish Chamber of Commerce, the rise in prices may be estimated for the year:

	Per cent
Pulpwood	30 to 60
Dyestuffs	400
Chloride of lime	1,000
Coal	400 to 500
Resin and other chemicals	300

All countries suffer in a similar manner.

In connection with the rise of paper prices, the value of timber limits in Canada has also improved 100 per cent. In Quebec due to scarcity of labor the pulpwood cut is said to be reduced 50 per cent.

The Germans have learned to make a textile fabric from paper with 20 per cent cotton, made into clothes. In ordinary times this would be too expensive to allow competition with the real woolen and cotton articles.

It is estimated that there is enough waste from the sawmills of the Southern States alone to produce 20,000 tons of paper a day.

The Canadian Northern Railway is reported to have completed a survey of the pulpwood and other resources along its line between Ottawa and Port Arthur, Ontario. The survey estimates that there are over 8,000,000 cords of pulpwood, and 25,000,000 ties available mainly within the area from which it can select the land grant given by the Province of Ontario in aid of the building of the line.

What extent of area is involved in this estimate is not divulged, but from private information it would appear that the total acreage will not yield more than three cords on the average, and five cords per acre if the Jack pine lands are excluded; but under fire conditions and transportation development, as they exist today, and due to inaccessibility, on account of topography, two fifths of the apparent supply may remain unavailable, leaving an average cut on the pulp lands of only three cords per acre.

The Riordan Pulp and Paper Company are making plans for beginning forest planting on cut-over portions of their timber limits in the Province of Quebec. Arrangements have already been made for planting out about 400,000 seedlings of forest species during the season of 1917. A forest nursery is also to be developed, the capacity of which will be one million small trees each year for planting on the holdings of the company. A. C. Volkmar is the forester in charge of this work, with headquarters at St. Jovite, Quebec. In addition to the nursery and planting work, information is being collected systematically with regard to the amount of growth which is taking place on the Company's property. It is obvious that this information is very important in connection with the preparation of plans for the permanent handling of a large area of forest land, on the basis of perpetual operation. The investment involved in the erection of a pulp and paper mill is so great that a company of this kind must look far into the future, in figuring on its sources of timber supplies.

The Laurentide Company and the Pejepscot Paper Company have already made a considerable showing in the direction of forest planting on their lands in Quebec, with a view to the future production of timber for the manufacture of pulp and paper. The Laurentide Company is the pioneer in this direction in Canada, its forestry work having for years been handled by Ellwood Wilson. The forestry and planting work for the Pejepscot Company are being handled under the direction of J. E. Rothery.

The St. Maurice Forest Protective Association, representing some 12,000 square miles of forest property in the St. Maurice watershed, Quebec, reports only four fires set by human agency, the balance having been set by lightning, This result is ascribed to a vigorous campaign of education among settlers, river drivers, and other careless users of fires, together with a permit system for settlers and ranger work.

The use of tank cars in fighting fires along railways is becoming more general in Canada. The Grand Trunk, Timiskaming and Northern Ontario, Canadian Government roads, and the Canadian Pacific use them. Two tank cars were installed lately by the Canadian Pacific Railway in the Muskoka district, after satisfactory experience in Maine. These comprise a single unit. On one of them is a pump, on the other the hose rack and water tanks, holding 7,000 gallons of water on each. The pump has a capacity of 400 gallons per minute. A total of 4,000 feet of 2.5-inch hose permits fires to be reached a considerable distance from the track.

Canada has lost through forest fires in 1916 over nine million dollars worth of timber, more than six times the amount spent on forest protection. The big fire in Ontario's clay belt alone called for the sacrifice of 262 lives and a destruction of property estimated at six million dollars.

Protection against forest fires from railroads has been effectually secured in Canadian chartered roads due to superior organization and good will on the part of the companies in carrying out instructions from the Board of Railway Commissioners and maintaining speeder patrols. All fires discovered, some coming from outside the right of way, this year were extinguished before material damage was done. Settlers' clearing fires are now the greatest hazard.

The reasonable success of the forest fire-weather warnings of the U. S. Weather Bureau forecasters of the West in 1913 and 1914, has led to an extension of the service with increased appropriations. Warnings of the probable occurrence of winds of sufficient velocity to be dangerous make it possible to increase fire crews, stop burning permits and take other precautionary measures.

