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THE OBJECTS FOR WHICH THIS JOURNAL IS PUBLISHED ARE:

To aid in the establishment of rational forest maangement.

To offer an organ for the publication of technical papers of interest to professional foresters of America.

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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ERIC OUTLOOK SYSTEM.

By F. B. Knapp.

The old adage, "In time of peace, prepare for war," was never more applicable than in the various phases of the fight to prevent the loss by forest fires.

Though still in its infancy, scientific fire fighting is making rapid progress in organization, equipment, and methods, preparation being made in advance.

While much has already been done in the attempt to reduce the number of fires started the forester is very much handicapped, even when he has funds, by the lack of satisfactory laws, the unwillingness of the local authorities to enforce those we have, and, above all, the disregard of the laws and rights of others by the public and lack of a feeling of personal responsibility of the individual. At best, it will take much hard work to bring about reasonable care, and even then we must still be ready for some unavoidable fires.

On the other hand, with a moderate appropriation, much can be done at once to prepare for quick detection of fires and prompt notification of the wardens.

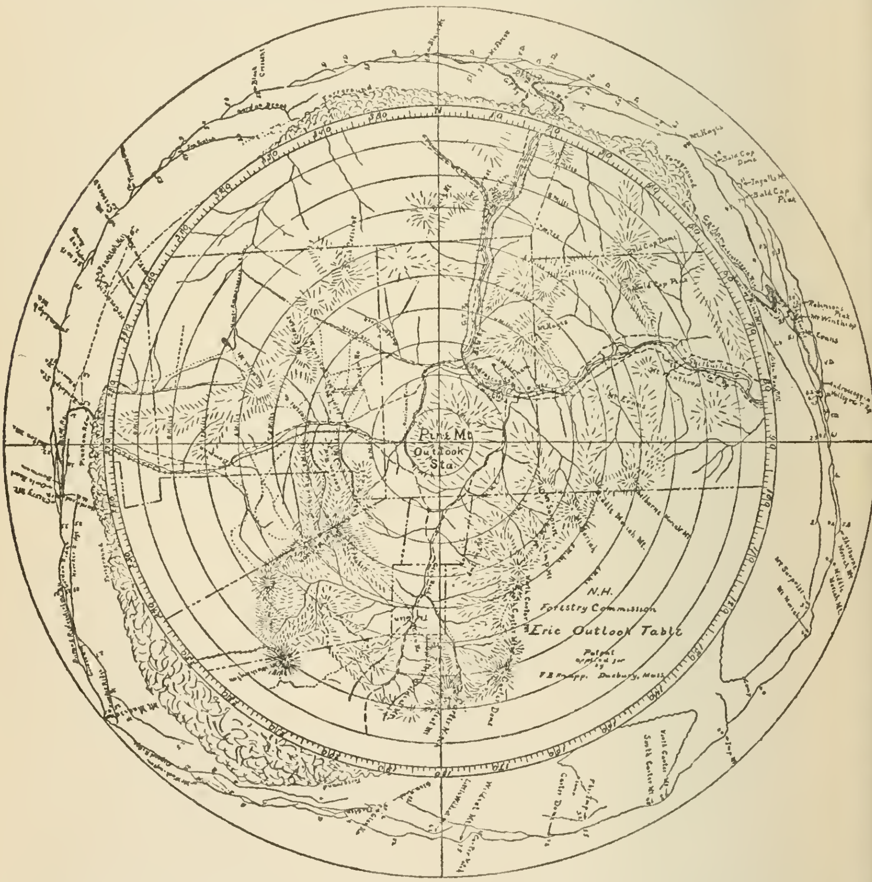
Two methods are in use for this purpose, the patrol and the lookout station. The patrolman is a great help in the prevention of fires by both the warnings and instruction he gives to persons who might start them and by the fear of detection which he inspires in careless and malicious persons; but, in general, he is not in position to discover a fire quickly or to give a prompt alarm. For, in a well wooded district, the trails which he must watch are apt to be under the forest cover from which for considerable times he has only an exceedingly restricted view. And even where his route is on ridges, he is often little better off; when having discovered one fire, his duty prevents him from watching

ERIC OUTLOOK TABLE.

A Fixed Table for Forest Fire Outlook Station, With Oriented Map, Divided Circle, Panorama With Names and Distances, Alidade Pivoted at the Center.

A fire discovered by the naked eye or field-glasses is sighted to by the alidade with mined by tying in from another station or telephoning along the line of sight.

If the fire is in plain view, it is located by the panorama or map. When the smoke rises between two ridges, it is determined within certain limits by the panorama and in direction by the circle. When seen vaguely or over a ridge with a broad unseen



expanse beyond, the direction is obtained by the circle, the exact location to be determined by tieing in from another station or telephoning along the line of sight.

The panorama is very much easier to read than a map, requiring less technical skill.

The table being fixed, there is no need for adjustment or danger of error from accidental disturbance.

The circle, divided into degrees, has not the uncertainty of a compass. Starting from the true north, it coincides with the map. Being marked from 0° to 360°, merely a number has to be telephoned to give the bearing. The maps of the superintendent and wardens are readily arranged so as to give the line of sight as telephoned from the station.

A new man can report a fire correctly at once instead of requiring days or weeks to become familiar with the landmarks. This is especially important; for, with the increased number of stations, some observers are sure to give out at the height of a fire season, and a substitute ordinarily cannot do efficient work.

for another. In contrast to this, the lookout watchman is where he constantly commands a wide expanse of country; he has his instruments of precision right at hand and can give notice more accurately and promptly than the patrolman.

Different plans are being experimented with for the use of the watchman. That adopted by New Hampshire, the Eric Outlook System, is giving very good satisfaction; with telephone connection; field glasses; and an outlook table having an oriented map, azimuth circle, panorama, and alidade. This, supplemented by secondary stations with simpler tables to be used in thick weather and times of extreme danger, and by maps with attached protractors and threads, in the hands of the wardens, enables the fire fighting force to be put in the field quickly and where needed.

At the risk of being charged with the desire to advertise the apparatus, I may be allowed to quote from a letter by one of the watchmen forwarded by the State Forester of New Hampshire:

"We have found the panoramic map sent to us for locating fires of the greatest value in locating forest fires of any apparatus supplied as yet. Its simplicity and accuracy can not be too highly complimented. Every detail necessary in locating the most obscure places seems to be included in our maps. The concentric circles, drawn on the scale of every mile, enables the operator to calculate the shortest possible distances. This feature of the map is especially useful when the watchman wishes to inform the warden of the location of the fire with respect to a certain point with which the warden is more familiar than the watchman."

I may add that the New Hampshire Forestry Commission has adopted this system.

Main outlook stations, manned the whole season, have the Eric Outlook Table, twenty-six inches in diameter, fixed in position.

oriented map, divided circle, panorama, and alidade pivoted at the center.

Secondary stations, manned at times of special danger, have either the Table or Sub-Table.

Sub-stations, with no regular observer, have the Sub-Table, eight inches in diameter, fixed in position, divided circle, pin- and thread alidade. (This sheet has the divided circle of the Sub-table.) All stations are connected by telephone with each other, fire wardens, and officials. The Despatcher (who may be in the District Chief's office or an observer at a main Outlook Station) has the district map on a large table. He is the central officer to whom fires are reported, who gives orders, and, in a big fire, directs the general movements of fire fighters, apparatus, and supplies. All maps are supplied with thread fastened at the location of each station within its bounds and a four-inch protractor surrounding such station. The fire is located on the map by description by one bearing and the distance; or by two bearings as indicated by the intersection of threads.

THE PRESERVATIVE TREATMENT OF WOOD.

I. THE VALIDITY OF CERTAIN THEORIES CONCERNING THE PENETRATION OF GASES AND PRESERVATIVES INTO SEASONED WOOD.*

By Irving W. Bailey.

In the preservative treatment of wood the engineer and business man are frequently confronted by results which cannot be explained satisfactorily. It is reasonable to suppose that the study of fundamental factors which control the penetration of preservatives would assist materially in clearing away many of these difficulties which at present confront the timber preserving industry. Since wood is a highly specialized and complicated tissue, one of whose functions in nature is to conduct aqueous solutions from the roots to the crown, the anatomy and physiology of plants have a direct bearing upon the problem.

In certain lines of research the theories and observations of one investigator must be carefully checked by an independent investigator before they are generally accepted as conclusive. This practice might well be applied in all technical research which has a direct economic significance to individuals who are unable unassisted to test the accuracy of the investigations. It is the object of the writer to analyze in the following pages certain theories of Tiemann and Weiss, which if correct are of fundamental importance in the seasoning and impregnation of timber.

Tiemann's hypothesis may best be summarized by extracts from his paper in the bulletin of the American Railway Engineering and Maintenance of Way Association.†

"In fresh green wood of all species the cells of all kinds (except the resin ducts and the vessels) are completely closed by the continuous primary wall, and gases cannot be forced through this enclosing membrane even at extreme pressures. Water may per-

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*Contributions from Laboratory of Wood Technology of the Harvard School of Forestry. No. 1.

†Tiemann, H. D. The physical structure of wood in relation to its penetrability by preservative fluids. Bulletin 120. American Railway Engineering and Maintenance of Way Association.

colate through this membrane gradually as through a filter, but this action must be comparatively slow even under high pressure. * * * *Whenever wood seasons (beyond its fiber saturation point) whether naturally or by artificial means, narrow microscopical slits occur in the walls of the fibers and tracheids which render them penetrable to gases and liquids.* These slits do not reunite when the wood is resoaked, although they may close up somewhat. The greater the degree of dryness, the more penetrable the wood becomes. * * * Steaming opens up these slits in the cell walls, but they are not as numerous nor as wide as in air-dried material."

This hypothesis strengthens the position of those impregnation experts who claim that timber must be thoroughly air-dried to secure a rapid, thorough penetration. Furthermore, it apparently explains the value of preliminary steaming under pressure in kiln-drying green lumber. It indicates the reason why wood dried and then resoaked is weaker than the original green material, why the failure of resoaked beams resembles that of dry beams, etc., etc.

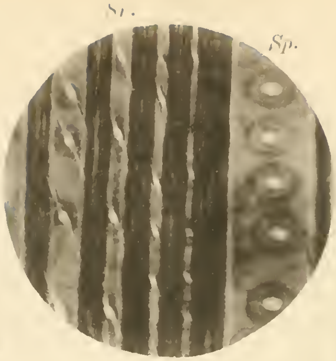
A. Distribution of "Slits" in Air-dry Wood.

As a special test of this point the writer has examined thin sections cut from one hundred specimens of thoroughly air-dried wood. The material included all the important timber producing conifers or "softwoods" of the United States. Spiral cracks in the cell walls occurred (as a result of drying or seasoning) in 10 per cent. of the material examined. In the remaining 90 per cent. the walls were entire, unruptured by the heavy stresses produced by contraction of the cells in drying. The examination of a large number of thoroughly air-dried Dicotyledons or "hardwoods" showed as in the case of the "softwoods" that cracking of the cell walls in drying is of comparatively limited occurrence.

Furthermore, numerous experiments showed that air may be passed as easily through the unruptured dry material as through the material whose cell walls had been "slit" in drying.

B. Distribution of "Slits" in the Annual Ring.

In all the material of coniferous woods examined by the writer the drying cracks or "slits" were invariably confined to the heavy



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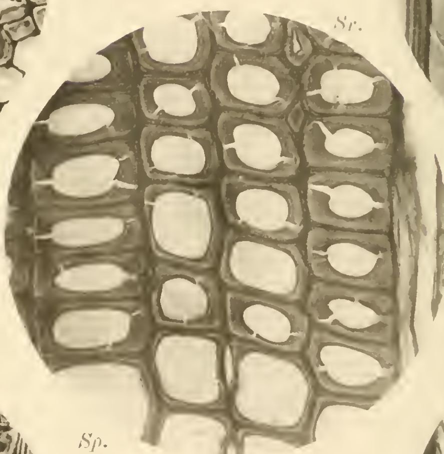

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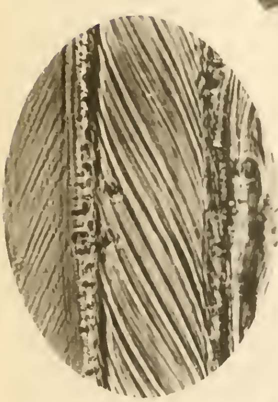

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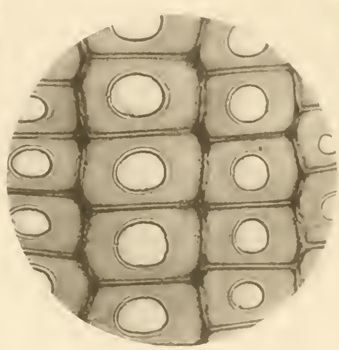


BAILEY — VALIDITY OF THE "SLIT" HYPOTHESIS thick-walled cells of the so-called "summer" or "autumn-wood" (Sr.), which are formed during the last part of the year's growth. (See Figs. 1 and 4.) The larger thin-walled cells of the so-called "spring-wood" (Sg) were unruptured and therefore, according to Tiemann's theory impervious to gases and heavy oils. Yet as Tiemann has figured clearly,* air passes very rapidly through the thin-walled cells of dry "spring-wood."

C. Distribution of "Slits" in the Layers of the Cell Wall.

The wall of a wood cell is not chemically and stucturally homogeneous throughout, but is differentiated in most cases into three more or less clearly defined layers or coats. The outer membrane or layer which is supposed to entirely inclose the rest of the cell is called the primary wall, and is considerably thinner than the succeeding layer within, which is heavily lignified and very variable in thickness (Fig. 4). The latter layer is called the secondary wall and is separated from the lumen or cavity of the cell by a third, usually extremely thin, layer or tertiary wall (Fig. 7). The secondary wall is comparatively thin in the large "spring-wood" cells, but becomes much thicker in the cells formed at the end of the year's growth. (See Fig. 4). As has been stated, cracks or "slits" due to drying are confined to the heavy walled cells of the "summer-wood" (See Sr. Figs. 1 and 4). If very thin, carefully cut and stained sections are examined under high powers of magnification it becomes evident at once that the so-called "slits" or rents in the cell walls are confined entirely to the secondary and tertiary layers (See Fig. 4). The primary walls remain unruptured *preventing effectively the penetration of gases and heavy oils from one cell to another by means of the cracks in the secondary walls.* In Fig. 4, a cross section of pine wood, it may be noted that in order for air to pass from one cell cavity to another it must pass through two layers of unruptured primary wall, which together possess considerable thickness, equal in many places to the thickness of a single layer of secondary wall. A similar condition is illustrated in Fig. 2, a cross section of the fibers of a "hardwood" or broad-leaf tree. From this it is clear that drying cracks or "slits" even when pre-

*Tiemann, H. D. The physical structure of wood in relation to its penetrability by preservative fluids. Fig. 5, page 8.

sent cannot account for the rapid penetration of gases and preserving fluids.

D. Penetration of Air Through Green Wood and Re-soaked Dry Wood.

The observations of the writer confirm the statement of Tiemann that the spiral cracks when once formed do not close when seasoned material is re-soaked. In view of this fact is is significant that in many cases dry wood when thoroughly re-soaked is, under moderate pressure, as impervious to air as unseasoned material. Furthermore, although long pieces of green sapwood are impervious to air, even under heavy pressures, short pieces of the same wood, more than one fiber length long, may be penetrated easily and rapidly and by slight pressure.

E. Weiss' Modification of Tiemann's Hypothesis.

In a paper read before the American Wood Preservers' Association, Weiss* explains the greater penetration of creosote in dense woods and in heavy "summer-wood" of long-leaf pine paving blocks by the fact that dense tissue cracks more in drying. "Such splitting does not occur to the same extent in the light thin walls, as they seem to yield and bend more under the readjustment of the wood during drying. The heavy walls it seems, therefore, cannot readily adjust themselves to moisture changes, and consequently split somewhat in the manner of a tie when it dries too rapidly."

The objections to Tiemann's hypothesis which have been outlined above are equally significant in this case. However, as a special test of this theory I have examined the wood of long-leaf pine paving blocks in which the penetration of heavy creosote and tar oils was confined almost exclusively to the dense bands of "summer-wood." The secondary walls of the "summer-wood" in the majority of cases were found to be unruptured. Fig. 7 illustrates a cross section of the "summer-wood" of a very dense specimen of long-leaf pine. The heavy secondary walls are seen to be devoid of drying cracks (Compare Fig. 4). Since greater

*Weiss, H. F. Structure of Commercial Woods in Relation to the Injection of Preservatives. Proceedings of the Eighth Annual Meeting of the American Wood Preservers' Association, 1912, pp. 158-87.

penetration occurs in unruptured as well as ruptured bands of "summer-wood" cells the phenomenon must be due to some undetermined factor.

F. Certain Structures Easily Confused With Drying Cracks.

In those portions of the stem and branches of coniferous trees which are called upon to resist heavy stresses in compression a highly specialized type of tissue is laid down by the cambium. This tissue is structurally designed to resist compression. The inner and thicker part of the secondary wall of its component cells or tracheids is composed of very fine more or less closely approximated spiral bands. In longitudinal or cross sections of dry wood these cells might easily be mistaken by the unsuspecting observer for cells whose walls had developed numerous fine cracks or "slits" in drying. However, as is shown in Fig. 5, a longitudinal section of freshly cut green white pine sapwood taken from the immediate vicinity of the cambium, these structures are not a concomitant of drying or seasoning, but are fine screw like bands deposited upon the inside of the cells by the protoplasm. In a subsequent article of this series, the writer will consider in detail this specialized tissue or "Rothholz" as it is called by European investigators.

Fig. 6 is a photomicrograph of a longitudinal section of air-dried loblolly pine sapwood, and illustrates a condition which occurs in air-dried hard pine from the Southern United States. The striated or cracked appearance has not been produced by shrinkage of the cell walls in drying, but is the result of incipient stages of decay. The minute mycelium of the fungus travels spirally within the thick secondary walls of the "summer-wood," gradually dissolving the wall substance by its enzymes or ferments. Seen under magnifications such as are commonly used in studying woody tissues these spiral cavities, in longitudinal sections of the wood, might easily be mistaken for drying cracks. However, by using thin sections and high-power, oil-immersion lenses the structures are seen to be produced by a wood destroying fungus. In cross section the secondary wall is seen to be not cracked as in Fig. 4, but drilled by numerous small circular burrows which contain the dried mycelium of the fungus.

Summary and Conclusions.

1. Spiral cracks in the walls of tracheids and fibers occur in only a small percentage of dry wood.

2. Spiral cracks when present are confined in coniferous woods to the heavy thick-walled tracheids at the end of the year's growth.

3. Spiral cracks are confined to the secondary and tertiary layers of the cell wall and the primary wall remains unruptured.

4. Air passes as easily through dry cells whose walls are unruptured as through cells whose secondary walls have cracked in drying.

5. In many cases air cannot be passed through dried cells whose secondary walls possess well developed "slits" or cracks.

6. Although drying cracks or "slits" do not close when dry wood is thoroughly re-soaked, re-soaked wood is in many cases as impervious to air as unseasoned material.

7. Although air cannot be forced through long pieces of green coniferous wood even under heavy pressures, it passes in many cases through short pieces of more than one fiber length.

8. In long-leaf pine paving blocks, when the penetration was confined largely to the dense bands of "summer-wood," the walls of the latter were in the majority of cases found to be unruptured.

From this it is clear that Tiemann's "slit" hypothesis cannot account for the penetration of gases and oils into seasoned wood. Similarly, Weiss' theory cannot account for the greater penetration of preservatives into dense tissues. In both cases some undetermined factor or factors are at work which control the injection phenomena.

Description of Plate I.

Fig. 1. Radial longitudinal section of a western hard pine showing spiral cracks or "slits" in the thick walls of the "summer-wood" (Sr). The thin-walled spring tracheid (Sp) at the right is seen to be unruptured. X 400.

Fig. 2. Cross section of the dense fibers of a broad-leaved tree or "hardwood" showing drying cracks in the thick secondary walls. The darker colored primary walls which enclose the inner layer are seen to be unruptured. X 500.

Fig. 3. Tangential longitudinal section of the "summer-wood" of western yellow pine showing spiral cracks or "slits." X 500.

Fig. 4. Cross section of both the "summer" (Sr) and "spring-wood" (Sg) of a Mexican hard pine. The cracks or slits are confined to the thick secondary wall of the "summer-wood." The dark primary walls are seen to be unruptured. X 500.

Fig. 5. Longitudinal section of freshly cut white pine sapwood taken from the immediate vicinity of the cambium showing the fine spiral bands which occur in specialized cells that resist compression. X 700.

Fig. 6. Longitudinal section of loblolly pine tracheids showing striated effect produced by incipient stages of decay. X 1000.

Fig. 7. Cross section of the air-dried "summer-wood" of a very dense specimen of long-leaf pine. The thick secondary wall as well as the primary and tertiary walls are seen to be unruptured. Compare *Fig. 4.* The faint lines crossing the section from right to left were made by the minute irregularities which occur on the edge of even the sharpest microtome knife. X 500.

THE PRESERVATIVE TREATMENT OF WOOD.

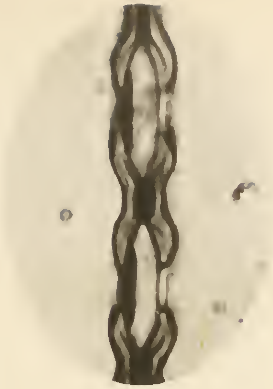
II. THE STRUCTURE OF THE PIT MEMBRANES IN THE TRACHEIDS OF CONIFERS AND THEIR RELATION TO THE PENETRATION OF GASES, LIQUIDS, AND FINELY DIVIDED SOLIDS INTO GREEN AND SEASONED WOOD.*

By Irving W. Bailey.

The xylem or woody portion of arborescent plants has three important functions. It conducts large quantities of water, with gases and salts in solution, from the roots to the cambium and leaves, provides a strong and rigid stem which lifts the foliage to a position when it can secure desired amounts of air and light, and serves as an important reservoir for the storage of elaborated food substances. The structure of wood has been evolved to fulfill these functions and varies greatly in different species and even in the same individual with variations in the expression of these functions. In the less complex woods the same elements serve in more than one capacity, but in those which are more highly organized a division of labor takes place and certain elements act principally as conductors of water, whereas others have almost, if not entirely, ceased to act in that capacity. It is quite clear, therefore, in studying the water conducting passages of wood, as a means of securing information in regard to the behavior of preservative fluids when injected into timber, that one must consider, to some extent at least, other functions which this tissue is called upon to perform.

If we turn to the microscopic examination of the wood of coniferous trees or "softwoods," which is less complex than that of the higher seed plants or "hardwoods," we find that the woody tissue is composed largely of minute vertically arranged elements or tracheids which are devoid of living contents. These cells, resembling minute tubes with closed tapering ends, are a fraction of a centimeter long and serve the double purpose of conducting fluids and providing strength and rigidity to the stem. In accomplishing the latter object the cells are provided with a

*Contributions from the Laboratory of Wood Technology of the Harvard School of Forestry. No. 2.



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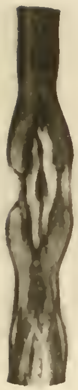

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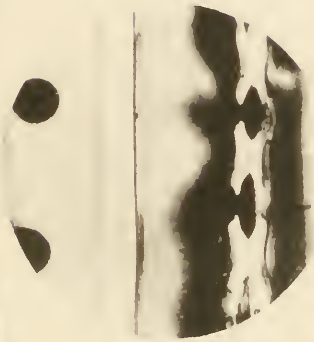

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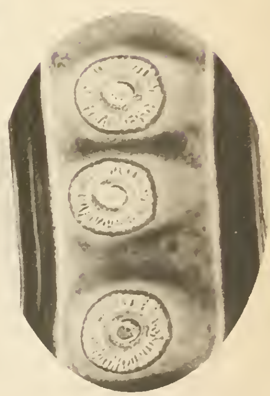

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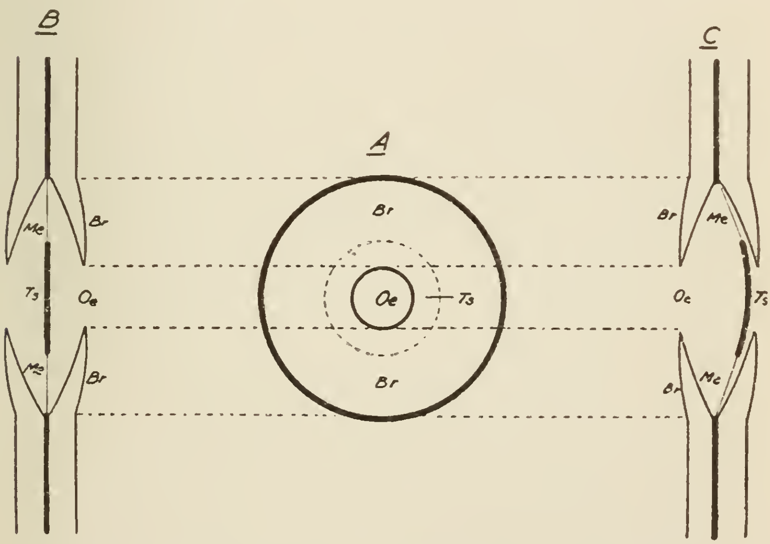
BAILEY—STRUCTURE OF PIT MEMBRANES IN CONIFERS

thick and heavily lignified wall, the so-called secondary wall, which is completely enveloped by the thin primary wall. These layers or walls surround an elongated cavity or *lumen* through which fluids pass on their way to the leaves. It is quite obvious, however, that provision must be made for enabling fluids to pass easily and rapidly from the cavity of one cell into that of adjoining cells. The dense secondary wall, although hygroscopic, is not easily permeable to solutions and is therefore provided with numerous pores or minute openings called *bordered pits.* Since these structures are of fundamental importance in the penetration of liquids through woody tissues it is essential to examine them with considerable care.



A, surface view of bordered pit. B and C, sectional views of bordered pits. Br, embossed or bordered area of secondary wall. Oe, pit or orifice in secondary wall. Me, membrane. Ts, thickened area of membrane or torus.

A circular area of the secondary wall surrounding the minute opening or pit orifice is embossed or pulled away from the primary wall forming a saucer shaped blister which projects into the cavity of the cell In surface view (see text figure A) this area forms a halo or border (Br) about the opening (Oe) in the secondary wall. The bordered pits of adjacent cells are exactly opposite to one another and form a row of lens shaped cavities (See Figs. 5 and 6) which communicate with the cavities of the two cells by means of the two openings (Oe) in the adjacent walls. Communication between the two cells is interrupted, however, by the primary walls which in this region become very thin and form a delicate membrane (Me) which divides the lens shaped cavity into two plano-convex cavities (text figure B). The dividing membrane possesses a circular thickened area (Ts) called the *torus* which acts as a valve. Before sufficient pressure can be brought to bear upon the delicate membrane to rupture it, the torus is forced to one side or the other sealing more or less effectively one of the openings in the secondary walls. (See text figure C, also Figs. 1 and 3.)

The necessity for these delicate and complicated valve-like structures is seen when it is taken into consideration that water in passing from the roots to the leaves of a tall tree must pass through a large number of minute cells which are less than a centimeter in length. Not only must the aqueous solutions pass through a large number of cell walls, but at times they must do so comparatively rapidly. The bordered pit is designed, therefore, to expose a relatively large surface of very thin, permeable membrane without seriously impairing the strength and rigidity of the secondary wall.

Detailed Structure of the Pit Membrane.

It is a commonly accepted fact among physiologists and anatomists that in conifers the wood cells or tracheids are entirely enclosed in the thin primary membrane. In the region of the bordered pits the "primary wall" may be greatly reduced in thickness but, although very permeable to water containing salts and gases in solution, it is supposed to be impervious to undissolved gases and finely divided solids, and more or less impervious to heavy oils and other heavy or viscous liquids. This conclusion, that the primary wall or membrane is unperforated even in the region of the bordered pits, is based upon two lines of evidence. Careful microscopic examinations have failed to reveal perforations in the pit membranes. (Russow, Nägeli, Strassburger and others discovered that the pit membrane was not homogenous throughout, but frequently composed of fine alternating radial bands of thinner and thicker wall substance. They concluded, however, that the membrane was unperforated). In addition, numerous experiments in injecting freshly cut green wood with water containing powdered solids and heavy liquids, e. g. Sachs' cinnabar and mercury experiments, have led to the same conclusion, *that the pit membranes are entire* in the wood of a living tree.

This fact afforded, apparently, a satisfactory explanation of the difficulty in forcing air through green wood; the use of salt solutions, but not creosote, in the Boucherie and Kyanizing processes; the necessity for preliminary steaming or seasoning in the Bethell process, etc., etc.

The question may well be raised at this point, since Tiemann's "slit" hypothesis cannot be accepted as conclusive, what structural change, if any, produces the difference in the behavior of green and seasoned wood. It occurred to the writer that the delicate pit membranes were ruptured by the shrinkage of the cell walls in drying. To determine conclusively by microscopic examination whether the pit membranes are ruptured in a given piece of seasoned timber is difficult, since it is not easy to eliminate the possibility that the ruptured condition was produced by the process of sectioning. However, by embedding material in nitro-cellulose and subsequently cutting sections with a very sharp microtome knife the writer was able, in large measure to overcome this difficulty, and to determine that in many pieces of seasoned wood the pit membranes had been ruptured by the shrinkage of the cell in drying. In order to test this point experimentally the writer injected the thoroughly air-dried wood of several conifers with an aqueous mass containing very finely divided particles of carbon held in suspension. Obviously this dark colored liquid could penetrate only when actual openings existed in the cell walls. Subsequent examination of the material revealed the interesting fact that the penetration from one cell to another occurred entirely through the bordered pits. Fig. 5, a longitudinal section of air-dry Sequoia heartwood, illustrates the penetration of the carbon particles from one cell to another. The tracheid in the centre of the photomicrograph is entirely filled with the dark colored mass. The carbon particles are passing through the chain of bordered pits into the adjacent cell cavity on the right. It may be noted that the bordered pit in the centre of the photomicrograph is partly filled with a resinous substance and slight penetration occurs. At the extreme left is a so-called "medullary" ray which, with carbon particles of this size, remained unpenetrated. Fig. 6 illustrates a tangential section of the "summer-wood" of an ordinary long-leaf pine paving block. Since the heavy tar oils had penetrated almost exclusively the dense bands of "summer-wood", it is significant, in view of Weiss' theory, that the penetration from one cell to another takes places by means of the bordered pits and not by cracks or "slits" in the thick secondary walls.

As a "control" for these experiments the writer tested the penetration of the carbon mass with pieces of freshly cut green sapwood. A deeper and easier penetration was secured in green material of white pine, pitch pine, spruce, hemlock, larch, and cedar than could be secured in the same material after thorough kiln or air drying. In both cases the material was subjected to similar temperatures (65° F.), pressures, and duration of treatment. At first negative and positive pressures of approximately one atmosphere were used. In order to obviate the possibility that the membranes were ruptured by these pressures, two series of tests were made. In the first, experiments were made to determine at what pressure the pit membranes could be broken. With pressures up to 250℔. per sq. in., the maximum capacity of the pressure cylinder used, the membranes of all conifers remained unruptured. This was undoubtedly due to the valve-like action of the torus which has been described earlier in this article (see text Figure C and Figures 1 and 3). A second series of experiments was then made to test the penetration of the carbon mass under very slight hydrostatic pressure. Hartig showed that if a stick of freshly cut green sapwood several inches long was held in a vertical position and a drop of water placed upon the top it disappeared very quickly and appeared at the lower end of the stick. The writer repeated this experiment, connecting the upper end of the stick to a rubber tube of a few cubic centimeters capacity. If a sufficiently dilute solution of the carbon mass was used the water passed rapidly through the stick carrying the carbon particles with it. Fig. 4, a longitudinal tangential section of freshly cut green white pine sapwood, shows the carbon passing from one tracheid to the next, through the membranes of the bordered pits. On the left two tangential pits filled with carbon are seen in surface view. Fig. 8 illustrates a radial section of the same wood under high magnification. The carbon particles are seen to penetrate the membrane in a rim about the torus and in lines radiating outward from it. Thus, the writer was forced to the conclusion that *the pit membranes in the tracheids of living coniferous trees are not entire* as has previously been supposed, *but are perforated by extremely minute openings,* which are located in the thinner radii of the membrane.

The next step was to subject coniferous woods to a microscopic examination to determine if these perforations were visible under the highest powers of the microscope. This proved a difficult undertaking owing to the minute size of the structures under observation. Special methods of sectioning and staining were essential owing to the peculiar structure of the bordered pits. However, fairly satisfactory results were finally secured by cutting exceedingly thin sections (2 micra). In this way it was possible to cut away one of the embossed areas of the secondary wall exposing to view the membrane and torus. By careful staining and the use of very high magnification the detailed structure of the membrane could in many cases be successfully studied. Fig. 7 illustrates in a diagrammatic manner the structure of the pit membrane. In the center is the thickened portion of the membrane or torus. Surrounding the torus is the thin, permeable portion of the pit membrane. This is seen to be composed of alternating bands of denser and thinner membrane substance. The perforations are located in the thin, lighter colored radii of the membrane. They are extremely variable in size and may in certain species increase in size or coalesce to form larger and more conspicuous openings. Fig. 9 illustrates an unusually coarse type of perforation which sometimes occurs in the wood of the larch.

It may well be asked in view of the perforated structure of the pit membranes, why it is that gases cannot be forced easily through long pieces of green wood and through many specimens of thoroughly re-soaked, dry wood. This is, I believe, due to capillary or surface tension phenomena combined with the valve-like structure of the bordered pits. If we have an aqueous solution on both sides of the pit membrane shown in Fig. 2 and the molecules or minute particles of water are set in motion by a slight pressure they are free to pass easily and rapidly from one cell to another through the perforations in the pit membrane. Now let us suppose that we force air into either of the cells. The water will be gradually driven out until the air comes in contact with the pit membrane. As soon as this happens the surface tension of the water in the minute openings of the membrane resist the further penetration of the air. When additional pressure is applied to force the water from the perforations this membrane is forced to the side and the torus seals, more or less effectively, the opening in the secondary wall. (See Figs. 1 and 3.) If a very short piece of wood is used so that the air has to penetrate only one or two membranes it is sometimes possible to pump air through green wood. On the other hand, if there are numerous membranes to be encountered, capillarity or surface tension and the valve-like structure of the tori effectively prevent the penetration of air, even under heavy pressures. The fact that re-soaked dry woods is, in many cases, somewhat less impervious to air than unseasoned material is probably due to the rupturing of the pit membrane during the process of drying.

Summary and Conclusions.

1. Wood is a highly specialized and complex plant tissue, designed primarily to conduct aqueous solutions and to give strength and rigidity to stem and branches.

2. It is extremely variable in different species and even in different parts of the same individual due to variations in the functions which it is called upon to perform.

3. Coniferous woods or "softwoods" are composed largely of minute cells or tubes with closed ends. Liquids in passing through this tissue travel primarily in the cavities of the cells and pass from cell to cell by means of delicately constructed valves or bordered pits in the cell walls.

4. The membranes of the bordered pits are not always entire as has been previously supposed, but possess (in all species examined) numerous minute perforations whose presence may be demonstrated by careful microscopic examination and by experimental means.

5. When wood is thoroughly dried no structural modification, such as the rupturing of the cell walls, is essential in order to account for the penetration of gases and preservatives into seasoned wood.

6. In green wood the bordered pits and membranes are very permeable to aqueous solutions, but are comparatively impervious to undissolved gases, and to oils, and other heavy or viscous liquids. This is due undoubtedly to capillary or surface tension phenomena and the valve-like action of the torus.

7. Dry wood (except when the cells are clogged with resins or other secretions) is very permeable to gases, since water is no longer present to resist the passage of the gases through the perforations in the pit membranes.

8. Whenever preservatives are injected rapidly into green or seasoned wood the penetration takes place primarily through the cavities of the cells, and the preservatives pass from one cell to another through the bordered pits.

9. Rupturing of the pit membranes was found in some specimens to be a concomitant of the process of drying, and may account for the fact that in certain cases resoaked dry wood is less impervious to aii than green material.

10. The impregnation of wood by modern commercial methods is a complicated chemical, physical, and anatomical problem, since any given phenomenon may be the result of numerous interacting chemical, physical, and anatomical factors.

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Description of Plate II.

Fig. 1. Tangential section of Sequoia showing sectional view of bordered pits. The membrane and torus are seen to occupy a median position between the two arching cell walls. X 1200.

Fig. 2. Tangential section of hard pine showing sectional view of bordered pits. The tori have been pressed against the left hand orifices by excessive pressure. X 1000.

Fig. 3. Tangential section of hard pine showing sectional view of bordered pits. The torus in this case is thin and flexible and has been jammed into the right hand orifice so firmly that it appears bow-shaped. X 1000.

Fig. 4. Tangential section of freshly cut green white pine sapwood injected with a carbon mass. The minute carbon particles are seen to penetrate from one cell to another by the bordered pits. X 700.

Fig. 5. Tangential section of Sequoia heartwood, showing the penetration of carbon mass from one tracheid to another through the numerous bordered pits. X 500

Fig. 6. Tangential section of the summer wood of a common longleaf pine paving block. The heavy tar oils are seen to penetrate by means of the bordered pits. X 600.

Fig. 7. Diagrammatic drawing of pit membrane and torus. The perforations are seen to occur in the thinner bands of membrane substance. X 3500.

Fig. 8. Radial section of freshly cut green white pine sapwood treated with a carbon mass. The carbon particles are seen to penetrate the pit membrane in a rim about the torus and in lines radiating outward from it. X 1500.

Fig. 9. Radial section of larch showing large perforations in the pit membranes. X 800.

NOTE.—With the exception of *Fig. 7* these illustrations are "unretouched" photomicrographs.

METHOD FOR REGULATING THE YIELD IN SELECTION FORESTS.

For Application in Small Timber Sales.

BY WALTER J. MORRILL.

Timber sales, properly conducted, offer an opportunity to increase the stand's productivity. The degree to which beneficial results are attained depends largely upon the intensity of intelligent care given by the Forest officer in charge. He should be proficient in the fundamental laws of *silviculture,* the art of growing trees for timber. It is only little less essential that he understand and apply some of the principles of *forest regulation.*

Much literature on silviculture is available to him, and this should be complemented by his own observation. It is not purposed here to enter into that subject. Relatively little on forest regulation has been written for Forest Rangers, who handle the small sales. This may be due to the fact that regulation marks an advanced stage in the development of forestry practice in a country still young in that art. Forest regulation of selection forests implies the application of such measures as best tend eventually to secure *normal stands* that, usually connectively, will *sustainedly* yield the highest possible returns. A stand of a few acres does not ordinarily admit of the best business management unless it is handled in connection with other stands. Many such stands, therefore, are more profitably grouped for business reasons into one unit, in order that the yield of the whole may be more economically marketed in a manner that results in fairly even annual or periodical returns that will perpetually recur.

The maps and written plans outlining in more or less detail when and where fellings shall be made in the group of stands and prescribing the volume of the fellings based upon the annual growth, the silvicultural systems to be used, the rotation, measures for fire protection, grazing restrictions, and matter pertinent to the organization of the tract form *the working plan.*

Without a working plan, regulation can not be fully applied. But in any stand where a green timber sale is progressing in a selection forest, one can usually make definite progress toward normality, one of the elements in regulation, and the main one so far as that particular stand in concerned.

At present the material cut in timber sales is prescribed chiefly in cultural, or marking, rules. Since these are discussed in "The National Forest Manual, Timber Sales", (p. 45-48) it is assumed that foresters are familiar with them. They very properly specify the removal of "all mature and overmature trees, except when required for seed or protection. Similarly, all trees which show defects—will be marked", provided at least one merchantable log from the tree can be obtained. A flexible diameter limit may be given, but no instructions are given for determining it.

The domain of forest regulation, however, is entered a short distance when in "The Manual" the rules specify "as far as type conditions permit, the marking should leave on the ground sufficient timber for a second cut within a period of 50 years or less"; and again (p. 13) when it states, "Where no working plan exists, the maximum cut will be based upon the most accurate estimate of merchantable timber, assuming a rotation based on the best available growth data"; and in Regulation S-2, "The Secretary of Agriculture will prescribe each year, upon data and information furnished by the Forester, the maximum amount of dead, matured, and large-growth timber that may be cut on each National Forest". No edition of the "Use Book", the forerunner of "The Manual", mentions regulating the cutting except that sales may be made up to the capacity of the Forest.

Instructions for marking timber of different types in various administrative districts have recently been issued, as, for example, "Instructions for Marking Timber in the Yellow Pine Region in District VI". In the latter, it is prescribed that the type shall be managed by the selection system or modification of it; that the decadent trees shall be cut together with the thoroughly mature ones and those that will not survive 60 years until the next period of return; that a *well distributed* stand of thrifty saplings, poles, and young standards shall be left; and that from 20 to 25 per cent. of the estimated volume of trees over 12 inches in diameter shall be reserved. It is planned that the exploitable age, or rotation, of the species shall be 180 years.

These cultural rules are now mingled with those aimed at rough regulation, the latter marking recent progress. All these are necessarily general, applying as they do to varied conditions over a large area, and much is left to the intelligence of the local administrating officer for the successful application of them.

Cultural rules alone are all that are necessary for treating very irregular stands where a superabundance of over-mature trees form the bulk of the felling, and for those partially ruined by misuse or fire. Elsewhere, in addition to cultural rules, guides for regulation are demanded. Especially is this true in the management of the selection forest.

Before developing principles for the regulation of the selection forest, a few words as to what constitutes a normal selection forest will not be out of place. In the normal selection forest the trees of all ages are apparently intermingled with no degree of order, but, ideally, on each area the total area occupied by any age class will equal the total area occupied by any other age class. It follows, then, that the number of individual trees on such an area will progressively vary from very many of a young age class to relatively few of an old age class; but the areas occupied by each class will be equal.

If to this normal age class gradation we add the condition that each tree at all times must be correctly spaced so that it is neither unfavorably retarded by crowding nor yet given so much space that it develops into a limby, knotty tree of impaired commercial value, we shall attain both *normal growing stock* and *normal increment* and hence a normal forest. Such a stand might well serve as the ideal to strive for, or, rather, toward; for the complete attainment of it can scarcely be expected. Each timber sale, however, offers the opportunity to make some headway toward the desired goal.

Our forests are abnormal, except possibly by accident on small areas, in one, two, or all three of the above conditions. Before remedial measures can be wisely taken, obviously, it is necessary to analyze the stand in order to ascertain in what respect and to what extent it is abnormal. General rules for regulation, unlike cultural rules, are of slight value, because each stand differs so widely. Hence, principles for deriving specific rules applicable to the stand in question should be understood, in order that each may formulate his own rules to fit the case. With normal yield tables for our different species and types on different quality sites these rules could be easily deduced after we had made a careful analysis of the stand. Unfortunately, we do not have many normal yield tables at present, and temporarily at least we must usually construct for ourselves, rough ones, or substitutes for them. Since the common methods for constructing yield tables require more time and opportunities than is commonly to be had by forest officers in charge of small timber sales, the following method is offered; developed from a suggestion in "Forest Working Plans" by D'Arcy.

Method of Regulation.

To construct our picture of a normal forest of a particular type and site quality, first, from measurements on the whole tract or on sample plots with the aid of which an estimate is made for the whole, we determine the actual number of trees in each diameter class. The age of standing trees is obtained only with great difficulty, unless one has a record of their planting. The diameter of a dominant tree is roughly proportionate to its age. For practical purposes, we shall substitute diameter classes for age classes. Instead, then, of regulating age classes we will aim to regulate diameter classes, since practically it will amount to nearly the same thing. The trees may be divided either into inch classes or, more usually, into classes comprising several inches. But a knowledge of the actual number of trees in each diameter class is of slight value, except in estimating the volume of the stand, unless we have some means of comparing this data with the normal number of trees in each diameter class. As we have no known normal stands with which to make comparison we are forced to construct them theoretically This may be done as follows: *the first step is to determine the average horizontal crown-spread of average dominant trees of each diameter class.* The field work may be done by sighting along a plumb line at several points on the margin of the crown, placing sticks or surveying pins in the ground to mark the crown's projection; after which measurements of the ground area in square feet is computed. It is suggested that a curve be drawn, from which a table of crown-spread may be prepared. If such a table is prepared in advance for different types on three or more qualities of locality sites, time will be saved at slight expense in accuracy. Then *divide the square feet in an acre, 43,560, by the number of diameter classes.* The quotient will give the total area which normally should be occupied by each diameter class. But this is only a preliminary step, because the real information desired is the answer to the question, "How many trees should there normally be in each diameter class?" The answer is easily found in each case by *dividing the total area occupied by the diameter class, by the average crown-spread of the average tree in that class.*

For a forest type and quality of locality capable of forming an unbroken crown-canopy the above operations will give the actual number of trees which would be normal in each diameter class; but for other conditions these numbers will express only the *normal proportion* in the trees of the different diameter classes. This, alone, should be of considerable value in measuring the abnormality of the stand in respect to normal diameter distribution; yet the deductions are still in a clumsy form for practical use, and the following improvement, although introducing a source of inaccuracy, is suggested:

Determine for the different types on the different sites the *total crown-spread per acre in the best* stocked stands you can find, considering only the trees that are unsuppressed, or only the dominant and co-dominant trees. Assume that such stands are normal in respect to crown density. *Express by a fraction the relation existing between the actual total crown-spread in square feet and 43,560 square feet. With the reducing factor thus found multiply each number representing the normal proportion, and the normal number of trees in each diameter class will be found.*

The foregoing explanations are made concrete in the following imaginary example in which the reducing factor is .8, the other data as given, and the diameter limit is 16″.