As the article in this issue on fire season forecasts shows, a seasonal prediction is as yet impractical.

The Bell Telephone system of New Jersey exhibits the cooprative spirit for the protection of forests. The operators in each central office have listed among the emergency calls the names of one or more rangers who can be readily reached. Upon the report of a fire being called in, the fire warden can be communicated with without delay. In British Columbia also the telephone companies report forest fires, operators being instructed to give precedence to reports of fires.

The Massachusetts Forestry Association is sending out a sensible bulletin on the White pine blister rust scare intended to alleviate the fears that White pine is doomed, that no more White pine will be planted, that the whole forestry movement will be discouraged by this scare. Besides a vigorous campaign to control the disease, the proposition is made to do henceforth planting in mixture with Red pine, so that in 15 to 20 years by thinning either the White pine if infected, or the Red pine may be taken out.

Recent appointments to the Office of Investigations in Forest Pathology, Bureau of Plant Industry, are as follows: Samuel B. Detwiler, formerly field superintendent of the Pennsylvania Chestnut Tree Blight Commission, to be forest inspector in charge of field work on the White pine blister rust; Reginald H. Colley, lately assistant professor of Botany in Dartmouth College, and Minnie W. Taylor, lately assistant in Botany in Brown University, to be agents to assist Dr. Perley Spaulding in research work on the White pine blister rust. Mr. Detwiler is to have four assistants. Also about 40 field agents have been appointed for temporary periods of work on the blister rust. The field work east of Ohio is organized under the general direction of Mr. Detwiler; west of, and including Ohio, under Mr. R. G. Pierce.

Mr. S. O. Huckins,[1] of Mountain View, New Hampshire, who for many years has successfully operated small woodlots under conservative methods until now his operations extend to around 10,000 acres with three mills and 100 men, participated in the Forest Conference of the Society for the Protection of New Hampshire Forests, and has kindly furnished the following statement regarding his work:

"At the recent forestry meeting held at Crawford House,[2] the writer was impressed by a group of comparatively young men who were present and taking an active part in the sessions. They were filled with sufficient enthusiasm, ability, and energy to solve any problem. I was also disappointed by the entire absence at that meeting of the many strong men who direct the harvesting of New Hampshire's forest products, for without their cooperation improved methods will come slowly. I feel like saying to those gentlemen, let us join hands with those men who are doing pioneer work in forest conservation, and do our work by rule and line. By so doing, you can erect a monument, studding each hill, mountain, and valley, and every sparkling brook and crystal lake, that will challenge the approval of the present generation and receive a fervent blessing from those to follow. The papers read, lectures delivered, and rapid fire catechisms simply serve

[1] Mr. Huckins has shown his public spirit by donating for demonstration purposes a 100-acre tract of cut-over sand-plain land to the State of New Hamshire, on which plantations of White, Red and Scotch pine have been started in various ways.

[2] Conference of Soc. for Prot. of N. H. Forests.

as blazed paths for us to follow. If by our careless indifference we allow those paths to become obscure, chaos will continue in our forests. Last, but not least, please remember that a free, intelligent and progressive people govern this good old Granite State. If we fail to make good, we shall lose our job. We should demand of those people reasonable taxation laws. Laws that will encourage the retention and propagation of undersized trees, those that really possess little stumpage value but if allowed to stand will soon develop a second gleaning, for in the end the bread line rather than sentiment will be the deciding factor.

In 1872, the writer acquired title to 100 acres of forest land from which had been removed every tree possessing a stumpage value. There were in large numbers scattered unevenly over the lot rejected trees with short gnarled trunks and long widespreading branches, occupying small space on the ground, but shading (which discourages the growth of small trees) a large part of it. I recall taking measurements of a section shaded by one straggling, obnoxious looking tree, and found the dimensions to be 60 by 80 feet, 4800 square feet. Think of allowing this scavenger of the forest to control sufficient, almost ideal, forest land for upwards of forty years to grow, according to approved methods of forest estimates, 4,000 feet of box grade lumber, whose stumpage value in that location is $32. I succeeded in marketing those trees for cordwood for a small margin above cost of operating. For ten years I did not cruise the lot. After that period nearly every five years I did so, removing poplar trees that mature early and a stand of matured softwood growth. This lot is now covered, without an acre of waste land, with a mixed growth of hard- and soft-wood trees in various stages of development, from which trees can be taken in large numbers and of almost ideal formation. Around this lot, although not always contiguous, I have acquired title, and applied similar treatment to 10,000 acres of forest land, removing timber in large quantities from the same. This land is in all stages of development from the entirely denuded to perfect stands of matured growth. With approved methods of forestry there can be continuous operations on these lands without reducing the quantity of stumpage with the organization now perfected of about 60 horses and 100 men.

I also note a marked change in my sentiment toward forest growth. At first, my methods were almost brutal, no matter whether it was a tree of promise or of matured growth, if there was a dollar in it I wanted it quick regardless of the damage to small trees. I now note if they are needlessly injured or destroyed I experience a feeling of pity and compassion.

I have never practised tree planting, but feel certain from observing the results of others it will pay if an opportune time is taken when there is a surplus of labor. I expect to work along this line soon."

Professor Retan furnishes the following data on an improvement cutting on the Mont Alto Forest (Pennsylvania):

In the summer of 1908 an improvement cutting was made over the Oak Knob Compartment, comprising 30 acres of a mixed coppice stand of chestnut, Rock, oak, Red maple, locust, and inferior hardwoods. A careful calipering of the entire stand before cutting gave the following as the composition and volume of the stand:

	Number per acre	*Number per cent*	*Volume per cent*
Chestnut....................	148	22.5	31
Rock Oak....................	133	20	14
Other species................	377	57.5	55

The stand was 62 years old, 70 to 80 feet high, and had a sectional area of 87.5 square feet per acre. The improvement cutting was carried out under the direction of L. E. Staley, Forester, the marking being done by the Mensuration class of the Pennsylvania State Forest Academy. All crooked, diseased, and poor trees of valuable species were marked, and as many stems of other species as was possible without too great interruption of the canopy. The cutting yielded:

264.5 cords of wood	valued at...............	$506.74
68 telephone poles	" "...............	137.50
137 locust posts at 10–30 cents	" "...............	42.91
Total..............................		$687.15

or $22.90 per acre gross; net about $10 per acre.

In 1915, the stand was again measured by the Mensuration class of the Academy and showed the following composition:

	Number per acre	*Per cent*	*Av. Diam. inches*
Chestnut	56	35	11
Rock oak	50	31.2	8.5
Other species	54	33.8	4 +
	160		

The sectional area in 1915 was 87.54 square feet; practically identical with that of 1908, before the thinning was made. In eight growing seasons 160 trees had added a sectional area equal to that of the 598 trees taken out.

The following note on "*Cutleaf*" *Chestnut* is furnished by Prof. Retan:

In 1908, a thinning was made near "Orebank Eight" on the Mont Alto Forest in Pennsylvania. In 1913 to 1914 a permanent sample plot was laid off in this area and underplanted. While collecting growth data in 1915, one of the students called my attention to the peculiar leaves of a chestnut sprout. Two or three of the sprouts of one stool bore leaves very deeply cleft. The leaves resembled those of such varieties as the cut leaf maples and birches. The sprouts were about four or five feet high, and rather dense around the stool.

At the time, it seemed possible that it was only a freak and no especial attention was paid to it. But on returning to the plot this summer (1916), it was found that the sprouts again bore the same peculiar type of leaf. The other sprouts of the stool were cut away and the sprout showing the most marked variation will be favored to ascertain if the variation be permanent, or if it be only a result of the limited food supply.

The advocacy of municipal forests is bearing results, some ten cities can now be named in the United States having municipal forests, aggregating around 150,000 acres, and it is probable that altogether 250,000 acres are under such ownership; the largest perhaps is that of Newark, New Jersey, with 22,000 acres. Hartford, Connecticut, owns 4,000 acres; Fall River, Massachusetts, around 4800, of which 1550 acres is fit for planting, while the Metropolitan Water Board of Boston has planted about 1800 acres of its reservations.