Table 1—Sample Acre—Normal and Actual Distribution by Diameter Classes.

Engelmann Spruce—Site Quality.

	Actual Stand.			Normal Stand.					
Diameter.	Diam. Class.	Number of trees.	Crown-spread.	Average crown-spread.	1/6 acres = 7260 sq. ft.	Normal proportion.	Reducing factor.	Normal.	Divergence from normal.
Inches.			*Sq. ft.*	*Sq. ft.*				*Number.*	
0- 3	VI	400	4000	10	7260÷ 10=	726	x .8	581	—181
4- 6	V	100	3000	30	7260÷ 30=	242	x .8	194	—94
7- 9	IV	95	4750	50	7260÷ 50=	145	x .8	116	—21
10-12	III	80	6400	80	7260÷ 80=	91	x .8	73	+7
13-15	II	60	7200	120	7260÷120=	60	x .8	48	+12
16-18	I	25	5000	200	7260÷200=	36	x .8	29	—4
Totals,..................			30350	43560					

Actual Density: 30350 — 43560 = .7
Actual stand = 16,000 ft. B. M.
(From volume tables.)

Normal Density before cutting.
43560 x .8 = 34848.

Treatment.

Cut now everything above 16″ diameter, if silvicultural conditions permit; also 6 trees of Class II. Place the remaining 6 of Class II in Class III. Put Class III into Class IV, or having removed 6 of Class II to compensate for deficiency in volume in Class I, place the surplus of 7 in Class III and the remaining surplus of 6 of Class II into Class IV in order to assure a full harvest for the fourth cutting cycle, at which time a portion of the surplus volume, if any, can be thrown back into Class II (now Class V.).

The proposed treatment in the example should result in nearly equalizing the fellings until the Class IV shall have grown into the exploitable Class I. By placing the surplus of 7 trees of Class III with the deficiency of 21 in Class IV, the net deficiency in the latter class becomes 14. However, 7 of the redistributed trees in that class are larger than is normal for Class IV, and the deficiency in volume will be less than the deficiency in numbers would indicate. A felling at the present time also should result in augmenting Class VI, so that toward the end of the rotation it may be possible to add trees from that class to those in the present Class V and equalize the yield of these two classes. The number of years required to grow a tree 13 inches in diameter into one 16 inches in diameter will determine the cutting cycle, or the years that must elapse before a second felling will be made. The Forest Officer can quite readily prepare a diameter-age table in any timber sale of the species in question and thus determine the number of years required to grow a 13-inch tree into a 16-inch tree.

When the marking is being done the area can be roughly divided into individual acres on which the marking is done in conformity with instructions indicated in the analysis illustrated in Table 1. Less accurately, one or more acres may be thus carefully worked and the rest marked by judgment based on the carefully marked acres.

It must be remembered that practical forestry is commonly a compromise between what is best from a purely forester's point of view and what the timber purchaser is willing to do. But the forester should have a definite opinion of what is best from his view point. It is well that his ideas be established on concrete data rather than on surmise. To what extent he is willing to sacrifice good forestry to practical lumbering is a matter which only local conditions can govern. It is even advisable to sacrifice stumpage prices in order to practice good forestry, which in the long run will prove most remunerative. The above analysis should assist him at least in his conception of good forestry. If the data is reliable nothing further is needed as a guide. With a suitable rotation, or exploitable age, involving the proper diameter limit, with the diameter classes properly filled by trees well spaced, the annual growth, or increment, will be normal. Normal increment is the prime object to be attained, for that represents the returns on the investment.

SOUTH DAKOTA SCHOOL LANDS.

By Paul D. Kelleter.

Upon its admittance to the Union as a state, South Dakota received from the Federal Government a grant of large areas of the public domain in the State. The lands so granted were to be used for various purposes. One such purpose was land especially designated for the support of the common schools and consisted of sections 16 and 36 in every township in the State. Title to such lands did not rest in the State until the location of the particular section was determined by the extension of the public land surveys. Provision was also made to indemnify the State in lieu of any land in these sections that it might fail to acquire title of, through the existence of a prior adverse claim, or through the fact that the land appeared to be mineral in character.

The right of squatters to the land covered by their squatter location, made on the public domain before survey, is paramount to the rights of the State, should upon the extension of the public land surveys it occur that such settlement be on section 16 or 36, nor can the State acquire any sections that prove to be mineral in character.

No difficulty arose in carrying out the provisions of the legislation in regard to these lands except that through the creation of the National Forests in the western part of the State here was raised the question as to whether or not the right of the State to sections 16 and 36, held, although such townships were included within the National Forests before the extension of the public land surveys so as to properly identify the sections.

Being included within the National Forests was felt to be an adverse claim defeating any right the State might have, yet on the other hand it was felt that this adverse claim differed from such as might be held by an individual in that the extinguishment of the National Forests would automatically revive any right the State might have had in the premises prior to the creation of the National Forests.

Such being the case, it was felt that the best interests of the State justified some adjustment at once rather than to allow matters to remain unsettled pending the very remote possibility of the extinguishment of the National Forests. Accordingly on January 4, 1910, an agreement was entered into by the State of South Dakota, and the United States for the immediate adjustment of this question and the results of this agreement form the basis for the proclamation issued by President Taft on February 15, 1912.

The essential facts of this agreement stripped of all unnecessary verbiage are as follows:

(1) That the State of South Dakota relinquish all claim to sections 16 and 36 within the Black Hills National Forest that were unsurveyed at the time of the creation of the Forest and accept in lieu thereof lands of equal value and acreage. The lieu lands to be selected from lands along the exterior boundaries of the Forests and the selection to be made so that they will be in one or two compact bodies.

(2) That a board of three be constituted to carry out the provisions of the agreement, one member to represent the State of South Dakota, one the United States Department of Agriculture, and these two representatives to select the third member. The board completing the work consisted of F. F. Brinker, Commissioner of School and Public Lands of the State of South Dakota; Paul D. Kelleter, Forest Supervisor of the Black Hills National Forest; and Seth Bullock, of Deadwood, South Dakota.

The school sections subject to the provisions of this agreement had a total acreage of 60,143.92 acres, and the lieu area agreed upon presents the same acreage, as well as being equal in value to the school sections. For the Board to determine upon a lieu tract presenting an equivalency in acreage as well as value to the school sections surrendered, presented a difficulty of considerable magnitude which difficulty was, however, finally overcome, so that the finally selected lieu area represents an exact equivalency in both acreage and value.

In view of the fact that this exchange is the first of its kind, it became necessary to formulate plans for the field work without having the benefit of similar work previously done, and, therefore, as it may be a matter of some interest, a brief account of the field work and other incidental steps leading up to the final compilation of the figures involved may not be amiss.

The field work was done by the members of the Board assisted by two field parties. Each of the latter consisted of four men with equal representation of the State and Forest Service. As the work done by the field parties formed the basis of the work done by the members of the Board, such will be described first.

Each crew organized itself into a compassman whose duty it was to maintain a straight and correct course as well as to handle the front end of the chain; two caliper men, who made diameter measurements of all trees; and a tallyman, who recorded the measurements called off by the caliper men. A section formed the unit for the field work. Owing to the area to be covered, it was impossible to make measurements of the entire area of each individual section and, therefore, a valuation survey of but a certain percentage of each section was made. A 2½-per cent. measurement was made on sections where there was a uniformity of conditions throughout, and a 5 per cent. measurement was made in all others. In addition to the above measurements, complete notes on the topography; character of land whether agricultural, grazing, or suitable for timber growing only; nature of the ground cover; occurrence of streams or springs; wagon roads; trails; and all other information that had bearing on the value of the land involved were made, as well as a sketch map showing graphically the individual sections and serving as a necessary complement to the field data recorded.

The thoroughness of the field work and the completeness of the data recorded was of value not only in making possible the exchange, but will also serve a valuable purpose in the preparation of subsequent plants of management of the lieu area on the part of the State, as well as for the National Forest within which the surrendered school sections occurred, on the part of the Forest Service.

The members of the Board on their part made personal examination of the areas involved and agreed upon the figures of value used in the valuation.

Owing to the nature and difference in the various factors that go to make up the values of the individual sections consisting of mature timber, young timber and reproduction, agricultural, grazing, and timber land, it would have been an impossibility to select an area that would by individual sections correspond to the individual sections surrendered. Hence it was considered that the exchange could best be made and permit of the easiest handling if done in money values. Accordingly, each section was reduced to a money value, using as converting factors the current value of the different types represented in the section.

The value of each section is very largely determined by its location in reference to market and, as the main value is for the growing of timber, its topography is also very important. Topography determines the ease or difficulty that would be experienced in logging operations, accessibility to market, and the value of the timber after having been cut.

The type of the timber, the character of the reproduction, the value of the land from an agricultural, grazing, or merely timber standpoint was determined from the data obtained by the field party and the value given each class in accordance with the table of values prepared by the Board. Each section was appraised in reference to its accessibility and topography and certain factors of allowance used. These factors of allowance were applied to the basic valuation given to the different classes under the best or perfect conditions.

The following table shows the classification of the sections on the basis of allowance for accessibility and topography:

	Class.	*Deductions.*	*Percentage.*
A	Accessibility,	0-5	90-100
	Topography,	0-5	
B	Accessibility,	0-5	75-85
	Topography,	10-20	
C	Accessibility	10-20	75-85
	Topography,	0-5	
D	Accessibility	10-20	60-80
	Topography,	10-20	

By this method, the classification of the section shows for which factor affecting value allowance was made.

The following table shows the basic value of the timber and reproduction for each type as well as the value under the different allowances as indicated above:

Type.	Basic value per M.	5	10	15	20	25	30	35	40
		Value on basis of deductions.							
I	$5.00	$4.75	$4.50	$4.25	$4.00	$3.75	$3.50	$3.25	$3.00
II	4.00	3.80	3.60	3.40	3.20	3.00	2.80	2.60	2.40
III	3.00	2.85	2.70	2.55	2.40	2.25	2.10	1.95	1.80

Type.	Basic. value per Acre.	5	10	15	20	25	30	35	40
		Value on basis of deductions.							
Very good,	$12.00	$11.40	$10.80	$10.20	$9.60	$9.00	$8.40	$7.80	$7.20
Good,	9.00	8.55	8.10	7.65	7.20	6.75	6.30	5.85	5.40
Fair,	6.00	5.70	5.40	5.10	4.80	4.50	4.20	3.90	3.60
Poor,	3.00	2.85	2.70	2.55	2.40	2.25	2.10	1.95	1.80

The valuation given for the agricultural, grazing, and timber land is that as idicated by the field data after, however, having had careful consideration by the Board.

In the field, all trees having a diameter of six inches or over were calipered but the volume table used in converting these diameter measurements into board feet does not consider any tree under eight inches diameter breast high. As this excludes from computation a large number of trees under eight inches which are too large to be considered as reproduction, in the interpretation given for that classification for the purpose of this work, the following method was used:

The reproduction was divided into four types as shown by the table. If there occurred fifteen or more six and seven inch trees to the acre in any type of reproduction, this class was rated as the type next higher; if forty or more occurred, the class was rated as two types higher. As for example, a section may show eighty acres "poor" reproduction with an average of twenty trees six to seven inches in diameter. In the used classification, these eighty acres are classed "fair"; if forty-five trees to the acre, the classification is "good".

The classification of the land as agricultural, grazing, or timber was based on the field data. As agricultural was considered land that was under cultivation at the present time as well as land that possessed the necessary characteristics as to be potential agricultural land. In other words, all cultivable land was classed as agricultural. The value given it depended upon the conditions surrounding each particular area of land of this character, and not upon any hard and fast rule of value. It is felt that by this method a better and fairer valuation was obtained than if such valuation had been determined otherwise. Under this method of classification, land at the present time not under cultivation and having upon it a heavy stand of timber or a dense growth of reproduction was classified as agricultural if the land was without doubt of more value for agricultural purposes than for the raising of timber, or than for merely grazing purposes where at present the land was used for such purpose yet was cultivable, the cost of clearing the land being taken into consideration in each instance.

Under grazing land was considered such as was not cultivable and yet possessed a higher value than for the raising of timber alone.

As timber land, was classified such land as did not possess the value either at the present time nor potentially to permit its being classified under agricultural or grazing land.

The considerations and methods enumerated in the foregoing were the basis for the actual work of appraising the value of the school sections as well as the lieu area and as such form the basis of the work done by the Board.

The Board found it impossible to select the lieu area in one solid body owing to the necessity of having an equivalency in both value and acreage, as well as on account of certain administrative difficulties, and accordingly the lieu lands selected are in two separate tracts. A tract of 47,937.65 acres was selected along the exterior boundary of the Harney National Forest and one of 12,212.17 acres in the Sioux National Forest.

Under the terms of the proclamation, the lieu areas were tentatively excluded from the Harney and Sioux National Forests and the State of South Dakota given a period of ninety days within which to make the necessary filings before the land office covering the lands selected by the Board. The State has now made the necessary filings and so the last step in the exchange of the school sections has been taken and the State of South Dakota has assumed jurisdiction over the lieu selection and the Forest Service over the surrendered school sections.

The data concerning each section were compiled in tables, of which the following is a sample:

Section 14, Township 3 South, Range 5 East.

	M. Ft.	Value.	Amount.	
Timber:				
Type I,	242	4.50	1,089	
Type II,	2,865	3.60	10,314	
Type III,				11,403
Reproduction:				
Very good,	80	10.80	864	
Good,	280	8.10	2,268	
Fair,	240	5.40	1,396	
Poor,	40	2.70	108	4.536
Land:				
Agricultural,				
Grazing,				
Timber,	640	1.80	1,152	1,152
Total value,				17,091

PROBABLE EVOLUTION IN THE SAWMILL INDUSTRY.

By Burt P. Kirkland.

Volume VI, Number 4, of the Forestry Quarterly contains an article by Mr. E. A. Sherman entitled "The Sawmill of the Future." Inasmuch as the conclusions reached in that article and in similar forecasts of the future of the industry have both theoretical and practical bearings, a further discussion of the subject may be of interest. Such conclusions have practical bearings because of the more or less influence the Forest Service is able to bring to bear on the size of the mill in which National Forest timber shall be manufactured. The question of whether the large or small mill should be encouraged must frequently be met.

The main conclusion reached in Mr. Sherman's article is that in the future the big sawmill will be superseded by small mills. It is the purpose of this discussion to consider whether the conditions in the lumber industry are such as to bring about a result such as he predicts—an evolution, it may be said, entirely contrary to that in any other well known industry.

It is well known that the tendency in other industries such as the packing industry, for example, has constantly been toward large scale production. The reasons for this are chiefly the profits from saving of wastes too small in amount in the small plant to be utilized and the economy of effort due to the more specialized use of machinery in the large plant. There are also economies of organization, transportation, etc., available to the latter. I do not refer here to the great aggregations of capital often brought together nowadays, which, though they may represent some additional economies over the moderately large plant, often have their chief reason for being in the desire for promoters' profits coupled with the facility they afford for concentration of enormous power in the hands of a few men. Leaving these out of consideration, let us examine the evidence and conclude whether in the lumber industry alone the savings of large scale production will not be sufficient to induce a continuation of the concentration which has already taken place or at least prevent a retrogression to the small mill condition. I shall take the ground that the savings by large scale manufacture of lumber are sufficient to preserve the large mill as an industrial unit and continue to put the small mill out of business, except under certain conditions. The basis for this contention is in the superior efficiency of machinery in the large mill, in the specialization of labor, and the possibilities for utilization of waste, due in part to its concentration in large masses and in part to its usually originating in centers of population.

Savings due to Machinery.

The savings due to efficient machinery in the large mill are in general well understood and occur in many ways. First, there is a cheapening of products due to complete machinery. In a large mill it is possible to have many operations conducted by machinery which have to be done by hand in the small mill. For example, in the large Pacific Coast mills, floor chains carry slabs and waste from the edger table broadside against a battery of cutoff saws (the slasher) which reduce this waste material to cordwood lengths without the direct application of any labor. In smaller mills it is not uncommon to see two or three men toiling to dispose of a smaller amount of the same class of material. Similar economies of labor are effected with the pneumatic trimmer saws. Few of these efficiencies are possible with the small mill because the cost of the machinery, in depreciation and interest charges distributed over the output, would simply place a prohibitive charge on the lumber manufactured.

A second efficiency of machinery possible in the large mill consists in the superior character of the product turned out due to higher character of machinery and better care which it can receive. For example in the small mill, if it has a planer at all, a single machine has to serve all purposes, while various styles of planers, each adapted to its purposes, are employed in the large mill. It is notorious that the product of the small mill is characterized by wedge shaped boards and other imperfections due to imperfect manufacture. So marked is this that in the eastern part of the United States it is common for lumber cut locally in small mills to sell for much less than imported lumber of the same species. This is due as much to poor manufacture as to poor quality of wood in many cases. It is impossible for the small mill to employ high grade mechanics or to buy specialized machinery. As already pointed out the cost of such machinery distributed over a small product would be prohibitive. Moreover, a mill possessing such machinery would no longer be a small mill nor turn out a small output. While, therefore, its output can no doubt be improved, it can never equal in character that of the efficient large mill.

A third efficiency of machinery in the large mill lies in its elimination of waste as compared with the small mill. This is perhaps at the present time most marked in the difference in the sawkerf between the two classes of mills, the large mill using the band saw with not over half the sawkerf taken by the circular saw used in the small mill. That the band saw will be used in the small mill is to be doubted. It requires much higher priced labor to manipulate, it is more difficult to keep in adjustment, and is in every way a more expensive machine to operate. The saving effected in lumber will not pay for the increased cost of operation where the output is small. It can be considered as entirely impracticable in the portable mill. There are other savings in the large mill of the same kind but perhaps not so marked.

Specialization of Labor.

Still another efficiency and cost saving in the large mill is due to the specialization of labor there. This is a well known advantage of all large scale production and needs only brief mention here. Where high skill is needed it can be employed, as for example in grading. The same applies to running headsaws, planers, etc., and in the care of the machinery. No extremely high skilled man can be employed in one of these branches in a small mill because the output is not large enough to absorb the high wages. In the small mill men continually change from one task to another and attain proficiency in none.

Saving of Waste Effected by Location and Size of Large Mill.

Passing on to the saving of by-products we find a still more important advantage lying with the mill of large size, especially when located in a center of population as such mills almost invariably are, in order to secure abundant labor supply and easy access to transportation facilities and markets.

For example, considering only present utilization in mills in the Puget Sound region, it can be stated that the mill in the larger coast cities which does not sell a large part of its slab-wood for fuel is a rarity if not absolutely unknown. The mill in the interior which does not burn most or all of the slabs in the waste burner is equally rare. This, of course, is an advantage due largely to location. Other products commonly manufactured in the mills in the Sound cities but not in the interior mills, except the very largest and then rarely, are lath from slabs, and sash and door stock from planer ends. There are still others which, with those already mentioned, make up a large aggregate of products utilized in the Puget Sound mills from material which is wasted in the interior mills of the region.

There remain to be considered the great fields for utilization of waste as yet scarcely touched, such as the manufacture of pulp, ethyl alcohol, etc. Plants for the manufacture of these products are expensive and the margin of profit is narrow at present. Hence, none of them will be constructed where there is any doubt as to the permanency of the supply of raw material. Considering the Puget Sound region again as an example, waste from the interior mill is thus barred from this field of utilization, since all the advantage in this region is with a plant on Puget Sound where the supply of wood waste is enormous. There might be a few exceptions to this rule in the case of mills drawing supplies from National Forests should the policy of regulating the cut by watersheds be adopted by the Forest Service, since this would in many localities insure a permanent supply of timber to mills and plants for utilization of by-products. Even then, along the Sound, the particular kind of wood waste wanted can be better secured because it is not necessary to depend on one mill alone for the supply.

This sort of utilization is already beginning. Some Seattle mills now have no waste burners. At least one of them visited personally sells its waste to an ethyl alcohol plant. This mill cuts the lowest grade of logs in the Sound, but all the waste aside from sawdust is reduced by a fuel grinder to material the particles of which are only slightly larger in size than planer shavings. As much of this material as is needed is used in the mill's power plant while the remainder is shipped, together with the sawdust, to an alcohol plant. Other Puget Sound plants are making similar beginnings but these opportunities are not open to the interior mill unless exceptionally well situated.

Conclusion.

I have drawn on the Puget Sound region for illustrative material because of greater familiarity with that region. The same principles apply elsewhere, however, though sparsely timbered regions will have use for more small mills than well timbered regions.

On the basis of the foregoing it seems a safe prediction that in a few years a mill situated in a center of population, but which destroys sawdust, slabs, and other material now generally waste, in a waste burner instead of putting them to some use, will be looked upon much as a packing house would be to-day which did not utilize horns, hoofs, bones, etc., as useful by-products. On the other hand, the small mill in the interior has, or will have, no better chance of utilizing sawdust and similar by-products than the country butcher has of utilizing the hoofs and horns of cattle. It is no more reasonable to suppose that the concentration common to all modern industry will be discontinued in the lumber industry than it is that the packing industry will return to the country butcher stage. Even the use of this small mill waste as fuel, as could readily be done for generating electric power, would save thousands of tons of coal annually.

It is safe to say that the typical mill of the future will not be the small mill. The small mill will undoubtedly have its place for supplying small communities just as the small butcher shop now has its place for the same purpose. For supplying large or distant market it is now and will become still more an inefficient industrial unit. The material now wasted by the small mill in the forest is coming to have commercial value in centers of population or industrial centers where it accumulates in sufficient quantity to be utilizable. It can be most cheaply transported to those centers in the log, both because it thus bears a lower freight charge and because it is more cheaply handled in that condition. Thus, logs in Puget Sound, and other bodies of water, can be handled in rafts while other material has to be transported on scows. The greatest efficiency in manufacture and the closest utilization of the log in the Puget Sound region now occurs with timber cut in the Puget Sound cities. The good of the industry requires that manufacture in these cities continue to increase in the future.

For the other parts of the country where the industry is not so well organized as in the lumber regions proper, the building of large mills in industrial centers would be an advantageous development. A steady market for logs would make it possible for any farmer or other small holder of timber to ship to such mills whenever a carload of logs was available. This would result in the higher utilization of some timber now used for fuel, since, where transportation is available, timber could be utilized by this method where there is not enough for even a portable sawmill.

I conclude that the type of sawmill indicated to supply general market demands of the future will be the large mill located in an industrial center or center of population and that mechanical, chemical, or other equipment for the utilization of by-products either will be an essential part of the plant or such products will be disposed of to other plants especially adapted to their utilization.

SOME ASPECTS OF EUROPEAN FORESTRY.

By A. B. Recknagel.

Introduction.

In the following series of nine articles* the attempt has been made to sketch various phases of European forestry viewed from the American standpoint. They are not criticisms of European methods but an exposition of facts observed and of their possible application to American conditions.

The subjects presented are those which are deemed of especial interest and importance to American foresters to-day; namely Administration, Silvicultural Management and Methods of Regeneration, both natural and artificial, under a variety of conditions, choosing the salient accomplishments of Germany, France and Austria along each of these lines. The articles have been divided according to these subjects into groups as follows:

Group 1.	I.	The Prussian Forest Service.
	II.	Administration of a Prussian Forest.
Group 2.	III.	Management of Pine in Prussia.
	IV.	Management of Spruce in Saxony.
	V.	Management of Hardwoods in Eastern France.
Group 3.	VI.	Natural Regeneration in the Black Forest.
	VII.	Management of Alpine Forests in Bavaria.
Group 4.	VIII.	Methods of Natural Regeneration in Austria.
	IX.	Methods of Artificial Regeneration in Austria.

A study of European forestry brings home the value of seeing methods actually carried out over a long period of years. It is this impression which the article attempts to reproduce by emphasizing the history of stands and of their treatment.

Again and again it is brought home to the American that the experience we are making and the stages through which we are passing are nothing but merely the inexorable repetition of history

*These articles will appear successively in the four issues of the present year or more rapidly as space permits.

modified by changed economic conditions yet otherwise identical. Europe has gone through the familiar stages of exploitation, culling of the larger trees changing gradually to a crude selection system, followed by extensive areas cut clear and restocked artificially with pine stands until the soil has rebelled at this exhausting repetition of the same crop and the pure stand is everywhere making way for the mixed stand, and natural regeneration is again coming in to its own.

The studying of these changes is immensely stimulating especially since the examples are concrete and convincing beyond the power of any text book dissertation. One is apt to think of European forestry as 'cut and dried' perfection, and to accept certain technical teachings based thereon as sacrosanct. For example, there is a tendency among some American foresters to look upon the shelterwood—selection method of cutting as being universally applicable. This is quite natural, for the American forester sees only the beginning of this method whereas the European forester is thoroughly conversant with its ultimate results, good and bad.

Great as has been the progress made by European nations in the science of forestry, and startling as the revelation of this progress is to the American forester, it has not resulted in stagnation. New ideas and improvements on old methods are constantly being introduced and all this makes for progress towards the ideal forestry which is apparently as far removed from realization in Europe as it is in America. True, the European foresters have passed more milestones on this road toward an ideal forestry than have we, their American colleagues. But it is the same road and we shall reach the goal faster if we follow the trail blazed by them and profit by their experiences—and mistakes.

I. The Prussian Forest Service.

Part 1. *The Administrative Branch.*

The Prussian Forest Service divides into two very distinct branches—the higher or administrative career and the lower or ranger career. The exact requirements for either of these careers are well established, and no deviation therefrom is ordinarily permissible.

In order to secure a position of administrative responsibility in the Prussian Forest Service, many educational milestones must first be passed on a regularly prescribed cursus honorum. There are three main examinations: The preparatory examination (Forstliche Prüfung); the Referendar examination (Forstreferendar Prüfung); The Assessor examination (Forstassessor Prüfung).

Before attempting the preparatory examination, the would-be forester must have graduated from a "Gymnasium" (equivalent to having completed the sophomore year in an American college) with an absolutely satisfactory mark in mathematics; he must not be more than 22 years of age; he must have command of sufficient funds; have full possession of his five senses and be of irreproachable character; he must have served a practical apprenticeship and must have been in attendance at a Forstakademie.

Application for the administrative career is made to the Oberforstmeister (corresponding to our District Forester) of the Circuit in which the tyro wants to study. This official, if he is satisfied that the applicant measures up to the required standards, designates the Oberförsterei (National Forest) in which, under the direction of the Oberförster (Supervisor) the applicant is to serve his practical apprenticeship. The object of this apprenticeship is to give the Forstbeflissener (Forest student) a sufficient insight into the forest and its practical management to enable him to understand the subsequent lectures at the Forstakademie (Forest School).

Six months this apprenticeship lasts; during that time the Forstbeflissener must keep a very full diary of his doings and observations. Leave of absence is granted only in urgent cases and never to exceed fourteen days—any leave must be made up in subsequent vacations. The directing and assisting of apprentices assigned to his forest is counted among the most important duties of the Supervisor. Any bodily, mental or moral failing on the part of the apprentice must be reported by the Supervisor to his immediate superior. At the expiration of the apprenticeship the Supervisor gives the Forest Student a signed certificate of his service in which it must be specifically stated that the Forstbeflissener took part in Survey work while on the Oberförsterei. He must also sign the student's diary.

Next step in the preparation is the three years' course at the Forstakademie. There are two of these Royal Prussian Forest Academies, one at Eberswalde near Berlin, the other at Münden near Hannover. One can enter these academies either at the beginning of the winter semester on October 15 or of the summer semester on April 10. Both schools are of equal rank; however, the one at Eberswalde is better known and the significant fact remains that the students from Münden come to Eberswalde [near Berlin where the examination is held!] for a final polish before the Referendar examination whereas the reverse is not the case. Both academies are state institutions and the instructors are forest officials of high rank—Forstmeisters. The director is an Oberforstmeister, and the position is a very desirable one both professionally and socially. Both academies are admirably situated for purposes of instruction, being right in the midst of extensive forests which serve as splendid demonstration grounds. Besides this, frequent excursions are made to more distant points so that the graduate of either academy becomes acquainted with practically every kind of forest and tree in Germany.

Aside from the many foreigners attending these academies, there is a regular enrollment of about sixty-five students in all. Formerly the classes were much larger—fully twice as large, but as the Service became crowded, the graduates had to wait so long for a permanent appointment that in justice to the men only those are admitted for whom places can be provided within a reasonable time. Even then, a man is often forty before he gets a position as Oberförster of some Forest. Obviously, this means a careful weeding of the applicants of whom there are always a great number, for the career is an exceedingly popular one; and those who are accepted as Forstbeflissene can feel assured of permanent appointment by the state as long as they measure up to average standards. This induces carelessness on the part of the accepted students and a surprising lack of ambition to stand well in their studies. However, it is the less of two evils for, as with us in America, the technically trained forester is not fitted thereby for other lines of work, and if there is no place for him in the State Service or in private work, he is left stranded.

The student at the Forstakademie, therefore, has a definite rank and title. He is a Forstbeflissener and wears the regular grey-green uniform with green velvet collar but without any epaulets. The epaulet is not his until he becomes a Forstreferendar. At his side in lieu of a sword he carries the "Hirschfänger"—a long sheath knife.

The "plant" of a Forstakademie is very unostentatious—a simple office building; a larger building with lecture rooms and laboratories, fitted up more like a high school than like a college, having benches and desks instead of stationary chairs with wooden tablets on the right arm; and a botanical garden. The strictest discipline is maintained—which is emphasized by professors and students wearing uniforms. The utmost courtesy prevails among the students; to the American used to our rough and tumble college ways it is rather embarrassing to have a whole group of students doff their hats and bow as he approaches. He suspects that he is being chaffed, but the students do it constantly among themselves. When two of them meet on the way to a lecture, each stiffens into a military posture, heels click together, and the hat is swept off with an elaborate bow from the hips. And yet these two men may be the closest of friends! Handshaking is rare and occurs only after the formal bow has been duly executed.

Similarly the Professor—or "Docent" as he is styled—always bows at the beginning and completion of a lecture. He addresses the students as "Meine Herren"—my gentlemen.

The uniform courtesy is carried rather to an extreme when a crowded reading room in the library is thrown into repeated uproar of bows and "Guten Morgen," "Guten Tag," "Ich empfehle mich," etc., etc., at each entrance or exit.

As stated, the discipline is strict. Here are some of the rules: No gambling. No participation in forbidden societies or fraternities. No duelling. No parades "with or without music." No "excessive" debts.

The course at the Forstakademie comprises the following studies divided according to the six semesters (half years):

First and Second Semesters:—Mineralogy, Botany, Economics, Chemistry, Zoology, Physics, First Aid to Injured.

Third and Fourth Semesters.—Economics, *Forest Mensura-*

tion, History of Forestry, Meteorology, Forest Diseases, Law, Geodesy, Soil Chemistry, Agriculture.

Fifth and Sixth Semesters:—*Forest Utilization, Silviculture, Forest Policy, Forest Management, Forest Protection.*

The italicized subjects are designated as Forest Sciences (Forstwissenschaften); the others as Accessory Sciences (Hilfswissenschaften).

Having completed these Accessory Sciences, the student takes the Preparatory Examination already mentioned. If the examination is unsatisfactory it may be at once repeated; if it is satisfactory the student continues his studies with special emphasis on the Forest Sciences and on Law.

At the end of the three years at the Forstakademie, the student takes the Referendar Examination. If he fails he may take it once more, however, as in the case of failure in the Preparatory Examination; a very poor showing may serve to completely bar the student from further pursuance of the technical career.

These are state examinations, held by high officials of the Prussian Service in conjunction with the faculty of the Forstakademie. If, as is often the case with foreigners who receive their technical training here, an academic examination is desired, this is granted for a consideration of 40 mark (about $10.00). A certificate of attendance is furnished gratuitously on completion of the course. The entire tuition fee is very moderate—15 marks (about $3.75) on entering, then 75 marks (about $18.75) for each semester, or a total of 465 marks (about $116.00) for the three years.

The newly epauletted Forstreferendar now undergoes his requisite one year of military service or if, as is often the case, he served his year in the army before coming to the Forstakademie, he now attends some German University for two consecutive semesters in order to study Law, General Economics, Political economy and Finance.

In further preparation for his responsibilities, the Forstreferendar then spends at least two years in visiting various Oberförstereien (National Forests) and studying the methods of management there. During this time he is a subordinate of the Oberförster (Supervisor); they are expected to be of mutual assistance to each other. For six consecutive months of the period he has complete charge of a certain Ranger District (Försterei) and conducts all the Ranger business thereon. For another consecutive five months he acts as Supervisor of a designated portion of the Oberförsterei (National Forest) under the general direction and assistance of the Oberfôrster (Supervisor). The Referendar has access to all the files, joins with the Supervisor in preparing the customary reports and in short acts in the capacity of a Deputy Supervisor.

Furthermore, he must spend four months in preparation of a Working Plan (Plan of Management).

The Forstreferendar is obliged to keep a complete diary of his work and of all technical observations which he may make. On the first of each month this diary is viséed by the Oberförster and it must be shown all higher officials who visit the Oberförsterei (National Forest).

A Forstreferendar may be dismissed from the Service for a breach of the moral code, for unsatisfactory progress in education or for physical disability. The Oberförster must make frequent, complete reports to his superiors as to the work and character of Referendars on his Oberfôrsterei.

The Referendar is now ready to try the Assessor Examination. This examination he can not take more than six years after the Referendar Examination. If he passes, he becomes a Forstassessor and is eligible for a Supervisorship. If he fails he may repeat the examination once, although, if the showing he made was very poor he is apt to be dismissed then and there from the career.

Even a Forstassessor has no claim to permanent employment and remuneration. However, after six years of satisfactory service as a Forstassessor, the title and emolument of an Oberförster is granted him, even though there may not yet be a vacan Oberförsterei for him to administer. Until these six trial years have elapsed, a Forstassessor may be dismissed as unsuitable for the Service. After receiving an appointment as Oberförster he can be removed only as an extreme disciplinary measure.

Thus, a man who enters this protracted cursus honorum at the age of twenty as a Forstbeflissener becomes a Forstreferendar at about twenty-four, a Forstassessor at possibly twenty-eight, and an Oberförster at about thirty-four. This explains the requirement that candidates for the Administrative Service must have a visible means of support for at least twelve years of preparation.

Many men never advance beyond the rank of Oberförster. Those who serve twelve years in that capacity are usually granted the honorary title of Forstmeister. The next step is Regierungs und Förstrat, then Oberforstmeister, Landforstmeister and finally Oberlandforstmeister.*

The number and salaries of these positions are:

462 Oberförster }
378 Forstmeister } from $714 to $1,714 per annum.
99 Regierungs and Forstrat }
34 Oberforstmeister } from $1,000 to $1,714.
5 Landforstmeister from $1,600 to $2,738.
1 Oberlandforstmeister from $3,333 to $4,048.

These are exclusive of the emoluments—such as horses, stables, pasture, wood, garden, etc.—which the Government grants.

It is difficult to draw a parallel between these positions and those in the United States Forest Service. In the following attempt the differences in organization must be remembered and due allowance made.

Prussian Service.	*United States Service.*
Oberlandforstmeister.	Forester.
Landforstmeister.	Assistant Forester.
Oberforstmeister.	District Forester.
Regierungs and Forstrat.	Assistant District Forester.
Oberförster, Forstmeister.	Forest Supervisor.
Forstassessor.	Deputy Forest Supervisor, or Forest Examiner.
Forstreferendar.	Forest Assistant.
Forstbeflissener.	Forest Student.

It is unfortunately true that the German ideal of public service is much higher than ours in the United States. The Prussian forest career owes much of its popularity to that fact. Besides this, it offers a delightful vacation and an irreproachable social position. In this respect it is second only to the army. In fact, since the days of Frederick the Great, the army has been

*See following article on "Administration of a Prussian Forest."

one of the gateways to the forest career. He founded the Reitende Feldjägerkorps (Mounted Scouts) whose officers in time of peace were detailed to the Forstakademie and prepared themselves for the technical career. This organization has persisted and appointment to the Forstakademie as a Lieutenant of Feldjäger is eagerly sought by the sons of the wealthiest and most aristocratic families.

The fact that our Forest officials are mostly very young is due, of course, to the urgent need of men to fill the positions. Already this need has become one rather of positions for men. It would seem as if our technical schools of forestry are turning out graduates almost faster than the public and private demand can place them. Of course, the fittest will survive, but is it not a serious injustice to a young man to let him prepare himself for a career which has no place for him? Furthermore, this forest school training often leaves him without any adequate conception of the life and duties of a forester and leads to bitter disillusioning when he enters active work.

The Prussian system is admirable in requiring a practical apprenticeship. This would be equally feasible in our country. Whether a Government forest school on the order of West Point or Annapolis would be feasible is beyond the author's ability to judge. Certain it is that the Prussian schools add materially to the prestige and stability of the Prussian Forest Service; it is equally certain that our present system of many forest schools produces graduates of widely varying preparation. Oftentimes this is a serious handicap in their career as Government foresters. The need for greater uniformity has already been recognized.

The scheme of requiring an examination before admission to the lower grades is worthy of attention. It is an excellent stimulus to continued study.

The post graduate training would seem to be an excellent thing, though in length of time the Prussian system is scarcely suitable for us. However, it should be recognized that the average forest school graduate is not "worth his salt" to the Forest Service until he has had at least a year's experience in practical field work. Why not let him serve a term in a Working Plan crew, or serve as—or better with—a Ranger and finally a Deputy Supervisor? Then, when he does become a Supervisor he, and what is more important, the Government, will be saved many of the costly mistakes due to inexperience.

Part 2. *The Ranger Branch.*

The Prussian Ranger (Förster) is a trained forester. His "cursus honorum" is as definite as that of his technical superior. His position in the community is a high one; he feels a just pride in his calling.

Prussian rangers are "caught young." They usually enter the ranger schools at the age of eighteen and even before that they must have spent a year as apprentices on an Oberförsterei in order to learn something of what forests and forestry mean. In accepting applications to the ranger service, preference is given to the sons of Prussian rangers. The entrance requirements are quite rigid: Physically the applicant must be at least 5 feet 3 inches tall with proportionate chest development, must be free from organic or chronic diseases, and must be able to see, hear and speak perfectly. Mentally his training must have progressed to Tertia in the Gymnasium—equivalent to senior year in our High Schools.

Prussia has four state schools for rangers (at Steinbusch, Margoninsdorf, Spangenberg, and Hachenburg) and one private school at Templin. This last was founded by the German society of foresters in private employ (Verein für Privatforstbeamte Deutschlands) for the training of rangers for private work. All five of these Forstlehrlingschulen are run on the same principles. Each has between 40 and 50 students, chosen from among 3 to 4 times the number of applicants.

The schooling lasts a year. Tuition, board and lodging all together cost each pupil $10.00 per month; not counting the annual payment of 24 cents for compulsory insurance.* Where the boy's father is a Prussian forester whose means do not suffice to pay the school dues, these may be waived.

The course of instruction comprises:

1. Silviculture in connection with Dendrology and Ecology.
2. Lumbering and road building.

*This arrangement similar to our Government Employees Mutual Relief Association provides $250 payment in case of death, $3,125.00 in case of permanent disability, 36 cents per day in case of temporary disability and payment of all medicines, doctors, fees, etc., from the first day of illness.

3. Forest Protection in connection with Forest Zoology and Meteorology.
4. Forest Mensuration.
5. Hunting.
6. Ichthyology (Fish Culture).
7. Agriculture, Horticulture, Bee-keeping.
8. Forest Book-keeping.
9. Forest and Hunting laws.
10. Insurance.
11. General training in culture courses and elementary sciences.
12. Physical training in gymnastics, swimming, shooting, etc.

As far as possible these subjects are illustrated by means of frequent excursions.

The instruction is kept simple on the principle that a ranger had better be well grounded in the essentials than have a smattering of many technical subjects which are beyond his scope and needs.

The "plants" are very simple; a feature of each is the "Forstgarten" (Nursery) where thorough instruction is given in nursery practice. The utmost military discipline prevails and the school resembles a well-kept barracks. The boys are a splendid, healthy, vigorous, manly lot and present quite a striking appearance in their simple uniforms of regulation green-gray cloth.

The teachers are chosen from the higher or technical branch of the Service; the Director is usually a Forstmeister or an Oberförster.

At the end of the year's schooling a rigid examination is held, Försterexamen; those who pass receive the title of Forstkandidat. Then begins their service in the army, i. e. in the Jäger or Schützen Battalion for which the military discipline in the school is an excellent preparation. Schooling in forestry is continued by men specially detailed as teachers. At the end of three years service most of the men enter the reserve for 12 years more, during 8 of which they are still liable for active service even in peace times. Those who stay in the army for 9 years more of active service usually become Ober-jäger and are given preference in employment at the end of their service. In the eighth and before the eleventh year after the 3 year term is over, the men take the "Försterprüfüng"—Ranger Examination. If successful they are eligible for Förster places as vacancies occur. In the meanwhile they are employed as Hilfsjäger (Forest Guard) on a per diem basis; later as Forstaufseher (Assistant Ranger) on a per mensem basis. A Hilfsjäger or Forstaufseher is usually assigned as assistant to some old and experienced ranger. The years which follow are in the nature of a second apprenticeship. Promotion to a position of responsibility is slow; at thirty-five he may be a Förster ohne Revier (Ranger without district); he is usually forty years old before he becomes a fullfledged Förster (Ranger) and has his definite Revier (District) and own Forsthaus (Ranger Station). Some years later his grey beard may win him the honorable title of Hegemeister but here his "cursus honorum" usually ends. Some four per cent. rise to be Revier förster (District Ranger) with wider responsibilities because of outlying districts. Two or three of them become "verwaltende Revierförster", i. e. have practically the authority of an Oberförster on a Revier too small to warrant employing an Oberförster. The Ranger is pensioned at the age of 65 with three-fourths pay. His salary has grown from 65½ cents per day as Hilfsjäger to $26.78 per month as Forstaufseher, to from $333 to $600 per year as Förster and a possible maximum of $787.55 per year as Revierförster.* However this meager sum is offset by the very substantial emoluments of free house and garden, certain hunting privileges, and the certainty of continuous service with a comfortable pension in old age. There are at present 5,151 rangers (Förster) in the Prussian service.

Some years ago the Forest Service of the United States inaugurated ranger schools in the several Western Districts. Unfortunately, these schools had to be discontinued; their early resumption is earnestly to be desired. Education along technical lines is as essential for the ranger as for his superior officer. Even if our system precludes "catching them young", they should receive systematic schooling after having served a practical apprenticeship as Forest Guards. This training which should extend over at least two months can best be given at permanent Ranger Schools situated very near (preferably in) important forests, by qualified men from the technical branch of the Service. Even if the government can not defray the salary and ex-

*An additional 10% is paid in the Eastern Provinces as "Ostmarkenzulagen" because of higher cost of living there.

penses of rangers thus detailed to study, the expenses can be kept at a minimum, as the Prussian example shows.

The Prussian ranger is a model of neatness—even in his work uniform he is always presentable. It is unfortunately true that the same can not always be said of our men. Those whose right it is to wear "coats of green" may, and it is hoped, will regard it also as a privilege and a just source of pride.

II. Administration of a Prussian Forest.

Of the 462 Oberförster in Prussia only 387 are in actual charge of a Forest (Revier verwalter). The others are waiting for vacancies or are engaged on special work. The position of Oberförster in charge of a Forest is commonly considered the most desirable in the entire service; while his responsibility is large it is not as oppressive as that of the higher official, nor is his life as confining. Furthermore he has time to indulge in that most enjoyable of duties—the hunt. His social obligations are not as great; hence his expenses are smaller. Formerly he was almost free from mere desk work but of late there has been a deplorable tendency toward more and more pure "paper work" at the expense of work in the field. Reports and correspondence are multiplying and the Oberförster is constrained to do clerical work if he is to accede to the "Eilt" (Rush!) stamped on almost every letter from the central office. This is aggravated by the extra technical duties imposed on the Oberförster. Thus in the "East Provinces" the Oberförster is also a magistrate. One Oberförster claimed that being a policeman required 80% of his time, leaving only 20% for his technical duties.

The organization of the Prussian field service is quite similar to that which obtains in the United States. It may be accepted as typical of the other German states.

The Central office at Berlin is small, confined to the Oberlandforstmeister and his staff of five Landforstmeister. Only questions of the greatest moment are referred to Berlin. Everything else is handled in the Central office of the various Regierungs Bezirk's (corresponding to our Districts). At the head is the Oberforstmeister assisted by a staff of usually three Regierungs and Forst Rath's (corresponding to our Assistant District Forester). Here also only matters of larger importance are referred—as far as possible each Oberförster is left to "paddle his own canoe". The central office is, therefore largely an inspecting one. The Oberforstmeister aims to visit each of the 22 or 23 Forests in his Bezirk once each year. His assistants each have a certain number of Forests (usually 7, constituting an "Inspection District") assigned to them which they are supposed to visit (inspect) four or five times each year.

Thus the Oberförster is given free rein and a large authority commensurate to his mature years and ample experience. Formerly an Oberförster was left for many years in one place—now the tendency is toward more frequent changes, a tendency which is heartily deplored among the field force, both high and low.

Where changes are too frequent there is no opportunity for the individual to leave his stamp—be it favorable or unfavorable—on the Forest he controlled.

When a vacancy occurs the fact is immediately advertised in different papers and the date up to which applications will be accepted is stated. The applicants are given preference according to length of service and standing—other things being equal the oldest man in length of service, gets it; for, as in our army, promotion is by age more than by achievements.

A Prussian Oberförster usually is monarch over some 10,000 acres—more in the Eastern Provinces, less in the Western. This is divided for purposes of administration into Schutzbezirke (Districts) of say 2,000 acres each—under the control of a Förster (Ranger). Where the work is heavy the Ranger is assisted by a Forstaufseher (Assistant Ranger) or for simpler tasks, by a Hilfsjäger (Forest Guard). Foresters who have served long and ably are given the honorary title of Hegemeister just as after about twelve years the Oberförster becomes a Forstmeister. Where the Ranger District is outlying and therefore impossible of immediate control by the Oberförster, it is given to a Revier Förster (District Ranger) who, for his large responsibilities, is granted an additional 450 marks ($187.50) per annum. At present there are 208 Revier Förster—two of them are "Verwaltende Revier Förster"—i. e. have practically the authority of an Oberförster. These are stationed on Forests too small to warrant the employment of an Oberförster.

As in the case of his superior officer, when vacancies occur in any Försterei, applications are received and the position awarded to the oldest in line. However transfer is only permissible within the Regierungsbezirk.

In most cases Oberförster and Förster alike have substantial emoluments in the nature of free houses, barns, pastures, forage, arable land, and the like. The office building, a simple unpretentious structure is placed close to the Oberförsterei. Each Ranger station has an office room for the transaction of business by the Ranger.

The Oberförsterei—headquarters for each Forest—is placed entirely with reference to the needs of the Forest. Usually it is as near to the geographical centre as possible; very often far away from any other habitation. This has its material drawbacks where children are to be educated and the present trend is therefore, toward a more far sighted placing of headquarters with reference to mail and telegraph and telephone facilities and to social and educational factors which play such an important rôle in keeping the men satisfied with their positions.

Each Oberförster has one clerk—a Forstaufseher (Assistant Ranger) who, when office work is slack, helps in the field. But office work is never slack; more often the supervisor must jump in and do routine work himself; for he can not call a Ranger out of his Schutzbezirk to help.

The office methods are frankly crude and cumbersome. Instead of typewriters and carbon copies and a vertical filing case, most letters and reports are written by hand, extracts or resumes made by hand and filed in big blue back covers on shelves. Of course this has one certain result—the amount of correspondence is reduced to a minimum. Indeed the instructions* are explicit that letters are to be few and short—no long titles, no long, courtly phrases, addresses are merely "To the Oberförster in ...." and that as far as possible business is to be transacted verbally. To this end the Ranger stations are being connected with each other and with the Oberförster by telephone and to this end the Forests are kept small in size so that the Oberförster may easily and frequently visit each Ranger and be in constant close touch with all the work on his Forest. In view of such frequent inspection no diary is required of the Rangers nor, in his turn of the Oberförster.

*See Schlieckmann: "Handbuch der Staatsforstverwaltung in Preussen."

The Rangers chief duties are: Protection, Silviculture and Hunting. The first and last extend over the entire year. The silvicultural work centers in spring, which is planting time; and fall which is logging time.

Logging and planting* proceed in accordance with the general provisions of the Working Plan† for each Forest. Detailed plans are drawn up annually for each planting and logging season by the Ranger, are then compiled and revised by the Supervisor, and are submitted to the Förstrath on one of his inspection trips—the planting plan in late summer for the following spring, the logging (cutting) plan soon after Christmas for the following fall. When the Förstrath has approved the plans they are sent to each Ranger concerned, for execution.

In cutting the timber designated in the annual plan, the government has it felled, (barked to expose any fungus injury) and numbered (each piece bearing the current number, length and diameter); for this work fixed prices are paid. The measuring is done by the Ranger and the values entered on "Scale Sheets" which the Ranger then submits to the supervisor who checks them with the Ranger in the field—usually viewing each stem but actually remeasuring only a certain per cent. as a check.

The checked sheets are then copied in the office scale book for the District concerned; the original is returned to the Ranger. From these books the annual "Notice of Sale" is prepared for the annual "Holz Termin" (Timber Sale), inserted in the "Holzmarkt—the representative lumber journal—and sent to persons interested. Sealed bids are the rule—only minor material is auctioned off. Other things being equal, the timber is awarded to the highest bidder, his name, the numbers, the price received, etc., are entered in the "Holzverwertungs-Buch" (Timber Sale Book), and the purchaser given a permit to remove the timber, which becomes valid upon being countersigned by the Oberförster and by the Fiscal Agent to whom payment is made.

If the purchaser desires to have the wood which he has bought shown him by the Ranger, he must apply to the Ranger concerned within three days after the sale. At the end of three days the government's responsibility for delivery of the product ceases.

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*See following article: "Management of Pine in Prussia."

†See: "The Theory and Practice of Working Plans", John Wiley & Sons, New York.

When the purchaser is ready to remove the wood, he turns in the receipt to the Ranger. The Ranger sees that the proper wood is removed without damage to the standing timber, etc., and then reports the fact to the supervisor. The supervisor then has his clerk enter the cutting in the Control Book. Part A* where for each 'Jagen'—or Distrikt†—there is a page divided into *"Hauptnutzung"* and *"Vornutzung"*—i. e. *final cuttings* of mature or nearly mature stands (and where over 5% of the entire volume of a stand must be removed because of fungus, insect, fire or other injuries) and thinnings, clearings, small fungus or insect cuttings, etc.

The total cut of the year** is entered in the Control Book Part C (Part B has long since been abandoned) which summarizes the Hauptnutzung, Vornutzung and the total, according to *Major Products* (sawtimber, cordwood, etc.) and *Minor Products* (stumps, brush, etc.). These totals are compared with the Allowed Annual Cut as given in the Working Plan, and the balance, be it a plus or minus sum, carried forward and used as the basis of the Cutting Plan for the year following. An Oberförster may not exceed the allowed annual cut more than 5% without the Oberforstmeister's consent; over 10% requires the consent of the "Minister" himself.

The proof of any pudding is in the eating. The Prussian administration may seem very intensive, but it pays for itself, and the results both financially and silviculturally are striking. On a specified forest in West Prussia the net income has been per acre: 1869; $2.86; 1874, $3.09; 1879, $4.30; 1884, $5.14; 1894, $8.40; and 1905, $19.18 net, per acre.

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*See: "The Theory and Practice of Working Plans", John Wiley & Sons, New York.

†For management purposes the Forest is divided as follows:.*Block* (a unit of sustained yield) about 2,000 acres, *Jagen* or (in mountains) *Distrikt*—about 50-100 acres each—*Abteilung* (Compartment) and Unterabteilung (Sub-compartment). The Jagen is for systematic division; the Abteilung a part of Jagen requiring different treatment.

**The management year is October to October; the fiscal year April to April.

LET'S NOT OVERLOOK THE WOODLOTS.

By Alfred Gaskill.

In *American Forestry* for October Dr. Fernow tells a doleful tale of the failure of forestry to interest lumbermen in its plans. There is no disputing the fact, and though some explanations other than those given by the good doctor can be advanced, it is worth while to use his "we leave out of consideration the farmer's woodlot", and an article in the Quarterly Journal of Forestry (Royal English Arboriculture Society) also for October, 1912, to emphasize the importance of what in this country we call woodlot forestry and what in England stands for forestry itself. No one will quarrel with my assumption that woodlot and woodlot forestry may apply to forests of considerable size and value.

I shall let the following quotations from the article referred to, *Forty Years' Management of Woods*, tell their own story. They have been abbreviated as much as possible without sacrificing important points, many of them suggestive of other things than yield and price.

"* * I undertook the management of the woods on the Owston Park estate, near Doncaster, forty-three years ago. My instructions were to manage them with a view to getting some pecuniary return. The welfare of the woods was not to be sacrificed for the sake of the game; at the same time the interests of the game were to have every consideration short of that. * * *

"I was to have full power to thin such of the woods as I considered proper; to sell the timber in the way I thought best, and, subject to rendering a proper account to the chief agent, was to have entire management and responsibility.

"From the time of entering to my duties until now I have never once been interfered with, either by the proprietor or his head agent. * * *

"The situation of the estate is low lying. * * quite four-fifths of the woods are at an elevation of 19 to 35 feet, with a clay soil, or in some cases a peaty soil resting on clay. * * In 1869 there were 335 acres of enclosed plantations. There were also several open woods which had been thrown into pasture land, and of which there would have been no occasion to speak here were it not for the fact that from time to time timber has been felled from these open woods, and accordingly I add 15 acres, which makes the total at that time 350 acres. Since 1869 twelve acres have been grubbed out and converted into arable land, and 57 acres have been planted. At the present time (1912) there are 380 acres of enclosed woods.

"At the time of my taking the management the ages of the woods were from 30 to 90 years. In 60 acres of the younger woods were a fair sprinkling of larch, the principal crop being oak with a small proportion of ash.

Throughout the woods there were a fair sprinkling of spruce preserved apparently for the sake of the game. In nearly all of the woods oak had unfortunately been planted as the main crop. A much larger proportion of ash would have given better results. * * *

"* * * Underwood was grown to a certain extent. That is to say, where any existed it was encouraged as far as possible and made the best of. There was, and is, a limited demand; but nothing was attempted in the district in the way of coppice growing.* * *

"When I began my duties I found a fair crop on most of the land. Some of the older ash woods, however, had been somewhat severely thinned with little or no underwood or younger trees to succeed the older ones; the best of the trees had been taken out and those left seemed rather at a standstill. * * *

"The custom previously adopted had been to sell the timber standing, getting in a qualified valuer for the occasion. The valuer in such cases is paid a percentage on the amount the timber is sold for. Where he also marks the trees to be taken down he naturally marks such as will bring the best price in his own and his employer's present interest. The future interest of the woods is a secondary consideration, and probably for that reason the trees left in all the woods were with few exceptions only of mediocre size and quality. So much was this so that I was told by the old experienced woodman on the estate that 'the spice had all been taken out of the pudding', and that I would not get much to sell. However, from that year to this, I have had an annual sale of timber, sometimes more and sometimes less, and we are not quite played out yet. * * *

"One of my first duties on coming to Owston Park was to value a lot of timber which had been marked by the owner and sell it standing to a local merchant who had been in the habit of buying anything there was for sale in the neighborhood. I made a satisfactory sale * * *. * * *

"The price realized was $1,575. The terms were 10 per cent. of the purchase money at the time of sale and the remainder on the 31st December following. The purchaser paid for all labor.

"The terms were customary on the estate, and I adopted them in this case, although I did not approve of them.

"Neither did I approve of selling the timber standing, and on this estate I have not sold any standing since. It is a very common practice, but in the interests of the owners of woods it ought not to be so common. I know there is much to be said in its favor, and it is a difficult matter to change the customs, even when advisable, of any particular district. * *

"* * * We have now given particulars of sales of timber and other produce for the first ten years of our management, and for the purposes of comparison here give the total number of feet sold in that period, with the total amount realized. The number of feet is 88,734, an average per year of 8,873, or about 25¼ feet per acre per annum. The price realized was $25,325 an average per year of $2,530 or an average per acre per annum of $7.

"Our entry on the second decade finds us with a trade outlook very different from that experienced ten years previously. Every branch of trade was depressed, and in agriculture we had one of the worst years ever experienced. * * *

"In the winter following we thinned out 41 acres of woods, 2 acres being about 70 years old and 19 about 50 years, the quantity felled being 5,438 feet. This year's experience was one of my worst in selling timber. I again had recourse to the auction sale, which had served us so well up to now. * * *

"The large buyers were represented by only two merchants, and it would not have been human nature if they had not made a compact in their own interest. * * * This brought forcibly home to me what I had previously been aware of in a general way in regard to these auction sales. When trade is brisk and there exists a good demand, there is no better way of disposing of a mixed lot of timber, but when trade is depressed, there is a difficulty in getting buyers to attend, and one runs the risk of failure. Buying in at an auction sale is always a delicate matter, as one has to meet the buyers another day. * * *

"* * * During this time (second decade) we disposed of 94,422 feet of timber. The total sum realized from the woods during the same period being $15,375. * * * This is an average per acre per annum of about $4.30. With 5,688 feet more than in the previous decade, we realized $9,940 less in price. * * * Well, with such a demonstration before us, what was the best policy to adopt with regard to the management of woods? Should we decide to cut down no more trees, until prices advanced to a more remunerative level? For three or four years one may adopt that plan without serious injury. But to continue this course for an indefinite number of years is, of course, out of the question. * * *

"* * * In our third decade the total quantity of timber sold was 75,184 feet, which realized $16,730. The quantity was 19,000 feet less than in the previous ten years, and the price $1,345 more. * * * The average amount realized per acre per annum about $5.

"* * * In the fourth decade, the sales amounted to 70,043 feet, the price realized being $16,705.

"The gross quantity of timber felled for sale during forty consecutive annual thinnings is 328,743 feet, the average per year being just over 8,200 feet, the average sum received per year being $1,850. * * *

"Some readers may be anxious to know in what condition the woods are at present, as to the crop they carry. The whole of the woods at the present time are well stocked with trees of various sizes, and, taken as a whole, have as large a quantity in feet of saleable timber as they had 40 years ago.

"I should, perhaps, state, in regard to young plantations formed since 1880 on land formerly under farm crops, that no credit has been taken in the report for produce sold from such plantations. * * *

"The pecuniary returns from woods is the aspect in which they are of most importance to most landed proprietors and to the country at large, and anything that can be done by arboricultural societies in getting reliable figures as to results of management will help on the arboricultural interests of the country more certainly than any other lines they can work on."

Those who take the trouble to read these extracts, or to refer to the original article, may be reminded that we have perhaps gone somewhat astray in taking Continental European forestry, especially German, as our sole model and ignoring the really intensive management of the English, and in some cases of the French. The territory within which woodlot forestry, as distinguished from timber growing, may be practiced is steadily increasing. Density of population forces back and further back the forests in which exploiting lumbermen may be interested. In a large part of the South as well as of the Northeast therefore we shall miss the chief opportunities for forestry if the woodlots are ignored. For let it be emphasized that the aggregate output of the woodlots of the Eastern and Central United States is now an important factor in the timber market. It can be marvelously increased if we do not despise it.

Trifling as the English record referred to may seem in many ways it stands as one of many successful enterprises in that country and representative of what undoubtedly must be done in portions of this. Its basis is local demand and we know that local markets always yield highest returns. Once get our people accustomed to satisfying their needs in local markets through local timber firms and real value of the woodlot will appear.

DISENGAGEMENT CUTTINGS IN MIXED SMALL SAPLING STANDS.

By W. D. Sterrett.

Dense mixed stands of small saplings, three to ten feet high, can often be much improved in value at comparatively little expense by freeing the crowns of trees of the more desirable species and individuals from injurious contact with and suppression by the less desirable. The term "disengagement cutting" is peculiarly well suited to designate this kind of work, as it consists primarily in disengaging the crowns of trees to be favored by lopping off the tops and branches of individuals which are interfering with their growth. These cuttings can be done most effectively in late summer as the saplings cut back are less liable to sprout and are conspicuous because of their foliage. It has been found that one man with either a well-sharpened corn knife or with a brush axe can readily cover one to two acres a day of dense small sapling thicket in this kind of work. There will usually be some spots where the crowns of desirable trees are already free and where of course, no cutting is necessary. The following tabulated summaries give the results of an experimental disengagement cutting made in a three to six year old mixed sapling stand of White Pine, Gray Birch, Red Maple, Aspen, Bird Cherry, and Willow in southern New Hampshire, the cutting being made to favor the White Pine. Two plots were laid off, on one of which a disengagement cutting was made in which the tops and branches of all interfering hardwoods were lopped off, while the other remained intact for comparison. Plot I was one-half acre and Plot II one-quarter acre in area. Table A shows the amount and condition of the White Pine on the two plots just before the cutting was made in 1906, while Table B summarizes a re-measurement of the two plots made in 1911.

Table A. (1906 Measurement.)

Height in ft.	Pine with tops free. Plot I.	Plot II.	Pine overtopped. Plot I.	Plot II.	Totals. Plot I.	Plot II.
	(Number per acre.)					
0'-2',	232	212	86	168	318	380
2'-4',	696	392	408	512	1,104	904
4'-6',	316	176	208	144	524	320
Totals,	1,244	780	702	824	1,946	1,604

Plot I was treated by a disengagement cutting after above data were collected.

Table B. (1911 Re-measurement.)

	Pine with tops free. Plot I.	Plot II.	Pine with tops shaded. Plot I.	Plot II.	Totals. Plot I.	Plot II.
0'- 2',	0	4	8	28	8	32
2'- 4',	18	18	100	204	118	228
4'- 6',	162	80	248	432	410	512
6'- 8',	520	128	276	488	796	616
8'-12',	508	112	38	92	546	204
12'-16',	10	....	....	....	10	....
Totals,	1,218	348	670*	1,244†	1,888	1,592

The better development of the pine on the disengaged plot is evident from the much greater percentage of pines with free crowns and in more rapid growth in height. In 1911 64 per cent. on Plot II; 72 per cent. of the pine on Plot I were over six feet in height, while only 54 per cent. on Plot II were over six feet. In addition to this, a large part of the overtopped pines, especially those overtopped by hardwoods on Plot II appear weak or sickly and many are distorted by suppression. The pines on the disengaged plot are uniformly healthy, vigorous and straight.

*Only 238 of these pine overtopped by hardwoods, the rest overtopped by pine.

†1,160 of these overtopped by hardwoods, and 84 by pine.

NORTHERN LIMITS OF EAST CANADIAN TREES IN RELATION TO THE CLIMATE.

By H. R. Christie.

Mayr based his division of forest regions on climate. Temperature, precipitation and humidity are the most important climatic features. The average temperature of the tetrahore (i. e. the four growing months) is the most important factor in determining the distribution and extension of species in the northern hemisphere.

According to Mayr forest cannot exist if, during the tetrahore, the average temperature is below 50° F; precipitation is less than 1.95 inches; average humidity is below 50° and at the same time precipitation less than 3.9, say 4 inches.

If precipitation exceed 4 inches, a forest will exist even though the air be dry.

The problem was to ascertain what relation, if any, exists between the climate of the tetrahore and the northern limits of Canadian trees of the Atlantic flora.

The desired data were obtained from "Canadian Monthly Weather Review", and "Canada's Fertile Northland", through the courtesy of R. S. Stupart, Director of Meteorological Station, Toronto.

A number of representative stations distributed as evenly as possible along the different parallels of latitude were selected. For these points the tetrahoral average temperatures, as well as the total precipitation for the tetrahore, were determined. Humidity was given for so few stations (ranging from 57° to 80+) that it was neglected. Where the average temperature of any month fell below 40°, it was excluded, and the average temperature at such points stated on the map includes only the months of June, July and August.

Examination of the tables shows that precipitation at practically every station is abundantly sufficient for supporting forest growth, being well above Mayr's 4 inch limit. We may, therefore, say that the deciding climatic factor in Canada (exclusive of British Columbia and prairie) is temperature.

Nevertheless the influence of other factors, presumably moisture conditions, bears on the distribution of some of the species decidedly. White and Red Pine, Hemlock and Sugar Maple show this influence in most marked manner.

The different stations, with their temperatures, were plotted on a map, showing limits of forest trees. (C. F. S., Atlas of Canada, No. 9, Limits, Forest Trees.) Lines were drawn connecting approximately points of equal temperature. These lines may be called the tetrahoral isotherms. For the lines of 50° and 52° only one station each was available. Hence, it was assumed that they run more or less parallel to the limits of tree growth.

These isotherms do not follow the parallels of latitude, but push away up above them in the northwest toward MacKenzie Basin.

Local cold areas seem to exist in the following places: Newfoundland and the Gulf of St. Lawrence; Bay of Fundy; mountainous region of the New England States.

The results of this study allow the following relations in broad lines to be stated.

Black and White Spruce and larch (probably) follow approximately the line of 50°. The data are too scanty to be certain but this line coincides with the contention of Mayr that this isotherm forms the limit of tree growth and these species are at the limit. Balsam Poplar, Canoe Birch and aspen probably follow approximately the line of 52°, S. E. as far as James Bay, beyond which no data are available, but apparently this isotherm is maintained by these species.

Balsam Fir follows isotherm 54°, S. E. as far as south of York Factory, in its western extension dropping to 55°.

White Cedar *(Thuja occidentalis)* ranges from 53 to 54° as its northern limit to 65° as its southern limit, except at the east end of Lake Ontario, where it bends southwards.

White Pine follows 52° from Newfoundland to Lake St. John, then approximately follows a line between 55° to 60° to Lake Winnipeg, where it turns south.

Red Pine follows nearly the same line with a tendency to more northern location.

Sugar Maple runs on the Eastern end along 52°, dropping to 58° at the Western end (Lake of the Woods).

Hemlock is found nowhere north of 55°, and finds its limits mostly at 58°.

Chestnut, Tulip, Black Walnut, Sycamore and Sassafras are practically confined to the Ontario peninsula south of 62°.

Butternut and White Ash *(Fraxinus americana)* are found chiefly south of the isotherm 60°, but push up to 58° in Maine and New Brunswick.

With reference to the tetrahoral isotherms Canada's Atlantic flora may be roughly divided as follows:

1. Northern border of Southern Hardwood Forest, isotherm 62°.

2. Transition zone of mixed Hardwoods and Conifers, 62° to 56°.

3. Northern Coniferous Forest, 56° to 50°.

It may be concluded that in Eastern Canada, temperature is controlling climatic factor for forest types, but not for species; precipitation is practically everywhere abundant; humidity data are not available, but it is safe to say that the moisture content of the air is ample (except tundras).

CONCERNING SEED SPOTS.

By J. A. Larsen and R. J. Smith.

In connection with the sowing of Yellow pine, White pine and Western larch on The Blackfeet National Forest during the seasons of 1911 and 1912, seventeen and one-half acres were sowed directly in seed spots. The total of this sowing is divided into:

A. 10 acres of Yellow pine (Black Hills) spring 1911.
B. 5 acres of Yellow pine (Black Hills) spring 1911.
C. 2½ acres of Western larch (Blackfeet) spring 1912.

Each area covered burns of the season 1910 and each area lying on a different watershed draining south, north and east respectively.

On area A where every bit of humus, sod and other material had been consumed, and where all the methods of direct seeding used were eminently successful, every one of the seed spots had seedlings. On area B where there was considerable sod everything failed but the seed spots. While on C with all humus, litter and brush removed the 15 acres sowed to White pine with cornplanters and broadcast failed, and the 2½ acres of seed spots proved successful.

Various reasons contributed toward the failure of the cornplanter method, such as sod, rodents and lack of moisture.

Before undertaking this work the writers entertained some skepticism as to the success of the seed spots method, largely because of the numerous failures of earlier experiments at large; but our results have shown it to be safer than sowing with cornplanter.

On the land where the soil had been burned off completely the spots were made with a garden rake, and in the presence of sod a mattock was used. After the litter had been removed from a spot from eight to ten inches wide the soil was loosened and mashed up to a depth of from one-half to one inch, whereupon a handful of loose soil picked up from the spot was strewn over the seed after it had been firmly pressed into a flat surface with the foot. Where the lay of the ground did not dip over 15% the seed were stuck into a surface which had a slope equal to the general slope of the land, but where the land sloped more than this these spots were given a lesser slope, enough to allow good drainage. Moreover the seed was set firmly into a compact surface of loosened soil and this again allowed close contact with the underground, leaving no loose or unpacked soil under the seed and thus no obstacle to percolation by evaporation of the soil moisture. Since the snow had barely disappeared the ground was very wet and the evaporation of this moisture was depended upon to germinate the seed, which it did, germination of the Yellow pine seed being in progress within 10 days after sowing.

By the method described the surface of the seed spots was well drained and remained moist as long as there was moisture in the earth. The water from occasional rain was thus applied gradually, having to evaporate first. The loose earth thrown over the seed kept dry most of the time. It assisted in keeping the seed damp during periods of evaporation, prevented rapid drying, equalized the temperature by day and night and prevented drying and cracking of the seed spot surface, simultaneously hiding it from rodents and birds.

CURRENT LITERATURE.

Forest Conditions of Nova Scotia. By B. E. Fernow, assisted by C. D. Howe and J. H. White, Commission of Conservation. Ottawa. 1912. Pp. 93. Maps.

Nova Scotia is the only province of Canada which can, so far, boast of a forest survey. Such a survey, or forest reconnaissance, was made under the direction of Dr. B. E. Fernow, of the Faculty of Forestry, of the University of Toronto during the summers of 1910 and 1911 and has been recently published by the Commission of Conservation. He had the assistance on the survey of Mr. J. H. White and Dr. C. D. Howe, also of the Forestry School faculty, the latter very ably handling the relation of forest types to physiography and soils as given in the latter part of the report.

The object of the reconnaissance was to furnish reliable data as to the value of the forest resources of the province, so that with this as a working basis the Government might formulate a progressive policy for the handling of Crown and private timber lands. Its need is best shown by the statement that a resource representing a potential capital of at least $300,000,000 is rapidly deteriorating by injudicious use and that restorative measures should be undertaken at once by all who have the continued prosperity of the province at heart. About 21,000 square miles was covered by the survey and while its accuracy cannot exceed that of the maps upon which it was plotted, it is safe to say that these Crown Land sheets contain the most detailed information in regard to forest lands upon this continent.

The report begins with a discussion of the physiographic features of the province and assigns the whole province, ecologically, to the Appalachian or Acadian forest type, namely a maple-birch-beech formation, with coniferous admixture. An assignment of different types of forest to the underlying rock formations is made in an interesting and comprehensive manner but cannot be entered upon here.

The main species making up the forest are enumerated and briefly discussed. Red spruce is given as forming the bulk of the coniferous timber, while balsam fir is numerically the most common conifer, with cedar entirely absent. White pine represents about ten per cent. of the coniferous cut, hemlock about 30 and spruce 60 per cent.; the composition, however, varying considerably from locality to locality.

Outside of the three main hardwoods, beech, maple and yellow birch, Paper birch is the only one worthy of mention, with basswood entirely absent.

A detailed land classification of the province follows, showing that there are on the mainland 5,053,000 acres of green forest and 552,000 recently burned which may recuperate. Of the green area, 10.8% is coniferous growth in pure stands, 3.4% pure hardwoods and the balance mixed forest. Fully 70% of the province is classified as potential forest land, and of this forest area about 30% or about 1,400,000 acres of virgin, semi-virgin and moderately culled area is furnishing the present supply of lumber. Assuming the annual cut as 300 million feet B. M. and the available stand as about ten billion feet, the life of the industry in its present development is indicated as not more than 20 to 30 years.

Attention is called to the erroneous idea held by most of the people in regard to the rapid growth of spruce, such assumption being based upon the White spruce of pastures rather than upon the Red spruce in virgin stands, whose rate of growth on the stump may be annually as slow as an inch in 10 to 12 years on the average.

Under recommendations, it is advised that the province appoint a technically trained provincial forester whose duties would be analagous to those of the state forester, in the United States. Besides making investigations in regard to the restoration of barrens and waste land planting, such an official would carry on educational work in the province at large and in the Agricultural College at Truro, and the province could more successfully carry out its forest policy. The author, in conclusion, expresses the hope that the survey may at least emphasize the importance of the forest as a resource in Nova Scotia—a province which on account of its intelligent and well distributed population, has unprecedented advantages for the inauguration of a successful forest policy.

R. B. M.

Minnesota Trees and Shrubs: An Illustrated Manual of the Native and Cultivated Woody Plants of the State. By F. E. Clements, C. O Rosendahl, F. K. Butters. Report of the Botanical Survey, IX. University of Minnesota, Minneapolis, Minn. 1912. Pp. 314.

The present book is the ninth volume in the botanical series of the publications of the Geological and Natural History Survey of the State, issued irregularly during the last twenty years. The creditable standard of excellence which characterized the preceding volumes is maintained in this issue.

The text deals with 300 species and varieties belonging to 100 genera, arranged after the Besseyan sequence of families. It is profusely illustrated, nearly all the species being figured. An introduction of some twenty pages deals with the use of keys, questions of nomenclature and phylogeny, and a brief discussion of the vegetable types. This is followed by a key to the genera, based on leaf and twig characters, and a flower key to the families. In addition, a species key is given in connection with each genus. The descriptive portion is very full, and notes are given as to distribution, ornamental use, character and uses of wood, and meaning of the scientific names. A generous glossary completes the book.

The paper, typography and binding are excellent.

J. H. W.

Nitrogenous Soil Constituents and their Bearing on Soil Fertility. By Oswald Schreiner and J. J. Skinner. Bulletin 87, Bureau of Soils, Dept. of Agriculture. Washington, D. C. 1912. Pp. 1-84.

Progress of the U. S. Bureau of Soils in the study of organic materials in the soil has been noted from time to time in this journal (F. Q., Vol. IX, p. 99). Thirty-five such compounds have now been isolated. Of these, thirteen are organic acids, nine organic basic compounds, three carbo-hydrates, two aldehydes, two alcohols, one each hydro-carbon, glyceride, ester, sulphur compound, phosphorus compound and acid hydride. The present bulletin, however, is concerned only with those organic compounds containing nitrogen. Most of these are decomposition products of proteins, nucleic acids, lecithins and similar complex compounds of biological origin.

The authors in the beginning elucidate a fact long understood by the plant physiologist but too often not comprehended by the silviculturist, namely that the intake of mineral food materials in the soil water is not regulated by the amount of transpiration, but rather by the life processes and their requirements, within the plant. For example, in one of their culture solutions the loss of water in a three day period was about 10%, while the mineral elements were decreased by 70% in the same period, or, in other words, the plants absorbed the mineral food elements much faster than the water in which they were dissolved.

The authors then show that plant roots have the power of directly absorbing certain nitrogenous compounds without their first being changed to ammonia or nitrates, and, indeed, that these compounds may serve as substitutes for nitrates. For example, when combined with phosphate and potash in a culture solution with nitrates absent, they increased the growth of plants from 30 to 74%. Here the compounds were the only source of nitrogen. When nitrates were also present, the addition of the compounds produced a further increase in growth, but this was not so marked as when the compounds served as a substitute for nitrates. Nine compounds of this nature beneficial to growth have been isolated; others are injurious.

If these cultural experiments are an index of what happens in the nature, then a mere nitrate determination is erroneous and misleading as to the nitrogen content of the soil readily available to plants. Indeed, it may be that the formation of nitrates is harmful rather than beneficial, since they are readily leached away, do not last from season to season and so result in an actual loss of soil nitrogen. On the other hand, the organic nitrogen bearing compounds are leached out with the greatest difficulty; they remain in the soil from season to season, ready for absorption and use by the plants at any time, and so conserve the soil nitrogen.

Thus we have to make another adjustment in our knowledge of soil chemistry.

C. D. H.

Service Tests of Ties: Progress Report. By H. F. Weiss and C. P. Winslow. Circular 209, U. S. Forest Service. Washington, D. C. 1912. Pp. 25.

"Since 1902 the Forest Service has constructed eight test tracks in co-operation with seven different railroad organizations. Because a long time must elapse before data can be obtained on durability, few of these tracks have thus far yielded conclusive results. The information already received indicates that test tracks, if property constructed and inspected, prove a valuable index in showing economies in track maintenance.

"So far as can be told by present results, all treatments, with one exception, have increased the durability of the ties over that of similar untreated material. Just how much the natural life of the ties can be prolonged is not yet determined, but that it may in many cases be doubled or even trebled seems certain. For example, untreated loblolly pine and hemlock ties laid in Texas lasted only 1.5 years, while of those burnettized over 70 per cent. were still serviceable after seven years.

"Ties with low decay resistance, such as loblolly pine, hemlock, tamarack, and beech, if laid untreated, should not be tieplated, as they will decay before they will wear out.

"The increased resistance to decay secured from preservative treatment makes it highly desirable to protect treated ties from deterioration by mechanical cause. This is particularly true of ties with low-crushing strength.

"Experience thus far is not conclusive as to the best form of plate to use. Wooden plates, when simply laid under the rail, have not proved satisfactory, as they either become loose, split, or, in some cases, become embedded in the tie. Flanged metal plates have a decided tendency to split the tie, thus forming cracks which enable moisture to reach the interior and hasten decay. Metal plates with flat or slightly corrugated bottom have thus far given the best results.

"Service tests on screw and cut spikes have, to the present time, yielded no definite conclusions. It has been shown, however, that when screw spikes are used it is desirable to have some form of boss on the plates to re-enforce the heads of spikes against lateral thrust."

S. J. R.

Principles of Drying Lumber at Atmospheric Pressure and Humidity Diagram. By H. D. Tiemann. Bulletin 104, U. S. Forest Service. Washington, D. C. 1912. Pp. 19.

Part I is a progress report of the investigations by the Forest Service of the fundamental principles in drying lumber. The work has all been done on a small scale and two series of experiments are now under way to determine how these principles may best be applied in commercial practice.

The experiments so far made indicate that successful dry-kiln operation requires the observance of the following points:

"(1) The timber should be heated through before drying begins.

"(2) The air should be very humid at the beginning of the drying process, and be made drier only gradually.

"(3) The temperature of the lumber must be maintained uniformly throughout the entire pile. For this an exceedingly large circulation of air is essential.

"(4) Control of the drying process at any given temperature must be secured by controlling the relative humidity, not by decreasing the circulation.

"(5) In general, high temperatures permit more rapid drying than do lower ones. The higher the temperature of the lumber the more efficient is the kiln. It is believed that temperatures as high as the boiling point are not injurious to most woods, providing all the other fundamentally important factors are taken care of. Some species, however, may not be able to stand as high temperatures as others.

"(6) The degree of dryness attained, where strength is the prime requisite, should not exceed that at which the wood is to be used."

Part II contains a humidity diagram the purpose of which is to enable the dry-kiln operator to determine quickly the humidity conditions and vapor pressures, as well as the changes which take place with changes in temperature. The diagram, which consists of two distinct sets of curves on the same sheet, is adapted to the direct solution of a great many problems of this character without recourse to tables of mathematical calculations. It is fully explained both as to theory and its practical application.

S. J. R.

Prolonging the Life of Crossties. By H. F. Weiss. Bulletin 118, U. S. Forest Service. Washington, D. C. 1912. Pp. 51.

Following are twenty-five recommendations made by the Forest Service for prolonging the life of ties.

"(1) The winter cutting of ties should be encouraged. It leaves the forest in better condition and the ties season with less danger of checking, insect injury, and decay.

"(2) Preference should be given to sawed ties. These result in less forest waste and permit in general a more uniform bearing of the plate on the tie and the tie on the ballast. As a rule their use does away with the necessity for adzing and avoids the mechanical destruction resulting from an uneven bearing surface. Moreover, more sawed ties can be loaded on a cylinder truck, thus decreasing the cost of labor in the preservative treatment.

"(3) As a general rule, all bark should be removed from ties immediately after they are cut. If, however, they caseharden or are otherwise injured they may be permitted to season with the bark on, but all bark should be removed before the ties are placed in the treating cylinder.

"(4) If ties are to be adzed or bored, this should be done before they are treated.

"(5) It is almost always cheaper and better to use treated than untreated ties. In localities where black locust, redwood, cedar, and cypress ties are available it may be cheaper to use these untreated than to use treated ties.

"(6) In selecting ties for treatment, preference should be given to those which are hard and which absorb the preservatives readily. Treated red oak, beech, maple, and gum ties will give better service than treated chestnut, spruce, and white-pine ties.

"(7) Since sapwood is just as strong as heartwood and much easier to inject with preservatives, ties with a large amount of sapwood, provided it is properly distributed, should be preferred in preservative treatment to those with little or none.

"(8) All ties should be thoroughly seasoned before treatment. Of the various methods of seasoning, air seasoning is preferred, because it is usually safer. If ties must be artificially seasoned, they should be heated at low temperatures and lose moisture gradually, to avoid serious checking.

"(9) The sites selected for air seasoning should be free from weeds and decayed wood and well exposed to air currents. If possible, the yard should be covered with cinders. The ties should be elevated on creosoted stringers at least 6 inches above ground. The stringers should be laid close to the ends of the ties in order to retard checking.

"(10) Ties cut from conifers are less likely to check during seasoning than ties cut from broadleaf trees, and in consequence can be piled more openly.

"(11) If ties are seasoning too fast they should be piled closer together; if seasoning too slowly they should be piled more openly. Ties cut in winter can be piled more openly without danger of checking than ties cut in summer. The 8 by 2 form of pile will give general satisfaction; more open forms are the 7 by 1 and 7 by 2.

"(12) Serious end checking, if not controlled by methods of piling, can be retarded by driving S-shaped irons over the check.

"(13) The length of time ties should season before treatment will vary primarily with the species of wood, form of pile, and period of the year. In general, ties cut in spring and summer will be seasoned sufficiently for treatment by the end of the following autumn; ties cut in early spring will be seasoned sufficiently by the following early autumn; the seasoning period varying from about five to eight months. The periods necessary to season dense ties like the oaks will generally be from two to three months longer than those just given.

"(14) A preliminary soaking of ties in water to increase their rate of air seasoning and their absorptive properties is not recommended unless it can be done without extra expense. The slight advantages gained are not sufficient to warrant an appreciable expenditure of time or money.

"(15) When ties are received at the treating plant they should be piled in groups according to the way in which they take treatment, those which absorb large quantities of preservative being piled separately from those which are difficult to impregnate. The species which should comprise the various groups are not as yet as well known as is desirable, but the distinction can at least be made between those that behave very differently under treatment. Only thoroughly seasoned ties should be treated. It is bad practice to mix seasoned and green or only partially seasoned ties in one charge. The aim should be to treat all ties in a charge with approximately the same amount of preservative.

"(16) At present it is not known definitely what preservative or process is most economical in all cases. Under heavy traffic, where the ties wear out before they rot, treatments with zinc chloride or light treatments with creosote may be advisable. When the traffic is light, heavier injections may be better. If the ballast is wet or moist, creosote is to be preferred to zinc chloride.

"(17) No matter what kind of ties are treated or what preservative is used, at least all of the sapwood and as much of the heartwood as possible should be impregnated with the preservative.

"(18) If ties are to be treated with zinc chloride, and absorb the preservative readily, the solution should be made dilute, and as much as possible injected. This is better practice than having the solution more concentrated and forcing only a limited amount into the outer fibers of the wood.

"(19) The treating plant should be in good operating condition before any ties are treated. Leaky valves and pumps should not be permitted, and all gauge scales should be accurate and the pulleys and floats running free. After treatment the excess preservative should be returned to the same measuring tank from which it came, and the reading corrected for temperature if necessary. If the float system is used, the amount of absorption should be determined by measuring the difference in the height of the float before the preservative is run out of the tank and after it has been returned to it.

"(20) While track scales are generally desirable for determining absorption, they can not be depended upon if the ties are to be steamed or boiled in oil.

"(21) As the composition of the preservative is very likely to change after a number of treatments, it is highly desirable to have it analyzed frequently to see that it meets the specifications.

"(22) Creosoted ties which are not to be used immediately should be piled solidly (9 x 9), while those injected with zinc chloride should be openly piled, to permit of rapid seasoning. In doing this the precautions against too rapid seasoning should be observed. Zinc-treated ties should be seasoned before being placed in the track, in order to avoid as far as possible the leaching out of the preservative and corrosion of the spikes.

"(23) If a nine-sixteenth-inch diamond-pointed cut spike is driven into previously bored hole three-eighths to seven-sixteenth inch in diameter it will hold better than an ordinary cut spike driven directly into the tie.

"(24) From the results of tests thus far made it appears highly desirable to use screw spikes whenever possible. When they are used holes should first be bored deep enough in the tie to allow a space between the base of the hole and the point of the spike, or the hole may be bored entirely through the tie .

"(25) It is not possible at present to say which of the various types of tie-plates are best. The data thus far secured, however, point to the advisability of using heavy metal plates with flat or only slightly corrugated bottoms. When screw spikes are used, the heads of the spikes should be protected from lateral thrust by a boss of metal fitting snugly under the head."

S. J. R.

Some Facts about Treating Railroad Ties. By W. F. Goltra. Cleveland, Ohio. 1912. Pp. 105.

The author of this interesting booklet is president of the W. F. Goltra Tie Company, formerly general tie agent of the New York Central Lines west of Buffalo. He has not hesitated to depart from the beaten path and his conclusions as to the most efficient methods of preserving ties are in many ways at decided variance to those commonly stated. Following is a summary of his recommendations:

"1. It is useless and impracticable to group ties for treatment according to species, proportion of heartwood and sapwood, degree of seasoning, etc.

"2. Ties should be thoroughly seasoned (preferably by artificial method) and treated to total refusal.

"3. Zinc chloride alone or in combination with creosote oil is more economical than creosote alone in treating railroad ties to refusal."

The several steps in Mr. Goltra's method of treatment are as follows:

Immediately upon arrival of the ties or timbers at the treating plants, they are transferred by hand from standard gauge cars to narrow gauge tram cars, which are placed alongside of the former. The tram cars after being loaded are run on tracks into the steaming cylinder. The cylinders are provided with a heavy cast steel door adapted to slide up and down and close hermetically. It is operated by an electric hoist and can be lowered or raised in the space of one minute. The ties or timbers, in whatever form, are then subjected to live steam for a period varying from thirty minutes to four hours, depending upon the character and condition, such as thickness of pieces, density of the wood, proportion of heartwood and sapwood, species of wood, moisture condition and the like, and at steam pressure of about fifteen pounds per square inch. In most cases possibly fifteen to twenty pounds should be the maximum.

Next in order is to evaporate the condensed steam or moisture from the ties or timbers. This is accomplished by stacking in a yard for air seasoning.

The ties should be piled in such manner that the air will have free access to all surfaces, and a good way to stack ties for seasoning is to pile them by what is known as one by eight and running the stacks fourteen to sixteen feet high, which can easily be done with a locomotive crane.

Ties which have been given a preliminary steaming dry rapidly, and the average time required to evaporate the moisture from them to put them in condition for treatment is about three months, depending upon the character of the wood and climatic conditions. Ordinarily it requires from nine to twelve months in the open air for hardwood ties to season sufficiently for treatment.

When the ties have sufficiently seasoned and are ready for treatment, they are taken from stacks, passed through an adzing and boring machine and loaded directly on tram cars to be transported to the ovens for the completion of the drying and thence to the impregnating cylinder for treatment with preservatives.

It is essential to know the date when the ties were treated. Some railroads affix galvanized dating nails. This method is expensive and unsatisfactory. Instead of using dating nails a pneumatic branding device, consisting of two opposite cylinders with pistons, provided with dies for stamping dates, or any other information, and controlled by automatic air valves, may be placed directly behind the boring spindles and so timed to the machine feed that when the tie moves to the proper position, the dies advance and leave their deep-sunken impression in both ends of the tie.

After the ties have been machined and loaded directly upon tram cars, they are transported to the drying ovens. The time required in the ovens to complete the drying of railroad ties which have undergone the several preceding steps is about from eighteen to thirty hours, or an average of twenty-four hours.