A very readable and well illustrated article in *Logging* for October describes the operations in securing chicle in Mexico; the import of which material into the United States being in the neighborhood of five million pounds. The Mexican trees which are bled for the milky juice of chicle are *Diospyrus obtusifolia* and *Achras sapota*, of the Sapodilla family, both occurring in the river forests of Mexico, especially Yucatan. Lately a new field for chicle has been found in Brazil in *Mimusopa globosa*, the Bully tree.

In the record of the Investigative Program of the Forest Service for 1916, there are listed 162 problems, classified under 13 main headings, which are under investigation. It is interesting to note that the lion's share (70) is still occupied by investigations of products (which at one time were considered not within the sphere of a forestry bureau). The next largest number of problems concerns itself with grazing (28). Real forestry problems, to which we would count those in protection and mensuration, occupy about the same number. The problems in dendrology, tree studies (dendrology with a view to practical application) and forest types, altogether 13, belong to the forest botanical field, while the fire studies, forest influence, and other special studies number 14.

It is an enormous amount of work that is here undertaken, and from the appearance of the record thoroughly organized. Such work naturally leads to specialization, which some of the forest schools should particularly be fitted to take care of.

From a Bulletin of the Forest Products Laboratory at Madison it would appear that the manufacture of ethyl alcohol from sawdust can be accomplished profitably. If this can be done, as claimed, at 20 cents per gallon, it would be a most welcome method of using waste. Hitherto all attempts at commercial manufacture seem to have failed. For success, it is claimed large plants are needed, consuming larger quantities than can be cheaply enough brought to the distillery.

At the Forest Products Laboratory at Madison, Wisconsin, the Forest Service is carrying on a series of tests, in cooperation with the American Society for Testing Materials and the National

Association of Box Manufacturers, to show the strength of boxes of various woods and of different construction. The results of these tests show a decided need for standard classification of box woods. The demonstration machine for testing consists of a horizontal drum with 3½-foot sides, which is lined with thin steel sheets. Pieces of scantling belted to the bottom form what are known as "hazards." The boxes, filled with cans containing water, are placed in the drum, which is then rotated, the hazards causing the boxes to be carried part way around and then dropped back to the lower level in imitation of the probable treatment that would be received in shipment.

Receipts from the National Forests for the fiscal year 1916 reached the highwater mark of approximately $2,820,000, being $341,000 more than for 1915, which exceeded any previous year. There seems to be an increase from all sources of revenue from these Forests, but the largest was $203,000 from timber sales. Grazing fees show a gain of $77,000 and water power development, $12,000, over 1915.

Apropos of the appropriation of $3,000,000 for continuing land purchases for forestry purposes under the Weeks law, Congress was recently furnished with information to show that various States are cooperating with the government in the expenditure of money for forestry, fire protection, and watershed benefit purposes, with appropriations as follows: Maine, annual, $71,400; New Hampshire, annual, $38,800; Vermont, annual, $19,500; Massachusetts, annual, $83,000; Connecticut, total, $7,500; Rhode Island, $3,000; New York, total, $177,840; New Jersey, total, $43,000; Pennsylvania, total, $315,375; Maryland, total, $10,000; Virginia, total, $5,000; West Virginia, total, $10,000; North Carolina, total, $23,000; Tennessee, total, $3,000; Kentucky, total, $15,000; Alabama, total, $500.

The Hawaii National Park, just created by Congress, is the first National Park lying outside the continental boundaries of the United States. Located within its bounds are three Hawaiian volcanoes said to be "truly a national asset, wholly unique of their kind, the most famous in the world of science, and the most continuously, variously and harmlessly active volcanoes of the earth."

The recent conference of Federal and States representatives in Melbourne unanimously carried a resolution approving the establishment of a central school of forestry by the Commonwealth and the States, and also that a special training school of tropical forestry should be instituted. The subject of forestry is one that is attracting increasing attention throughout Australia, and all the States are giving it serious attention, though so far small practical results have been achieved. The Minister for Lands of New South Wales has announced his intention of submitting to his Cabinet definite forestry proposals, and he states that very shortly three million acres of State forests will be allocated.