The transfer from the drying ovens is quickly made by means of a transfer table and no appreciable amount of heat is lost while making the shift from said ovens to the impregnating retorts. It has been popularly supposed that in operations on a large scale it would involve considerable expense to move the ties from the steaming cylinders to the drying yards and from the drying yards to the drying ovens, and from the drying ovens to the impregnating retorts, and thereby increase the cost of handling. This is incorrect. On the contrary, by means of the transfer table and the locomotive crane, the cost of handling ties and lumber may be actually reduced in most cases.

Green timber fresh from the saw can be treated as readily as older stock; sometimes apparently more readily, so that preliminary air seasoning may be dispensed with; therefore this system of steaming and drying ties or lumber may be employed with or without a treating plant adjunct.

After the timbers have remained in the ovens a sufficient length of time thoroughly to dry and warm them, the trams are drawn out onto a transfer table and immediately run into the impregnating cylinders for chemical treatment. The length of the said cylinders corresponds with that of the drying oven and is capable of holding twelve tram loads of eight-foot ties, each tram carrying between forty-five and fifty ties, or approximately five hundred and sixty ties per charge.

The duration of the diverse phases of one complete operation occupying four hours is as follows:

(1) Charging the cylinder with ties, ...	15	minutes
(2) Producing vacuum to 14 inches, ...	45	"
(3) Filling cylinder with chemical, ...	15	"
(4) Continuation of filling with pressure pump,..	90	"

(5) Returning surplus chemical to working tank, 15 "
(6) Producing vacuum to hasten drying of ties, .. 30 "
(7) Blowing back last remnant of chemical to working tank, ... 15 "
(8) Opening door and discharging cylinder, ... 15 "

Impregnation is considered complete when the manometer shows, for at least twenty minutes, that without further pumping the pressure has remained stationary at one hundred pounds —thus showing that the chemical is no longer penetrating into the wood. The duration of this phase of the operation varies from one to two hours, depending upon many factors, such as species of wood, its physical structures, proportion of heartwood and sapwood, degree of seasoning, size, shape, mass, and many other conditions, not a single one of which is sufficiently well defined to make it possible or practicable to segregate timbers into many groups for treatment. The treatment should in all cases be carried to "refusal," which obviates the necessity for sorting ties or timbers into numerous groups, and this is the only way to secure complete and thorough impregnation.

S. J. R.

OTHER CURRENT LITERATURE.

Forest Fire Protection under the Weeks Law in Co-operation with States. By J. Girvin Peters. Circular 205 (first revision), U. S. Forest Service. Washington, D. C. 1913. Pp. 14.

Greenheart. By C. D. Mell and W. D. Brush. Circular 211, U. S. Forest Service. Washington, D. C. 1913. Pp. 12.

The wood of Greenheart *(Nectandra rodiaei)* a South American and West Indian tree is greatly esteemed for dock construction and ship-building. The circular discusses the uses and durability of the wood, logging and transportation methods, markets, and the chief anatomical features of its structure.

Circassian Walnut. By G. B. Sudworth and C. D. Mell. Circular 212, U. S. Forest Service. Washington, D. C. 1913. Pp. 12.

Methods and Apparatus for the Prevention and Control of Forest Fires, as exemplified on the Arkansas National Forest. By D. W. Adams. Bulletin 113, U. S. Forest Service. Washington, D. C. 1912. Pp. 27.

Mechanical Properties of Western Hemlock. By O. P. M. Goss. Bulletin 115, U. S. Forest Service. Washington, D. C. 1913. Pp. 45.

Based on Forest Service tests of green stringers of all grades, assuming Douglas fir to have a strength value of 100, western hemlock has a strength of 88 and western larch a strength of 81.7. Although there is a prejudice against the name "hemlock," manufacturers often mix it with Douglas fir and it is sold and used for the same purposes. It makes excellent barrels and boxes for shipping food stuffs, and is recommended for edge-grain flooring, interior finish, and framing. A large future demand for it is predicted.

An Examination of the Oleoresins of Some Western Pines. By A. W. Schorger. Bulletin 119, U. S. Forest Service. Washington, D. C. 1913. Pp. 36.

The Composite Type on the Apache National Forest. By H. H. Greenamyre. Bulletin 125, U. S. Forest Service. Washington, D. C. 1913. Pp. 32.

This bulletin includes a discussion of a type of forest composed of western yellow pine, Douglas fir, and Colorado blue spruce which is found on some of the National Forests in Arizona. The bulletin discusses the chief features of the type, the comparative growth of the species, the effect of cutting upon reproduction, and the form of management adapted to this type of forest.

Report of The Forester for 1912. By H. S. Graves, U. S. Forest Service. Washington, D. C. Pp. 95.

Record of Wholesale Prices of Lumber. Based on actual sales made F. O. B. each market for July, August, September, 1912, and the three preceding quarters. U. S. Forest Service. Washington. November, 1912.

Yields and Returns of Blue Gum (Eucalyptus) in California. By T. D. Woodbury. Circular 210, U. S. Forest Service. Washington, D. C. 1912. Pp. 8.

Proceedings of The Society of American Foresters. Volume VII, Number 2. Washington, D. C. 1912. Pp. 133-238.

Contains: Forest Resources and Problems of Canada, by B. E. Fernow; Border Cuttings: A Suggested Departure in American Silviculture, by A. B. Recknagel; Grazing in the National Forests, by L. F. Kneipp; Range Improvement and Improved Methods of Handling Stock in National Forests, by J. T. Jardine; Silvicultural Systems for Western Yellow Pine, by E. H. Clapp; State Forestry Problems, by A. F. Hawes; A Synopsis of the Red Firs, by W. H. Lamb; Natural versus Artificial Regeneration in the Douglas Fir Region of the Pacific Coast, by T. T. Munger; A System for Getting Topography in Reconnaissance Work in the Western Cascades, by W. H. Leve; Forest Planting in Northern Michigan, by W. H. Piper; Interrelation between Brush and Tree Growth on the Crater National Forest, Oregon, by H. D. Foster; Sitka Spruce of Alaska, by B. E. Hoffman.

Forestry in New Hampshire: Eleventh Report of the Society for Protection of Forests, 1912. Pp. 96.

Fourth Annual Report of the State Forester of Vermont, 1912. By A. F. Hawes. Burlington, Vt. Pp. 59.

Fifteenth Annual Report of the Massachusetts Forestry Association, 1912. Boston, Mass. Pp. 64.

Annual Report of the Connecticut Agricultural Experiment Station, 1912, Part III: Twelfth Report of the State Entomologist. By W. E. Britton. New Haven, Conn. 1913. Pp. 209-296.

Report of the Pennsylvania Department of Forestry for the Years 1910-11. Harrisburg, Pa. 1912. Pp. 277.

The Chestnut Blight Disease: Means of identification, remedies suggested and need of co-operation to control and eradicate the blight. Bulletin No. 1, Pennsylvania Chestnut Tree Blight Commission. Harrisburg, Pa. 1912. Pp. 9.

A Tricarpellary Walnut. By W. H. Lamb. Reprinted from Torreya, Vol. 12, No. 12. New York. 1912.

Fifty-first Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan and the Twenty-fifth Annual Report of the Experiment Station, 1911-12. Lansing, Mich. Pp. 607.

Contains the report of the Forestry Department.

Missouri Botanical Garden: Twenty-third Annual Report, 1912. St. Louis, Mo. Pp. 207.

Contains the following scientific papers: A Study of the Problem of Water Absorption, by L. O. Kunkel; A Consideration of the Physiology and Life History of a parasitic Botrytis on Pepper and Lettuce by G. L. Peltier; Biometric data on the Inflorescence and Fruit of Crinum longifolium, by J. A. Harris; The Relation between the Density of Cell Saps and the Freezing Points of Leaves, by W. W. Ohlweiler; A Monograph of the North American Usneaceae, by R. H. Howe, Jr.; The Effect of Toluol and CS2 upon the Micro-flora and Fauna of the Soil, by P. L. Gainey; The Relation of Algae to Dissolved Oxygen and Carbon-dioxide, with Special Reference to Carbonates, by C. O. Chambers.

Annual Report of the Director of Forestry of the Philippine Islands for the year ended June 30, 1912. By W. F. Sherfesee. Manila, P. I. 1913. Pp. 59.

A Guide to the Dominion Experimental Farms and Stations, Department of Agriculture. Government Printing Bureau, Ottawa, Canada. 1912. Pp. 162.

Botanic Gardens and Government Domains, New South Wales, Annual Report, 1911. By J. H. Maiden. Sydney, N. S. W. 1913. Pp. 30.

Kokia: A new Genus of Hawaiian Trees. By F. L. Lewton. Smithsonian Miscellaneous Collections, Vol. 60, No. 5 (Publication No. 2,145). Washington, D. C. 1912. Pp. 4.

Electrical Resistance of Trees. By G. E. Stone and G. H. Chapman. Twenty-fourth Annual Report of the Massachusetts Agricultural Experiment Station. Public Document, No. 31, Part I. Amherst, Mass. 1912. Pp. 144-176.

Diseases of the Chestnut and other Trees. By Dr. H. Metcalf. Transactions of the Massachusetts Horticultural Society for the year 1912. Part I. Pp. 69-95.

The First Annual Report of the Conservation Commission, 1911, State of New York, Vol. I. Division of Lands and Forest and Fish and Game. Albany, N. Y. 1912. Pp. 223.

Forest Taxation. By C. R. Pettis. Bulletin 8, State of New York Conservation Commission. Albany, N. Y. 1913. Pp. 19.

An Analysis and Summary of Modern Opinions on the Taxation of Our Woodlands and Forests. By H. S. Drinker. Pp. 18.

An address delivered at the State Forest Academy, Mont Alto, Pa., August 14, 1912.

Annual Report Potlatch Timber Protection Association, 1912. Potlatch, Idaho. 1913. Pp. 22.

First Annual Report of the Industrial Insurance Department, for the twelve Months ending September 30, 1912. Olympia, Wash. Pp. 516.

An excellent report which contains a detailed account of the workings of the "Workmen's Compensation Act," of special interest to lumbermen because of the great importance of the industry in that State.

Climatic Influence of Forests. By L. A. Fosbery. Bulletin 4, Department of Forestry. Sydney, N. S. W. 1912. Pp. 9.

PERIODICAL LITERATURE.

FOREST GEOGRAPHY AND DESCRIPTION.

Richest Forest in France.

France is to a large extent in coppice, but in the Jura mountains she has still magnificent stands of fir, namely near the Swiss border in the arondissement of Pontarliers. One of these fir forests, of 6 to 7,000 acres extent, is that of Levier, which is described in greatest detail in a pamphlet by Mongenot, the once manager of the same, copious extracts from the volume being given by the Revue. Here firs of 200 to 260 and even 300 years of age persist, with diameters of 10 to 12 and even 13 feet and heights of 130 feet.

The history of the forest from the year 1674, when it became the property of the State, is given.

Ninety per cent. is fir, 10 per cent. spruce, by way of introduction planted in clearings. The fir is, of course, all the result of natural regeneration which here in a mild moist climate at elevations of 2,000 to 2,800 feet and seed years every two years, is prolific. Here stems are still squared, and logging is done by oxen, 8 to 10 to the log skidding. The logging costs only 1 to 2 cents per cubic foot, but the transport to the salt mines at Salins as much as 4 to 5 cents.

The exploitation until the first quarter of the 19th century was by unregulated selection, although 100 years earlier an attempt of regulation was made, namely making four feet diameter the exploitable size and removing in 20 to 25 year return periods 1.5 tree per hectare. In 1819 to 1820 Lorenz, well known afterwards as director of the forest school at Nancy, pupil of Hartig, introduced a silvicultural program leading to a regular shelterwood system, removing the old timber over young stands wherever a good reproduction existed. The result is beautiful stands from 60 to 100 years of age.

In 1844 again the budget was determined as 100 cubic feet per acre. In 1861 the forest was divided into 8 felling series, and each of these in 4 to 5 coupes, the first coupe was to furnish the main budget and be regenerated, the other coupes were to be gone through every 4 or 5 years in selection fashion to take the dying and overripe timber and free young growth, without limitation as to volume.

This area arrangement the author considers one of the happiest innovations which allowed to harvest the excess stock of old material. From 1861 to 1894, 147 cubic feet per acre of a value of 9.2 cents or $13.52 per acre.

In 1894 a revision of working plans took place and the budget was fixed for 2.35 per cent. of the measured stock, namely all trees over 2.5 feet circumference with the silvicultural prescription to regenerate, or as the author says "rejuvenate" (rajeunir), a certain number of divisions and select for cultural purposes in the rest in periods of return of 8 years.

The product under this rule, from 1895 to 1904, was 140 cubic feet worth $13.23 per acre.

Then again a stock-taking and revision of plans was made. The enumeration showed altogether on the 6,770 acres 629,902 trees of between 25 and 15 feet circumference per acre with 42,832,000 cubic feet, or 94.7 trees with 5,705 cubic feet per acre. The budget was then fixed at 2.35 per cent. on this stock, with an addition of the stock considered in excess, or altogether 171.6 cubic feet, which is 2.74 per cent. of the total stock.

During the seven years for which this budget has run, there have been cut 1.2 trees per acre of not quite the full cubic foot content or 2.66 per cent. of the stock, bringing $14.77 per acre, the price for workwood being 11.5 cents.

To make a satisfactory visit to this interesting forest two days are required, and an itinerary pointing out the matters of interest to be seen is given; also a map showing the subdivisions, roads, etc.

La Forêt domaniale de Levier. Revue des Eaux et Forêts. September, 1912. Pp. 525-538.

Travel in France. Those who propose to inspect and understand the reboisement work, which has made French forest engineers celebrated, will do well to read the well illustrated account of the excursions made by members of the Société Forestière de Franche-Comté et Belfort, lasting for a week, in 1911, which was instituted to dedicate a monument in celebration of the nearly centennial birthday of the "father of reboisement," Surell.

The account is full of detail and can serve as a guide to any subsequent visitor.

Another excursion of interest is described in 1912 into municipal valley forests in the process of conversion. as well as into the magnificent fir forests in the canton Maîche and broadleaf mountain forests in the neighboring Swiss territory.

In the same journal for December, there appears also a full account (with itinerary) of the Forest of Levier, a shorter account of which is briefed in this issue on preceding page from the Revue.

In the same number a full statement is given of the program for the International Forestry Congress at Paris, June 16-20, 1913.

Bulletin, Société Forestière de Franche-Comté et Belfort. September, 1911. Pp. 191-263. September, December, 1912. Pp. 517-556; 580-599.

Conditions in Corsica.

A lugubrious picture is drawn by Girod-Genet of the deplorable conditions of Corsica due to excessive pasturing, especially of goats.

The total area of the island is around 2,200,000 acres. Somewhat uncertain statistics make more than 50 per cent. of this territory unproductive, a little over 27 per cent. in farms, vineyards, orchards and pastures, and only 20 per cent. in woods. Some of these are still in good condition (*Pinus laricio*).

Much of the once fertile plains along the shores have been spoiled by soil washes and floods.

It is proposed to recover these plains for productive use, but the writer points out that nothing permanent can be gained without attending to the mountain slopes. A very prompt undertaking by State aid or private enterprise is needed to restore pasture grounds, much in mismanaged overgrazed condition. Over 600,000 animals, mostly sheep and goats, are allowed to roam anywhere, winter and summer, to find scanty pasturage: the herdsmen "own the island." No respect for property rights exists.

Fire is still used to "improve" the pasture and to increase the waste area, especially on the denuded limestone mountains.

The attempts by the French government for more than half a century to bring about improvement have failed: it is impossible to break the habits of the people; no number of guards can keep the straying animals out of forest or plantation. The writer thinks that half the sterile area may be recuperated.

This would, of course, require that the animals be kept out of a given limited area, but he thinks the population could be persuaded to see that it is to their advantage to do so, and he proposes educational efforts to bring it about.

Le Régime pastoral de la Corse. Bulletin, Société Forestière de Franche-Comté et Belfort. December, 1912. Pp. 600-613.

Cork Oak.

Dr. Klein writes a very interesting article on the economic significance of the cork oak in Portugal, which contains, however, other information regarding the tree and its products, and also references to other forestry interests of the country.

There are about 550,000 acres of *Quercus suber,* often in extensive close stands, usually with broad bushy crowns and boles branching only 5 to 10 feet above ground, the branches being trimmed to let in the light. Growing at first rapidly so that a first harvest of cork may be secured when the tree is 20 to 25 years old, it later becomes slow, but it can grow to considerable dimension, so that 4,000 lbs. of cork may come from one tree.

The total harvest in Portugal is 50,000 tons of bark, mostly exported in plates. The acorns are also an important harvest for the fattening of swine. Usually $5 to 6 per head is the rent for the season's use of the forest for this purpose. Moreover, in the open stands the peasants grow grain. This prevents fires, and accelerates the cork formation, although not the quality which is better when slowly grown.

The cork oak forests are mostly private property and are either worked by their owner or rented for 20 to 40 years under varying conditions. Most of the woods are the result of natural reproduction, but lately reforestation by sowing is being practised, the acorns of known good producing trees being used. In such plantations the virgin oak cork (which is used only for decorative work, for linoleum, etc., or for fuel) may be barked when ten years old.

Die Korkeiche und ihre Produkte in ihrer ökonomischen Bedeutung für Portugal. Naturwissenschaftliche Zeitschrift für Forst- und Landwirtschaft. November, 1912. Pp. 549-559.

The Forests of Isle Royale, Lake Superior.

Cooper finds that the climax forest of Isle Royale is of the Balsam-Paper Birch-White Spruce type. The stand is 78.7% Balsam when trees of all ages are counted, but when trees from 5 inches to 10 inches in diameter are considered the Balsam composition becomes 56.7%, and as to trees 10 inches and over in diameter, it falls to 33.3 per cent. In the percentage composition of the various classes Paper Birch works the other way, that is when trees of all sizes are considered it forms only 10.6 per cent. of the stand; trees between 5 inches and 10 inches, 26.8 per cent.; trees over 10 inches in diameter 39 per cent. The preponderance of Balsam in the young growth is due to the wide range of situations in which it can establish itself, provided sufficient light is available, the seedlings being absent in even moderately dense shade. A good deal of the young growth arises from the layering habit of the Balsam. The high birth rate is offset by a high death rate, owing to susceptibility to fungous diseases and liability to windfall. White Spruce enters less abundantly into the type, making only 2.8 per cent. of the trees of all ages but forming 16.7 per cent of the trees 10 inches or more in diameter.

Judging from reports of other observers, the author believes this to be the characteristic type of the northeastern coniferous forest and in some respects comparable to the coniferous zone of the southern Alleghanies.

The Climax Forest of Isle Royale, Lake Superior, and its Development. Botanical Gazette. January, 1913. Pp. 1-44.

BOTANY AND ZOOLOGY.

New Light on the Influence of Light.

Dr. Engler of the Swiss Experiment Station reports in an unusually well illustrated number of the Mitteilungen the results of 12 years' important observations on the influence of light on the phaenology of beech and other broadleaf trees as maple, ash, oak, and especially on the time of leafing, which has a considerable silvicultural bearing. He finds that young specimens of these species open their buds earlier and are earlier fully foliaged when standing under the shade of old stands than when in the open or than older trees. Next follow the lower twigs and branches of old trees, and then the tops of crowns, and last the young unshaded plants.

The difference in the beginning of budding between shaded and unshaded young growth was 11 days and in the finish of complete foliage 15 days. Neither temperature nor relative humidity was found to produce this difference. The earlier leafing out on north slopes than on south slopes by about a week suggested the light as the operative influence, and a series of beech partly grown under the influence of light, and others under shade were subjected to observation. It was found that beech forms buds in the shade or diffused light which open earlier and develop foliage faster, than those formed on shoots exposed to direct or stronger light. And this characteristic belonging to shoots and buds formed under given light conditions persists for a number of years after the light conditions have changed, and it takes some time for them to adjust themselves.

"Light" beeches also show superior form and growth when planted in the open, than "shade" beeches, but when placed under shade do less well than the latter.

They also differ in habitus; the light beeches show a plentiful obliquely set foliage on upreaching shoots, while the shade beeches have a horizontal spread of branch and foliage. The structure of leaves also differs.

The persistency of the acquired habit continues about as long as the influence lasted beyond the time of the change of position. While, however, intense light produces buds which bud late, on the other hand, great light intensity at time of budding accelerates the development of foliage.

The "light" bud compared with the "shade" bud is heavier, larger, more robust and firmly closed with more numerous thicker scales and with the disposition of a longer, more fully foliaged shoot.

Not high, even temperatures, but sudden temperature changes exercise a stimulating influence on buds. The author concludes that shade buds or shade plants react more readily to outer stimuli, than light plants or buds, because temperature changes are more readily felt by the looser shade buds.

The application in silvicultural practice is to lead to a slower removal of nursetrees, to give time for a change from shade to light buds, to avoid suffering by the young crop due to sudden light changes. Also, if it is desired to retard the beech crop in order to give interplanted spruces a chance a sudden setting free will accomplish this. The use of shade plants for planting in the open is explained as undesirable, if older than 1 to 3 years, when the characteristics are not yet much developed. Similarly older light plants should not be used for underplanting.

Untersuchungen über den Blattausbruch und das sonstige Verhalten von Schatten- und Lichtpflanzen der Buche und einiger anderer Laubhölzer. Mitteilungen der Schweiz. Zentralanstalt für das forstliche Versuchswesen. X Band, 2 Heft, 1912.

Burning of Foliage.

The phenomenon of a sudden wilting of foliage in dry seasons (winter or summer) is usually explained as a result of excessive transpiration with deficient soil moisture supply. Eulefeld recites the experiences of the dry season of 1911, when trees on better soils, due to rank weed growth, suffered more than on sand soils without such competition. Shallow soils and southern exposures, of course, suffered most. Trees damaged by fungi, especially leaf fungi (spot fungi) also seemed to suffer more than vigorous ones, all of which conditions influence transpiration.

The author, however, claims that this damage was not alone due to excessive transpiration, for trees whose foliage was best protected against this, also suffered. In one case, on a small flat island, a stand of spruce ten feet high, whose roots were all abundantly supplied with water, died without exception. The author suggested electrical conditions in soil and air as a possible reason. The reflection of the intense light from the pond was undoubtedly largely influential.

It is with the evil effects of reflected light from trees and stands that the article chiefly deals, and the author proves this influence by citing many examples.

In 1892, a stand of 40-years-old oak with some spruce intermixed, was bordered on the east, south and west sides by a field of potatoes. In September it was observed that, whereas in the middle of the field the soil was fresh and the plants green, for a considerable width around the edges of the forest the plants were dead or nearly so and the soil was dry and pulverized—except when opposite the spruce stands. Also on the east side the damage was not so great as on the south and west because the sun's heat was not so intense there.

That this soil influence was not due to the tree roots is apparent, for a deep trench separated them from the field and the damage also extended far beyond their possible range.

Vines are most susceptible to this reflected light. A vineyard in Karlsberg south of a full-crowned stand of oak was unfavorably affected to a distance of 96 feet from the forest edge.

That species and consequently character of foliage affects the influence by reflected light is apparent from the above. This is further proved in the following examples:

In 1886 a seed bed fully stocked with yearling ash and red alder was killed by the reflected light of a 55 foot beech tree within a radius of 35 feet from the tree which stood at the north edge of the bed. The line between the burned and unburned parts of the bed was an arc roughly similar to the curve of the crown. In another instance, a seed bed of black alder was in similar relationship to a near-by ash, yet under the same drought conditions no harm was done. In both cases the tree roots were separated from the beds by trenches.

It was subsequent to a heavy morning shower followed by bright sunlight that the burning of the foliage began to be apparent, and this was apparently due to the dense large-leaved foliage of the beech retaining the moisture which acted as a lens in concentrating the reflected light on the seed beds, whereas the foliage of the ash being scanty did not have a similar effect.

It has been noticed in forests (especially beech) that wherever this reflected light gets a chance to operate on the forest floor, the ground flora is more scanty.

The greater the heat and intensity of the light and the less the rainfall, i. e. the supply of ground water available, the greater the injury done by this reflected light, especially from broad-leaved, thick-foliaged trees with shiny leaves. The damage is also influenced by the susceptibility of the affected plants to this reflected light. G. E. B.

Das "Brennen" der Waldbäume. Allgemeine Forst- und Jagd Zeitung. October, 1912. Pp. 336-342.

Elm Twig Disease.

A disease of young elms was first observed in a nursery at Stockholm in 1905. A later study showed it to be due to an undescribed species of *Exosporium* which killed the twigs at the tips of the plant, or over the entire crown, often causing the death of the smaller stock. The disease was confined to *Ulmus montana, U. montana oxoniensis. U. campestris* and *U. effusa.* While most serious on young nursery plants it also occurs on various-sized trees under natural conditions. In one locality it is said to have been destructive long before 1888, but most of the outbreaks in different parts of Sweden have been noted during the past five years.

The black fruiting-pustules are grouped on the dead areas, particularly in the axils of the small limbs, causing an irregular rupture of the epidermis. Infection experiments with young elms in the greenhouses, by applying conidia to the internodes of the delicate green shoots of the year, prove that the fungus is pathogenic and requires an incubation period of about ten months. The development of the disease was studied on trees of different age in the experimental garden. This study led to the conclusion that infection takes place through the young shoots of the season, these being wholly or partially killed by the following May or June, but remaining at least another year on the tree and bearing black pustules far into the summer. The second spring, almost without exception, a red *Nectria* appears; however, the authors have not yet shown this to be the perfect stage of the Exosporium. There seems to be a second method of infection on 2-4 year old branches by the mycelium progressing down the young lateral into the parent branch, which, if strong, is not killed the first season.

Remedial measures consist: (1) careful inspection of nurseries which furnish the stock; (2) examination of all plants in April or May, before the new shoots form, and the cutting out and burning of all dead or diseased twigs, repeating once or twice at intervals of one or two weeks.

A technical description of the fungus is given.

Ueber Exposporium Ulmi n. sp. als Erreger von Zweigbrand an Jungen Ulmenpflanzen. Mycol. Centralbl. 1, March, 1912. Pp. 35.42.

Sycamore Leaf Disease.

During June of the present year Eddelbüttel and Engelke received from Hildesheim, Germany, diseased leaves of *Platanus occidentalis* which were infected with *Gloeosporium nervisequum* and a new species of *Microstroma* which they name *M. platani.* The fungus produces nearly circular dark-brown spots. As long as the leaves remained on the tree the organism was not in evidence, but developed well in the laboratory, where the fruit-bodies emerged from the stomata and gave a grayish-white appearance to the spots. Experiments are under way to show that the fungus is not a new conidial stage of *Gnomonia veneta,* to which *Gloesosporium nervisequum* belongs.

Ein neuer Pilz auf Platanenblättern, Microstroma Platani nov. spec. Mycol. Centralbl. I, September, 1912. Pp. 274-277.

"Tar-spot" of Maples.

The biological relationships of the fungi which cause the "tar-spot" of maples, and which have formerly been grouped under *Rhytisma acerinum* (Pers.)Fr., are partially unravelled by Müller in a recent paper. Several authors had intimated a specialization into biological races, but no experimental proof was at hand. J. Müller worked nearly twenty years to distinguish the races morphologically and finally concluded that the variations were not sharp enough to be of specific value.

Karl Müller performed two series of innoculation experiments. In the first series he took potted plants of *Acer plananoides, A. pseudoplatanus* and *A. campestre* and assembled them in groups some distance apart. In April the nearly ripe sclerotia of a definite kind were spread under the little trees, so that the developing ascospores could infect them. From these experiments in the open he concludes:

1. That the fungus on *A. Platanoides* readily infects *A. campestre,* but only weakly attacks *A. pseudoplatanus* and *A. saccharum.*

2. That one form on *A. pseudoplatanus* infects only this host —hence the name *Rh. pseudoplatani* is proposed.

3. That the fungus from *A. campestre* infects *A. platanoides* weakly and *A. pseudoplatanus* not at all—hence named *Rh. acerinum* forma sp. *campestris.*

In the second series of tests under glass in the greenhouse, made by spraying or crushing the ripe sclerotia on the leaves, the results bore out the above statements and, in addition, showed two biological species on *Acer pseudoplatanus,* viz: the *Rh. pseudoplatani n. sp.,* and *Rh. acerinum.* Spore infection is said to take place through the stomates on the lower surface of the leaf, the period of incubation being about eight weeks in the open.

To insure a rich infection in nature the sclerotia should sufficiently mature before leaf-fall and they should have sufficient moisture to mature the ascospores in spring. The ascospores have a thicker gelatinous coat which causes them to adhere to the leaves.

The author promises an exhaustive article in a forthcoming number of the Centralblatt für Bakteriologie.

Ueber das biologische Verhalten von Rhylisma acerinum auf verschiedenen Ahornarten. Ber deutsch. bot. Gesell 30, July 1912. Pp. 385-391.

Rhizina and Fires.

The root disease of various conifers which is prevalent in France and Germany and is said to be due to *Rhizina inflata* (Schäff.) Sace, is generally thought to start around the seat of fires lighted by woodsmen and tramps. From these points it seems to spread out in a circular area.

Mangin made observations on the fungus, following the bad fires of the past summer at Fontainebleau, and maintains that the organism fruits abundantly in certain places where the stand is sound and that fruit-bodies which were abundant before the fire in certain places were lacking after the fire. For these reasons he thinks it an error to attribute an influence of any kind to fires. The disease exerts its ravages before it is recognized, the fires being a result of cutting the first trees attacked. The fruits, which are often abundant on burned spots, are thought to be favored by the presence of the nutritive elements in wood ashes.

The author is also skeptical as to the cause of the disease and thinks the invasion of *Rhizina* only secondary, the primary cause being yet unknown.

Contribution à l'Etude de la Maladie des Ronds. Compt. Rend. Acad. Sci. 154, June 3, 1912. Pp. 1525-1528.

Mistletoe on Incense Cedar.

A very interesting paper from Dr. Meinicke on the Californian mistletoe, *Phoradendron juniperinum libocedri* Engelm throws much light on the biology of this parasite. It is a small hanging shrub which frequently nests high up in the crowns of the incense cedar, and is responsible for the barrel-shaped swellings on the trunks of old trees.

Several such burls, ranging up to 350 years of age and 45 inches in diameter, were sectioned. The dead mistletoe sinkers in the hartwood and living ones in the sap were very conspicuous, extending from the surface nearly to the center, and being more or less arranged in concentric rings. In one tree an average living sinker measured $\frac{7}{8}$ inch long and extended through 19 annual rings. In another tree the first 37 years, counting from the center, were free of sinkers and the remaining 219 years showed persistent infection.

These observations establish the fact that the parasite often reaches a great age, and it is of particular interest to note that when it reaches this high age it lives without green exterior organs. This phenomenon opens up the entire subject of the degree of parasitism which it enjoys and, hence, the question of physiological relation to its host. It normally starts as a hemi-parasite, functioning, in part, as any chlorophyll-bearing plant. The enormous development of bark finally eliminates both the green shoots and the aerial haustoria, leaving the plant only with the wide-spread parasitic root-system, which thrives many years without serious injury to the host.

Whether the phloems of the parasite and host are in direct connection was not worked out.

Parasitism of Phoradendron juniperinum libocedri Engelm. Proceed. Soc. Am. Foresters 7, March, 1912. Pp. 35-41.

Oak Mildew.

The discussion over the identity of the oak-mildew in Europe still wages. The opinion of Arnaud & Foëx, who first found the perfect stage and called it *Microsphaera extensa* (Schw.) Burr., is challenged by Griffon & Maublanc. Both authors have examined authentic specimens of American Microsphaeras and compared them with the three known collections on European oaks and a mass of details is presented as to the minor points in which they vary.

As a result of the study Griffon & Maublanc hold that the American species or forms on oak can be placed in two species and one variety, as follows:

1. *M. abbreviata Pk.* (=*M. densissima* Cke. & Pk., *M. quercina* Schw. et auct., *M. alni* of Salmon, in part).
2. *M. abbreviata* Pk. var. *calocladophora* Atk.
3. *M. extensa* Cke. & Pk. (=*M. quercina* of authors, in part, *M. quercina* var. *extensa* Atk., *M. alni* var. *extensa* Salm.).

These are said to be distinct from the true *M. alni,* and also from the three previously known European collections, hence the authors propose the name of *Microsphaera alphitoides* Griff. & Maubl. They suggest that the fungus was probably imported.

Arnaud & Foëx reply to this in support of their former contention and conclude with the statement that *Microsphaera alphitoides* is only a synonym of a species "already too richly supplied with names." They still hold to their former view of the fungus being indigenous.

Les Microsphaera des Chênes. Bull. Soc. Myc. Fr. 28, April, 1912. Pp. 88-104.

Les Microsphaera des Chênes et les Perithèces du blanc du Chêne. Compt. Rend. Acad. Sci. 154, April 9, 1912. Pp. 935-538.

Sur l'oiidium des Chênes. Compt. Rend. Acad. Sci. 154, May 13, 1912. Pp. 1302-1305.

SOIL, WATER AND CLIMATE.

Soil Water.

An article by Schmerhowsky brings together what is known of soil physics with reference to water movement, and especially discusses the ability of the soil in periods of drought to condense water from the atmosphere for the use of plants. From these theoretical discussions he concludes that the soil can do so, when capillary water cannot be conducted to the surface; that, however, such condensation cannot penetrate deeper than the daily variations of temperature; that they reduce the consumption of soil water and supply young plants and shallow-rooted ones with the necessary water during periods of drought. This condensation can be increased by inducing granular structure of soil or improving temperature movement by soil work. On soil covered with vegetation the amplitude of daily temperatures is smaller and hence the intensity of condensation. In dry situations cultures can derive the most use of such condensation, hence here granular soil structure is most desirable.

Ueber das Bodenwasser. Centralblatt für das gesammte Forstwesen. November, 1912. Pp. 485-496.

SILVICULTURE, PROTECTION AND EXTENSION.

Effects of Lupine on Spruce.

These investigations were performed by a Flander assisted by Oberforster Dr. Mathes of Eisenach in the red Marl districts of the Steiger Mts. on soil badly infested with couchgrass. In consequence of this and of a droughty season the seeding of spruce in the spring of 1900 was a failure. Two years later a small plot was cultivated 12 inches deep and drilled with perennial lupines without nitrogen inoculation. The spruce which was sown germinated but suffered by the grazing of the deer besides the couchgrass. The lupines, growing slowly in the first two years, reached full bloom in the third year and extended their roots from their drills into the couchgrass.

The final advantages of the interculture of lupines may be noted as (a) The spruce branches were darker green and more pendulous, the buds were thicker and showed quicker growth. It is also less liable to the attacks of insects (Chermes).

(b) The soil is made granular or less compacted.

(c) The root development is increased, tap roots being stronger and longer; secondary roots being more numerous and tending to go deeper in the soil; root hairs being more numerous, healthier and going deeper into the soil. Altogether, the root mass occupies a larger area.

Moreover, decomposition of the organic matter is more complete on account of the penetration of air through the decayed lupine roots, and increased work of the colonies of angle worms induced by the more favorable soil conditions.

Thus the spruce with the lupine interculture *becomes a deep rooted species,* and may claim the advantages of such. As regards influence on diameter growth rate as exhibited by curves, the spruce without lupines appears to be stronger in the first six years, probably because its growth was not hindered by the shade of the lupines or the grazing of deer. By the seventh year, however, the spruce in the lupines has reached the others and afterward showed superior growth. It did especially and surprisingly well in the dry summer of 1911 on account of its deep root system, while the spruce without lupines grew well in the wet summer of 1910 but showed a very narrow ring in the dry summer.

Better results are obtained from planting three-year-old spruces at the time of sowing lupines. This method avoids the damages in early life before mentioned.

Success of these experiments has induced further sowing, and since the spring of 1906 the lupines have been inoculated with nitrogen. Other numerous experiments are incomplete and their results do not as yet justify publication.

S. H. C.

Beeinflussung der Wurzelbildung und Wuchsenergie der Fichte durch Zwischenbau von perennierender Lupine. Allgemeine Forst- und Jagd Zeitung. November, 1912. Pp. 367-370.

Selection Strip Method in France.

Barthon develops in an interesting manner the impropriety of applying the usual selection method to a stand of spruce with a 135-year rotation, as was done. The objection is based on an enumeration of the trees by diameter, age and increment, which shows that the trees of smaller diameter are by no means younger, but merely poorer trees, which have only hindered the development of their neighbors without being able to produce much themselves.

Under such conditions to take out the largest and leave the smaller diameters, conserving the runts of poor increment and incapable of growing with good dimensions, means a selection of the wrong kind. According to the author such stands at low altitudes (2,500 feet) should be treated by the group method, the openings to be approximately the square of one and one-half the height of the stand; larger on north exposures, smaller on south sides, and smaller in open stands exposed to the light.

In higher altitudes, where the regeneration is hindered by the snow, two or more fellings for reproduction are needed: the first felling consists in thinning severely a strip, leaving the stoutest and most wind resistant trees; by the second cut a new strip is thinned and the whole stand on the first strip is removed. [Wagner's selection strip method!] If necessary, the regeneration is completed by planting. Meanwhile the rest of the forest is thinned by removal of dead and dying, always for the benefit of the vigorous trees.

An appeal for more extended studies of the composition from this point of view of selection forest is made.

Etude d'un peuplement de forêt jardinée. Bulletin, Société Forestière de Franche-Comté et Belfort. June, 1912. Pp. 411-48.

Tolerance of Pine.

The author first of all enters a protest against the prevailing notion that Scotch Pine is always and under all conditions intolerant. Instances are cited of stands on the heavy clay soils of West Germany where this species is fairly tolerant. Of course, on sandy soils like those of East Germany pine grows only in open stands. But given a loamy soil and a fair degree of soil moisture and atmospheric humidity pine develops well in moderately dense stands after the crowns have closed in the 40th year. Even at the end of a rotation of 150 years there are many suppressed individuals in an unthinned stand whose well developed, thrifty crowns indicate the tolerance of the species under favorable conditions.

However in spite of the fairly close crown cover which stands of pine form, the soil is apt to deteriorate without underplanting. This should be done when the soil conditions demand it, preferably from 40 to 60 years before the end of the rotation, so as to obtain salable material from the understory. Spruce and beech are the species recommended for this purpose. A marked advantage of the former is its ability to fill in any gaps which may occur in the pine crown. For, although a tolerant species, spruce responds very quickly to the stimulus of light and quickly rises from a suppressed position when the shade is removed.

K. W.

Uber das Sichlichten und die Behandlung älterer Kiefernbestände. Forstwissenschaftliches Centralblatt. May, 1912. Pp. 254-262.

Propagation of Juglans.

Forstmeister Rebman at Strassburg reports on his experience with the growing of *Juglans regia, nigra* and *cinerea,* which he has grown for the last three decades.

Soil and climate, which suit the English (Persian) Walnut, also suit our two walnuts, except that ours are less liable to frost, but make still greater demands than *regia* on depth, looseness and freshness of soil.

For *regia,* it is stated, that it occurs on the greatest variety of soils, but, of course, with different development. Eighty-year trees average, b. h. diameters, on poor sand of 16 to 17 inches; on slate, 20 to 22 inches; on better diluvial sand, 22 to 24; on lime and loam soils, 26 to 28 inches.

The first attempt at nut culture in 1882 was made with 3 to 4 year transplants like oak, ash or maple, and failed. The cause assigned is the inability of remedying any injury to the roots. The first year root of *nigra* consists of a taproot, up to 30 inch long beset directly with fibers; on more compact or gravelly soil, several shorter roots may develop. Even transplanting in the first year can hardly be done without damage and the plants suffer. Hence sowing is the only proper way for propagation. Yet, if sown in fall, squirrels, mice, birds will find them, and nuts planted in spring germinate late, often not before August or September, or lie over the following winter. The late comers are usually frost killed. To be successful the plants must be out in May. To secure this, the ripe fruit (November) is peeled and dried enough to prevent mildew, then loosely spread out in a single layer (very important for *regia* and *cinerea*) on the ground in the open and covered with 2 or 3 inches of soil, of course in a place where protection against animals can be provided. If frost is hard and no snow cover had, cover with litter or straw, but remove when not necessary to prevent mice from finding their way into the cover.

When warm weather appears, frequent inspection is necessary to see whether the nuts are germinating. If this does not take place at the right time, a cover of horse manure will expedite the germination, although this is not generally necessary; the first nuts germinate from March 30 (very early) to April 30, and then the rest follow quickly. The germinating nuts are daily gathered carefully into baskets with moist moss, and without breaking the germ, which is the root, carried to the planting place and either at once planted or heeled in. In a few days the germs are two and more inches in length and care is necessary not to break them off. They should then be dibbled in with the germ downward, the nuts lying on their sides. The soil should, of course, have been prepared in the previous fall.

The arrangement of plantations was made variously in pure groups, in mixed groups, in the open, under cover, among other species, etc.

Pure planting in close spacing seem to have furnished best results; single specimens or wide spacing produces spreading crowns and short boles, even in mixture with other species which the walnuts soon outgrow. Considering all conditions, shaft form as well as weed-growth, a spacing of 3 x 4 feet seem to be the most commendable.

Planting under shade for protection against frost, especially with the decidedly intolerant *nigra*, was a failure, although *regia* and *cinerea*, being less intolerant, can revive more readily. To be sure, May frosts kill frequently the first leader, but in 4 to 5 years the plants have grown out of the frost region.

The planting with 1,600 nuts to the acre, including gathering the nuts, protection and care for two years, comes to around $20, and where soil preparation is necessary up to $35 (with us it might go to double that figure), using 2,900 nuts (allowing 40% loss).

Under the pure stands naturally there is considerable weed-growth coming up, and cultivation is necessary; the result is then astonishing on the growth, effecting a difference in heightgrowth of over 40 inches in 5 years.

The experience is recorded that the species does not stand pruning very well and that wounds heal over very slowly, even 1 to 1.5 inch wounds do not callous over in 10 years. Hence pruning is undesirable, and, since late frosts are apt to kill leaders, in order to correct the form the author pinches off frozen leaders the shoots formed afterwards, leaving only one stout one for leadership. Such wounds of the young shoot callous readily the same season.

Silvicultural treatment similar to the oak, is suggested; only all operations of thinning should come a little earlier, and underplanting as soil cover, since under these intolerant species weed-growth cannot be kept down otherwise, is indicated, and for such a valuable species pays.

Of these three nut trees *nigra* is the most rapid, *cinerea* the slowest grower. The latter grows very evenly, but the former quite erratically, some yearlings may be 30 to 45 inches in height, others again not over half that height and down to 7 inches in dry or wet cold summers, and occasionally a second growth takes place in August to September.

The average and maximum heights for the two American species were as follows in inches:

Year.		*1*	*3*	*5*	*7*	*10*	*15*	*18*
J. nigra	Av.	16	56	106	160	236	346	414
	Max.	32	70	160	204	300	400	560
J. cinerea,	Av.	7	20	50	104			
	Max.	9	24	60	122			

For the first 18 years then *nigra* has grown at the rate of 2 to 2.5 feet per annum. Some 70 to 80 year old trees in the neighborhood grown in close stand show that this rate can be maintained for a long time, several specimens of 124 feet being present; and park trees with over 100 feet and 28 to 36 inches diameter make this one of the most rapid persistent growers. It is a very lightneeding tree and a treatment like oak probably will produce the best results.

A number of the old trees were measured and their volumes calculated, showing for dominant trees in the average 25 inch average diameter and 178 cubic feet contents.

As to acre yields no experiences are as yet attainable, but from the above data and comparisons of many young stands, measurements of which are given, the promise of greater results than from the native oak is most favorable, the walnut accomplishing in half the time, that is in an 80 year rotation, the dimensions of the oak.

The prices paid for *nigra* wood, 4 trees, down to 3 inch diameter averaged 70 cents per cubic foot, more than double the price for oak of like class, and, as this is attained in half the time the walnut financially is 14 times more profitable than the oak. This was an ordinary average price, which may be doubled and trebled for the better logs.

In addition to the wood the nuts are of value, naturally those of *regia* more than *nigra*. The latter fruits early; the outside trees on the south side of an 18 year stand have already borne fruit for four years. From various measurements taken from old trees it appears that trees in full mast may bear as many as 4,500 nuts and in the average 2,000 nuts; full masts occurring apparently every four years; other years 200 to 600 nuts may be secured. The size and weight vary greatly, so that from 30 to 60 nuts go to a pound, hence it is best to buy by number, $2 to $3 being paid per M. In the forest the yield will, of course, be smaller, yet it is calculated that a 60 to 70 year old stand may furnish with only 70 trees (32-40 hl.) 195-120 bushels and $3 to $4 money return.

If it is added that these nut trees have the fewest enemies except a few half innocuous leaf insects and borers (and in Germany the all destructive May beetle), the species are among the most promising of the broadleaf tribe.

Neuere Erfahrungen über die Anzucht einiger Junglandaceen. Allgemeine Forst- und Jagd Zeitung. August, September, 1912. Pp. 257-272, 401-403.

Soil Improvement in Mixed Forest.

The theoretical and practical aspects of the subject of mixed versus pure forests are discussed by Forstmeister D. Tiemann.

By way of introduction the author shows that the extensive forests of pure pine and spruce prevailing in many parts of Germany have come into being rather through the influences of economic situations and through accident than from the application of sound silvicultural principles. The impoverishment of the country by the 30 Years' War and later by the Napoleonic wars, followed by the decline in the use of charcoal, as mineral coal came into general use gave impetus to the cultivation of valuable conifers in pure stands. This, coupled with a lack of knowledge of the methods of regenerating mixed forests, led to a decline in the cultivation of beech and some other deciduous species.

The cultivation of these pure coniferous stands, according to Tiemann, is based not only on unsound biology, but on unsound economic grounds as well. Pure coniferous stands, especially if even-aged, are subject to many kinds of damage which are not so severe in mixed forests. Snowbreaks, windthrow, fire, fungi, and the ravages of insect epidemics do great damage in pure stands; besides this, these lightneeding conifers are not only indifferent soil preservers but are actually soil robbers.

Beech with its great tolerance of shade and its copious leaf fall giving full protection to, and enriching the soil beneath may be styled the nursetree of the forest and should be introduced whereever the soil fertility is endangered. An underwood of beech beneath an open coniferous stand not only takes care of the soil, and in so doing benefits the increment of the main crop, but is of great value in aiding the cleaning process.

Several methods of introducing the beech into gaps in spruce and pine stands of advancing age are given, as well as for planting in the fail spots in young plantations. These methods all necessitate the planting of groups large or small, or of strips of beech, and, as this must be done by ball planting, are apt to be rather expensive.

In reforesting clearings, barren places, and wastelands, both species may be planted by seed. In all such cases the beech is planted in groups or strips from 6 to 10 years earlier than the spruce or pine which is planted between these groups. This gives the slowgrowing beech a good start.

With soils too poor for the immediate introduction of beech, other less exacting but soil improving species must be grown as an "advance crop". Until the soil is fit to receive the beech, such species are White Alder and Birch. However, experiments are being tried with such species as our Jack Pine, on very poor sands, and in some cases with nitrogen gathering crops such as *Robinia* among trees and with the lupine.

This last might be of interest to foresters on this continent, and much good might come from trying experiments in this direction.

F. McV.

Begründung der Mischbestände von Fichten und Buchen, sowie Kiefern und Buchen. Forstwissenschaftliches Centralblatt. June and July, 1912. Pp. 297-309; 345-353.

Mixed vs. Pure Forest.

This is one of the many articles which indicate the reaction in Germany from pure even-aged stands toward mixed forests. After the Napoleonic wars, when railway transportation made it possible to distribute coal cheaply and thus relieve the demand for fire-wood, even-aged, pure stands of conifers were considered most profitable. These gave material for which there was a ready market and were more cheaply logged than the heavier hardwoods. In addition, the leaf litter was eagerly prized by the nearby farmers.

After a hundred years of ascendancy the pure stand is giving place to the uneven-aged mixed forest, because the latter gives higher yields per acre and prevents soil deterioration. The present article is mainly concerned in setting forth the good results to be secured by introducing beech into spruce and pine stands. The improvement of the soil is most marked with a light-needing species like pine, but even with the tolerant spruce soil conditions are bettered and there is a greater resistance to storm, snow, fire and insect damage. One authority insists that beech should cover at least one-third of the total forest area in Germany.

In a spruce stand where holes have been caused by wind or snow damage, the planting of beech seedlings is recommended. This same method is advised to fill in the fail spots in a spruce plantation. With spruce stands handled by the selection method beech regeneration may be secured either naturally or artificially, depending upon the presence or absence of suitable seed trees. Where new stands are to be started, a mixture of spruce and beech is advocated, with other valuable species inserted in favorable sites. For example, ash should be planted in the damp places and hornbeam in the frost "holes". As nurse trees for the slower growing, tolerant spruce and beech, pine and larch are recommended. The harvesting of these will frequently give by-products valuable enough to pay the cost of establishing the stand.

K. W.

Begründung der Mischbestände von Fichten und Buchen. Forstwissenschaftliches Centralblatt. June, 1912. Pp. 297-309.

Natural Regeneration vs. Planting.

After an excursion to nearby points of interest the second day was spent in discussing natural regeneration in coniferous stands, treatment of poorly nourished stands.

The first subject brought out all the arguments in favor of using natural regeneration instead of planting to re-establish coniferous stands. By reason of the cost of planting and the soil deterioration resulting from clear cutting, a cheaper method of natural regeneration (the group method) which conserves the soil moisture has been worked out. Some 50 years' experience in various places prove it to be a success. The different steps in the method most commonly used are:

1. Advance cutting of defective trees which stimulates the seed production of the trees left.

2. Removal of the best and largest trees over groups of seedlings.

3. Gradual opening of the holes occupied by the young growth, thus letting in more light as needed.

In discussing poorly nourished stands five main causes were recognized. The importance of good seed was emphasized and reference made to the recent discoveries in the importance of hereditary traits in plants. The damage done by weed growth, especially heather, was given due weight. The sterility of soils containing raw humus and dry peat was indicated. Allusion was also made to the injury caused by wound fungi, and to diseases causing leaf shedding as important causes of poor nourishment. In conclusion, the want of nutritive substances in some lime soils was cited. K. W.

33 Versammlung des Vereins Thüringer Forstwirte. Forstwissenschaftliches Centralblatt. May, 1912. Pp. 267-279.

Natural Regeneration of Scotch Pine.

L. Pardé describes in detail the results of the regeneration of Scotch pine in the neighborhood of Paris, which in most cases has proved a failure. Waiting for natural seeding after the ground has run wild has resulted in severe losses. But before clear cutting, followed by planting or sowing is adopted, the writer recommends the trial of clear cutting in strips with the thorough preparation of the soil, coupled with sowings where conditions are unfavorable. If the results are not successful within 5 years, immediate completion by artificial means are urged before the soil is overgrown with weeds. T. S. W. Jr.

Traitement du pin sylvestre dans la région de Paris. Revue des Eaux et Forêts. October 1 and 15, 1912. Pp. 577-586; 609-619.

Underplanting and Nurse Planting.

Forstmeister Foetsch sums up in this article the conclusions he has reached after thirty years' experience in southwest Germany. The composition of the stands under his direction vary with the soil. On the heavier clay soils the hardwoods predominate, while the lighter sandy soils have been planted up to pine, spruce and fir. On the best sites a specialty has been made of raising large oak standards with a rotation of 200 years.

In the regeneration of oak the main danger to be guarded against is injury from frost. The most effective method is the planting of some quick growing nurse tree which will prevent too rapid radiation of heat on frosty nights, and conserve by its shade the soil moisture. In cases where oak regeneration is to be secured under mature stands, the same end may be accomplished by the gradual thinning out of the larger trees.

Underplanting has been found to be very necessary if the soil is to be kept in good condition in the oak stands after they have reached an age of 40 to 45 years. Beech is the best species to underplant in oak stands. Similarly good results have been found to result from the underplanting of mixed stands of pine and beech or pure stands of pine, but with such stands the second story is made up of spruce and fir. Although the complete utilization of the available light by means of a two-storied forest prevents the growth of blueberries, the picking of which has been an important local industry, it insures better soil conditions and produces more rapid growth.

Good local markets make it possible to sell advantageously the produce of thinning operations. This renders feasible improvement cuttings, which make the trees left more wind firm, less liable to snow break, and greatly accelerates their growth. So intensively can this work be carried on that limbs broken by the heavy snowfall of 1887 were cut off with ladders and saws at an expense of 45 marks per hectare. K. W.

Aus dreissigjähriger Praxis. Forstwissenschaftliches Centralblatt. May 1912. Pp. 233-247.

MENSURATION, FINANCE AND MANAGEMENT.

Cross Section Calipers.

Calipers that read off cubic contents of logs are limited for practical reasons to six log lengths at the most, as many as it is practically possible to put figures on the arm. By graduating for cross section areas the caliper becomes of universal use by keeping log lengths apart and multiplying the added cross sections by the log length.

The question as to the necessary degree of accuracy is settled by giving the cross section to the square centimeter $\frac{1}{10,000} m^2$. In constructing the graduation the decimal point is left out, the four figures of the fraction are disposed two to the right, two to the left of the graduation line, the even centimeter of diameter measure at bottom, the uneven at the top side of the face and the diameter measure on the thin edge of the arm.

For lengths up to $6m$ (20 feet), i. e. ordinary log lengths, it is found that $\frac{1}{1,000} m^2$ is a quite satisfactory degree of accuracy, hence a very considerable reduction in figures is secured on such calipers, namely to at most three.

Several pages of records of actual measurements calculated to volumes by five different methods and curves prove the propriety of the contention as to the needful accuracy, as long as not single cases but a series is measured. Schedules for keeping records are given.

Die Kreisflächenkluppe. Centralblatt für das gesammte Forstwesen. December, 1912. Pp. 541-554.

New Working Plans for Baden.

During the last few years, Bavaria, Württemberg and Hesse have started in to thoroughly revise and modernize their working plans for State Forests. In 1912, Baden has followed suit with instructions for new working plans, after having passed through just a century since the first beginning of collecting data for working plans, several methods of budget regulation having been tried since that time.

In 1836, a volume allotment, in 1846 a combined area and volume allotment was prescribed, first worked out for a whole rotation, then determining volumes only for the first decade.

The area allotment found difficulties on account of the favored selection forest system, so that by 1869 another change was made to a normal forest method, but not the excellent one of Heyer, namely without his allotment plan, calculating the actual stock not with felling age increment, but relying on the current increment, and faulty in various ways.

The new prescription makes the stand (Unterabteilung) the unit of management; as far as according to species, age, and site it will probably remain permanently an area for independent treatment.

The minimum size of such a stand is not prescribed. Site classes are made by use of average height and age according to Eberhard's site class tables. For determining stock the same tables are used, but, although the tables are correct, they are reduced by 10% to allow for the difference of the theoretical and the practically available and saleable part of the volume. Only the volume of the main stand is used, the intermediary stand, 5-10% of the total, is neglected, which opens up the possibility of great variety of opinion as to what to count to main or intermediary stand, and to likely underestimates.

The increment, however, is to be ascertained on both final and intermediary yield; namely a total average increment for the rotation under normal stock conditions, and a current increment for the first decade. Also the average felling age increment for each management class is to be ascertained by use of the tables checked by sample areas. These latter are to be kept permanent, so that the progress of increment can be studied.

Age class conditions according to area and volume, and comparison with normality are to be specially looked after, but the normal stock is to be figured from the yield tables, not as hitherto according to formula.

The forest capital is to be ascertained for comparison with the annual net yield according to most modern valuation methods. Stands up to 40 years of age are to be calculated at actual cost value, older stands at sale values; soil values as soilrent values checked by actual sale values. The prescribed interest rate is 2.5%. While—quite properly—the management is not to be based upon a strict soilrent calculation, the principle is laid down, that the aim of the management is to be to secure the highest forest net yield possible under sustained yield management besides at the same time attempting to secure an adequate interest rate on the capital involved in the management.

Hence, stands are to be considered ripe, when the periodic increment of the forest net yield begins to decline considerably, and to determine this rotation, forest net yields and average interest calculations are to be made, also soil expectancy values with interest rates of 1.5 and 3% are to be calculated to exhibit the time of culmination.

If then the rotation based on the forest rent and the financial rotation based on an "adequate" (if, no special considerations, 2.5%) interest rate coincide, it is accepted. If not, then an investigation is to be made to see by what changes in management coincidence can be secured.

In this way, for the first time, at least a financial check is introduced.

Where the determination of the rotation in this way leaves uncertainty, the index per cent., or with very valuable stands only the value increment per cent., is to be used for judging ripeness.

Rules of management for districts of similar conditions of production are to be formulated to stop the continual experimenting of each manager.

For regulation of the budget the Saxon method of "stand management", which determines the budget from a consideration of silvicultural needs of each stand, and the final amount by considerations of the whole range, has been adopted.

Silvicultural necessities and silvicultural desirabilities direct the formulation of the preliminary felling plan; pressing needs for felling offer the overripe and deteriorating stands, necessary fellings are those in regeneration stands or in the interest of proper ageclass distribution and felling series; other fellings are matters of choice, based upon considerations of the total average (normal) increment, the current increment, the normal felling area in clearing system, and the stock on normal felling area in selection and shelterwood system.

The securing of normal ageclass relations in area and volume are to be especially attempted.

In very unevenaged stands or with long regeneration periods a comparison between actual and normal stock is to be used as check with the formula hitherto in use, namely b (budget) $= I + \frac{Sa - Sn}{e}$, or else the volume rate per cent. may be used as a check.

In the selection forest the current increment furnishes the principal index for the budget, as well as other considerations, like market and labor conditions, etc.

A large number of schedules for gathering the necessary data accompany this instruction not much different from those in use, except that the management ledger is to furnish a complete chronicle by stands. Besides the sample areas mentioned, so-called special typical "index stands" are to be used to accumulate data of yield and finance, and these are to be specially booked.

The map work is also to be improved by stand maps showing species, ageclass, site.

The working plans are to be made by a special bureau, as hitherto, except that the head of the bureau is now made a member of the central direction.

Lack of sufficient personnel to carry out this excellent program is foreshadowed by the reviewer, and has already been experienced during the first summer.

Die neue Dienstanweisung für Forsteinrichtung. Allgemeine Forst-u. Jagd Zeitung. December, 1912. Pp. 420-425.

Price of Oak in France.

In Eastern France the price of oak on the stump may vary from $5\frac{1}{2}$ to 65 cents and more per cubic foot according to size and qualtiy.

Algan states that in a general way the price rises with the diameter or circumference proportionally up to a certain size, then to rise much more rapidly than the diameter. He finds, however, that the average price for ordinary oak stumpage, the diameter measured at man height, varies proportionally for diameter from 8 to 32 inch by approximately $2\frac{1}{4}$ cents for every increase by two inches, the 8 inch tree bringing $5\frac{1}{2}$ cents, the 32 inch tree brings 32.5 cents per cubic foot.

This price, of course, is reduced or increased by 5 to 15 per cent. and more according to ease or difficulty of logging and character of trees.

Ce que valent les chênes sur pied. Bulletin, Société Forestière de Franche-Comté et Belfort. March, 1912. Pp. 365-368.

STATISTICS AND HISTORY.

Prussian Forests in 1910.

The area of State forests in Prussia showed a net increase in 1910 of 12,600 ha. (31,000 acres) or one-half of one per cent. This is less than the average for the preceding decade by about 20%. The decline in acquisition is due to a rise in land values and an increasing indisposition on the part of private owners to part with their holdings at fair valuation. The largest accessions lay in the northeastern plains. The heaths of northwestern Prussia which were largely bought up for forest planting some years ago are now being developed as farms instead. A large part of the newly added area is unforested. The total barren area has, however, been reduced by planting despite these accessions.

The area of private forest has declined much more than enough to balance the gain in State forests. Land speculation is rife, especially in the eastern provinces, and owners holding for speculative rise in values not only neglect the forests but add to the profits of their brief tenure by overcutting them. This speculation is hardly noticeable in the western provinces of Hanover and Westphalia.

State aid to private forest management in Prussia is given through the provincial Boards of Agriculture which furnish advice, and also through financial assistance at planting time. In some provinces notably Brandenburg, the demands upon these boards have severely taxed their personnel and resources. Somewhat more than 11% of the total area of the private forests of moderate area (100-2,000 ha.) are permanently placed under the advisership of these boards. The area of private forest worked under plans provided by these boards increased by 22 per cent. during the year.

Week-long lecture courses in forestry were given by these boards under various auspices to encourage the rational practice of private forestry. In Posen ten voluntary associations of small forest owners have been organized to co-operate more effectively with the local board.

These boards have given especial attention to improving the quality of forest tree seed and plants furnished by commercial nurserymen. The use of Scotch Pine seed from southern Europe is regarded as especially calamitous and many of the leading seed dealers and nurserymen have entered into an agreement to handle only German-grown seeds and plants from such seeds.

The Bavarian State forest administration requires that all Scotch Pine seed offered for sale shall be guaranteed German-grown and the price based on 85% germination. Seed collection in the State forest by firms who submit to regulation of their work is encouraged and aided. The use of seeds grown in the forest in which they are to be sown is not yet attempted there as in Prussia.

This effort to use none but German-grown pine seed has been defeated by the failure of the pine to set a full crop of seed during several years past. As a result large amounts of cones and seed have been imported from Russia, Austria-Hungary and Belgium. The Prussian State forest administration was able to harvest but 12,400 Kg. of seed in the face of a demand for 45,000 Kg.

As for pine, so too for other species. The seed crop of 1910 was unusually poor. Spruce, larch, Silver Fir, Jack Pine, Douglas Fir, Sitka Spruce, oak, beech and locust all failed to set seed. Maple, alder, linden and White Pine yielded small crops. Only birch, ash and hornbeam seeded rather abundantly.

The winter weather both at the beginning and end of the year was unusually mild; the spring was dry until June, then the summer and fall were cold and wet. Plantations throve well, especially where weeds were held in check. Beech mast sprouted well except where they were gotten into the ground too late in the spring.

The cost of combatting insect pests in the Prussian State forests was large in 1910, though somewhat lower than in the record year 1907. To the continued campaign against the pine moth were added campaigns against the nun moth and the bark beetles which always assume theatening proportions after a moth attack. All these campaigns have centered in the Koenigsberg district in East Prussia. The work against the nun moth was successfully concluded in 1911 and serious damage by bark beetles was entirely prevented by these measures. It is interesting to note that the famous campaign against the nun moth in the middle of the last century lasted eight years; and that on the average only 40 per cent. of the entire loss was directly caused by the nun, while 60 per cent. was done by the concomitant bark beeetle.

The sale of the large amounts of wood felled during this campaign did not lower the market price seriously. Successful remedial measures and a stronger market for wood have dispelled the alarm with which insect pests were once viewed.

Oak and beech suffered less serious insect attacks during the year. Mice and rabbits contributed more than their usual amount of damage, the mild winters favoring their increase. A frost on the night of June 24 did serious damage.

Forest fires were notable in 1910 for their rarity and small size. The only considerable one, one in Wildungen, West Prussia, destroyed 313 ha. (770 acres) or more than half the total area burned over in the whole State. The fires all occurred during the spring drought, that is before July 1. The average annual damage from forest fires in Prussia ranges from ten to thirty dollars per acre. Even in Prussia, it is impossible to get all fires reported.

A large forest fire insurance company has paid losses on many more fires than are reported in the official statistics.

The volume of wood cut in 1910 in the Prussian State forests was greater than ever before, due chiefly to the cut from stands attacked by the nun moth in East Prussia, although there is a slight increase in the cut nearly everywhere. The cut is chiefly coniferous, the hardwoods forming a small and dwindling portion. This necessary increase in the cut which is now 30 per cent. greater than two years ago is accompanied by a fall in the net yield of 15 per cent. This is due in part to the attacks of the nun in East Prussia which has there overloaded the market, especially with firewood, for which the mild winter reduced the demands, in part to the industrial reaction and general fall of prices since 1907, and in part to the increase in overhead charges due to increased salaries. It is also accentuated by unpaid accounts which will be credited to next year's receipts.

The market for mine props and cross ties has been overstocked by the low grade material cut during the year and prices have fallen and imports declined. This appears to be only a transitory condition.

Four per cent. of the forest area of Prussia is oak coppice managed for the production of tanbark. The steady decline of the price of tanbark has gradually removed all profit, while many economic factors tend to prevent the change to profitable coniferous high forest. This crisis has been studied notably by Dr. Jentsch and no relief found. Progress in the tanning industry has developed large plants which draw their tannins from the tropics. Besides these the older type of small tannery has failed to hold its own, and with the small tannery the demand for tanbark will vanish. Import duties have failed to reduce the use of foreign tannins or increase the demand for bark. Finally chrome leather and other mineral tans are entering and promise to usurp the whole field. Dr. Jentsch has concluded that about two-thirds of this oak coppice will be changed over into coniferous high forest probably after changing owners. One-third will remain in present hands and continue to produce tanbark which will be utilized in home tanneries.

Building materials, wood and stone, are "barometers of trade," indices of industrial conditions for the coming year. Prosperous periods are ushered in by vigor in the building trades and these decline first in industrial crises. In Germany home production falls far short of meeting the demand for wood. Here their wood imports furnish this barometer when corrected for the slight variations which usually occur in home production. When the imports for 1910 are considered, no cause for alarm is revealed.

More than half the wood imported into Germany comes from Russia, nearly a third from Austria-Hungary, while Sweden and the United States occupy third and fourth places. Imports of sawn timber are increasing slightly faster than log imports.

Reports of the amount of wood freighted by rail and water show the largest tonnage ever reported.

Strikes accompany industrial activity. The agreement between workmen and employees in the building trades ran out March 31, 1910. After much parley a new agreement reducing hours of labor and increasing wages was entered upon to run three years. The building trades have prospered in spite of this untoward occurrence.

For the sawmill industry the year 1910 was a profitable one, even though all hopes were not fulfilled.

Likewise in the furniture manufactories trade was active but the manufacture of stock articles on a large scale declined, the demand being rather for special orders. This has given impetus to a variety of small shops and halted the development of larger establishments.

Syndicates organized for the control of prices of matches and of mine timbers failed of their purpose and were dissolved, and they demoralized the market for these articles.

Forstwirtschaftliche Rückblicke auf das Jahr 1910. Zeitschrift für Forst- und Jagdwesen. July and August, 1912. Pp. 399-425; 481-500.

Bavarian Statistics.

The official blue book of the Bavarian Forest Administration for 1909 contains very complete information regarding the State Forests, which with 2,300,000 acres (14 per cent. unproductive) represent 35 per cent. of the total forest area, 48 per cent. being privately owned and the balance municipal forest.

The cut was 168.6 million cubic feet (an increase of over 18 million over the previous year), which brought $13,387,000, and, since the harvest cost was $2,103,000 (1¼ cents per cubic foot), the productive 2,019,500 acres produced at the rate of 84 cubic feet or $5.60 for the wood alone. The workwood per cent. was 56, and the average value of it not quite 12 cents, while fuelwood sold at 4 2-3 cents per cubic foot.

The total net yield was $7,454,000 or $3.24 per acre over all. Planting cost was 32 cents, road expenses a little less. An unusual fire loss occurred; 202 fires, 26 through locomotives, destroyed over 2,000 acres, or 1 in every 2,272 acres.

In the same year the municipal forests produced only $2.88 per acre.

An extensive tabulation and discussion on wood prices shows the great variation of prices in different localities, e. g. the highest price was paid for oak, namely $2.08 per cubic foot for the best, but in other parts as low as 61 cents; for beech the limits lie between 29 and 12 cents. The highest price for pine logs was 26 cents, the lowest, in another locality, 17 cents. No influence of the increased cut on prices was noted.

Logging cost also varies greatly from ¾ to 1¾ cents per cubic foot.

Very full statistics of labor employment are given. Total labor-days were 4,811,964, or a little over two days per acre, or about one full laborer to every 140 acres.

While theoretically 16,040 full laborers represent the labor requirement, actually 73,620 persons had longer or shorter employment in the woods. The distribution of labor on different jobs appears from the following calculation. For 250 acres of forest area there were required 586 days labor, of these 328 for logging; 87 for roadbuilding, 136 for cultures, 35 for other work.

A significant fact is reported regarding private forests, namely that 45,000 acres were reforested in the last 13 years.

Mitteilungen aus der Staatsforstverwaltung Bayerns. Allgemeine Forst- und Jagd Zeitung. August, 1912. Pp. 284-286.

Baden Statistics

The official statistics of the forest administration of Baden for 1910 show that in the last 32 years the principal yield of wood has increased by 73 per cent., that of intermediary yields by 89 per cent., and the total yield by 75 per cent. 7.5 per cent. of which are shown to be during the last year. So that now the total cut per acre has reached 107.5 cubic feet per acre, of which 25.9 is from thinnings. This is probably the highest yield in Germany from a forest area of 236,000 acres.

The increase in product is in part due to utilization of surplus in old stock which had accumulated, due to undercutting in previous years. The thinning practice has been greatly increased and improved through the development of the pulpwood industry. The workwood per cent. is exceptionally high with 46.2 per cent. and with 63.6 per cent. for coniferous wood, which forms 68.6 per cent. of the cut, broad-leaved species furnishing only 6.2 to 7.4 per cent. of workwood.

The net yield for wood was $8.20 per acre, and the total net yield $6.09, an increase of 80 cents over the previous year.

Statistische Nachweisungen aus der Forstverwaltung Badens für 1910. Allgemeine Forst- und Jagd Zeitung. December, 1912. Pp. 417.

Statistics of Norway.

The forests of Norway are largely in private or municipal ownership, the State owning only 28.5 per cent. or 4.8 million acres, of which, however, hardly 2 million are productive and may be alone considered in making up budgets.

The total income (1912) from the State forests was only $292,000, with an expenditure of $195,000, leaving less than $100,000 net; but there should be deducted from the expense $20,000 for purchases and subventions, and added to the income the value of wood given away without charges (servitudes) with $56,000 and incomes from public institute forests of $140,000, so that the revenue would be $313,000, which works out hardly more than 15 cents per acre.

It would appear that the State forests are so far mainly supporting their administration and such public interests as the State can aid. The administration under the Director of Forests comprises 4 inspectors at $1,150, 26 supervisors at $730 to $1,000, one for making working plans, four assistants at $420 to $550, and 12 "planters" at $336 to $450; altogether the salary list is $50,000, besides $9,400 for guards and $95,200 for logging and $15,000 for various expenses, leaving for reforestation $33,700.

The State expends besides $61,500 for encouragement of private forestry, education and in other directions of public policy, which just about uses up the receipts of the State forests.

These latter expenditures divide themselves up into support of three primary forest schools $6,630, the courses, all practical, running for one year, most of the 96 (out of 256 applicants) attending the schools becoming private foresters. Some $2,740 go to the support of a provincial forest school of Hedemart, the most densely wooded province in Norway. This school at Evenstad is not much different from the previously mentioned schools, the course lasting also a year, with 20 students, who secure a State subsidy.

The Norwegian Forestry Association secures $56,500, besides the salary of a technical forester of $730. This Association consists of 1,700 members and 7,500 adherents, subdivided into 18 provincial sections. The State subvention is distributed by the Association to would-be planters as it thinks proper, but $5 to 6 per acre is the obligatory contribution to plantings in the protection forests. This work is supervised by the technical adviser and the provincial forest officers. Another peculiar subvention by the State of $2,240 is given to the provinces, who fix a minimum diameter for exploitation of protective forests, this sum representing half the cost of putting this regulation into effect.

Indemnity for damage done by beavers, which are protected by regulations for their chase, are provided by the State with $560; and finally a subvention of $12,140 for travel and salaries of provincial foresters.

After Tidskrift for Skogbrug. Revue des Eaux et Forêts. July, 1912. Pp. 397-402.

MISCELLANEOUS.

Market for Foresters.

A commission appointed to consider the matter warns graduates of the higher grade forest schools that there is little hope of obtaining a livelihood by securing positions with private or communal owners of forest lands. While there is a demand for guards and foresters of the lower grade, technically trained men can only look forward to obtaining a livelihood in this kind of practice in exceptional cases.

Warnung von dem Eintritt in die Privatforstverwaltungslaufbahn. Forstwissenschaftliches Centralblatt. June, 1912. P. 343.

Educating Rangers. V. S. Iyer reviews the history of ranger training in India during the past 36 years. "Decentralization was the central idea * * * even as early as 1876-77. Is it a wonder, then, that decentralization is the order of the day?" There are now local ranger schools for Burma, Bengal, United Provinces, Central Provinces and Madras, in addition to the "Imperial Forest College" at Dehra Dun, which is the seat of the Forest Research Branch. T. S. W. Jr.

Forest Education in Madras. The Indian Forester. January, 1913. Pp. 15-23.

OTHER PERIODICAL LITERATURE.

Forest Leaves, XIII, 1912,—

Pennsylvania Forest Reserves. Pp. 184-187.

The Botanical Gazette, LIV, 1912,—

Growth Studies in Forest Trees: I. Pinus rigida. Pp. 386-403.

[LV, 1913]

The Climax Forest of Isle Royale, Lake Superior, and its Development. I. Pp. 1-44.

Ray Tracheids in the Coniferales. Pp. 56-64.

Canadian Forestry Journal, VIII, 1912,—

Forest Insect Conditions in the Riding Mountains, Manitoba. Pp. 152-154.

Quarterly Journal of Forestry, VII, 1913,—

Forestry in the Black Forest. Pp. 1-19.

Hungarian Forestry School, Selmeczbanya. Pp. 30-32.

State Afforestation in New Zealand. Pp. 50-53.

Economic Organization of Forest Proprietors in Austria. Pp. 73-76.

The Journal of the Board of Agriculture, XIX, 1913,—

Provision of Technical Advice in Forestry. Pp. 850-852. The arrangements made for the administration of the grant by the Development Commission of England and Wales.

The Norwegian Forestry Budget. Pp. 871-872.

Transactions of the Royal Scottish Arboricultural Society, XXVII, 1913,—

Continental Notes—France. Pp. 41-51.
Interesting miscellany, mainly silvicultural.

The Gardeners' Chronicle, LII, 1912,—

The Woburn Forests. Pp. 422.

Corsica. Pp. 424-425; 445-446.
Description of economic and forest conditions.

NEWS AND NOTES.

Forest Supervisor P. S. Lovejoy sends the following interesting observations:

"I have just been reading 'Forests and Water in the Light of Scientific Investigations.' (Final Report of the National Waterways Commission), and thinking over what I knew that tended to prove or disprove the conclusions of the report, my opinion is that they are correct.

Of course, the effect on run-off after fire, especially in the case of small streams and springs in the irrigating country, could be amplified indefinitely.

The other day I noticed what I had never seen before and what seems to give ocular proof of the theory of paragraph 3, page 220, which states:

"Another reason for greater precipitation over forests may be the mechanical action of the trees themselves. When a cloud in the mountains passes through a forest, the branches and the leaves of the trees retard its movement. It comes, therefore, into a state when it can no longer retain its moisture in suspension, just as a river carrying sediment deposits part of it as soon as the rapidity of its flow is diminished. The moisture from such clouds is intercepted by the forest in the form of mist or drops of dew or crystals of hoar frost on the branches and foliage of the trees."

The weather had been very hot and dry and the roads were very dusty. Heavy clouds came in from the Strait of Juan de Fuca toward the Olympic mountains early in the morning. It did not rain a drop, as was shown by the dust of the road, but, on the lee side of all the tall fir trees which stood on the Strait side of the road, the road dust was wetted down by fine drops. This was not *under* the trees only, but in the lee in a pattern *in dust* of the same shape, but of the reverse character as if there had been a light rain under the same wind conditions, i. e., while with precipitation the pattern would have been dry, in this case it was wet and its surroundings dry, an inverse rain pattern.

Ranger Chris Morgenroth, of Port Angles, Wn., an old timer and good observer, informed me that the occurrence was not at all unusual on the Olympic peninsula."

A forester in the private field writes pertinently to us:

We are all overwhelmed with volume tables; but it is hard to get the figures on which they are based. For the rule applied as scale each table may be fit: but when one table is given in terms of the Scribner, and results are wanted by the Doyle rule, you know the unsatisfactory figures obtained by comparisons. Now what would be of much value to all of us poor devils who are working in the field would be the publication of actual stem or tree analyses—the real figures, from which the *tables* are made up. Then we could apply any rule needed—and not have to puzzle and check as we now often do. Why could not the government publish their figures—a sort of big data handbook?

The following definitions lately submitted to the Editor meet entirely his own conception of some commonplace terms:

"There seems to be some confusion among foresters in the proper definition of "step" and "pace." I am accustomed to consider a "pace" as the distance covered in walking while the same foot is placed to the ground. The distance covered in placing the feet alternately on the ground I consider a "step." Thus two steps make one "pace." I also consider a step and a pace as the distance covered without special effort in walking, while an extra long step made with an effort to cover as much ground as possible, or a greater distance than a natural gaited step, I consider a "stride."

To show how "attitude" influences definitions we may refer to decisions of courts in Germany in cases of trespass in hunting, where size of the area and the ability of the hunter to hide seem to be necessary characteristics. Cut-off forests (Wald) are not forests (Wald). Similarly an area covered with low growth is no forest (Wald).

Divorce of forest fire organizations from politics, efficient forest patrolmen and co-operation between the State and private fire-fighting associations formed between timber owners and lumbermen, were the slogans of those who attended the second annual meeting of the Lake States Forest Fire Conference, held at Lansing, Michigan, January 21 and 22.

The legislative committee also recommended:

"Absolute divorce between game and forest departments. Work of forest protection and administration placed in hands of competent and non-partisan board. Appointment by board or commission of an expert and competent forester, together with necessary assistants, who shall have charge of and supervision over all forest administration and protection. General forest and fire law along lines of the present Minnesota law, with annual land tax based on soil values, and timber tax based on value of timber at the time it is removed from the land. Appropriation of sufficient funds to enable the State forester to enforce the full existing forest and fire laws and such others as may be passed."

Resolutions were adopted urging the Lake States and the Province of Ontario, which was officially represented, to provide larger appropriations for fire protection, to form new associations for fire-fighting; to co-operate with the forest fire-fighting organizations; and to urge and advocate the reservation of non-agricultural lands.

It was shown at the Conference that the new forestry law of Minnesota is the most progressive in the Great Lakes region, and that of Michigan is the most inefficient.

The organization of fire protective work in British Columbia has been much more effective during the past season than previously. The Forest Act of 1912 provides for regulating railways, slash along roads and other dangerous places, construction of fire-brakes on logged-off lands, requiring permits to burn slashings, establishing a dry season and providing for patrol and fire fighting forces. The patrol during the summer of 1912 consisted of 17 divisional wardens and about 150 district wardens and patrolmen. The cost of patrolling and fire-fighting amounted to about $175,000. Funds for this purpose were obtained by a tax of one cent per acre on all timberlands in private ownership, and under lease and license, with an equal amount raised by general taxation.

During the season of 1913 the efficiency of all lines of work, including fire protection, will be materially increased by the establishment of the district system. The Province will be divided into districts with a district forester in charge of each, who will be responsible for the general supervision of all lines of work, subject to the direction of the Chief Forester, Mr. H. R. MacMillan, from the Victoria office.

The Western Forestry and Conservation Association, which embraces California, Oregon, Idaho, Montana, Washington and British Columbia, spent $200,000 patrolling forests last summer. Only 76,000,000 feet of standing timber, less than one-seventieth of one per cent. of the 500,000,000,000 patrolled, was destroyed by forest fires in the season of 1912 in territory represented. Mr. Allen states that this record was as much the result of fortunate weather conditions as of preventive measures.

The province of Quebec has inaugurated a novel plan for formation of forest township reserves. In the old townships that have been opened since half a century and more to settlement, there is a good deal of waste lands that were never located by settlers but were cut over in due form, or, if they were sold to settlers, these were unable to live on them and had to abandon them. All these lands that are vacant in a given township of which there is not the least doubt as to their non-agricultural character are to be grouped into reserves. But "to gild the pill," the farmers or settlers of the surrounding parishes are to be allowed to cut timber in these reserves on the following terms: Each year only 1-20th of the area is opened up to them; no permit can be given for more than 10,000 feet b. m.; the permittees must cut where and how directed by the warden of the reserve; they must pay one-half of the dues in taking the permit and the balance when they have cut their timber, which must be piled and is measured by the wardens. The cutting is directed by a diameter limit, the same as on Crown Lands, and the dues are fixed at the same rate. Thus, in the neighborhood of each village, little forests aggregating from 2,000 to 15,000 acres more or less in blocks are to be created, where the farmers can cut each year enough timber for their real wants.

There are now 8 such reserves established, covering 255,000 acres and plans to establish 12 more.

Three were under operation last year and produced good results. This year the inventory of at least 5 of these will be taken, so as to prepare a working plan for each.

It is proposed to establish each reserve on a sound basis by building a good system of roads and trails, by providing it with a main system of telephone lines, observation towers, and houses for the wardens; eventually, by reforesting the parts denuded. The reproduction is so good in this province that anywhere,

where fire can be prevented from occurring periodically, the land will be soon clothed with some kind of forest growth, generally birch and aspen, into which plants of more desirable species, in openings made artificially or naturally, may be introduced.

At the Fourth Annual Meeting of the Commission of Conservation of Canada, held at Ottawa January 21st and 22nd, the report of the Committee on Forests was approved, containing recommendations with regard to the following points; Approving the plan of co-operation in effect between the Board of Railway Commissioners and the Dominion and Provincial Governments for the enforcement of the fire regulations of the Board; urging the establishment of a fire-protective service along the Intercolonial and National Transcontinental Railways similar to that provided for in the fire regulations of the Railway Commission; urging the Governments of New Brunswick and Nova Scotia to organize separate branches devoted especially to forest fire work and to establish technically educated provincial foresters as has been done in British Columbia, Ontario and Quebec; calling attention to the necessity of considering the requirement of brush disposal in the issuance of new licenses and the renewal of old licenses by Dominion and Provincial Governments; approving the organization of co-operative associations of limit holders and the principle of contribution by the Dominion of Provincial Government in proportion to the benefits received; urging the Dominion and Provincial Governments to begin a systematic study of the extent and character of the forest resources; emphasizing the necessity for the collection of complete fire statistics; approving co-operation with the Government of Ontario in an examination of forest conditions west of Sudbury and south of the Clay Belt; approving the proposed extension of the Dominion Forest Reserves and the establishment of a game preserve in the southern portion of the Rocky Mountain Forest Reserve and in southeastern British Columbia adjoining the Glacier National Park; urging that all appointments in the forest services of the Dominion and Provincial Governments should be based solely on capability and experience; urging the Government of Ontario to undertake a systematic classification in the Clay Belt in advance of settlement to the end that settlement may be properly directed, and that non-agricultural lands may be reserved from settlement and entry.

The Canadian Forestry Association and the Society of Canadian Forest Engineers, at their annual meetings on February 5, voted contributions toward the memorials to be dedicated to two celebrated foresters of the Old World, namely the late Professor K. Gayer at Munich and the late Professor Charles Broilliard at Nancy.

It is to be hoped that other associations may recognize in this way the indebtedness of the profession to these two leading silviculturists.

The Yale Forest School starts a publication with the new year giving the news of the school and its alumni, in addition to contributions from the latter. The first issue of 8 closely printed quarto pages brings a number of interesting short articles of an informatory character regarding the educational work of the institution and of conditions elsewhere.

Popular education through newspapers is now done by all government agencies in a most systematic manner. Press Bulletins from all directions and on all subjects flood the Editors' tables. Census figures are prepared in detachments and are made at once available before the whole volumes are published. Commissions and Schools are anxious to advertise their doings. Even international agencies are active collecting and diffusing knowledge by these means.

Popular education in technical matters is attempted by a number of State Foresters and Forestry Commissions. The Department of Forestry of Indiana, for instance, tries to reach the woodlot owner in special through the daily press by furnishing such bulletins. It also stimulates interest by offering prizes for essays.

The Forestry Branch at Ottawa is doing this service for Canada, the latest issue relating to the Massachusetts fire protective organization. Other subjects referred to by the Forestry Branch are Canada's pulpwood interests, description of forest conditions in limited sections of the country; recommendations for specific forest reservations; trees *vs.* sheep, in which a British finding is reported that 2,500 acres are required to support one shepherd and his family with 500 sheep to look after, but as forest would support 25 woodsmen and their families.

The Pennsylvania Chestnut Tree Blight Commission has issued its first Bulletin, an illustrated publication which can be had from the Commission free of charge at 1112 Morris Building, Philadelphia.

The U. S. Census Bureau sends out the data on railroad ties, telegraph poles for 1911, and general exports of manufactures for 1912. The latter amount to over 1,021 million dollars, excluding food stuff, more than double what it was in 1903, wood manufactures being among the first four leading articles with nearly 100 million dollars. Cedar poles form still the bulk of telegraph pole supply, with over 2 million; chestnut comes next with 693,000, which is more than all the rest put together. Of cross ties, 135 million were purchased, oak, southern pine and Douglas Fir making over two-thirds of the whole consumption, but oak is declining in comparison with previous years. A constant increase in the number of ties treated is noticeable, yet hardly 25 per cent. are treated.

The Biltmore Doings continue to give account of the flights of this unstable body. But a new, formidable bidder for public attention comes from the New York State College of Forestry at Syracuse University, evidently trying to justify the lavish appropriations which the State sees fit to give to this institution. The announcement of a course in "City Forestry" and the inclusion of an investigation into diseases of fish by this college ought to bring public favor indeed!

The experimental tract of the Department of Forestry at Cornell has been increased by the gift of an additional 200 acres of land. The lands which have previously been given to the Department for experimental work comprise eight woodlots and a farm of thirty-eight acres. The woodlots include stands of White Pine, hemlock and hardwoods, and represent a wide variety of silvicultural conditions. All of the lands, including the addition of 200 acres, are within three miles of the Campus.

Ground for the forestry building at Cornell has been broken, and it is expected that construction will be pushed rapidly.

Mr. C. R. Orton, of Purdue University, has been elected to fill the vacancy at the Pennsylvania State College, made by the resignation of Professor H. R. Fulton, who will have charge of the teaching and investigation of Plant Pathology which includes Forest Pathology as well as the other special courses in plant diseases.

Mr. Ernest A. Sterling, who formerly held the position of forester with the Pennsylvania Railroad Company, and who severed that connection some time ago, has opened offices at 1331 and 1332 Real Estate Trust Building, Broad and Chestnut streets, for the purpose of actively engaging in professional practice as a consulting forest and timber engineer.

Dr. F. Fankhauser, for 19 years editor of the Schweizerische Zeitschrift für Forstwesen, well known to many American readers, has retired from this editorship, Professor Decoppet taking his place.

COMMENT.

Could a whole State be committed to an Insane Asylum? If so, is the State of New York, as far as its forest policies are concerned, not a fit candidate?

Students of history of the forestry movement in future days will wonder how in the present days the divergent attitudes of the State could be reconciled.

In 1893, the State by constitutional amendment forbade itself the practice of forestry on its own lands, declaring that its forest lands shall be forever kept as wild lands, and that no trees should be cut on them—which is clearly negativing any forestry practice.

In 1898, it instituted a College of Forestry at Cornell University, and a demonstration in the Adirondacks, intended to educate the people to a realization of what forestry involved.

In 1902, or thereabout, its Forest Commission began planting on State lands—a clear violation of the Constitution—and has continued doing so.

In 1903, it discontinued not the school, but the appropriation for the school, virtually closing it, as well as the demonstration, although the name as well as the equipment remained at Cornell.

In 1911, the teaching of forestry was again taken up, albeit in a different form, at the College of Agriculture in Cornell University, with State funds, and, in 1912, to clinch the matter, a forestry building, worth $100,000, was voted for the institution, at which four professors and instructors are employed—surely a strong enough department.

Yet, the Legislature of 1911 also provided a second school of forestry at Syracuse University, reviving the old name of New York State College of Forestry, and appropriating not less than $50,000 for its inauguration the first year—five times as much as the original College had required.

Now this College is asking for an appropriation of $384,000, to secure a $250,000 building and $103,260 for equipment, maintenance and instruction, besides some other items.

At present writing the question as to where the bounty of the

State is to go remains still open. But it would be interesting to know, where the common sense of the people of the State of New York has been hibernating while matters have taken the turn that they have.

What historian will be able to trace the subtle philosophy and the practical methods by which a State, that does not want to practise forestry, is committed to supporting two such expensive institutions to teach it.

For the sake of the future historian we invite those who know, to elucidate this conundrum now.

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Volume XI No. 2

FORESTRY QUARTERLY

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FORESTRY QUARTERLY

THE OBJECTS FOR WHICH THIS JOURNAL IS PUBLISHED ARE:

To aid in the establishment of rational forest management.

To offer an organ for the publication of technical papers of interest to professional foresters of America.

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

Manuscripts may be sent to the Editor-in-Chief at the University of Toronto, Toronto, Canada, or to any of the board of editors.

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Bellefonte, Pa.
1913.

FORESTRY QUARTERLY

ERRATA IN VOLUME XI.

Please Correct!

A serious error appears in a number of statements, and especially in the tables accompanying the article on *Some Aspects of European Forestry*, due to the use of an erroneous factor in converting cubic meter per hectare into feet board measure per acre. It should also be realized that no single conversion factor can be employed to translate a yield table, since the sawlog per cent. varies with the age. This matter is elucidated under *Comment* of the present issue.