The usual annual Forest Conference under the auspices of the Society for the Protection of New Hampshire Forests was held September 5 to 7, at Crawford House in the White Mountains and was well attended by foresters. The main subjects discussed were the woodlot problems by Professors Roth and Toumey, and questions of taxation, White pine blister rust, State aid in forestry, national parks, purchases and policy in regard to purchases under the Weeks Law. Dr. Fernow, reviewing past and forecasting future aims of the forestry movement, suggested the need of a broader, national policy, which would take the form of cooperation between federal and State governments in the acquisition and management of State forests.

The Western Forestry and Conservation Association held a two-day session in Portland, Oregon, October 24 and 25, followed by a two-day session of the Pacific Logging Congress. Mr. W. B. Greeley gave the leading address, discussing the assistance which the Forest Service is giving the lumber industry and reciting statistical information. Post-bellum possibilities were discussed by Dr. Pratt, of the United States Bureau of Foreign and Domestic Commerce, arguing for a great boom to fill a deficit of the European countries of $800,000,000 worth of lumber.

In a bulletin of the United States Geological Survey on "The Flora of the Fox Hills Sandstone in Northeastern Colorado," Mr. F. H. Knowlton concludes from floral remains that in early geological times this region was forested, the remains showing two species of Sequoia, two yew-like trees, a fig, a tree related to the wax myrtle, a tree like the buckthorn, a relative of black haw, and some other land plants. It is evident from these species that in those times, before the Rocky Mountains came into existence, the climate of this corner was totally different.

Another bulletin from the Survey, by Watson and Berry, brings floral evidence that the climate of certain parts of Mississippi at one time was tropical in character, date palms, tropical myrtle and fig having been found in the remains, as well as bones of camels.

The Executive Committee of The New York State Forestry Association at a meeting held at the Hotel Ten Eyck, Albany, New York, October 4, issued the following statement. "The Executive Committee of The New York State Forestry Association urges every public spirited citizen of New York State to approve the Meier $10,000,000 referendum providing funds for the purchase of land in the Adirondack, Catskill and Palisade Parks at the November election."

The following facts were cited in favor of its adoption by the people:

1. The purchase of Mountain land in the Adirondack and Catskill Parks has proved to be one of the few profitable investments ever made by the Empire State since the present holdings could be sold for some five times the original purchase price.
2. The use of these mountain lands is of increasing value to the State not only from the standpoint of recreation value, but also from their importance in conserving the run-off of mountain streams.
3. By properly and systematically locating the purchase areas, present holdings could be consolidated to a large degree. In addition, lands in danger of denudation or partially burned lands could be brought under State control and so handled as to make them an asset to the State.

Members of the Executive Committee, however, expressed it as their firm conviction that in view of the possibilities of extensive land purchases in the Adirondack and Catskills, the Conservation Commission should enunciate a clear cut policy for the management of forest land both public and privately owned with the idea of avoiding any possible hardships to present owners. They also stated it to be their belief that a thorough boundary survey and stock-taking of the present holdings were extremely important, since such surveys in the past have been largely ocular estimates owing to the lack of funds, and which are likely to be only approximate.

Mr. Victor A. Beede, Assistant State Forester of New Hampshire, has been elected Executive Secretary of the Association, with headquarters at the Chamber of Co nmerce Building, Syracuse, New York. Mr. Beede is a graduate of Yale University, the Yale Forest School. Following his graduation he visited France, Germany and Switzerland and observed the forest practice in those countries. He has served as Forester and Assistant Secretary of the Massachusetts Forestry Association, and as Forest Assistant on the Pike National Forest in Colorado. Mr. Beede will take up his new position on November 1.

During the past summer the forestry department of Iowa State College took its sophomore students on a three months' study excursion of several thousand miles through the Western forests under guidance of the faculty. For the most time the party camped with its own outfit; the longest camp, of three weeks' duration, being made at Columbia National Forest in Washington·

Lumber manufacturers' associations and lumbermen have cooperated cordially with the New York State College of Forestry in supplying wood panels for the rotunda of the College. Panels of the native hard- and softwoods of the home State occupy the central place, the more important commercial woods from the Western States and from foreign countries, for example, such woods as African gaboon, East Indian koa, rosewood, satinwood, camphor wood, teak, Circassian walnut and different kinds of mahogany, being grouped along the walls. Labels with common and scientific names of the woods have not been forgotten.

The farm woodlots in the United States are said to contain about 10 per cent of the standing timber in the country, and the annual value of the products to be over 195 million dollars.