By multiplying with the factor .84 the board feet statements can be reduced to a correct cubic foot statement in the tables referred to.

These errors occur in the following places:

F. Q., Vol. X, No. 1, p. 62, last two lines of table.
F. Q., Vol. XI, No. 2, p. 135, last line.
p. 136, table.
p. 137, paragraph 1.
p. 146, paragraph 4.
p. 147, table and next to last paragraph.
p. 273, line 28.
F. Q., Vol. XI, No. 3, p. 328, tables.
p. 331, paragraph 3 is all right.
p. 332, line 24.
F. Q., Vol. XI, No. 4, p. 478, table.

is that of the Jack pine in the Lake States.

Mature stands of Scotch pine average from 14 to 18 inches in diameter at breast height, about 75 to 90 feet in total height, some 200 stems to the acre, and a yield of from 50,000 to 75,000 feet board measure per acre.

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FORESTRY QUARTERLY

Vol. XI.] JUNE, 1913. [No. 2.

SOME ASPECTS OF EUROPEAN FORESTRY.

By A. B. Recknagel,

III. Management of Pine in Prussia.

The "Common Pine" as the Germans call it—*Pinus silvestris*—the Scotch Pine as we anomalously term it, is the very backbone of Prussian forestry. If, as is frequently asserted "the beech is the mother of the woods," then it is no less true that the pine is the most numerously represented in the forest family, covering 80% of the forest area of northern Germany and about 60% of the 6,175,000 acres of Prussian National Forests. Compare this 60% of pine with the percentage of other common species: Spruce and fir, 12%; Oak, 5%; Beech, 15%; Birch and Alder, 4%.

In the mountains of Prussia, the pine extends up to an elevation of 1,500 feet; in the Carpathians it reaches 3,600 feet, and in the Bavarian Alps, 6,000 feet elevation.

In appearance and in character of its wood, this pine closely resembles the Western Yellow Pine *(Pinus ponderosa)*. It is one of the "pitch pines" without any of the sinister significance which sometimes attaches to this term. Where it grows in pure stands on sandy soils, the resemblance to the longleaf pine of the South is striking; where oak and beech enter into the composition, the forest seems like a shortleaf pine and hardwood stand in the Southern Appalachians; where on the poorest soils, yes, even on shifting sands, it grows in irregular scraggly groups, the effect is that of the Jack pine in the Lake States.

Mature stands of Scotch pine average from 14 to 18 inches in diameter at breast height, about 75 to 90 feet in total height, some 200 stems to the acre, and a yield of from 50,000 to 75,000 feet board measure per acre.

Of course, large individuals are common, especially where there is a lower story of hardwoods. Thus the "Königskiefer" near Eberswalde is 36 inches in diameter and over one hundred feet in height with 80 feet of clear length.

To give a clearer idea of the average yield, the following Yield Table is taken from Dr. Schwappach's work "Die Kiefer" (The Pine).

Yield Table for Scotch Pine—III Site —For one acre fully stocked.

Age—years.	*Growing stock i. e. stand right after thinning.*	*Growth per annum. (Current annual Increment for each decade.)*	*Yield from thinnings in decade.*	*Total yield of thinnings from start.*	*Total yield of final harvest and thinnings.*
	Feet B. M. per Acre.				
10,					
20,	4,760	476			4,760
30,	13,600	884	170	170	13,770
40,	23,800	1,020	1,530	1,700	25,500
50,	33,490	969	3,910	5,610	39,100
60,	41,140	765	4,420	10,030	51,170
70,	47,260	612	4,080	14,110	61,370
80,	52,190	493	3,910	18,020	70,210
90,	56,440	425	3,570	21,590	78,030
100,	60,180	374	3,230	24,820	85,000
110,	63,580	340	2,890	27,710	91,290
120,	66,810	323	2,380	30,090	96,900

Volumes include all wood over 2.76 inches in diameter.

The usual rotation is 120 years which naturally divides into six age classes of 20 years each. For the sake of convenience, the periods are usually made to conform with the age class divisions. Thus the stands of the first period of working are those from 100 to 120 years old, the stands of the second period of working those from 80 to 100 years, etc. However, the working plan is usually for ten years only, with a complete revision at the end of that time. Hence, only the treatment of stands of the first and second periods is dealt with in detail in the plan of cutting.

The stands of pine are divided into five arbitrary site classes, according to the yield: Site I, up to 102,000 feet board measure per acre; Site II, up to 85,000; Site III, up to 68,000; Site IV, up to 51,000; Site V, under 34,000 feet board measure per acre.

These volumes include all wood over 2.76 inches in diameter.

In actual practice, the schematic step-like arrangement of the age classes, decreasing in height (and age) towards the prevailing wind direction, is never adhered to, nor can it ever be. However, it does present a definite, tangible ideal, nor is a sustained *annual* yield attempted, but merely a *periodic* one.

The great dividing points in the management of pine in Prussia are: First: Whether the object of management should be a financial one—greatest net income—or a silvicultural one—greatest production of wood. Second: Whether the system of management should be one of pure stands and clear cutting, or of mixed stands and shelterwood cutting.

The former was settled (?) by an ex cathedra utterance of the Minister of Agriculture, Domains and Forests to the effect that: "The Prussian Forest Administration does not consider itself decreed to practice a narrow financial management of the Forests, much less one based on capital and interest, rather the Administration considers itself bound to handle the Forests as a trust fund of the nation in such a way that the present may have the largest yields and benefits possible from the Forests, but without in any way impairing, but rather wherever possible increasing, the yields and benefits from the Forests for future generations."

The latter point is still a moot one, but the tendency is strongly away from pure stands and clear cuttings and towards mixed stands, leaving some of the old stand as shelter to the new.

G. L. Hartig at the end of the eighteenth century preached in favor of shelterwood cuttings and natural regeneration by shelterwood methods. His influence was very powerful during the first half of the nineteenth century, but gradually the methods of clear cutting, chiefly in strips with either natural or artificial regeneration, grew in popularity. As Borggreve points out in his polemic volume "Die Holzzucht,"* the evident advantages of in-

*"Die Holzzucht" by Professor Dr. Bernhard Borggreve, 2d. Edition, Paul Parey, Berlin, 1891, pp. 186 and 187.

creased light together with protection from the remaining stands on the side, resulting in increased rapidity of growth, while offering a much simpler method of getting the amount to be cut each year than the technically difficult method of repeated cuttings in the shelterwood systems, blinded the advocates of clear cutting to the resulting disadvantages of insect damage, deterioration of the soil and of the stand to drouth, frost and wind dangers, and finally, to the important fact that during the period of regeneration, the clear cut area was not only unproductive, but usually deteriorating, whereas under shelterwood cuttings the productivity of the old stand was maintained until the new stand became fully established.

The very wide clear cut strips led to immense destruction of the young stands by the May beetle. In some parts of Prussia, foresters despaired of ever successfully re-establishing pine on the cut-over areas. At this juncture, Danckelmann evolved the scheme of narrowing the strips to not over twice the tree height and alternating them so that the age classes would not be in successive steps but spaced irregularly. In this way, he hoped to combat the May beetle which flies diagonally from the tops of standing trees and thus, at the short width of two tree-heights, would fly over the regenerated strip and into the next mature strip where it would be comparatively harmless. This scheme proved successful only in so far as the May beetle danger which is still a very real one has been kept at bay.

But Danckelmann's narrow strips—as Borggreve points out—had many real disadvantages. The last strips were always most difficult to regenerate, even by planting of sturdy stock, owing to the rapid deterioration of the soil and the choking cover of weeds and other herbaceous growth—notably Vaccinium and Erica.

Therefore, the tendency of the best practice in Prussia to-day is towards encouraging all hardwoods which occur naturally in mixture—and especially beech, oak, birch, blue beech (Carpinus), aspen, and locust. All of these trees (with the possible exception of birch) have the property of improving the soil aside from the well known silvicultural advantages of mixed stands. Thus pine needles or beech leaves alone do not decompose as readily or as advantageously as do pine needles and beech leaf litter mixed.

It is true that, temporarily, pure stands of pine are still officially countenanced in Prussia, but this is largely from an economic standpoint. Pure stands are much easier and cheaper to manage and to market. However, the tremendous insect scourge in 1900 drove home the vital fact that the occasional stands of hardwoods in mixture with pine alone prevented the total destruction of the pine.

The best present practice aims to cut in small strips—leaving occasional beech, juniper, and other hardwoods, and natural seedlings of pine. The beech and other hardwoods do not impede the growth of the young pines—in fact, they favor it by protecting it in earlier years, and when, as is almost invariably the case, the pine overtops them, they make for better stems, clearer boles, and maintain the soil in good condition. The mature stand of to-day is essentially two-storied; pines dominating, hardwoods forming the lower story with commonly a quantity of advance reproduction of hardwoods (chiefly beech) on the ground. In this method, the "left over" natural seedlings of pine often develop into "Wolf trees" whereupon they are removed in subsequent thinnings. The juniper, of course, becomes suppressed, since it seldom attains a height of over ten feet.

It should be noted that occasional thrifty, windfirm pines are left over a rotation in order to furnish timber of larger dimensions. However, the stripwise cutting areas are not laid out arbitrarily, but adapted to the conformation of the ground.

The advantages of these mixed stands, both in quality and quantity of the pine produced, are very striking—no less striking is the much better condition of the soil and the greater freedom from fungus and insect attacks. It is the result of recognizing the fact that the forest of Prussia is not of pine alone, but is a family of species, big and little.

Despite Borggreve's polemics in favor of natural regeneration by the shelterwood method and Wagner's later arguments for natural regeneration by narrow selection cut strips,* the bulk of the pine management of yesterday, to-day, and probably of to-morrow too, depends on artificial reproduction of the stand. The reason lies in the quicker, more uniform results of artificial regeneration, and an often sod-bound soil. The relatively low cost of labor also comes into play.

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*"Blendersaumschlag" as described in C. Wagner's "Die Grundlagen der Räumlichen Ordnung im Walde." 2d Edition, Tübingen, 1911. See also—Proceedings of the Society of American Foresters. Vol. 7, No. 2, "Border Cuttings."

Except on the most unfavorable sites this regeneration is by sowing. Not by broad casting or harrowing, but by sowing in carefully prepared drills by means of a seeding-machine such as the well known one of Drewitz. Either the area to be seeded in the spring is plowed in the fall by means of a standard forest plow such as H. F. Eckert's model, or—and this is considered the better practice—the strips are hacked in the fall or winter by a gang of women armed with ordinary potato hacks. The sod, moss and weeds thus removed are piled on the adjacent, unhacked strips. Then the area is seeded in spring. Seed spots find little favor; for although they are cheaper than the strips, the better growth of pine in strips more than offsets this.

Formerly large amounts of seed were used per acre. In 1881 no less an authority than the late Danckelmann taught 7½ pounds of seed per acre; now it is universally 2¼ pounds of seed per acre on an average.

The success achieved has actually been in reverse ratio to the amount of seed used; since the thickly seeded areas came up so densely that the resulting stand stagnated in its youth.

In present practice the strips are about 50 inches apart.

For planting the area is prepared similarly; the plants—usually one or two year old seedlings, or 3—5 year old transplants, according to the difficulty of the site—are spaced some 18 inches apart in rows 50 inches apart. This means from 8,000 to 12,000 plants per acre. Balled plants or wild stock find little favor—the former because of the great expense, the latter because it is seldom as thrifty as and but little cheaper than nursery stock.

The seed is secured from cones gathered at the various Oberförstereien (National Forests) and dried at one of the many, centrally located, government owned "Darren." A germination of 85% is considered standard, but variations occur between 65% and 95%.*

The seedlings are usually raised in a nursery on the Oberförsterei. Where the area to be restocked is large, the stock is taken from the permanent, large nursery; where the area is small, the stock is raised in a small, temporary nursery, provided a suitable site can be found. In this case, some of the plants are left

*See Forestry Quarterly, Volume 9, No. 1, and Volume 10, No. 2, "Seed Extracting Establishments."

right in the temporary nursery, to form the future stand at this point.

Occasional sites which are too poor for the native pine have been planted to the American "Jack Pine" *(Pinus divaricata*)* and Pitch pine *(Pinus rigida)* with indifferent success. The latter is usually seen in mixture with the native pine which it was supposed to assist. Douglas fir *(Pseudotsuga taxifolia)* has been used with good success in mixture with the native pine on fresh soils.

The natural regeneration of pine is, as stated, uncommon. Sometimes a shelterwood system is used, where the stand though not yet mature is in poor condition, requiring heavy thinning, but instead of depending on natural seedlings which would be apt to suffer from the tremendous competition with weeds and sod, strips are hacked as for sowing, and these are planted up, usually with one or two year old seedlings.

Forstmeister Kienitz in Chorin (Brandenburg) is trying a new departure in pine reproduction—the Wagner selection border method mentioned above. He has applied it to a fully mature stand of practically pure Scotch pine making selection cuttings in thirty-five foot wide strips, some 550 feet apart; from East to West the strips run and progress in a southerly direction. In cutting these strips all trees which lean into it, from either side are removed, thus the regenerated strips cannot be damaged in subsequent fellings. The tops are lopped and the brush scattered —as indeed is commonly the practice here since Dr. Schwappach demonstrated that not only does proper brush scattering increase the humus, and mitigate erosion and frost, but actually prevents evaporation to such an extent that a covered (sand) soil contains four times as much water as an uncovered (sand) soil. Here too, as everywhere, the stumps have been cut to the very ground, and, in addition, covered with sand to prevent insects breeding there.

By this method, Dr. Kienitz hopes to regenerate the area completely in 20 years, and where natural regeneration fails seed will be sown.

The true selection system and the group method (or its variation, the "oil spot method") are not used in commercial forests, but in the city forest surrounding Eberswalde it finds very success-

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In European nomenclature, this is Banksian pine—*Pinus Banksiana.*

ful application. The over-mature, defective and decadent trees are removed (selection) and the vacancies planted or left to reseed naturally, or else small circular patches are cut clear and planted up, here and there as the stand requires; these groups are then enlarged until they merge into each other—the "oil spot method." Sometimes a group of natural reproduction forms the necessary nucleus "oil spot".

The understory of hardwoods is almost always regenerated naturally; not only do birch and beech seed abundantly, but they can come in under the shade of the pine stand just as the pine can well endure their shade—if not too heavy—in its youth. Sometimes, to encourage hardwood regeneration, and especially oak and beech, the ground under seed-bearing trees of the desired species is broken up—i. e., the mineral soil exposed—as by the use of potato hoes.

Only occasionally are acorns or beech nuts dibbled in or seedling hardwoods planted. The expense is too great for extensive planting aside from the planting of birch (often our *Betula lutea* —yellow birch) on the fire breaks.

As the stand approaches maturity the number of stems per acre naturally diminishes so that on an average site there are: 3,200 trees per acre at 25 years, 800 trees per acre at 50 years, 200 trees per acre at 100 years, and only 140 trees per acre at 120 years. Established sowings or plantations are not "patched up" after the first or second year, but any small gaps which may occur are left to close up naturally. The patching process has not proven successful since the newcomers seldom thrive.

The diminution in number is encouraged by thinnings which beginning at about the 20th year of the stand with "Cleanings"—i. e. removal of only the over-grown, poorly shaped, suppressed trees, become moderate between the fortieth and eightieth years of the stand, removing not only the dead, dying, diseased, malformed trees and the "wolf" trees, but also those of the intermediate class, which crowd the crowns of the dominant trees, and after the eightieth year till the hundredth year, become "heavy", removing even co-dominant trees which are retarding the development of the chosen individuals for the final stand. At present thinnings are made every 5 or 10 years; the tendency is toward greater frequency—"thin early and often"—since otherwise the light thinnings exert too temporary a benefit, the heavy thinnings, however, fail to produce the expected increase of growth possibly because opening the stand too much. However, the trend is toward heavier thinnings as Schwappach advocates, although Borggreve's selection thinning has not found favor in pine since it is too drastic for the species.

To us, who must for many years to come, depend almost entirely on natural regeneration of our pineries, the chief lesson to be derived from Prussia's methods is the maintenance of hardwoods in mixture, as an understory. There is no American pinery but has its hardwood species suitable for this purpose, with a little care in the management they can be maintained to the betterment of the stand, soil and yield.

As for regeneration—there is no soil in the Lake States poorer than the shifting sands of Frederick the Great's domain, where now stands pine forests yielding 50, 100 and even more M. board feet per acre. It may not pay us as yet to restock the "pine barrens" of the Lake States, but how about the cut-over pine lands of the South with their wealth of natural reproduction? A small investment now will bring large returns in the future. So too, in the West where despite constant fires, the young stands are springing up on the old slashings. The names of many Prussian towns still show in their derivation the former times of slashing and burning which were a necessary antecedent to the present civilization and forest culture. It is only reasonable to expect that America must also travel this road and in the traveling, Prussia's hard won experience of how best to treat her pineries should be of value.

IV. Management of Spruce in Saxony.

If the Scotch pine is the backbone of Prussian forestry, then the common or Norway spruce—*Picea excelsa*—is certainly the mainstay of the Saxon woods. It occupies over 90% of the 433,502 acres of State Forests; the balance is stocked with pine, fir, larch, beech, oak, ash, maple, hornbeam, alder, and birch in almost negligible per cents. And yet Saxony, with its rugged highlands, was originally covered with mixed stands of all these species with no such marked preponderance of spruce. Why then the transformation into pure spruce?

Simply because it paid best. Saxon forestry, in contradistinction to the Prussian, is on a distinctly financial basis; result of the "Bodenreinertrag" theory as against the "Waldreinertrag" theory." The former, which finds its highest exemplification in Saxony, treats the soil as the capital and the forest strictly as a crop, to be grown as quickly and economically as possible and marketed as profitably as possible, i. e. to make each acre of ground yield the highest money returns, while the latter attempts to secure from the forest as a capital the most satisfactory return.

Saxony's policy has paid, as the following figures bear witness: Average gross income per annum, $2,000,000; average net income, per annum, $1,378,530; average net income per acre, per annum, $3.18.*

This is a rate of revenue of about 2½%. But, if one takes into account the latent revenue represented by improvements in the growing stock and character of the forest, the rate of revenue reaches 5½%.

At first glance the Saxons should, therefore, be well pleased with themselves and their management. As usual, however, there is a fly in the ointment and that is the universally admitted fact that the constant growing of pure spruce stands started by Cotta some hundred years ago, continued under Pressler and endorsed by Judeich, has impoverished the soil and brought on all the scourges to which pure stands are heir. Areas that once bore splendid stands of spruce no longer can support them.

In this lies a tremendous argument for the golden mean. Prussia hoards her forest capital like a treasure trove and because she feels that too rapid a rotation causes the soil to deteriorate in productive power, sometimes has 40% of an Oberförsterei in mature stands. Saxony, hoisting the banner of "high yields and many of them" does not content herself with preventing an over-accumulation of capital, but goes to the extreme of imperiling the future for the sake of present cash returns.

The disastrous results are seen in the income from the Tharandt Revier which is typical of Saxon Forests in this respect:

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* These figures must be antiquated, for in 1910, the net income was $5.17 per acre; the net yield being $2,203,327.—Ed.

1873-1878 the net income was 2.66% per annum.
1879-1883 the net income was 2.35% per annum.
1884-1888 the net income was 2.43% per annum.
1889-1893 the net income was 1.96% per annum.
1894-1898 the net income was 1.51% per annum.
1899-1903 the net income was 1.34% per annum.
1903-1908 the net income was 1.49% per annum.

The last five years show, at last, a slight increase.

This is concurrent with the increased percentage of species other than spruce. Spruce in 1899 occupied 98% of the coniferous area; pine 2%. Spruce in 1909 occupied 91% of the coniferous area; pine 9%.

The Saxon foresters have come to realize clearly that repeated crops of pure spruce are a thing of evil. As in Prussia, the tendency is away from pure stands and towards mixed stands.* The beech, that patient "mother of the forest" is being brought into requisition to rejuvenate the soil. Beech is sown or planted in with spruce; beech and other hardwoods which may be present on a cutting area are retained in order that they may disseminate themselves and grow up with the coniferous seedlings.

But although Saxon foresters have been forced to abandon their time-honored principle of pure stands, they have clung tenaciously to artificial as against natural regeneration. Only in the method has there been a change. Formerly all the spruce stands were created by sowing; now planting is used except in the most favorable sites. Of course, the sowing is decidedly cheaper, but the resulting stand was unnecessarily dense, and yet a lesser density was impossible, because of the great damage the deer and other game did to the young plants. Planting costs more at first, but is cheaper in the long run because the growth is better and the injury through game more easily prevented—as, for instance, by sticking brush alongside of the plants or daubing the growing tips with whitewash.

Four, and in some cases five year old transplants are planted exclusively, i. e. 2-2 or 2-3 stock. On very difficult sites balled plants are used. The seedlings are usually transplanted when

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*In this connection it is interesting to note the dying out of the fir (*Abies pectinata*) in Saxony. Some attribute this to factory smoke; others claim that repeated spruce crops have rendered the soil unfit for fir.

they are two years old; only rarely are one-year old seedlings transplanted; 3,020 to 4,800 plants per acre; the cost seldom exceeds $10 per acre. Where the soil is sod-bound the sod is removed in strips. Where pine and spruce are planted in mixture (the latter as an understory) 3,200 pine and 1,600 spruce are used per acre—a total of 4,800 plants.

This mixture of spruce and pine is advocated wherever pure spruce stands are out of the question; the spruce, with occasional hardwoods, forms an understory which maintains the soil in better condition than does an open stand of pure pine.

The only system (or method) of silviculture in the spruce stands of Saxony is clear cutting with artificial regeneration. The cutting proceeds against the direction of the prevailing wind (that is usually from East to West) in strips ordinarily not over 200 feet wide. The result is quite steplike. After logging, the cutting area is often left a year, for the roots and other debris to decay, before it is replanted. Before cutting the adjacent strip to windward, six years are usually allowed to elapse, in order that the young growth may become well established. All attempts to regenerate the spruce by natural means have been unsatisfactory. Regeneration by means of shelterwood cuttings gave such poor results that, in the words of the Working Plan for Tharandt: "Even expensive underplantings could not bring about a satisfactory regeneration· Broken, sod-bound, overmature stands are now awaiting the axe! It should, however, be left to the supervisor to continue on a small scale where nature herself has begun the regeneration."

The rotation is now usually 80 years. Formerly it ranged as low as 60 years in an attempt to increase the income. By means of very intensified thinnings it was hoped to raise trees of 4 1/3 to 5½ inches diameter in that time, to be sold at a big profit as mine props. However, unforseen contingencies arose and nature herself apparently rebelled at these financial fetters.

The present eighty year rotation brings in an average annual yield of 900 board feet per acre.

The utilization is, of course, perfect. Saxony is a densely populated kingdom, labor is cheap and wood is high. It is all the more surprising, therefore, to find stumps higher than would be accepted in timber sale contracts under the Forest Service of the United States. To be sure these stumps are on steep hill sides, but that is not the reason. The reason lies in the old-fashioned style of saw which has a wooden bow-shaped handle and, when sawing on the up-hill side of a tree on a steep slope, this bow hits the ground if the cut is taken too low.

Saxon foresters confess freely that they could not possibly make the splendid financial showing they do were it not for a perfect accessibility to a perfect market for every kind and piece of wood that they raise. Theirs is a simple silviculture, but under the Saxon conditions, it is undoubtedly a most successful one. Aside from the money returns, this is evidenced by the high volume yields which they secure. Reduced to an acre basis, these are shown in the following table:

YIELD TABLE FOR NORWAY SPRUCE (PICEA EXCELSA).

For one acre, fully stocked.

Age. Years.	*1 Site Class.*	*2 Site Class.*	*3 Site Class.*	*4 Site Class.*	*5 Site Class.*
			Feet Board Measure.		
10	1,020	2,040	3,060	5,100	6,800
20	2,720	5,950	9,180	14,110	25,840
30	5,610	12,410	19,210	29,240	49,980
40	8,840	21,760	32,810	47,770	75,820
50	12,750	33,150	50,490	68,850	102,510
60	17,340	44,710	66,980	93,330	126,310
70	21,420	54,910	81,940	112,710	145,010
80	24,480	62,390	95,030	127,500	157,080
90	26,520	68,510	105,400	138,890	166,940
100	28,050	74,290	114,580	147,390	174,930
110	29,410	78,540	122,400	154,700	181,560
120	30,770	81,600	129,200	161,500	187,000

The following statistics for all the Saxon State Forests give further evidence of the high place which forestry has reached in Saxony:

Relation of age classes:

1-20 yrs.	*21-40 yrs.*	*41-60 yrs.*	*60 yrs. & over.*
24%	22%	25%	27%

The growing stock has increased from 25,840 board feet per acre in 1850 to 32,130 board feet per acre in 1900.

The annual cut has risen from 17 cords per acre cut in 1850 to 25½ cords per acre cut in 1900.

The value of timber nearly trebled between 1850 and 1900.

The gross receipts rose from $1.75 per acre in 1850 to $7.60 per acre in 1900.

The gross expenses per unit of timber raised, practically doubled between 1850 and 1900.

The gross expenses per acre rose from $.80 in 1850 to $2.89 in 1900.

The net revenue has increased from $.98 in 1850 to $4.90 in 1900.

The forest capital has been valued as follows:

1850-1863, ...	$115.60 per acre.
1864-1873, ...	$141.70 per acre.
1874-1883, ...	$168.20 per acre.
1884-1893, ...	$185.90 per acre.
1894-1903, ...	$220.60 per acre.

ECOLOGICAL STUDIES ON A NORTHERN ONTARIO SAND PLAIN.

By A. B. Connell.

The following data have resulted from the field practice work of the senior class in the Faculty of Forestry of the University of Toronto.

The investigations were carried out during the progress of the camp at Frank's Bay, Lake Nipissing, Ontario, in the fall of 1912. They are interesting as forming, perhaps, the first systematic studies of the forest types of this region. Although at present mainly of scientific interest, yet they possess considerable practicable importance in connection with the future management and value of such lands after logging.

The *physiography* of the Nipissing region is typical of the old Laurentian Plateau within which it lies. In general it is a low rolling peneplain which has practically reached a base level. The elevation is, on the average, 700 feet above sea level but occasionally reaches 1,000 feet.

The geology of this Archean formation is complicated. The rocks are mainly metamorphic, both the igneous and sedimentary types being represented. The most widespread form is a granitic gneiss which is often cut by dykes of pegmatite.

The soils are not residual but transported by glacial action. The old soils were removed by the Keewatin and Labrador ice sheets, both of which swept this district, and the present soils were mainly laid down in the post-glacial lakes which formed along the retreating face of the glaciers. The old beach lines of Lake Algonquin and the Nipissing Great Lakes, which represent a lower stage of the Algonquin waters, are evident near Frank's Bay.

The greater part of the country is covered by a thin sand deepening in places to form Sand Plains of varying extent. Occasional areas of heavy clays occur in the deeper depressions between the low rounded ridges and give rise to dense swamps.

The *climate* is rather severe, late June frosts being reported as occurring every year and July frosts once in five years. Figures obtained from the Meteorological Station at North Bay indicate an annual precipitation of 30 inches, of which 12.5 inches falls in the tetrahore or four growing months. The mean monthly temperature of the tetrahore averages 60° F., the extremes lying at a minimum of 4° F. in May and a maximum of 96° F. in July. The minimum winter temperature falls to —45° F.

In the classification of the forest growth three natural *types* were distinguished. This separation was based on physiography, which forms a more permanent basis than the nature of the tree growth which is often transient. The types were designated as Ridge Type; Swamp Type; Sand Plain Type.

The Ridge Type.

This, in the area under investigation, is the most extensive formation and comprises the bulk of the region. The low broad ridges are covered with a thin sand. The growth is stunted and open, the trees finding a foothold mainly in the crevices of the rocks. The three prominent associations which appear are:

1. *Jack Pine-Red Pine-White Pine.* This association comes in mainly on the better situations where the soil on the ridge tops has deepened. It forms a transition to the better sites.

2. *Pure Jack Pine.* The Jack Pine occurs on the most exposed and rocky situations where the soil is very thin and often lacking save in the crevices and fissures.

3. *Jack Pine-White Pine-Red Oak.* On many of the exposures scrubby oak enters in the composition but the Jack Pine is here also the prominent tree.

The Swamp Type.

The deep water deposits of heavy clay occurring in patches of varying extent are the cause of this formation. These clays lying at the lower levels are poorly drained and the small creeks which often meander through them are sluggish. The two associations which were noted are: 1. Cedar-Fir-Yellow Birch; 2. Black Ash-Elm. The former is the more widespread, the latter being comparatively restricted.

The Sand Plain Type.

Sand Plains are not numerous in this district but where they occur they support the best timber. They appear to form an ideal site for both the Red and the White Pine, the former often occurring in pure stands. A splendid example of this type lies near the lake at Frank's Bay and upon it the studies were carried out.

The method used consisted in running strips one chain in width through the various associations and upon these the trees were calipered down to 5 inches d. b. h. Square rod plots were taken at the end of every chain to determine the reproduction and soil flora. In the case of the cut-over areas the strips were narrowed to one rod in width and the reproduction on the entire strip was determined.

This plain has an area of something over 1,000 acres and small ridges outcrop through it in various places. The soil consists principally of quartz and orthoclase, and varies in the texture from very coarse sand around the low ridges to a fine sandy loam in the deeper parts. This physical variation in texture is apparently the cause of the reaction in the tree growth which produces the several distinctly separated associations.

These associations or societies are: 1. Pure Red Pine; 2. Red Pine-White Pine-Hardwoods; 3. Pure Hemlock; 4. Pure Hardwood.

Pure Red Pine.

The Red Pine *(Pinus resinosa)* occurs in a pure stand covering approximately 60 acres and is confined to the coarse and shallow sands near the ridges. This stand is past the period of its maximum development and the rate of growth is now declining with a consequent opening of the crown. The crown level is even and stands at an average height of 90 feet. The average stock density is 300 trees per acre, or expressed in basal areas 129 square feet. The composition is as below.

Red Pine	63	per	cent.
White Pine	15	"	"
Balsam Fir	7	"	"
Black Spruce	4	"	"

The balance of 11 per cent. is made up of Poplar 2 per cent., Red Maple 2 per cent., Hard Maple 1.3 per cent., White Birch 1.3 per cent., Hemlock 1.5 per cent., Beech .5 per cent. Cedar .2 per cent. and Red Oak .1 per cent. These last named species together

2

with the Fir and Spruce form a suppressed understory. The Spruce, which seldom exceeds 6 inches d. b. h. was in many cases found to be upwards of 60 years of age. Even if released it is doubtful if there would be a response in this growth.

The diameter classes in the Red Pine are not evenly distributed. Eighty-three per cent. of the stand falls into the large and small pole groups (5-12"), standards (over 12 inch) comprise 15 per cent. of the total and the saplings and veterans are practically negligible. The White Pine is graded more evenly, the saplings forming 21 per cent., large and small poles 62 per cent., and standards 16 per cent. Of the Spruce 66 per cent. and of the Fir 76 per cent. is below 4 inches d. b. h.

In the reproduction the interesting fact is that it is mainly White Pine which attains an average of 1,100 seedlings per acre and forms 73 per cent. of the whole. The remainder is composed of: Balsam Fir 10 per cent., Red Maple 7 per cent., Black Spruce 7 per cent., Cedar 3 per cent., while in scattered situations a sprinkling of Red Pine, Birch, Spruce, Beech, and Red Oak occurs.

Among the woody shrubs the Blueberries *(Vaccinium pennsylvanicum* and *canadense)* form 95 per cent. of the total, the balance being made up of Hazelnut *(Corylus rostrata)*, Juniper and Moosewood *(Acer pennsylvanicum.)*

The common brake *(Pteris aquilina)* is the only fern found, but is very abundant averaging something less than 4,000 to the acre.

The flowering herbs run in the neighborhood of 600 to the square rod and are composed as follows:

Pyrola sp.	22. %	*Chimaphila umbellata*	2.5%
Cornus canadensis	15.	*Aralia nudicaulis*	1.5
Linnea borealis	13.	*Goodyera* sp.	2.5
Lonicera canadensis	10.	*Aster* sp.	.5
Gaultheria procumbens	15.	*Trientalis americana*	.3
Epigaea repens	13.	*Majanthemum canadense*	.1
Clintonia borealis	2.5	*Monotropa uniflora*	.1

A mechanical analysis of the soil beneath the Red Pine yields the following results:

Fine gravel	21.30	per cent.
Coarse sand	42.45	" "
Medium sand	16.10	" "
Fine sand	16.40	" "
Very fine sand	2.07	" "
Clay	.22	" "
Organic matter	.40	" "
Moisture content	.50	" "
Coarse gravel	.15	" "

The soil is thus rather coarse and the moisture content low.

The litter is 2 inches in depth and loose. The humus, however, is in a raw condition, the fibres being matted and overlying directly the mineral soil. The gradual opening up of the crown and the entrance of the Vaccinium are probably contributing causes of this condition. The humus layer of the soil is not deep averaging usually one inch.

An idea of the conditions which will exist on such an area after it has been logged may be obtained by the examination of two pieces of cut-over land which lie immediately adjoining. Both were originally Red Pine. The first which was logged one year previous and practically cut clean now shows a young growth remaining of 950 seedlings, saplings and poles per acre, composed as follows:

Spruce	33.%	Red Pine	.2 %
White Pine	29.4	White Birch	.2
Balsam Fir	19.7	Oak	.02
Maple	.6	Hemlock	.02
Poplar	.5		

This practically represents the volunteer growth which escaped damage during the logging. The mineral soil has been well exposed by the operations and now forms an excellent seed bed.

The second is a 23-year old cutting which is now covered with a dense and valuable reproduction. As it was evidently cut to a 10 inch diameter limit, the remaining seed trees are quite numerous and seeding has also been aided by the proximity of the uncut stand. A total of 2.7 acres counted in this growth yielded the following averages which include as before seedlings, saplings and poles, and total 1,500 per acre.

White Pine	37.4%	Maple	4.3%
Red Pine	25.9	Oak	2.8
Balsam Fir	12.9	Poplar	1.6
White Birch	8.6	Hemlock	1.4
Spruce	5.	Beech	.6

The Red Pine now standing in this area consists to the extent of 8 per cent. of scattered large poles of 8 and 9 inch d. b. h. Below these there is a large gap as might be expected from the absence of sapling growth in the mature stand. Then at 3 inches and under, the great bulk of the 20-year old reproduction comes in, 30 per cent of it running in the 2 inch class. These large poles are apparently the oppressed trees of the old stand. They are over 140 years of age and have proved too old to respond to the opening up. Their crowns are still short and narrow, and save for slightly increased growth-rings of the past 23 years they are unchanged.

The Mixed Association—Red Pine-White Pine-Hardwoods.

This formation covers about 70 acres of the Sand Plain. It lies as a belt between the Red Pine and the pure Hardwoods. It is here that the White Pine reaches its best individual development, and the Red Pine also shows an improvement over its condition in the pure stand.

The total density averages 340 trees per acre and up as follows:

Red Pine	33%	Yellow Birch	2. %
Hard Maple	19	Red Oak	2.
White Pine	17	Poplar	1.
Red Maple	9	Black Spruce	1.
Balsam Fir	5	Cedar	.3
Beech	4	Hemlock	.3
White Birch	4	Ironwood	.3

In the diameter classes 61 per cent. of the Red Pine lies in the large and small pole group, while 37 per cent. of it rises into standards (over 12 inch). Of the White Pine, 27 per cent. is sapling growth, 58 per cent. poles, 12 per cent. standards, and 2 per cent. veterans (over 24 inches).

The reproduction is overwhelmingly fir, which occurs to the extent of 1,600 seedlings per acre. The percentage composition in the reproduction was found to be:

Balsam Fir	75%	Red Pine	2%
White Pine	13	Red Oak	2
Hard Maple	4	Hemlock	1
Beech	3		

Among the woody shrubs the Hazelnut predominates with 49 per cent. of the total. The Blueberries and Moosewood make up the remainder with 29 per cent. and 22 per cent. respectively. They are approximately two-thirds as numerous as beneath the Red Pine association.

The bracken also falls off in numbers, being only one-half as abundant as in the other formation.

The flowering herbs vary considerably from the Red Pine flora. They are one-third more abundant and several new species enter, while a number is left out. The composition is as below, those with asterisk (*) being the new comers, in response to changed soil or light conditions:

Gaultheria procumbens	55%	*Clintonia borealis*	3. %
**Mitchella repens*	11	*Pyrola* sp.	.7
Cornus canadensis	7	*Goodyera* sp.	.2
**Diervilla lonicera*	6	**Viburnum alnifolium*	.2
**Aralia nudicaulis*	5	*Majanthemum canadense*	.1
Chimaphilla umbellata	5	**Viola* sp.	.1
Trientalis americana	3		

It will be noted that the Twinflower, Honeysuckle and Trailing Arbutus are lacking.

The sandy soil is finer than is the case with the Red Pine association. The percentage of coarse gravel is .09 per cent. The mechanical analysis of the fine earth of a typical sample yields the following percentages:

Fine gravel	.52	per cent.
Coarse sand	4.550	
Medium sand	17.470	
Fine sand	64.825	
Very fine sand	9.875	
Silt	1.150	
Clay	.620	

The percentage of organic matter is .5 and the moisture content of the air dried sample 1 per cent.

The litter is loose, the humus one inch in thickness, mild, and in good condition.

The soil is thus much finer than the previous sample and the moisture content twice as great, which perhaps explains the presence of the Hardwoods.

The Hemlock Association.

The pure Hemlock occurs in small isolated groups. Altogether, it comprises about 50 acres.

The average density of 180 trees per acre is made up as follows:

Hemlock	87 per cent.
Yellow Birch	8
Cedar	3
Balsam Fir	1

The trees are of good size but old and overmature and cast a dense shade on account of their spreading crowns.

The reproduction is very dense, and Hemlock, which averages 6,800 seedlings to the acre, forms 85 per cent. of the whole. The remainder is composed of:

Cedar	6.	per cent.
White Pine	4.	
Hard Maple	2.	
Red Maple	.7	
Yellow Birch	.3	

The rest of the soil flora is rather scanty. Blueberries, Hazelnut and Juniper are entirely lacking, whilst the Moosewood averages 250 to the acre. The flowering herbs are represented mainly by the Pigeon Berry, the proportion being (new comers starred):

Cornus canadensis	6%	*Mitchella repens*	2. %
Viola sp.	8	**Mitella diphylla*	1.5
**Anemone* sp.	8	**Gaultheria procumbens*	.6
**Coptis trifolia*	8	*Galium* sp.	.5
Clintonia borealis	2	*Pyrola* sp.	.5

Goodyera, Aster and *Trientalis americana* were also noted. The soil is verging towards a sandy loam, the coarse gravel being entirely lacking. The analysis of the fine earth shows the following proportions of the soil grades:

Fine gravel	4.565	per cent.
Coarse sand	5.025	" "
Medium sand	7.115	" "
Fine sand	59.225	" "
Very fine sand	21.685	" "
Silt	1.300	" "
Clay	.260	" "

Organic matter lost in burning amounts to 9.3 per cent. The moisture content is 2.3 per cent. The humus is mild and 2 inches deep.

The fineness of the soil together with the high percentage of organic matter is responsible for the high moisture content.

The Hemlock is extending itself rather widely by seeding in on old burns beneath the advance growth of birch and poplar. It appears that once it has taken possession of the soil it is able to retain it unless the situation is dry.

The Hardwood Association.

The hardwoods occupy the best and deepest soils on the Sand Plain. The formation covers perhaps 70 acres and presents sharp contrast to the other associations.

The stand is more open and of a lower density than any of the others. The total of 166 stems to the acre is composed of:

Beech	39%	Basswood	6%
Hard Maple	32	Ironwood	1
Yellow Birch	13	Balsam Fir	1
Red Maple	6	Hemlock	1

The reproduction is numerically the best in numbers of all the associations. It averages 8,300 to the acre but is practically confined to the Hard Maple. The composition is as follows:

Hard Maple	92.	per cent
Balsam Fir	3.	
Beech	3.	
Yellow Birch	.8	
White Pine	.6	

The balance of the soil flora exhibits a complete lack of ferns. The shrubs show a striking deviation from the other formations in the entrance of the Yew *(Taxus canadensis)*. This species occurs to the extent of 2,600 per acre and is accompanied by the Moosewood and Hazelnut with 800 each. The herbs are remarkable chiefly in the preponderance of the Teaberry *(Gaultheria)* which makes up 95 per cent. of this class. The remainder is composed of:

Clintonia borealis	1.	per	cent.
Aster	1.	"	"
Trientalis americana	.4	"	"
Mitchella repens	.4	"	"
Aralia nudicaulis	.1	"	"

The soil is a sandy loam and the finest in texture of any encountered upon the Sand Plain. The amount of coarse gravel present is 1.8 per cent. The fine earth of a typical sample on analysis yielded the following results:

Fine gravel	2.315
Coarse sand	4.520
Medium sand	11.635
Fine sand	39.035
Very fine sand	38.185
Silt	2.465
Clay	1.250

Loss of weight in burning due to organic matter amounts to 3 per cent. and the moisture content is 1.4 per cent. The humus is 2 inches in depth and in excellent condition.

One other association may perhaps be distinguished, namely the *Hemlock and Hardwood Mixture.* This, however, simply forms a transition between the Hardwoods and the Hemlock and is unimportant. A large part of this Sand Plain has been burned after logging. On these areas the Aspen and White Birch have come up rather thickly.

In summing up the results it would appear that only two of these four associations are permanent and form the climax type on their respective sites. These two are the Hemlock and the Hardwoods. Beneath both their own seedling growth is dense and in good condition, while other species appear to make no headway. The Red Pine on the other hand, casts a shade too dense for its intolerant seedlings with the result that the White Pine will eventually replace it if undisturbed. Although not permanent the Red Pine is very likely recurrent on these coarse soils whenever fire or logging opens them up.

The variance in the composition of the associations is illustrated in the subjoined table. When considered in relation to the soil the response to the physical conditions is striking.

Comparison of the Associations.

	Pure Red Pine.	*Pine and Hardwoods.*	*Pure Hemlock.*	*Pure Hardwoods.*
Red Pine	63.1%	33.7%	......	......
White Pine	15.	16.7	.5%	......
Balsam Fir	7.4	5.2	1.1	1.2%
Black spruce	4.4	.9	......	......
Red Maple	2.1	8.6	......	6.
Poplar	2.	1.4	......	......
Hemlock	1.5	.3	86.5	1.2
Hard Maple	1.3	18.7	......	31.9
White Birch	1.3	4.6	......	......
Red Oak	1.	2.	......	......
Beech	.5	4.9	......	39.1
Cedar	.2	.3	2.4	......
Yellow Birch	......	2.3	8.8	13.2
Ironwood	......	.3	......	1.2
Basswood	......	......	......	6.

THE GROWTH OF RED PINE IN ONTARIO.

By A. H. D. Ross.

The Red Pine *(Pinus resinosa,* Aiton*)*, or Norway Pine, adapts itself to many kinds of soils and usually forms groves scattered through other forests of pines and broadleaved trees. From Nova Scotia it ranges northeastward through New Brunswick to Lake Saint John, Quebec, and westward through the Provinces of Quebec and Ontario to the southeast corner of Lake Winnipeg; thence through the States of Minnesota, Wisconsin, southern Michigan and the mountains of Pennsylvania to Massachusetts. It is most abundant and of its largest size in the northern portions of Michigan, Wisconsin and Minnesota, the full grown trees being usually 60 to 75 feet in height and 18 to 24 inches in diameter; occasionally 90 to 120 feet and 30 to 36 inches.

The heartwood varies in color from a pale red to a rather deep red and the rather thin sapwood from a light yellow to nearly white. The wood is of medium texture, fairly stiff and strong, somewhat resinous but does not last in contact with the ground. Its hardness is about 40 per cent. that of white oak, and, when thoroughly kiln dried, it weighs about 30 pounds per cubic foot. The average of 95 tests, made on wood containing 12 per cent. moisture, shows that it has an endwise crushing strength of 6,700 pounds per square inch; a modulus of elasticity of 1,620,000 (77 per cent. that of white oak); and a modulus of rupture of 9,100, or 70 per cent. that of white oak.

In the lumber trade red pine is usually mixed and sold with white pine, and it is interesting to note that fifty years ago it commanded a better price in the English market than white pine did. This was partly due to the fact that it resembles Scotch pine more than white pine does and partly because the superior qualities of white pine were not so well known then as they are now.