The selling of lumber in short lengths for odd jobs is gradually becoming established. A company is reported as having been formed at Portland, under the name of the Miniature Lumber Company, to supply departmental stores with cabinets for the display of such lumber.

Balsa (*Ochroma logopus*) is a tropical American tree having a very soft wood that the Missouri Botanical Garden has shown is only about half as heavy as cork. This wood is being used in life-rafts, life-belts and for buoys of various kinds, and is claimed to be preferable to cork in other respects as well as in lightness.

The manufacture of dyes from the waste of osage orange wood is becoming a commercial success as a result of investigations carried on by the Forest Products Laboratory, at Madison, Wisconsin. Carloads of the wood are now being shipped to Eastern extract plants from Oklahoma, and the dye is being produced at the rate of about $750,000 per year. Before the establishment of this industry the waste of osage orange wood had no market value and the extract plants were importing dyewood from Mexico and Central America.

The St. Paul and Tacoma Lumber Company recently purchased from the General Vehicle Company a second and improved electric lumber tractor. The first machine has been in constant use for about one year and has given excellent results. The tractors, being operated by storage batteries, do not constitute a fire menace to the lumber plant, and the charging current being taken from the mill's lighting plant, the cost of power is almost nil. It is said the two tractors will displace 13 or 14 horses, effecting within a short time a saving that will pay for the entire investment. According to the factory records, the average length of life of electric tractors is 10 years.

A correspondent in the *Gardeners' Chronicle* states that "Perhaps the largest, certainly the most remarkable, Catalpa in London is that known as Bacon's Catalpa. It is growing near the center of Gray's Inn gardens, and has a tablet attached which bears the following words: 'Catalpa tree said to have been planted by Francis Bacon when Master of the Walks, Anno Domini 1598.' The tree is of unusual appearance owing to having been partly uprooted many years ago. The stem, which is 18 inches in diameter, rests on the ground for about 9 feet of its length, and has, fortunately, been well preserved by filling up the diseased and hollow portions with cement, while the far-spreading, heavy branches have been supported by props and thus prevented from breaking away from the main stem. Though there are some dead and dying branches on the tree, yet its general health is good, and, should no accident befall it, will live for many years to perpetuate the memory of the great writer. It produced flowers abundantly in 1909.

"On the opposite side of the gardens is a seedling from Bacon's tree, which has far surpassed the parent both in size and beauty of appearance. This noble specimen has a branch spread of 60 feet in diameter. From the main trunk, which is about 2 feet across, three great limbs have been sent out, and altogether the tree is in a healthy, thriving condition."

We regret to state that Mr. H. R. MacMillan, who was responsible for the excellent organization of the British Columbia Forest Branch, has resigned to accept the position as Assistant Manager of the Victoria Lumber and Manufacturing Company, at Chemainus, B. C., one of the largest lumber concerns on the Pacific Coast. The provincial government and the cause of forestry are losers, although we dare say Mr. MacMillan will not forget his forestry training and will eventually be again a power for good.

We record that the old, and favorably known, firm of Thomas Meehan and Son, nurserymen, have discontinued the seed business which department has been taken over by Thomas J. Lane, of Dresher, Pennsylvania, who in his first fall price list promises to continue "the same honorable policies of my past employers."

We note that White pine seed at $1.50 is now cheaper than Scotch pine ($1.75), but that Red pine is still quoted at $6.25.

The following announcement by Secretary H. A. Reynolds, of the Massachusetts Forestry Association, whose headquarters are at 4 Joy Street, Boston, Massachusetts, may be of interest to our readers:

Owing to lack of space in our offices, it has become necessary to dispose of scores of duplicate bulletins, booklets, etc., on practically every subject relating to trees and forestry. Some of these are valuable and we should be glad to have you call and look them over, or write for bulletins on any particular subject. They are yours for the taking. We shall hold them 30 days for you, after which time they will be disposed of.

Representative Albert Johnson, of Washington, in the last session of Congress introduced a bill (H. R. 528) to discontinue the use of the Fahrenheit thermometer scale in government publications, substituting the centigrade scale. It is, of course, expected that if the government changes, all the people would change; the change is proposed to take place after January 1, 1920. It is strange that the irrational Fahrenheit scale, which was discredited in the country of its inventor, should have been adopted by the English-speaking nations. But for the momentum of established usage, we would expect Great Britain to follow this example, especially now since hatred of everything German is the order of the day.