Reports from 225 Canadian mills in operation during 1911 show that the annual cut of red pine amounted to 150,806,000 board feet, and that practically 92 per cent. of this came from 104 mills in Ontario. Quebec produced 5 per cent., Nova Scotia 2 per cent. and New Brunswick 1 per cent. The total cut for the whole Dominion was 16 per cent. less than in 1910 and the average price rose 43 cents per M; being $17.73 per M during 1911.

Notwithstanding the commercial importance of red pine, there seems to be very little definite information concerning its rate of growth. Last October the writer had an excellent opportunity to secure data concerning its rate of growth in northern Ontario, and the present article gives the results of that investigation. The ring counts and measurements were made by the senior students of the Faculty of Forestry in the University of Toronto, the practice camp being held on the south shore of Lake Nipissing. This is a large body of water 641 feet above sea level and lying between the Ottawa and French Rivers. Some day it will form an important link in the Georgian Bay Canal connecting Montreal and Ottawa with Lake Huron. The ecology of this area is discussed by Mr. Connell in the preceding article (p. 149). A stand composed of 85 per cent. of red pine and 15 per cent. of white pine was being cut, and a complete stem analysis was made of 43 red pine stems representing the different diameter classes. A number of measurements were also made on 98 other stems for the purpose of supplementing our information regarding height and diameter growth and the construction of volume tables. All of the trees measured were grown on a sand plain 25 to 30 feet above the lake level and composed of a fine to medium coarse sand of rather poor quality.

Sample strips covering 20 per cent. of the area showed that the average number of red pine trees between 7 and 26 inches in diameter was 153 per acre, and of white pine 31, making a total of 184 merchantable stems per acre. The age of the stand is between 150 and 160 years and it appears to have established itself on a burned over area, as shown by the uniform age of the trees cut and the fire scars found on trees which survived the fires. Traces of three distinct burns were found, one of them occurring 355 years ago.

Taper.

Measurements made on 120 trees ranging from 7 to 14 inches in diameter, and averaging 10 inches, showed that the average taper for the first 16 foot log was 2.3 inches; for the second log 1.0 inches; for the third 0.8 inches; for the fourth 1.7 inches. For the trees between 14 and 26 inches, and averaging 16 inches, measurements on 21 of them showed that the average taper of the first log was 2.6 inches; of the second 1.6; of the third 1.3; and of the fourth 2.5 inches.

Form Factors and Form Quotients.

For 118 stems the form quotients were obtained by dividing the diameters at the middle point by the diameters at breast height. The quotients obtained were then plotted to a large scale on cross-section paper and averaged up by means of a regular curve.

In a similar manner the form factors for 113 stems were plotted and averaged up by means of a curve. As the two curves have practically the same shape, this suggests the possibility of a constant difference between the form quotients and form factors for trees of different diameters. The following table shows the form quotients, form factors and differences for trees ranging from seven to twenty-four inches in diameter:

D. B. H.	*Form Quotient.*	*Form Factor.*	*Difference.*
7	.810	.560	.250
8	.795	.556	.239
9	.785	.550	.235
10	.772	.546	.226
11	.762	.541	.221
12	.755	.536	.219
13	.746	.531	.215
14	.740	.527	.213
15	.740	.525	.215
16	.740	.524	.216
17	.742	.521	.221
18	.748	.525	.223
19	.754	.529	.225
20	.763	.535	.228
21	.777	.546	.231
22	.786	.553	.233
23	.795	.560	.235
24	.806	.569	.237
		Average	.216

From the last column of this table it will be seen that the *average* difference between the form quotients and form factors is .216, or 21.6 per cent if we express it percentically—a constant which comes very close to Judson Clark's difference of 21.87 per cent. for balsam fir (See Forest Quarterly, Volume I, p. 58) and the constant of 21 per cent. for Norway spruce.

Volume Tables.

The height of the trees was so uniform that it was decided to base the volume tables on diameters alone. The curve for total volume in cubic feet was based upon the measurement of 115 selected trees, and for the volume of the wood inside the bark on 92 of them. The percentage of bark was figured out for these 92 trees and a curve was drawn to show the relation of bark percentages to diameters. This curve was then compared with those showing the total volumes of the stems and the volume of wood inside the bark, and the necessary corrections resulted in the following table:

D. H. B.	*Total Volume. Including Bark. Cubic Feet.*	*Volume of Wood.*	*Percentage of Bark.*
7	8.5	7.6	10.5
8	13.1	11.8	10.4
9	18.1	16.5	10.4
10	23.5	21.1	10.2
11	29.4	26.4	10.1
12	35.6	32.1	9.9
13	42.0	37.9	9.8
14	48.0	43.4	9.6
15	54.0	49.0	9.3
16	60.0	54.6	9.0
17	66.5	60.7	8.7
18	73.4	67.2	8.0
19	80.6	74.2	8.0
20	87.5	80.8	7.7
21	97.2	90.1	7.3
22	106.5	99.2	6.9
23	117.0	109.5	6.4
24	128.0	120.3	6.0

Applying these figures to the 20 per cent. cruise made of the hundred acre lot on which the red pine stood we find that the average stand per acre was 4,165 cubic feet of wood and bark and 3,830 cubic feet of wood alone, which shows that the bark formed 8.06 per cent. of the standing timber.

The volume tables showing the number of board feet in the merchantable logs from trees of specified diameters were based upon the measurement of 141 trees ranging from 6.2 to 26.3 inches in diameter and were taken down to five inch tops. The results were worked out by the Doyle, Old Scribner and International log rules, and in the following table an extra column has been inserted for sake of comparing the volume of red pine of specified diameters in Cass County, Minnesota, with that of the trees on the south shore of Lake Nipissing. The Cass County table was based on measurements made on 1,166 trees ranging from 10 to 34 inches in diameter and worked out by the Old Scribner log rule.

LUMBER CONTENTS OF RED PINE IN RELATION TO DIAMETERS.

D. B. H.	*Doyle Scale.*	*Scribner Scale.* *Ont.*	*Minn.*	*International Scale.*
7	6	21	....	30
8	13	42	....	57
9	24	65	....	88
10	40	87	101	121
11	60	111	129	155
12	83	136	158	190
13	111	164	189	227
14	141	195	224	270
15	175	232	262	317
16	210	275	308	368
17	252	325	359	430
18	302	383	411	505
19	360	450	472	585
20	427	510	540	685
21	500	600	613	790
22	585	700	700	915
23	700	810	795	1,050
24	825	925	885	1,200

This table exhibits in a striking manner the enormous discrepancy that exists between the Doyle, Scribner and International log rules; especially for the smaller trees. Applied to the 20 per cent. cruise made of the stand, the figures in the table give only 10,812 board feet per acre by the Doyle rule; 17,107 by the Scribner; and 23,362 by the International. As the average number of merchantable red pine trees per acre is 138 this figures out to an average per tree of 78 board feet by the Doyle, 123 by the Scribner and 167 by the International. As timber limits in Ontario are generally estimated to have so many million feet of timber per square mile it is of interest to apply our figures to a square mile of red pine similar to that in which our studies were made. According to the Doyle rule it would contain approximately 7 million board feet; according to the Scribner 11 million; and according to the International 15 million.

As the stand contains 3,830 cubic feet of wood, inside the bark, per acre it is of some interest to note that the Doyle scale allows only 2.8 board feet as the equivalent of a cubic foot, the Scribner 4.5 and the International 6.1 board feet to the cubic foot. Leaving out the stumps and unused tops, and thus confining our converting factors to the merchantable saw logs, these numbers would be raised to 3, 5 and 7, respectively.

Height Growth.

A study of 197 red pine seedlings found in open spots and on adjoining cut-over lands showed that the average height growth during the first fifteen years was as follows:

Age. (*Years.*)	*Height.* (*Feet.*)	*Age.* (*Years.*)	*Height.* (*Feet.*)
1	.15	9	1.7
2	.30	10	2.0
3	.45	11	2.4
4	.62	12	2.8
5	.85	13	3.3
6	1.00	14	3.8
7	1.25	15	4.3
8	1.45		

This table shows that the "breast high" point of 4½ feet above the ground was reached between 15 and 16 years and enabled us to secure considerable information concerning the growth of such stems as were sectioned at the 4½ foot point.

From the complete stem analysis of 43 trees and measurements made on 98 others, some 369 measurements were selected and plotted for the purpose of striking curves showing the relations existing between age and height, and the following table shows the progress in height growth from one decade to another for tree classes. The last two columns show the height growth for red pine in the Muskoka region and in West Toronto, and form an interesting comparison with the Nipissing figures.

	Lake Nipissing.			*Bala, Ont. Muskoka Lake Region.*	*West Toronto, Ont.*
Age.	*Dom't.*	*Codom't.*	*Oppd.*	*Codominant.*	*Codominant.*
20	18	8.2	4.0	17	16
30	30	18	8.5	30	27
40	41	28	14	40	36
50	51	37	20	48	45
60	60	45	26	56	52
70	67	52	32	62	59
80	73	58	36	67	64
90	79	64	41	71	69
100	84	68	45	75	73
110	88	72	49	78	79
120	92	75	52	80	80
130	96	77	55	82	82
140	99	80	57	83	84
150	103	82	60	84	85
160	106	84	62	85	86
170	108	86	64	Based on 160 measurements on 32 trees.	87
180	111	87	65		88
190	114	88	66		
200	117	89	67		Based on 285 measurements on 53 trees.

Diameter Growth.

The Age-Diameter curves were plotted from 237 measurements selected from those obtained from the 141 trees mentioned above, and in the following table the diameter growth figures for open and crowded stands in Minnesota are inserted for sake of comparison.

Diameter In Inches.

Age.	*Lake Nipissing, Ont.*			*Minnesota.*	
(Yrs.)	*Dom't.*	*Codom't.*	*Oppressed.*	*Open Stand.*	*Crowded Stand.*
20	2.4	1.2	0.4	3.6	2.0
30	4.2	2.5	1.1	6.5	3.9
40	5.9	3.8	2.1	9.0	5.7
50	7.5	5.0	3.0	11.1	7.3
60	8.8	6.0	4.0	12.7	8.7
70	10.0	7.0	4.8	13.9	10.0
80	10.9	7.7	5.4	15.0	11.1
90	11.7	8.4	5.9	16.0	12.1
100	12.5	8.9	6.4	16.9	12.8
110	13.1	9.4	6.7	17.9	13.5
120	13.7	9.9	7.0	18.8	14.0
130	14.2	10.3	7.2	19.7	14.5
140	14.7	10.7	7.4	20.6	Study of 228
150	15.1	11.0	7.5	21.5	trees from
160	15.5	11.3	7.7	22.3	72 to 126
170	15.9	11.6	7.8	Study of 190	years old.
180	16.3	11.8	7.9	trees 78 to	
190	16.6	12.0	8.0	163 years	
200	17.0	12.2	8.1	old.	

The much greater diameter growth of the Minnesota trees is partly due to the more open character of the stands and also to the better soil conditions.

Diameter and Height.

From the figures given by the Age-Diameter and Age-Height curves for the codominant trees a curve was plotted to show the relationships existing between the diameters and heights of the codominant trees in the stand, which made up fully 85 per cent of it.

D. B. H. (Inches)	2	3	4	5	6	7	8	9	10	11	12	13	14
Height (Feet)	14	22	29	37	45	53	61	69	76	82	89	94	100

D. B. H.	15	16	17	18
Height	105	109	113	118

Age-Height-Diameter Growth.

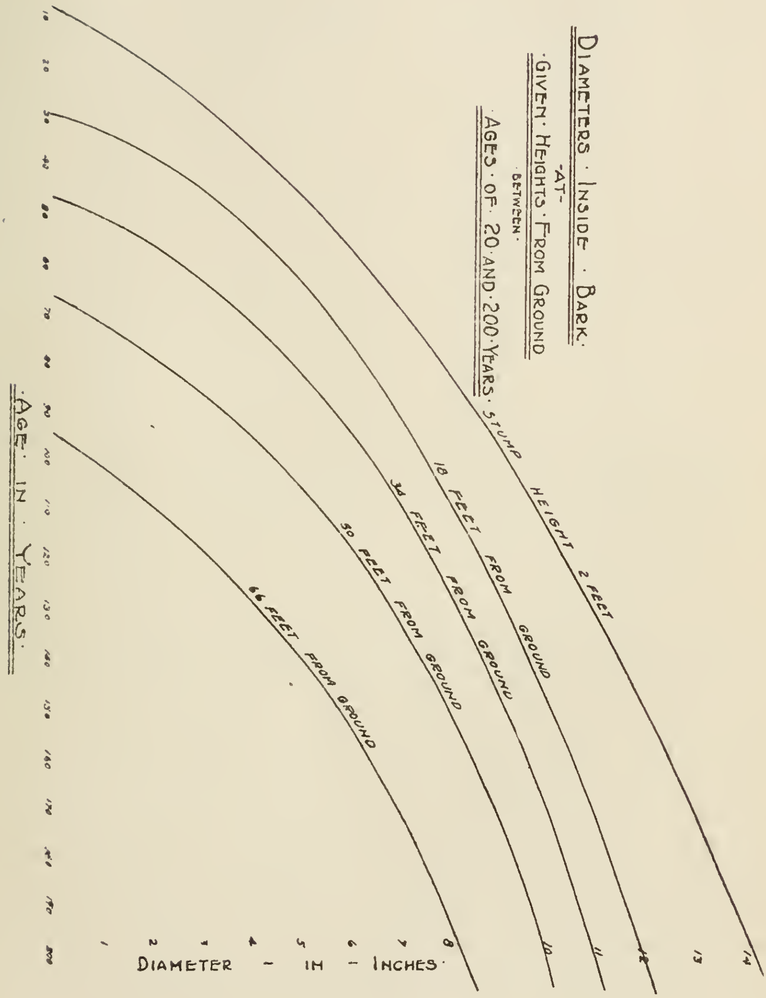
Applying Graves' modification of Mlodziansky's graphic method of determining the average volume growth of a group of trees to the case of our red pine stand, some 398 measurements were plotted to obtain the curve for diameter growth inside the bark at a height of two feet from the ground; 261 measurements for a point 18 feet from the ground; 135 for 34 foot point; 128 for the 50 foot point; and 86 for the 66 foot point. These curves were then transferred to a single sheet of cross-section paper—placing each curve to the right of the zero point as many years as are required to reach the heights at which the diameters are measured. Thus the stump curve is set over 8 years, the one for 18 feet above the ground 30 years, etc. The similar shape of the four lower curves at once suggests the method of interpolation for the 26, 42 and 58 foot points, as well as many others at which it may be desirable to know the diameter at any given age of the stand.

From the set of curves here shown it will be seen that at the age of 150 years the stump diameter inside the bark averages 12 inches, the top of the first sixteen foot log 10 inches, the top of the second log 9.2 inches; of the third log 8 inches; of the fourth log 5.7 inches.

Similarly, if it is desired to know at what age a red pine stem will measure 9 inches inside the bark at a height of 50 feet from the ground, an inspection of the 50 foot curve shows it is 173 years.

Age-Volume Growth.

By combining the results of the Age-Diameter and Diameter-Volume curves we get the following table showing the average volumes of red pine stems for each decade from 60 to 200 years.


Diameters · Inside · Bark ·
-At-
· Given · Heights · From Ground
· Between ·
Ages · of · 20 · and · 200 · Years ·
Stump Height 2 Feet
18 Feet from Ground
34 Feet from Ground
50 Feet from Ground
66 Feet from Ground
· Age · in · Years ·
Diameter – in – Inches ·

VOLUME GROWTH OF RED PINE.

	Cubic Feet.		Board Measure. (5 Inch Tops.)		
Age. (Years.)	*Total Volume.*	*Volume of Wood.*	*Doyle Scale.*	*Scribner Scale.*	*International Scale.*
60	4.2	3.7	1	3	6
70	8.5	7.6	5	21	30
80	11.7	9.5	10	36	50
90	15.0	13.4	17	57	69
100	17.6	15.8	23	62	85
110	20.3	18.2	29	74	101
120	23.0	20.7	37	85	117
130	25.2	22.7	45	95	131
140	25.7	24.7	52	103	145
150	29.5	26.5	59	111	156
160	31.2	28.1	66	118	166
170	33.1	29.8	73	125	176
180	34.4	31.0	79	131	183
190	35.6	32.0	85	136	190
200	37.0	33.3	90	141	196

Growth Rate.

The following is an attempt to determine the growth rate per cent.: From the complete stem analysis of 45 trees ranging in size from 7.2 to 18.1 inches in diameter, 4½ feet from the ground, it was found that the total present volume of wood inside the bark is 1,213.28 cubic feet for all the trees. Twenty years ago it was found to be 782.30 cubic feet and forty years ago 564.44 cubic feet. The trees were chosen so as to represent properly the different size classes in the stand. Calculating on a simple interest basis, these figures show that during the last twenty years the wood capital increased 55.1 per cent., which averages 2.75 per cent.; and during the last forty years 2.87 per cent. per annum; or 2.218 and 1.93 compound interest respectively.

Another way of computing the percentage rate of growth during the last twenty and forty years would be to figure out the board contents of the trees at the present time and what it was twenty and forty years ago. This was done for the 45 trees on which the calculations already given were based, and with the following results: The logs were being taken down to five inch tops, and as they were unusually sound and straight and had an average taper of only 2.1 inches for each 16 foot log, the board measure was computed by the International Log Rule, which is probably very close to the mill tally. On this basis the present contents of the logs from the 45 trees is 7,640 board feet; 5,775 feet twenty years ago; and 3,990 feet forty years ago. On a simple interest basis this would show an increase of 32·3 per cent. or a yearly average of 1.615 per cent. for the last twenty years; and an increase of 91.4 per cent. for the last forty years, or a yearly average of 2.285 per cent.; or by compound interest 1.41 and 1.636 per cent. respectively.

Applying the Schneider-Borggreve formula, $\frac{400}{nd}$, to determine the present rate of growth, it is found to be only .9 per cent.; the growth of the stand has practically ceased and only a rise in market prices would justify leaving it to increase in volume.

A GLIMPSE OF A SASKATCHEWAN FOREST.

By J. C. Blumer.

As that part of the transcontinental forest belt which is found in western Saskatchewan may not be well known, a glimpse of the forest of one of the great prairie provinces may not come amiss. During a trip made in July, 1912, due north of North Battleford, the coniferous forest was encountered north of Midnight Lake, near the fifty-fourth parallel. A low, morainic ridge, composed of glacial drift, marks its beginning. Jack pine *(Pinus divaricata)* is the dominant species, and mixed with it on higher ground is some white spruce *(Picea canadensis)* and a few birch *(Betula papyrifera)*, black spruce *(Picea mariana)* and balsam poplar *(Populus balsamifera)* and quite rarely a few tamarack *(Larix laricina)* are found in groups and crescents fringing the glacial pock-marks. Plenty of aspen *(Populus tremuloides)* is almost everywhere in mixture, completing the composition with seven species.

A very level, sandy country succeeds northward, and township after township is covered for the greater part with pure jack pine in stands of various ages. These jack pine plains are diversified at long intervals by slightly raised ridges, on which a little white spruce and birch is found, and by spbaguum bogs, known as muskeg, which have become increasingly abundant and often impassable northeastward. They are usually quite devoid of trees, the black spruce, and the rarely noted tamarack remaining in groups about the margins and on the slightly raised islets. Occasionally, groups of lakes lend charm to the country.

The forest is badly burned, there is perhaps not over five per cent. of the area traversed that does not show evidence of more or less recent fires, and it would be very difficult to find a single area where no signs of fire could be discovered. Although there are some quite barren areas, on the whole the forest restocks itself rapidly over much the greater area. But the fires may be responsible, to a considerable degree, on certain soils at least, for the preponderance of the jack pine over the other species. In a bit of tall, mature forest hung with reindeer moss, and composed of practically pure jack pine, the soil was examined. Below an inch or two of humus lying on the very level forest floor .there was pure, fine, white sand, evidently of lacustrine origin. At a greater depth the sand, of the same fineness and evenness of grain was red, similar to that seen by the writer in the longleaf pine belt of the Texan coastal plain. This suggests the close and widespread relation between sands and certain pines, and in a broader sense, between the geologic origin of soils and forest distribution. Whether or not either the fires or the climatic conditions or both together, are wholly, or even chiefly, responsible for the distribution and composition of the forest, or ultimately for the presence of forest or prairie on the plains of the Canadian Northwest, is a fundamental problem of great interest and importance.

The general, estimated height of mature stands is 60 to 90 feet, the trees having a usual diameter of 12 to 14 inches. The jack pine grows unexpectedly tall, straight, and clean, with its fairly great density producing a large quantity of timber. When aspen was mixed with it, the latter grew equally tall and straight, while birch in mixture reached only about two-thirds their height. White spruce is fully as tall as the pine, and black spruce is slightly shorter. The jack pine is a binodal (or trinodal) pine, hence a little difficult to estimate as to age, but the maximum height growth of dominant individuals was estimated at from 14 to 16 to 18 inches per year. A few felled trees of the size of tie timber were uniformly but 58 years old on the stump, or about 63 years from the seed. Considering the brevity of the growing season, this is rapid growth.

The jack pine is exceedingly fructiferous. Two branches on a certain tree bore 17 distinct and consecutive whorls of cones each, while others were seen to bear cones throughout their entire length, showing an even greater number of whorls of several cones each. As nearly every branch is usually loaded, some idea may be gained of the total number of cones and seeds borne by a single tree. It begins to bear cones at an early age (5 years), and unlike many other pines, keeps on doing so every year. The cones are sessile, highly persistent and serotinous, a few remaining closed even after the fire-killed branches have fallen to the ground. Some branches were seen, evidently from near the top of trees, with the apices of the tightly closed cones turned upward and inward, clinging to the branch as it were, with great tenacity.

The black spruce, likewise, is very prolific. Often it has the peculiarity of bearing at its very top a dark, oblong object from one to two or more feet in height. This is found to be a literally solid mass of cones and twigs, the former sometimes numbering many hundreds.

The entire forest is divided into even-aged stands, distributed in time and place according to the vagaries of the fire. Sometimes two or three ages of pine occur mixed in pure stand, probably due to lighter surface fires. But on much the larger area a single age class is found in pure, or practically pure stand. These classes naturally occur at irregular intervals in point of age, and with variously drawn boundaries, yet in their evenness of height, sharpness of boundary, and occupancy of all available ground space suggest a forest managed by man under the clear cutting system. Some such stands, with the road cut cleanly thru them, presented a picture not unlike German spruce forests in their great density of tall and straight boles.

One of the most striking facts to be observed on some of these northern jack pine plains is the natural thinning produced by great numbers of the common rabbit *(Lepus canadensis)*. On considerable areas of dense reproduction a part of the pine saplings had been cut off while at a diameter of one-half to one inch. This cutting was done at an almost exactly even height above ground of 18 to 24 inches, according to location. In many cases the stumps had been stripped of a part of their bark. It is probable that the living saplings had also been stripped of a portion of their bark, but being now of greater girth than the stumps, had recovered so that no injury was noticeable. The cutting evidently took place on top of the snow during one of the recent winters. The date of cutting, had time permitted, might have been ascertained from an inspection of the annual rings, while the depth of the snow at the time was self-evident. While a varying proportion, usually from 25 to 75 per cent. had been cut, no area was entirely denuded. This had produced a most effective thinning, as the trees remaining are now free to grow at a much faster rate than would otherwise have been possible. For the original stand, as once seen in some similar lodgepole pine flats in Idaho, is exceedingly dense and of even age and size, and the process of natural thinning by competition could be accomplished only at the expense of much growth increment in the survivors, possibly in places only by crippling, or impairment of at least diameter growth for life. Swine-raisers know by experience that a pig starved in its youth will always be a runt. It is a question in how far the same will apply to trees. The whole stand is of such even growth naturally as a result of the fire and the innate characteristics of the species, and the cutting is so similarly and evenly done, that it presents an appearance as if planted and thinned according to methods of forestry. While at times and places the rabbit may become destructive, it would appear that the future Canadian forester, far from waging indiscriminate war against this humble creature, may be called upon at times to protect and control it as one of his most efficient natural allies. [? Ed.] His greatest initial problem, however, here as almost everywhere else, will be that of fire protection and control. That solved, one of the next may be the encouragement of the spruce.

While as a forest these north woods of the west must take a humble rank in comparison with those of other parts of Canada and the States, it will yet constitute a great resource to the coming settler of the adjacent lands for construction material and fuel. While at present this "bush" is commonly considered as of little value, the fact remains that jack pine sells in the nearby prairie towns at $8.00 and even aspen, known as poplar, at $6.00 per cord. The forest will therefore steadily acquire value, depending only upon the increase in population, and the consequent building of industries. When this region will be crossed in many directions by railroads, these will gladly avail themselves of the large quantity of tie timber. For the coming of the railroads is only a question of a few years, because rich and untouched agricultural and mineral districts lie yet farther to the north and northwest, while the great prairie to the south will be dotted with its towns and cities, and millions of people will find their homes in this broad land in the future.

J. C. Blumer.

INFLUENCE OF SHADE AND OTHER FACTORS ON PLANTATIONS.

By George W. Kimball and E. E. Carter.

The summer of 1912 was a hard one for reproduction, natural and artificial, in central Massachusetts. While not exceptionally hot, there was a very scanty rainfall from June to November, and consequently a noticeable lack of ground moisture. Bogs which are ordinarily impassable except when frozen could be crossed dry-foot, and many farmers had their first experience in hauling water for stock and household uses. Natural reproduction of white pine from the seed year of 1911 practically disappeared in the open. Under these conditions, heavy losses in plantations established in the spring of the year were to be expected. Their occurrence, however, gave an unusual opportunity to distinguish the factors which result in survival or failure.

The data here presented were obtained in October and November following the drouth, on about three acres of the 1912 plantations on the Harvard Forest, Petersham, Mass.; and on a plantation established at the same time, belonging to the Brooks estate, also in Petersham. Both plantations were set out carefully,—the one on the Harvard Forest by students, the other by Italians working under the immediate supervision of a trained forester; and in the latter case, no counts were made on areas planted during the first day or two. Partial but careful inspection of both plantations early in June showed almost no immediate failure, and a very high percentage of plants with well developed new growth. The ordinary "mattock-hole" method of planting was used exclusively on the areas inspected, the only difference between the plantations being that on possibly half of the Harvard work the earth was compacted around the roots of the trees by the use of a wooden mallet instead of by stamping. The effect of this variation in the planting method could not be distinguished in this inspection.

The sites of the two plantations gave opportunities for contrasting the behavior of white pine stock under a variety of local influences. The portion of the Harvard white pine plantation occupied a gentle southerly slope near the crest of a well rounded ridge. The elevation is about 1,200 feet. The soil is well drained sandy loam, very stony. The area is typical of New England's abandoned ridge pastures, gradually seeding in with gray birch, white pine, red maple, and occasionally a black or red oak, or a chestnut. There are occasional bushes of Crataegus and Viburnum, and a low cover of grass, moss, sweet fern, and blueberry, grouped in some places, intermingled in others. With uniformity of stock, planting method, and broad site conditions, this area gave opportunity for determining the influence of shade, root competition, and proximity of stones. Small areas planted with Scotch pine and with red oak furnished a limited comparison of species. The Brooks plantation, all white pine, is on soil similar in composition, but much less stony, on the lower slopes and the flats of a valley at about 800 feet elevation. The area was almost completely cleared of a good stand of timber in the fall of 1910, and the brush burned in 1911. This plantation, within itself, furnished data on the influence of overhead shade and root competition. Within itself, and especially when compared with the Harvard plantation, it offered some data on stock.

The benefit, and in the case of natural reproduction, the practical necessity of some shade for white pine seedlings has never been disputed, to the knowledge of the writers. The degree of the benefit of shade was undoubtedly exaggerated by the drouth of 1912, in the plantations studied; but the figures for this factor should be of interest as an indication of what may be expected in similar dry years. In the inspection of the plantations, shade from trees of all species was recorded, for the six hours in the middle of a summer day, in four classes, based on duration. (See table.) Most of the trees in the first class had no shade from high trees whatever, although the class includes trees which received shade from high trees for not over an hour each day. Shade from low bushes, such as sweet fern or blueberry, or from tufts of grass, was recorded in three grades,—absent, medium, and heavy. To show the influence of shade, the record of three year white pine transplants, not subject to the influence of root competition or of nearby stones, is given in Table I.

TABLE I.

Shade Influence in a Plantation of Three-year White Pine Transplants.

Low Shade..	*High Shade.*	*Trees Alive.*	*Trees Dead.*	*Total Number of Trees.*	*Per cent. Alive.*
None,	None,	341	262	603	56.5
"	1 to 3 hrs.,	209	48	257	81
"	3 to 4½ hrs.,	179	34	213	84
"	Over 4½ hrs.	235	18	253	93
Medium,	None,	382	88	470	81
"	1 to 3 hrs.,	178	26	204	87
"	3 to 4½ hrs.,	83	9	92	90
"	Over 4½ hrs.,	46	0	46	100
Heavy,	None,	48	7	55	87
"	1 to 3 hrs.,	29	2	31	94
"	3 to 4½ hrs.,	12	1	13	92
"	Over 4½ hrs.,	18	4	22	82
		1760	499	2259	

These figures show plainly the benefit of some shade for white pine the first year after planting. In this dry year, 43 out of every 100 trees without any shade died, while even the moderate shelter furnished by low brush, such as sweet fern, cut this loss more than half. Or again, the trees without shade were only about one-fourth (26.9%) of the total number, but furnished over one-half (52.5%) of the losses. With *some* shade the percentage of survival does not fall below 81, and averages 85.5. With *no* shade, the percentage is 56.5.

The number of trees in the lower half of Table 1 are insufficient to justify conclusions as to the most favorable degree of shade, although the falling values at the bottom of the column "Per cent Alive" are at least suggestive. The table does indicate that, within limits, the greater the amount of shade, the better the chances for success; and, what is of especial interest if true, that a protection of low shrubbery is of substantially equal benefit to one of short open-grown trees which may later cause great damage, directly or indirectly. In other words, pine seedlings planted in the shade of birches, black oaks, or other trees in New England pastures get little more benefit from the shade than those planted in patches of sweet fern; and the latter will be free from injurious shade or mechanical damage in years to come. This is, of course, without considering the often compensating factor of root competition of the extra expense of planting in brush.

The Brooks plantation furnished striking corroboration of the value of shade in seasons like that of 1912. On one slope, scattered trees or small groups of hickory *(Hicoria ovata)* poles, 30 to 50 feet in height, had been left. The slope was planted without attention to these hickories, so that it was possible to get counts on two series of plots, each series alike in site, exposure, absence of low shade, ground cover, stock (2-year seedlings), planting method, and time of planting; but differing in that the plots of one series were shaded by these hickories at least three hours daily, while the plots of the other series were unshaded and more numerous. On the shaded plots, 201 out of 291 trees (69%) were alive; on the unshaded plots, 181 out of 500 trees (36%) were alive. The shade of the hickories had been insufficient to cause a noticeable difference in the growth of the coarse, low grass that covered the ground, but was enough to keep alive two seedlings out of every three, while only about one out of every three lived in the open.

By his experiments in the sand hills at Halsey, Neb., Bates has shown the great importance of root competition as a source of failure in plantations where rainfall is scanty. It was not to be expected, even after an unusual drouth, that its importance would be as great in New England, where the soil is loamy and the annual precipitation averages about 40 inches. Also no tree in the Harvard plantation was without some root competition from the bushes or sod that covered the old pasture, which afforded no comparison like the ridges and bottoms of the Nebraska sand hills. In this inspection of the Petersham plantations, root competition was noted when it was obvious, from the position of the tree with relation to other vegetation, that the ground occupied by the roots would also have to supply moisture to other plants, as when a tree had been planted at one side of a hole in a thicket of sweet fern. The results for the Harvard plantation are given in Table II.

Table II.

Influence of Root Competition in a Plantation of Three-Year White Pine Transplants.

		With Root Competition.				*No Root Competition. (From Table I.)*	
Low Shade.	*High Shade.*	*Number Alive.*	*Number Dead.*	*Per cent. Alive.*		*Per cent. Alive.*	
None,	None,	49	58	46		56.5	
	1 to 3 hrs.	11	12	48		81	
	3 to 4½ hrs.	10	8	56		84	
	Over 4½ hrs.	25	7	78		93	
Medium,	None,	124	91	57		81	
	1 to 3 hrs.	36	18	67	Average	87	Average
	3 to 4½ hrs.	36	6	86	65%	90	85.5%
	Over 4½ hrs.	18	5	78		100	
Heavy,	None,	48	23	68		87	
	1 to 3 hrs.	12	2	86		94	
	3 to 4½ hrs.	9	3	75		92	
	Over 4½ hrs.	9	7	56		82	
		387	242				

This table indicates that root competition caused an increase in the loss of 10% for the unshaded trees and of 20% for the shaded. It also emphasizes the importance of the shade factor, since we have the same general trend toward higher percentages alive with increase in shade. Medium or heavy low shade with root competition appears to have been preferable to no shade and no root competition.

A portion of the Brooks plantation had so heavy a ground cover of pine and hemlock needles and twigs from the cut off stand that there was no vegetation of any sort on the area when the planting was done. There was no shade. Grass and mullein started during the summer on the mineral soil exposed by digging the mattock holes, and their roots were the only competitors of the planted seedlings. The loss was very heavy, due partly to the stock (3-0) used. Of 231 without root competition, only 53 (22.9%) were alive; and of 214 with root competition, only 36 (16.9%) were alive. The strong influence of this root competition from herbaceous plants is best expressed by saying that for every three trees which successfully withstood both drouth and competition, a fourth would be alive had the latter factor been absent.

In the inspection of the Harvard plantation, a separate record was kept of those trees which had a stone as close as 6 to 8 inches from the stem, whether the stone had been placed there by the planter or not. Although the amount of data is not large, it is sufficient to indicate that an exposed stone close to a planted tree was a strong adverse influence in this dry season. The data on this factor are given in Table III.

Table III.

Stone Influence in a Plantation of Three-Year White Pine Transplants.

		With Stones.				*No Stone.*	
Low Shade.	*High Shade.*	*Number Alive.*	*Number Dead.*	*Per cent. Alive.*		*Table I. Per cent. Alive.*	*Table II. Per cent. Alive.*
None,	None,	47	64	42		56.5	46
	1 to 3 hrs.	26	14	65			
	3 to 4½ hrs.	19	5	79			
	Over 4½ hrs.	7	4	64			
Medium,	None,	41	9	82			
	1 to 3 hrs.	13	2	87	Aver-	Aver-	Aver-
	3 to 4½ hrs.	3	9	100	age	age	age
	Over 4½ hrs.	0	0		77%	85.5%	65%
Heavy,	None,	5	1	83			
	1 to 3 hrs.	2	0	100			
	3 to 4½ hrs.	2	0	100			
	Over 4½ hrs.	2	0	100			
		167	99				

In the open, the stones apparently caused the death of 14 trees out of every 100 which had them. The influence of the stones is much less marked, however, when some shade is present, and is less than the influence of root competition. Radiation from the sun-heated stones undoubtedly caused increased transpiration from the needles of the planted trees, and may have tended to dry out the soil underneath. Whatever the means, a stone was a greater danger to a tree than root competition in the absence of shade; but was distinctly less dangerous than root competition when shade was present, although still a danger.

A total of 29 trees were found which had contended with both root competition and the influence of nearby stones. Of these, 5 were without shade—2 alive and 3 dead; while of the 24 with some shade, 14 (58%) were alive. The numbers involved are too small to justify comment other than that the percentages of survival are about what might be expected after considering Table II and Table III.

In the Harvard white pine plantation the stock used was three year transplants. In the Brooks plantation, two and three year seedlings were used. As has been explained, the site conditions were not exactly similar; but they were sufficiently so to indicate broadly the relative values of transplant and seedling stock. The figures for trees in the open, without root competition or stones, follow:

Place.	*Stock.* (*White Pine.*)	*Number.*	*Per cent. Alive.*
Harvard plantation,	3 yr. transplants,	603	56.5
	2 yr. seedlings,	300	32.7
Brooks plantation,	3 yr. seedlings,*	231	22.9
	3 yr. seedlings,†	100	37.0

*On cut over land with heavy litter.
†On old sticking-ground, light sod.

It is possible to give only one other good comparison on this question of stock. If we take as the conditions some high shade, no low shade, no root competition, and no stones, we secure the following figures:

Place.	*Stock.*	*Number.*	*Per cent. Alive.*
Harvard plantation,	3 yr. transplants,	723	86
Brooks plantation,	2 yr. seedlings,	291	69

With the weather conditions as they were in Petersham in 1912, the use of seedling stock resulted in the loss of about 20% more of the trees than where transplant stock was used. The small numbers involved and minor variations in planting sites make it unwise to draw any conclusions as to the relative values of two years seedlings and three year seedlings. Neither of them gave a high enough percentage of survival in the open to establish a desirable stand.

The small 1912 Scotch pine plantation on the Harvard Forest, and the still smaller red oak plantation were inspected as well as the white pine area. Both of these small plantations were in a remarkably good condition, considering the circumstances.

Although planting method and time were the same for all three species, the average percentage of survivals show distinct variations, which might be partially accounted for, however, by variations in planting site:

Species.	*Stock.*	*Number. Inspected.*	*Per cent. Alive.*
White pine,	3 yr. transplants,	3183	73.5
Scotch pine,	2 yr. transplants,	656	88.7
Red oak,	1 yr. seedlings,	99	92.6

The number of the red oaks is too limited to warrant details. It should be noted, however, that they occupy the lower portion of a gentle southerly slope, and a small flat along an intermittent stream which was dry in the summer of 1912. The site was distinctly better than those of the pine plantations. It may also be of interest that 6 of the 92 live trees were sprouts. The stems of the trees had died, but in each case two sprouts had appeared.

The results in the case of the Scotch pine are worthy of a more detailed statement, for whatever one may think of this exotic for commercial planting in a region where the industries demand the soft light wood of the white pine, it showed remarkable hardiness. The site is an abandoned field, level, or sloping very gently to the south. The only shade was from two or three small birches and pines, and from one or two larger trees on the western edge. The soil is similar to that in the white pine area, but some of the stones were taken out when the field was plowed 20 to 40 years ago. In general, the site appears but very little better than the white pine area, especially if drouth is to be feared. The planting method was the same. A comparison of the figures for the two species, excluding all shaded trees, follows:

Species.	*No Stones or Root Competition.*		*With Stone.*		*With Root Competition.*	
	Number.	*% Alive.*	*Number.*	*% Alive.*	*Number.*	*% Alive.*
White Pine,	603	56.5	111	42	107	46
Scotch Pine,	526	89	87	89	24	75

The single Scotch pine which had both a nearby stone and root competition, but no shade, was alive. Of 18 Scotch pines with some shade (none with over $4\frac{1}{2}$ hours) not one was dead, although three of them had stones within six inches of the stem. Even after discounting these figures for possible differences in site (and the white pine's extra year in the nursery should more than offset this), the drouth-resisting ability of the Scotch pine was striking.

It is hoped that the foregoing data, incomplete though they are in many ways, will furnish an indication of what may be expected from planting under adverse weather conditions and on similar sites. The application of the data to the details of such a planting operation is obvious. The facts in the cases of these plantations may also be of use in determining the causes, exclusive of careful work or the opposite, of some successes or failures.

ALASKA WOODS, THEIR PRESENT AND PROSPECTIVE USES.

By B. E. Hoffman.

In addition to the valuable mineral and fishing resources of Alaska, the vast forest areas are one of the most important sources of the territory's wealth. Although these forests do not contain sufficient quantities of saw-timber to ever reach commercial importance outside of supplying the local market, they do contain an abundance of raw material for use in developing the other resources, besides an almost unlimited supply of paper pulp wood.

Local Consumption and Conditions of Timber.

The fishing industry has been making a rapid growth during recent years, and it is bound to be one of the permanent and principal industries of this region. The canneries of Alaska in 1912 packed very nearly three million cases of salmon and used in this connection approximately twenty-one million board feet of saw-timber for cases, about eight million board feet of which was supplied from National Forest timber, the remainder being shipped from the states. Aside from a small quantity of piling taken from the public domain, approximately two million linear feet of piling was taken from the Tongass National Forest and used in connection with the fishing business of southeastern Alaska, during the year 1912, while a much less amount was taken from the Chugach Forest and used for fish traps and wharves in that region.

During the more recent years there has been but little activity in the mining business and only limited quantities of timber have been used in that connection. The time is coming, however, when this industry will be active throughout the territory and comparatively large quantities of piling, construction lumber, mine props and fuel will be needed in carrying on extensive operations.

Aside from the uses stated above, moderately large quantities of building material are consumed locally for private and municipal improvements, also limited amounts for railroad ties in the Cook Inlet and Copper River regions.

In this paper only the several species which occur in abundance in the coastal forests are to be discussed, since they have great present and prospective values on account of their availability and the many other economic conditions which favor their early utilization. There has been no opportunity to study species found in the interior of Alaska and therefore they will be discussed only in a general way.

Interior Forests. The interior forests cover a vast extent of territory a large proportion of the forest area being included within the drainage basins of the Yukon and Kuskokwim rivers. A large percentage of the forest is of the woodland type, more or less open and not over 50 per cent. of the timber is valuable for saw-timber or cordwood. Among the several species found, White Spruce *(Picea canadensis)* is the most important, since it makes the best growth and attains suitable sizes for saw-timber. Practically all of the timber growing in this region will be locally consumed. The extensive mining and agricultural industries which are expected to develop will demand large quantities of material from the forests for construction purposes and fuel. White Spruce will furnish most of the saw-timber while White Birch, Balsam, Poplar, Black Cottonwood and Aspen will supply the principal part of the cordwood.

Coast Forests—The Tongass and Chugach National Forests include practically all of the valuable coast forests of the south and southeastern Alaska. These forests contain an abundant supply of saw and piling timber for local use as well as an abundance of inferior material that may be used for pulp.

Of the two forests, the Tongass is the most important. It has approximately ten million acres of timberland while the Chugach has only about four million acres, the forested area is more heavily timbered, the timber grows to larger sizes and is more advantageously located with respect to transportation facilities and water power. These coast forests have not been exploited except for local use and the lumbering industry has not grown to any great proportions. In southeastern Alaska however, there has been a continuous and rapid growth for the past several years as is shown by the following table:

Timber Cut on the Tongass Forest During Fiscal Years 1909 to 1912, Inclusive.

Year.	*Ft. B. M.*	*Cords.*	*Linear Feet.*
1909	5,611,940	1,858	60,433
1910	10,569,180	1,211	397,126
1911	23,019,560	1,911	627,978
1912	35,132,710	2,150	2,206,960

The mill methods are very wasteful and a prodigality in the manner of working up material has been engendered by the easy way in which logs have been obtained. The ordinary mill in operation at present has a daily capacity of about 30,000 board feet, the main saw is a circular, cutting $\frac{3}{8}$ inch kerf, and where box shooks are manufactured, a band resaw is operated; many inexperienced men are employed and no attempt is made to utilize the excessive amount of waste. Practically all of the timber is used locally the only outside shipment last season being made to the States and included about 800,000 board feet of first class, clear spruce lumber. Out of all the timber sawn by the mills of southeastern Alaska during the calendar year 1912, approximately 52 per cent. was construction material, 12 per cent. mine timbers, 30 per cent salmon cases, 4 per cent. herring and halibut cases and 2 per cent. shingles. The rapid growth of the fishing industry largely accounts for the large cut of saw timber and piling during the last few years, especially the season of 1912 which was one of exceptionally great activity. Although seasons of such great activity may not occur frequently, it is expected that the annual consumption of piling will seldom become lower as long as the supply of fish remains good. In each of the past two years the salmon canneries of southeastern Alaska have used very nearly fourteen million board feet of saw timber for cases, not over two-thirds of which was supplied by local mills, the remainder being shipped from mills of the Pacific Coast States. Even though boxes can be landed in this region by Puget Sound mills for the same prices demanded by local millmen, the business rightfully belongs to Alaska and could be kept there if the local mills were equipped to produce the necessary number of cases used.

The lumber industry on the Chugach Forest has developed only to very limited proportions. The mills are small and of the circular saw type with an average daily capacity of about 5,000 board feet. During the fiscal year 1912 only four mills were in operation at all, the entire output of these not exceeding 650,000 board feet, practically all of which was construction lumber. At the present time piling makes up the principal part of the timber cut from this forest, the canneries using moderately large quantities for traps and wharves each year besides small amounts used for mine and private wharves, there being very nearly 387,500 linear feet of piling used during the fiscal year 1912. A comparatively large number of ties have been cut and partially used in the construction of railroads in the Cook Inlet and Copper River regions; at present however, all such operations have ceased except on the Copper River & Northwestern R. R. upon which trains are being operated.

Species and Their Uses.