PERSONALITIES

1. *Northeastern United States and Eastern Canada*

Howard B. Waha was married on September 30 to Miss Henrietta Alcorn, of Ravenna, Ohio.

G. Harris Collingwood was married on September 1 to Miss Jean Cummings, of Centerville, Mich.

Seward Smith has succeeded G. H. Gutches as head of the New York State Ranger School, who has re-entered the service of the Dominion Forestry Branch.

R. R. Chaffee has resigned his position as Professor of Lumbering at Penn State to enter the employ of the Wheeler and Dusenberry Lumber Company, Endeavor, Pa., as forest engineer.

William A. McDonald, for three years Assistant Professor of Extension in the New York State College of Forestry, has resigned to engage in business at Owasso, Mich.

Theodore Salisbury Woolsey, Jr., is substituting for Chapman at the Yale Forest School during the latter's absence on Sabbatical leave.

John A. Sweigert has left the D. & H. and is with the B. P. I. on blister rust work in Massachusetts.

On November 1, Victor A. Beede, hitherto Assistant State Forester of New Hampshire, became permanent Executive Secretary of the New York State Forestry Association, with headquarters at the Syracuse Chamber of Commerce, Syracuse, N. Y.

Ralph C. Bryant spent the summer in the West, getting in touch with the lumber situation.

H. H. Chapman is taking his Sabbatical leave this winter, resuming work with the senior class at Urania, La., in March. He is spending part of the time in Minnesota and the remainder in the Southwest, where Mrs. Chapman will go for her health.

H. M. Curran is helping Whitford of Yale in getting the tropical forestry work started at the School of Forestry.

Lansing T. Shumway (Biltmore, 1912) and Miss Lucile Adelia Neilson, of Stillwater, N. Y., were married on June 24.

Carl H. Nye (Biltmore, 1911) and Miss Madeline Marie Neal, of Waterbury, Conn., were married on August 5.

Donald P. White (Biltmore, 1911) and Miss Marjorie Crane Sisson, of Potsdam, N. Y., were married on August 19.

The name of G. E. Bothwell, graduate (1913) of the Toronto Forest School, appeared in the Canadian casualty lists as "missing so long, believed killed," but is now known as killed.

K. B. Downie and F. G. Stupart, undergraduates in the Toronto Forest School, have been killed in action with the Canadian troops in France.

Capt. Alan Edward Parlow (B. Sc. F., Toronto, 1913), of the 11th Sherwood Foresters, B. E. F., France, was married to Grace Lee Ryan, of Victoria, B. C., in London in September, on leave of absence from the front. Capt. Parlow before enlistment at the outbreak of the war was employed in forestry work in British Columbia for the Dominion Forestry Branch.

Word has been received just as we go to press that Lieut. J. D. Aiken has been killed in action with the British Forces in France. Lieut. Aiken was a graduate of last year's class at the Forest School of the University of Toronto.

Ellwood Wilson, Jr., who studied forestry and engineering at Cornell and McGill Universities, has enlisted with the 242nd Forestry Battalion, C. E. F., and has been given a commission as lieutenant.

Dr. J. S. Bates, Superintendent of the Forest Products Laboratories, at Montreal, Quebec, has left for Shawinigan Falls to assist the Imperial Government in the production of chemical products needed in munitions manufacture. Dr. Bates is "loaned" to the Imperial Government by the Dominion Government for the period of the war.

W. B. Campbell, Assistant Superintendent, who has been to the front for the past twelve months, has returned to take up the duties of Dr. Bates until his return.

2. *Southern United States*

Samuel B. Detwiler is in charge of the field work of the Bureau of Plant Industry in detection of the White pine blister rust.

Lincoln Crowell has resigned from the Indian office, where he was in charge of the work on the Cherokee Indian Reservation, N. C., and, with his brother, has purchased a farm at Sandwich, Mass.

James O. Hazard has sold his farm at Tuckahoe to the Dupont Powder Company and has purchased another at Uhlerstown, Pa., opposite Frenchtown on the Delaware.

H. J. Kaestner, Forester for the Department of Forestry, Game and Fish, of West Virginia, has resigned to enter the employ of the William M. Lloyd Lumber Company of Philadelphia.

3. *Central United States*

William G. Baxter resigned from the Forest Service on September 1. He is farming in Iowa.

Stephen Klem has resigned from the faculty of the Michigan Agricultural College and is now agent for the Provident Life and Trust Company, with an office at East Lansing, Mich.

4. *Northern Rockies.*

Bartle T. Harvey has opened an office at Missoula, Mont., as consulting forest entomologist.

William M. Mace has been promoted from Deputy Supervisor to Supervisor of the Dixie National Forest, with headquarters at St. George, Utah.

5. *Southwest, Including Mexico*

Thomas McCullough has resigned from the Forest Service and is now with Babbett Bros. of Flagstaff, Ariz.

Emanuel Fritz has been transferred from Missoula to the Fort Valley Experiment Station at Flagstaff, Ariz.

John D. Guthrie has been elected as a member of the executive committee of the Northern Arizona Game Protective Association.

Clifford W. McKibbin has resigned from the Forest Service. He was forest examiner in the District office of Silviculture.

Athol A. Wynne, long-time lumberman in the District office, has resigned from the Forest Service.

6. *Pacific Coast, including Western Canada.*

R. M. Evans has been promoted from Deputy Supervisor to Supervisor of the Whitman National Forest, succeeding the late Henry Ireland.

Richard M. Brown (Biltmore, 1912) and Miss Dorothy Davies, of Seattle, Wash., were married on July 29.

Geo. T. McCaskie, Jr. (Biltmore, 1911), and Miss Jane Heilman, of Portland, were married May 10.

John P. Van Orsdel has been appointed to the position of Professor of Logging Engineering in the School of Forestry at the Oregon State College.

C. H. Morse, Assistant Inspector in the Forestry Branch at Alberta, has enlisted with the 224th Forestry Battalion.

C. P. Willis, forest examiner in the District office, has resigned from the Forest Service.

COMMENT

We do not apologize for publishing in one number, the last of this journal, three articles by the same author, which were received during the summer and bear testimony not only to the assiduity, but to various other virtues of the author. Mr. H. R. MacMillan, until recently the efficient Chief of the Forest Branch of British Columbia, as Special Commissioner of the Dominion Department of Trade, spent a year in making a tour of the world to investigate market conditions and possibilities of extending lumber exports from the Dominion. While on this mission, Mr. MacMillan found time not only to inform himself on the general forestry situation in the various countries he visited, but to record his facts and findings in a series of articles for the readers of the QUARTERLY, giving insight into forestry conditions in Ireland, India, South Africa, and certain phases in France. Written while still under the fresh impression of personal visit, with a singularly comprehensive grasp and rare critical judgment of the situations inspected, these articles are classics, and models of live reporting. Our readers will find them not only full of interest in the account of what other people are doing, but suggestive and helpful in shaping our own policies.

It is with great regret we have to record that, since his return, Mr. MacMillan has left the Forest Branch which he had so efficiently organized, to accept the position of Assistant Manager of one of the largest companies in British Columbia, the Victoria Lumber and Manufacturing Company. He thus in his own person illustrates his remark, speaking of the liberality of the British government, that "the lack of a defined salary policy on the part of many governments . . . is certain to render difficult the holding of the best men." Such men are gobbled up by private employers when they are recognized. The English governments in their dependencies certainly compensate their officials on a scale, including a pension, which binds them permanently to their work and gives them a certainty of their future, entirely lacking in American public service on either side of the line.

It appears that our forecast made on page 358, regarding ups and downs in the forestry movement in China, was to be realized sooner than expected. It appears that the friendly Minister

Chow-Tsz-chi resigned about the time we made reference to him, and has been succeeded by various ministers who have shown less ardor in advancing the forestry movement; indeed, attempts to discontinue the small beginnings of a forest service were made by more than one of them, and this may have been accomplished by this time. Meanwhile, we bring in translation the very wording of the Chinese forestry laws, kindly prepared for us by Mr. Sherfesee.

DATE	ISSUED TO
Dec 3 87	John [illegible]