Out of the comparatively large number of tree species found on the two National Forests in Alaska, only a few have present or future commercial importance. Sitka Spruce the valuable saw timber tree, will enter with Western Hemlock into the manufacture of paper pulp, Red Cedar is looked upon by some timbermen to supply limited quantities of poles for market in the States and Yellow Cypress is expected to supply moderately large quantities of lumber for the manufacture of furniture. Although the several other species present which are known to have qualities which adapt them to various economic uses they exist only in limited quantities and therefore will not have any commercial importance as far as the forests of this region are concerned. The tree species found on the Tongass National Forest are as follows:

Sitka Spruce, ...	*Picea sitchensis.*
Western Hemlock, ...	*Tsuga heterophylla.*
Alpine or Black Hemlock, ...	" *mertensiana.*
Western Red Cedar, ...	*Thuja plicata.*
Yellow Cypress, ...	*Chamaecyparis nootkatensis.*
Lodgepole Pine, ...	*Pinus contorta.*
Alpine Fir, ...	*Abies lasiocarpa.*
Amabilis Fir, ...	" *amabilis.*

Balm of Gilead, ...*Populus balsamifera.*
Black Cottonwood, ... " *trichocarpa.*
Red Alder, ...*Alnus oregona.*
Sitka Alder, ... " *sitchensis.*
Feltleaf Willow, ...*Salix alaxensis.*
Broadleaf Willow, ... " *amplifolia.*
Dwarf Maple, ...*Acer glabrum.*
Kenai Birch, ...*Betula kenaica.*
White Birch, ... " *alaskana.*
Western Yew, ...*Taxus brevifolia.*
Mountain Ash, ...*Sorbus sambucifolia.*

On the Chugach are found:

Sitka Spruce, ...*Picea sitchensis.*
White Spruce, ... " *canadensis.*
Black Spruce, ... " *mariana.*
Western Hemlock, ...*Tsuga heterophylla.*
Black Hemlock, ... " *mertensiana.*
Balm of Gilead, ...*Populus balsamifera.*
Black Cottonwood, ... " *trichocarpa.*
Aspen, ... " *tremuloides.*
Yellow Cypress, ...*Chamaecyparis nootkatensis.*
Kenai Birch, ...*Betula kenaica.*
White Birch, ... " *alaskana.*
Silky Willow, ...*Salix sitchensis.*
Dwarf Juniper, ...*Juniperus communis.*
Mountain Ash, ...*Sorbus sambucifolia.*

Sitka Spruce. This species is the most valuable timber tree within the coast forests. It occurs throughout the Tongass Forest and a large portion of the Chugach Forest and the large sizes attained together with its many other good qualities makes it adaptable to a variety of uses. The wood is light when dry, tough, soft, non-odorous, easily worked and takes a comparatively good finish. Although spruce is not a durable wood it lasts well above ground and standing green timber is comparatively free from defect. There are, however, two or more fungus diseases, the names of which have not been accurately determined, that attack living trees and cause considerable decay. One of these appears to enter the tree from the ground and starts decay in the center of the trunk and works radially to within a few inches of the bark and upward, generally destroying the first short log. As a rule this defect is found in large old swell-buttressed trees growing on low bottom land situations where there is a fairly deep loamy soil, approximately 25 per cent. of old trees in such locations being rotten in the butt. The other rot found in spruce occurs in the upper part of the trunk, generally beginning in the heart center and works radially and in a longitudinal direction, either destroying one-half or the whole of the section in which it works. This rot is most frequent in large overmature trees; however many healthy, sound appearing trees are affected, it being difficult to determine its presence except where conks of large longitudinal seams appear.

Ring shake occurs frequently in spruce, although not in sufficient quantity to be serious since it is found chiefly in large overmature unsound trees and those growing in exposed conditions.

Sitka spruce easily ranks first in the lumber industry, as construction lumber, it being practically the only species cut. It makes very good lumber for house siding, sheeting, dimension stuff or for any similar use wherein great strength is not required, since it kilndries fairly easily, checks but little and holds paint well. The chief objection to this wood is its decided tendency to shrink in a lateral direction as well as longitudinally, and, unless very thoroughly dried, it is not satisfactory where tight joints are desired. Aside from this, it shrinks and swells readily with changing conditions of moisture, therefore it is very essential in work requiring close fitting joints to have it used only where it will be kept either continuously wet or dry.

Spruce is not well adapted to use for heavy timbers wherein great breaking strength is required or for flooring or street planking where it is subject to rough wear. Douglas Fir or Western Hemlock is used principally for such purposes except where cheap material is desired and no lasting qualities are necessary.

Spruce contains many knots, especially in open grown trees, however they are generally sound and do not seriously injure the quality for most uses to which it is put.

Where a large per cent. of clear can be secured, this species makes very good turning squares, since it does not check readily, is easily worked and holds paint well.

Spruce free from knots and shake when sawn in tangential section has a very pretty grain and serves well for interior finish. It finishes rather smoothly, takes stain or paint readily and when well kilndried makes a very good material for ordinary inside finish and cheap cabinet work. Unless thoroughly kiln-dried, however, and used where moisture conditions are uniform, its decided tendency to shrink and swell renders it very unsatisfactory.

On account of the soft, light and tough qualities of its wood, Sitka Spruce is well adapted to the manufacture of *salmon cases.* The cases used in southeastern Alaska alone require several million board feet of sawtimber each year, and since this species is practically the only local wood suitable for that purpose, it is very essential that the local timber supply be closely utilized. The dimensions of finished salmon cases are as follows: Ends, $\frac{7}{8}$ inch by $9\frac{1}{2}$ inches by $12\frac{1}{8}$ inches; sides, 7-16 inch by $9\frac{1}{2}$ inches by $19\frac{7}{8}$ inches; top and bottom, 1-16 inch by 13 inches by $19\frac{7}{8}$ inches. It is usually specified that the lumber be free from sap, and loose knots, the top to be a full piece and that the bottom is to consist of not over two pieces. Each box requires about 7 board feet of rough lumber. The principal bad qualities of spruce for box material are ring shake, heart rot and loose knots, none of which are serious imperfections unless the mill is compelled to use a poor grade of logs.

Spruce is used altogether for *herring* and *halibut boxes* in southeastern Alaska, and as that business is growing rapidly, a large quantity of lumber will be used for that purpose in the future. Approximately 25,000 such boxes were cut by local mills during the calendar year 1912. Common rough lumber is used, the sizes being as follows:

Herring Boxes.

Ends,	$1\frac{1}{4}$ inch by 22 inches by 12 inches.
Sides,	1 inch by 12 inches by 42 inches.
Top and bottom,	1 inch by 24 inches by 42 inches.

Halibut Boxes.

Ends,	1 inch by 16 inches by 30 inches.
Sides,	1 inch by 16 inches by 54 inches.
Top and bottom,	1 inch by 32 inches by 54 inches.

Each box requires about 45 board feet, there being no special requirements except that the box must be strong and fairly tight. Spruce is light and tough and therefore well adapted to these uses.

Spruce is considered the best of material for *staves,* since it is soft, tough and conforms readily to any desired shape. Only a little cooperage work is done at present, locally, therefore there is but little timber used in that connection.

The best straight grained trees of this species make very good *shakes* and limited quantities of it are used for that purpose whenever other more durable woods cannot be easily obtained.

Spruce when placed in saltwater is very susceptible to the attacks of the shipworm (Teredo) in a majority of cases *piles* being rendered useless in two or three years. There are however cases where piles are short-lived regardless of their resistance to the shipworm, and in such instances the best long, straight and most accessible trees are taken. For wharves where lasting qualities are necessary, western hemlock is preferred on account of its tendency to withstand the attacks of the shipworm somewhat better than the former species. Spruce is slightly more difficult to drive than hemlock, on account of being more buoyant and having a greater tendency to batter up or break while being driven.

At the present time, practically all of the *cordwood* cut in southeastern Alaska is spruce. Although Western Hemlock is far superior to the former species as a heat producer, spruce is generally taken because large sound easy splitting trees of this species are more easy to get.

It is assumed that the Sitka Spruce of Alaska will reach its greatest future commercial importance, outside of its use as sawtimber, in connection with the manufacture of *paper pulp.* Southeastern Alaska, with its almost unlimited quatities of hemlock and spruce timber, its many protected inland waterways which make enormous quantities of the timber readily accessible, and its abundance of water-power is unexcelled as a location for the paper industry. Western Hemlock is expected to supply the bulk of the raw material since it makes up about 60 per cent. of the stand and is inferior to spruce for saw timber, while under conservative management by the Forest Service only the more scrubby and inferior trees of spruce will be used. It will be impracticable however to have a policy that will restrict the cutting of valuable saw timber trees of that species found scatteringly and in small quantities in mixture with stands consisting chiefly of hemlock, therefore large quantities of this species will enter into the manufacture of pulp. Since there have been no special tests made with spruce grown in Alaska to determine whether it differs materially from wood of the same species grown in the states, no definite information can be given as to the quantity and quality of pulp that it will produce. However, the general qualities of the wood are well known through its wide local use, and since it resembles more or less the spruce which is used for pulp in Eastern United States and Canada, it is reasonable to believe that it will produce a good grade of paper.

Since this species is chiefly concerned in connection with the local lumber industry it is very probable that some new uses may develop through the utilization of sawmill waste. The thick large slabs should be manufactured into box boards, and edgings of sound timber should be cut into quarter round, etc. The mills at present are very inefficient especially those that run box factories. In the first place they cannot produce enough lumber to supply the demand, and their methods are so far from perfect that they can afford to cut only the best of timber at a profit.

Western Hemlock. This species is considered inferior to spruce for saw timber and it is not used extensively except for piling. It makes a luxuriant growth and makes up a large percentage of the stand in southeastern Alaska as well as on a large proportion of the Chugach Forest. Trees of this species do not reach such large sizes as Sitka Spruce, the trunks are more irregular in shape and large old trees invariably contain much rot and defect. While it makes better lumber for many purposes than spruce, economic conditions are such that it is necessary for the millmen to resort almost exclusively to the best timber tree.

The wood of hemlock is comparatively soft, heavier than spruce, non-resinous, has a close even grain and works rather easily.

Although hemlock is considered superior to spruce for many purposes in *construction* work, only limited quantities are cut on account of the large amount of defect found in large trees. It is an excellent wood for uses wherein wearing qualities are required, such as for flooring, since it has a fine even grain and tends to become case-hardened after being sawn. It is much stronger than spruce and therefore good for heavy timbers, the only fault being its tendency to dry rot when left for any great length of time and thus to become useless. It has a decided tendency to split which prevents its use for thin lumber. Another fault found in this species, is the tendency of freshly cut lumber to warp and curl. This is not a serious objection however, since it may be prevented by proper care in the yard and by being well fastened wherever used.

Some millmen consider hemlock superior to either spruce or red cedar for mouldings and casings and other interior finish. It does not shrink so readily as spruce and will not shrink and swell to any great extent with the varying conditions of moisture.

Hemlock is considered much better for *fuel* than spruce although the latter species is generally cut on account of its larger size and the relatively easier task of getting trees having sound easy-splitting wood. It is desirable to have the hemlock used for cord-wood or other similar purposes, in order that the spruce may be utilized as far as possible for saw timber, and it is expected that the increase in the stumpage price for spruce cordwood will bring about more extensive use of the inferior species for fuel.

Hemlock is used principally for *piling* at the present time, it being considered superior to spruce for that purpose in that it is more resistant to the shipworm. Trees of suitable size for piling seldom contain the defects that are so prevalent in large overmature trees, and long straight piles can be secured in almost any quantity desired at a comparatively low cost. The largest portion of piling used in the future by local concerns, will be hemlock and aside from its use in connection with the pulp business, piling will be its most important product along the coast.

The western hemlock of southeastern Alaska is expected to reach its highest commercial importance in the manufacture of *paper pulp*. Although no tests have been made with locally grown wood of this species to determine whether there are any marked differences between it and wood of the same species grown in the States, the general qualities are more or less similar therefore it is assumed to be a good pulp wood. Lower slope hemlock makes a much more rapid growth than that found on higher elevations and it is doubtless the better wood for paper making. It is believed that this class of timber will make the common grades of paper at a comparatively low cost of production, and since enormous quantities of it can be secured from the shorelands without the outlay of heavy expense for railroads, it will be possible for the pulp industry to be introduced in the near future. The most evident faults in thrifty young growth timber of this species are the black knots and black seams. The quantity of material containing these imperfections, however, is comparatively small and while they will increase the cost of production more or less, they will not necessarily lower the grade of paper. The highest cost of production will be met with in the utilization of large overmature timber and the inferior young growth. The former class of timber, which invariably contains a large percentage of defective material, is found chiefly on the lowlands intermixed with the healthy young growth, and while it will be one of the many factors governing the cost of production, it will not be a serious obstacle to success in the pulp industry. The inferior young growth timber makes up the principal part of the upland types and owing to the exposed conditions under which growth has taken place, it is scrubby and contains a large percentage of black knots and other defects. The cost of working up such timber would be excessive, however, since there is an abundance of better timber available, it will not be necessary to resort to using any large quantities of inferior material until economic conditions will permit its manufacture at a profit.

White Spruce. This species occurs on the Chugach Forest, the most extensive forests being found on and adjacent to the shorelands of Cook Inlet and its tributaries. Trees of this species grow to about 24 inches in diameter and 60 feet in height. The wood is comparatively light, soft and is well adapted for such uses as construction lumber, piling and cordwood. Its chief present uses are for piling, building material and cordwood in the region where it is the most valuable species present. It is known to be, however, a good pulp wood, owing to the relative small quantity of timber of this species in the coastal forests only limited quantities of it will be used for pulp. Its chief future uses along the coast will be piling, building material and fuel.

Red Cedar. This species is found chiefly in the southern part of the Tongass Forest where it occurs in scattering quantities through the forest and makes up only a small percentage of the stand. Trees of this species grow very slowly and reach an old age without size. The trunks of old trees are generally very irregular in shape, have considerable taper and contain a large percentage of defective material. The wood is light, soft, not strong, brittle, has a coarse even grain but is durable. Practically all of this species cut in Alaska is used locally for shingles, building material, cabinet work, boat building and poles.

Only a very small quantity of red cedar is sawn by the local mills on account of the difficulty found in getting logs that will work up without a large percentage of waste. Old trees are generally very irregular in shape and contain so much defect that it is decidedly a loss to the ordinary millman to undertake to manufacture lumber from the general run of logs. Red cedar is very good for cheap *interior finish*, cabinet work, sheeting and house siding, since it is soft, works easily, takes a good finish, and holds paint well.

At the present time Western Red Cedar is considered the most valuable *shingle* wood in the United States. The quantity of this species in the forests of Alaska, however, is too small for it to ever become of commercial importance as a source of supply for shingle wood. There are at the present time three small shingle mills on the Tongass Forest, that operate for about nine months each year and produce approximately four and one-half million shingles, all of which are used locally. There is, undoubtedly, a sufficient quantity of mature and overmature timber, which is hardly fit for any other use except shingles, in the local forests to supply the local market with shingles for many years in the future, besides furnishing small amounts for outside shipment.

Owing to its durability when placed in contact with water, Red Cedar is valuable for planking small launches and building *row boats* and *skiffs*, the light weight being an important factor with small boats. The principal objection to using this wood for such purposes is its softness and weakness which render the boat hulls liable to injury and destruction if run on reefs or boulders on the beach.

Red Cedar is well known to be good timber for *poles* or *posts* on account of its durability in contact with the ground and the light weight of its wood. There is a moderately large quantity of this species on the islands and mainland of the southern half of the Tongass Forest that would be suitable for poles, and in the event that economic conditions become favorable for shipment of such material to the States the best stands of young timber will be especially valuable.

Red Cedar is much used for *floats* to which small boats are tied, or for transporting logging outfits on water since it lasts well in water and is very buoyant.

Yellow Cypress. This species occurs scatteringly throughout a large portion of the Tongass Forest and on the islands and mainland about Prince William Sound within the Chugach Forest. It occurs in largest quantities on the Tongass Forest and in this particular region it is expected to become important in the lumbering industry. It usually occurs in single trees scattered throughout the forest, there being occasionally bodies of one hundred thousand board feet or more. Mature trees usually range from 2 to 4 feet with a height of about 80 feet, the wood is rather light in weight, hard, fairly strong, brittle, has a fine even grain, and is susceptible of a beautiful polish. Many trees grow only to a diameter of about 10 inches and have a very crooked trunk. In spite of its tendency to grow in irregular form it is easily split. The oily nature of the wood prevents it from holding paint well. Practically all of the small quantity of this species cut in Alaska is used locally for cabinet work and in the building of small boats.

The close even grain present in wood of this species together with its easy working qualities and susceptibility of a high polish, renders it a very good wood for *cabinet work.* Its chief fault when used for this purpose is its tendency to split, which, however, is not a serious objection in that splitting may be prevented through careful workmanship.

Yellow Cypress is especially adapted for *furniture* since wood for this purpose must have qualities similar to those required in cabinet work and it is possible to utilize short and narrow boards. The most available portion (although not the best) of the stand of this species consists principally of small trees that would produce a large percentage of short lengths and narrow widths which could be used to advantage in furniture making, hence it is possible that the local lumbering industry will in the near future be extended to include the manufacture of a limited quantity of this timber for shipment to the States.

On account of its availability in small quantities Yellow Cypress is often used, in place of oak, by local boat builders for *boat ribs* or in other similar uses where tough natural crooks are desired, but it is expensive and cannot be afforded when a cheap boat is desired. Row boats and skiffs are often made from Yellow Cedar. They are light and last exceptionally well, but cannot be kept in a neat appearing condition on account of the inability of the wood to hold paint. The chief objection to the wood for ribs or any other use where it has to be bent is its tendency to split while being shaped or to check after being made fast.

Yellow Cypress makes exceptionally good *fuel* and is valuable for carving and in pyrography where a fine even grain is necessary. Small quantities of it are being used in the States for *cigar boxes.* It has also been favorably mentioned for *pencil* wood.

Black Hemlock. This species is used but little in southeastern Alaska where it occurs in mixture with Western Hemlock and Sitka Spruce most frequently near the upper limit of the best saw timber zone and extending up to the timber line.

Large quantities of Black Hemlock crossties have been cut on the Chugach Forest for the railroads which have been partially constructed in that region. It is not known to have any special qualities which adapt it to this use, but it has been found one of the best species available for that purpose. This species with the Western Hemlock is harder and slightly more durable than spruce or any other species that occurs in any abundance and therefore will have considerable use in connection with future railroad activity.

Lodgepole Pine. This species makes only a scrubby growth and has no particular use at the present time except for cordwood. It is far superior to either spruce or hemlock fuel and is used in small quantities where it can be readily obtained.

Balm of Gilead and Black Cottonwood. These species occur in limited quantities along the main river valleys and are used at present in limited amounts for fuel. The wood of both species is considered good for paper making and therefore may be used in limited quantities with the other more abundant species for that purpose.

Black Spruce. This species is found in various places on the Chugach Forest, but only sparsely and has no economic use at present.

Alpine Fir. This is found on the Tongass Forest in very limited quantities and has no special uses except where it is the most accessible species present.

Kenai Birch and White Birch. These species are found on the shores of Lynn Canal near Skagway and scatteringly throughout the greater portion of the Chugach Forest. Their wood is especially valuable for fuel when green and is used in preference to other species where it can be obtained cheaply. The quantity used is comparatively small.

Red Alder. This occurs in small quantities along river valleys and scatteringly throughout the greater portion of southeastern Alaska. It is considered valuable for fuel and for smoking fish, since it burns readily when green and imparts a sweetish flavor to the fish. Only very small amounts of this species are used on account of its scarcity.

Sitka Alder. Occurs sparsely on the Tongass Forest and has no economic use except for small quantities of fuel.

Aspen. Is found in small quantities and has no special uses except for fuel.

Silky Willow. Is found in limited quantities and is not known to have any economic use.

Broadleaf Willow and Feltleaf Willow. Only very small quantities of these species have been found on the Tongass Forest. They have no economic uses on account of their scarcity.

Dwarf Juniper. This species occurs sparsely in shrub form on the Chugach Forest. It is not known to have any economic uses.

Amabilis Fir. Occasional trees of this species have been found on the extreme southern part of the Tongass Forest. Owing to its scarcity it has no economic uses.

Western Yew and Dwarf Maple. These two species are occasionaly seen in southeastern Alaska but are of shrub form and only in sufficient quantity to identify their presence.

Mountain Ash. This species is not given by Sudworth in his "Forest Trees of The Pacific Slope," nor described by Sargent as extending to the coastal region of Alaska. Its presence on Tongass National Forest as well as on Kenai Peninsula has been identified by Forest Supervisor W. G. Weigle, and it is said to occur frequently along the shores of Cook Inlet, Knik Arm and certain parts of the Tongass Forest. No economic uses are known since it is only a shrub and is scarce.

METHOD OF A FOREST SURVEY AND ESTIMATE IN NOVA SCOTIA.

By Kenneth McR. Clark.

During the summer, autumn, and winter of 1911 it fell to me to take charge of a survey and estimate done by Appleton and Sewall Co., Foresters and Surveyors, of New York, for the Davison Lumber Co., Ltd., of Bridgewater, Nova Scotia. This latter company, operating mills at Bridgewater and Hastings, Nova Scotia, obtain their lumber from their holdings in Kings, Queens, Annapolis, and Lunenburg counties; and it was of part of these lands that this survey and estimate was made. In all the work covered about 200,000 acres, and was divided into two separate jobs. The first covered about 120,000 acres, while the second was of about 75,000 acres.

On these areas in order to obtain a good record of the timber in permanent and accurate form, to serve as a basis on which to control logging operations, the lumber company desired a rapid, yet thorough survey which should furnish a tolerably accurate map, determine the extent of existing timbered lands, locate waste lands, and give an estimate of the available timber. Speed was desired in the work, because the information to be obtained was wanted as a guide in the laying out of the operations for the following winter.

On the third of June I was sent with three other technical men to Crossburn, the woods headquarters of the Davison Lumber Company, to begin work.

As soon as the existing maps of the 120,000 acre tract were examined, it was apparent that our first work would be the survey of two main highways, one of which formed part of the south boundary of the tract, and the other part of the east boundary. Also level lines had to be run in order to establish throughout the tract bench marks to which to tie aneroid barometer readings later. These things my companions did, traversing the roads with transit and stadia, and running level lines on the same roads, on the Halifax and Southwestern Railroad, which formed the west boundary, and on a tote road which ran northerly through the center of the tract. The bench marks established by the lumber company in building their logging railroad, which ran northerly through the center of the eastern part of the tract, were located and marked so that they could easily be picked up. The survey of the Halifax and Southwestern R. R. was obtained from the files of that road. This preliminary work occupied my companions for three weeks, allowing time for me to arrange plans for the carrying out of the main part of the work, and organize the crews.

The lumber company did not care to go to the expense of blocking the area into mile squares or other rectangular units; and held that an estimate by water sheds or parts of the larger watersheds would answer their purpose. It was, however, deemed advisable, in order to accurately map the property and to aid in the proper estimating of the tract, to have some system of interior survey. After discussion with the lumber company's Woods Superintendent the following plan was decided upon. A spotted base line was to be run northerly from a point about midway of the south boundary to the north boundary. At intervals of two miles along this line other base lines were to be run east and west to the boundaries. The first of these was to begin at the starting point of the north and south line, and was to be numbered 1, and called East or West as it ran east or west from the north and south line. The second line was to begin at the 2 mile point of the north and south line, and was to be called No. 2 East and No. 2 West as the case might be. In all, there were to be five such lines. This system allowed of easy reference in the notes of the chainmen or cruisers to whichever line they were on. The lines were to be run with a staff compass, to be heavily spotted and well bushed, and accurately measured with a Gunter's chain. Heavy, well-marked posts were to be set at intersections with boundary lines, railroads, and important highways. Quarter-mile trees were to be established for future reference, and for the convenience of the estimators. The two-mile interval between base lines was chosen because it offered a maximum amount of control of area with a minimum of cost, and also made a fair day's work for the estimator to travel from one line to the other and back, four miles in all. In practice, an estimator can, if necessary, do more in this section; but as a rule it does not pay to push him so hard that he is forced to slight his work and neglect to give proper attention to the timber.

The estimating was to be done by traveling the country between the base lines at right angles to them every half mile, and counting the trees on ¼ acre sample plots every 165 steps, or four plots to the quarter mile. This system allowed a very good estimate at low cost and great speed. While not giving as high a percentage of area estimated on which to compute the total stands as would a caliper crew, it allowed the use of more expert men, with a resulting better knowledge of quality of timber and logging chances, for the same or less expenditure.

Because of the irregularities of the early surveys of the exterior boundaries it was thought best to allow the lumber company's own engineer, who knew the country well, to resurvey and renew these lines. At first it was expected that the would be able to keep ahead of the interior survey and estimate; but before the work was done, he had to have assistance from us on about 50 miles of the boundary.

As soon as Crew A was through with base line 2 East, it moved level work done, the north and south base line was run. This was completed by about the first of July, and then we were ready to undertake the main part of the survey and estimate. With the addition of one of our regular cruisers to our party, we split into two crews. Crew A. being merely a surveying crew, ran out base line 2 East. Crew B., a combined surveying and estimating crew, ran out base line 1 East, cruising the country north to base line 2 East and south to the boundary. The chainmen carried aneroid barometers, which they read at every quarter-mile at least, and at all well defined heights and valleys, and at all rivers, lakes, etc. The estimators, besides taking counts of trees, took notes on topography, aided by barometers; noted extent of growth types on their line of travel; and located all topographical and other features of interest. The barometer work was checked by an aneroid, read in Crossburn every half hour. All field readings were tied into bench marks established by the preliminary level work, or other points whose elevations had been carried through from such bench marks on some previous day.

As soon as Crews A was through with base line 2 East, it moved up to base line 4 East; while Crew B moved to base line 3 East, and repeated their operations on the new ground. This method, with slight modifications, allowed two crews to work together rapidly and economically. No office force was necessary to direct the work on such a simple system, nor could an office man have been able to compute much of the data at first; for, until the work was well advanced, not enough of it was available to allow accurate mapping. However, during the greater part of September I was able to be in the office to begin the map and compute data. Except for two more cruisers, who were sent up in late August, the work was handled with 14 men. The surveying crew was composed of a compassman, who could also estimate if necessary, 2 chainmen, 2 axemen and a cook. The combined surveying and estimating crew was of the same composition as the surveying crew, but with the addition of an estimator and an assistant, who calipered his sample plots for him. When the other two estimators came up they were placed with the surveying crew and handled the estimating on both sides of the line they were working on. The compassmen, rear chainmen, and estimators were our own men; while the rest of the crew was hired in the vicinity. With these men and the single crew of the lumber company on the boundaries, the work was finished about the middle of September.

The computation of data and making of the map took about four weeks more. The estimates of the ¼ acre plots were figured out by means of volume tables based on height and diameter breast height. Height curves showing average heights by diameter breast height were made up from observations in the field of several hundred trees of each species. This is easy to do and gives very good results in an uneven-aged forest such as usually found in the spruce region of the Northeast, where height is pretty constantly a function of the diameter. The results of the ¼ acre plots were grouped together according to the water sheds under which they came, totalled up and a sample acre made for each water shed. The figures for this acre multiplied by the acreage of the forested area of the watershed gave the total estimate. These figures, together with a detailed discussion of forest and lumbering condition, and a tabulation of the number and kinds of trees per acre on each watershed went to make up the report. This, together with the chain notes of the survey and two maps made up the compiled results which were turned in to the lumber company. One of the maps was a topographical plan showing elevations by means of 50 foot contours and also all other topographical features and the survey lines. The other plan was a growth sheet on which were shown the forest types in colors, with written modifications and comments upon them.

Meanwhile arrangements were made for us to continue our work on the 75,000 acre tract which lay to the southwest of the area already done. More men were available for this work, so by the second week in October four crews were in the field. Being farther away from the base of supplies, and necessitating closer co-ordination between the four crews than between the two on the other work, it was advisable to have a regular office to direct the work. Therefore I stayed in Crossburn with an assistant, where we attended to the arrangements for the field force while finishing the maps and reports of the first work. By the time these were done, new data was available in sufficient quantities to keep us busy.

Three of the four crews were put on the exterior boundaries, of which there were over 200 miles. They were regular six-men surveying crews, as before described. The fourth crew, which besides the six men for the surveying, carried two estimators with their assistants and a level crew established the interior base lines and did the estimating. The scheme of the interior survey resembled closely that worked out for the first tract. Base line No. 1 west of the first survey was prolonged across the northern end of the second tract, and from it three base lines were run south two miles apart to the south boundary. A third base line was run east and west across these as a check line about half way down. Levels were run and bench marks established every quarter-mile on the extension of the Base Line No. 1 West, and on the first and third base lines running south. The estimators cruised east and west between the base lines and between base lines and boundary at intervals of one-quarter mile. The closer spacing was used in this case, as more detailed and more accurate knowledge was required on this area, of which little definite knowledge was in the hands of the lumber company.

The three boundary crews were able to finish about three weeks before the interior crew, which allowed us to cut down these crews and concentrate all our own men on the last base line to be run and estimated. With the aid of these additional estimators, the interior crew was able to complete the field work by the middle of January. The compilation of the data was handled in the same way as in the first job.

The chief obstacle which the crews encountered was the heavy fall rains, which raised the lakes and streams to flood pitch. Snow was almost negligible; for, outside of making sloppy travelling on some days, it did no harm. Not enough fell to necessitate snow shoes before the work was finished; nor was the cold as severe as might be expected. However, it was an exceptionally open December and January, and such luck could not be counted on every year. Tents were used throughout both jobs, and stoves were needed only after the first of November. Even then, if it had not been for the heavy rains, baker tents with a front fire would have been as good as wall tents with stoves. In rain or snow, with cold weather, however, the wall tent and stove offers better protection and will often save the loss of a cook; for most of them object to cooking in the open in bad cold weather. Most camp moves were done by packing, unless roads were available where teams could go.

In conclusion, the following supply lists are given, showing a comparison between the amounts of each article used on the first job during the summer, the second job during the early winter, and those given by Mr. James W. Sewall in his article, "A Canadian Forest Survey," in the FORESTRY QUARTERLY, Vol. IX, No. 3. This latter list was one compiled from records of the work done by Appleton & Sewall Co. for the Chicoutimi Pulp Co. in the months of February, March, and April, in the vicinity of Chicoutimi, P. Q. It is reproduced here in order to show comparisons of amounts used under conditions of extreme cold, as occurred in Quebec, and the milder ones of Nova Scotia. The Chicoutimi list is based on about 6,000 meals, that for the first Nova Scotia work on about 3,250 meals, and that for the last Nova Scotia work on 5,900. Allowance is made in the last two for the number of meals which the crews obtained from the company's camps and farm-houses which were scattered through the surrounding country.

Articles.	*Amounts per man per week.* Winter, extreme cold—Chicoutimi job.	Summer 1st. Nova Scotia job.	Mild Winter—2nd. Nova Scotia job.
Apples, dried,	.45 lbs.	.44 lbs.	.26 lbs.
Allspice,	.001	.002	002
Bacon,		1.16	.52
Baking Powder,	.18		
Beans,	1.82	1.72	1.36
Beef,	5.32	1.72	1.36
Candles,	.76		
Cheese,	.95	.51	1.00
Codfish,		.16	.18
Cornmeal,	.14		
Cream O'Tartar,	.06	.10	.14
Flour,	4.85	4.68	6.67
Ginger,	.077	.01	.008
Ham,		1.38	.43
Hard Bread,	1.78	2.42	1.34
Kerosene oil,	.01 gals.		.024
Lard,	.65 lbs.	.94	.76
Molasses,	.10 gal.	.04 gal.	.07 gal.
Mustard,	.015 lbs.	.03 lbs.	.016 lbs.
Onions,	.27	.23	.33
Oatmeal,	.10		
Peas,	.59	.64	.33
Pepper,	.02	.02	.02
Pork, (fresh),	2.75		
Pork, (salt),	1.30	.89	.99
Potatoes,	3.46 lbs.	1.80 lbs.	3.30 lbs.
Prunes,	.48	.46	.33
Raisins,	.24	.37	.16
Rice,	.12	.01	
Salt,	.36	.20	.38
Soap,	.19 bars.	.17 bars.	.15 bars.
Soda,	.07 lbs.	.06 lbs.	.08 lbs.
Sugar,	2.13	2.53	2.07
Tea,	.17	.20	.18
Bread, (Frozen),	1.25		

An inspection of the above lists will disclose several minor cases where accessibility, varying market conditions, and tastes of the men employed cause abnormal variations, as for instance with baking powder, candles, rice and cornmeal. In the cases of some of the more staple articles, however, the variations seem worth while discussing. There is always a demand for fresh meats, beef and pork; but the cold winter weather is necessary to the keeping of it. When the weather is cold enough to keep it frozen, it will keep indefinitely and can be used consistently. This is shown clearly by the beef and pork as given in the Chicoutimi list. When the fresh meat is compared with bacon and ham, the reverse is shown; for more of these is used on the summer work than on the winter work in Nova Scotia, while none at all was used in Quebec. Not that bacon and ham are ideal summer foods, for they are not; but they are the only meat which can be carried in warm weather, except such game as the party is able to get on the ground. Sugar shows a higher use in the summer than in winter, though why this is so is not clear, although a man may need more in summer than in winter. The tendency in winter is for fatter foods,, as is shown by the salt pork. The flour, hard bread, and frozen bread should be taken as one; and they do not show as much as they might, for at times in both winter jobs the crews were without hard bread. In general, however, it has been my experience that the men will eat more flour in winter than in summer.

The difference in the amounts of potatoes used, I think, are greater than they should be, and reflect rather conditions of accessibility to market and means of transportation than actual normal increase in consumption. The winter should however, show some such normal increase over summer. Just how much is hard to say. Salt, which, at first would appear to be a rather steady article reflects the increase of fresh meats in the winter, and I believe the figures for it are good. In general, the tendency is to a considerable increase of most all food consumption, especially of fatty foods, in the winter time, depending upon the severity of and exposure to the weather.

A NEW TOPOGRAPHY METHOD.

By C. H. Amadon.

The taking of data necessary for the production of an accurate topographical map, was recently carried on in connection with the strip method of estimating hard wood timber in West Virginia, and with very satisfactory results.

It required the services of no extra men, the chain crew being made up of two native West Virginians, the man using the hand level never having done such work before, although he had had previous experience with surveying crews. His only duty was to determine the degree of slope and keep the record of the days work on the form which is printed herewith, and to tell the topographer, (or in this specific instance, the compass man) whenever a contour was crossed, in order that the latter might make his sketch as he went along.

A table was made showing the number of links to be added per 200 links, for each degree of slope, to obtain horizontal chainage, and the number of feet difference in elevation for 200 links distance for each degree of slope. Thus for a 12 degree slope the head chainman added 4 links to the 200; and the difference in elevation between the two points, that is, at 204 links, and not 200 links, on the 12 degree slope, is 28.1 feet.

Consulting the printed sample tally sheet, it will be seen, that the days work started with a predetermined elevation of 2,906 feet and that the first sight was one of 150 links on a 2 degree slope. In this case, the level man took $\frac{3}{4}$ of the tabular distance 4.6 feet, (see table) namely 3.4 feet, and throwing off the fraction, added three feet to his starting elevation, giving 2,909 for the elevation of his first station. Similarly, the second sight of 140 links, on a 1 degree slope, gave him 1.54 feet to add, and this time he threw the fraction to the next foot, adding 2 feet giving 2,911 for the elevation of the second station. It might be well to state that the number 1001 plus 92, is the number of a point on a road traverse from which on a bearing S. 40° W, 150 links, was a point on the strip line 42116212 plus 740. The latter

SAMPLE TALLEY SHEET.

Elevation Sheet.

Station.	*Point.*	*Bearing.*	*Distance.*	*Va.*	*Diff.*	*Elevation.*
1001+92		S 40° E	150	+2°	3	2906
42116212+470		S				2909
3			140	+1°	2	2911
2			200	0	0	2911
1			200	+1°	2	2913
42116212		S	200	+2°	5	2918
4			200	0	0	2918
3			200	—5°	12	2906
2			200	—11°	26	2880
1			200	—10°	23	2857
42116211		S	200	+1°	2	2859
4			200	+5°	12	2871
3			300	+5°	12	2883
2			200	—1°	2	2881
1			200	—15°	35	2846

Date................. Signature..................

number is deciphered as follows, 4211 is the number of the block (an arbitrary number) in which lay the tract under examination; 62 is the number of the strip line; and 12 plus 740 indicates that the point is 740 links from acre 12 and is in acre 13. As this line was being run toward the zero end, the first sight *on the line* was one of 140 links to stake 3, or 600 links (200 link chain being used) from acre 12. It will be seen from the accompanying sheet that but two contours were crossed—the 2,900 foot at a point between stakes 2 and 3 in acre 42116212—and since the difference in elevation was 26 feet, the contour would be close to stake 3; and the 2,850 foot at a point between stakes 1 and 2 in acre 42116211, and very close to stake 1. Thus was the work done easily and accurately with only the regulation chain crew.

Work of this kind is judged by the difficulties attendant upon it, and the results obtained by it.

Experience on this particular piece of work showed that the results obtained during the winter were not as accurate as those, which the same men were able to produce after warmer weather came. The work was carried on regardless of weather and atmospheric conditions, in severe cold, accompanied by high winds, in snow and fog. The hand level froze up, the mirror became clouded, the level man's fingers so cold he could scarcely turn the thumbscrew, and with nothing like the refinement of touch that became possible with warm weather. The results obtained under the conditions mentioned above, varied—the errors running between about 17 feet for distance under 1½ miles to 200 feet for distances up to 4½ miles. Later, in warm weather the same men were able to run levels over circuits of from 1½ to 6 miles with errors ranging from 1 foot to 23 feet. A very large amount of the work was done over extremely broken country with errors under 10 feet for an average distance of 3 miles. This work is close enough for a survey of any nature. It might be said that the work could scarcely be of sufficient accuracy to warrant conducting it under such severe conditions as prevailed on the job during last winter, while in good weather the work is easily done and produces very satisfactory results. During the severe weather of winter, not only was the quality of level work, seriously affected, but the quantity of work was at a minimum. At no time was there enough snow to make snowshoeing practicable, while it was deep enough to make travel very laborious. Thick beech and chestnut brush became laden with snow and formed as much of an impediment to compass work, as thick leaves. The laurel and rhododendron patches, always a serious problem, were rendered even more difficult to traverse. Under these conditions a mile a day was considered a good days work, while a mile and a half was the maximum. With the melting of the snow the amount of work and quality were both increased, a maximum days work being three miles. After the leaves came out, it became necessary to put on an extra man to clear away the brush, which resulted in another increase in the amount of work done, the average being 3¾ miles with a maximum or 4¼. Of course a certain amount of the increase was due to greater familiarity with their work on the part of the men. At all times the chain crew was able to keep up with the compass crew so that it is entirely probable that even 5 miles might be possible, even in such broken country as West Virginia.

Errors may be due to a variety of causes. Error in reading the level was common at first, such as recording 7 degrees for 2 degrees—or vice versa—or 15 degrees for 5 degrees—or vice versa—the error in the first case being 11.6 feet, and in the second, 23.9 feet. Very small angles were often recorded with the wrong sign, as minus 2 for plus 2, the error in this case being 9.2 feet.

Error due to change in degree of slope frequently happens, especially along the top of ridges where ledges are common, and along the foot of slopes where the creek bed forms the bottom. In these cases, taking only one hundred link sights would often suffice, but very often this led to the error of neglecting to divide the tabular value by two. Or the actual distance from a station to the point of change of slope was measured. Then the horizontal distance was computed and from that the elevation of the point of change. This necessitated another computation in getting the additional distance for the full chain, a proceeding which is unpopular with the level man especially if he understands merely the method and not the reason therefor. So it usually resulted in the inaccurate method of adding links for a certain degree of slope when a change in degree resulted in an indeterminate error. With a level man who understands thoroughly what his work is, this class of error would be eliminated.

Errors in computation were very uncommon for the reason that the level man checked his work at the end of each acre, by adding all plus and minus readings, separately, and adding or subtracting the difference between them to, or from, the elevation at the beginning of the acre.

The topographer used a sheet of co-ordinate paper ruled in fifths of inches—each division representing 200 links. The strip lines were run five chains, or one linear acre apart, and it was a very easy thing to sketch the contours for a distance of 500 links on each side of the line. All features of the terrain were sketched in by the topographer, and their location noted in his book, by the level man.

A circuit was selected at random from among the tally sheets of several months work which showed the following:

Total distance,	5.12 miles.
Total plus readings,	2,127 feet.
Total minus readings,	2,284 feet.
Total difference in elevation,	4,411 feet.

This circuit was one around three sides of a rectangle, there being two starting points with predetermined elevations. The circuit was run in one direction to a point and left. Then it was run from the other end back to the finish of the previous days work. The elevations of the point were 2771 and 2769 showing an error of but 2 feet over a distance of 5.12 miles and a total difference of elevation of 4411 feet. Such work needs no comment.

With the demand for accurate estimates of standing timber and dependable topographical maps from which to plan logging operations, work of this character will be of more frequent occurrence in the future than has been the case in the past. The methods suggested herein may be of use to those having this work in charge.

Any additional work of road traversing, laying out of base lines and such other work as was necessary, was done by a special crew, only the topography away from roads, and base lines, being taken by the estimating crew.

Table for Chaining on Continuous Slopes for 200 Link Chain.

Slope. *Degree.*	*Correct'n to Horiz. Chainage.* *Links.*	*Difference in Elevation.* *Feet.*	*Slope.* *Degree.*	*Correct'n to Horiz. Chainage.* *Links.*	*Difference in Elevation.* *Feet.*
1	0	2.3	31	33	79.3
2	4	4.6	32	36	82.5
3	0	6.9	33	38	85.7
4	0	9.2	34	41	89.0
5	1	11.5	35	44	92.4
6	1	13.9	36	47	95.9
7	1	16.2	37	50	99.5
8	2	18.6	38	54	103.1
9	2	20.9	39	57	106.9
10	3	23.3	40	61	110.8
11	4	25.7	41	65	114.7
12	4	28.1	42	69	118.8
13	5	30.5	43	73	123.1
14	6	32.9	44	78	127.5

Slope. Degree.	Correct'n to Horiz. Chainage. Links.	Difference in Elevation. Feet.	Slope. Degree.	Correct'n to Horiz. Chainage. Links.	Difference in Elevation. Feet.
15	7	35.4	45	83	132.0
16	8	37.8	46	88	136.7
17	9	40.4	47	93	141.5
18	10	42.9	48	99	146.6
19	11	45.4	49	105	151.8
20	13	48.0	50	111	157.3
21	14	50.7	51	118	163.0
22	16	53.3	52	125	168.9
23	17	56.0	53	132	175.2
24	19	58.8	54	140	181.7
25	21	61.5	55	149	188.5
26	22	64.4	56	158	195.7
27	24	67.3	57	167	203.3
28	26	70.2	58	177	211.2
29	29	73.2	59	188	219.7
30	31	76.2	60	200	228.6

A PLANE TABLE SKETCHING CASE.

By Wm. J. Paeth.

The usual method employed by the Forest Service in obtaining topography when a topographic map is made in conjunction with a timber reconnaissance is termed the strip system. Straight lines are run through the territory to be mapped. The primary control is established accurately with standard surveying instruments by base line crews. The secondary lines of control are run by one man, the compassman. The compass is the instrument used, and a standard form of compass has been adopted by the Forest Service.

Several forms of map sheet holders have been used, each type designed to meet the requirements of the work peculiar to the region where it was used. A map sheet holder fitted to meet the requirements of all conditions must satisfy the following demands: it must be light and strong. It cannot be bulky since it must be portable. The compassman must run straight lines, and small patches of dense underbrush will impede his progress, hence the instrument should be equipped with carrying straps, or raw-hide laces, so that it can be carried suspended from the shoulder. This gives the compass-man the use of both hands. It is of further advantage in sighting with the compass.

Provision must be made in the construction of the map sheet holder to furnish protection to the map sheets. Showers are encountered during the day and going to and from the work. A wet map sheet cannot be used satisfactorily.

When only one map sheet is mounted, the unused sheets are not subject to injury. The compass-man should be able to protect his clean sheets. Often two or three sections are being worked the same day. When two sections are covered in one strip the compass-man could mount the new sheet at the end of the section. The map sheet holder must provide for a quick changing of sheets without injury to the map sheets. Further, the compass-man must have a map sheet holder equipped with a separate water-proof, closed compartment for the reception of the unused sheets. He must be able to preserve them flat and dry and free from dirt. A clean sheet stimulates neatness in the field work of the compass-man.

When in the field, a sudden shower may render a map sheet unfit for further use. The compass-man should be able to proceed on his strip after the rain with a clean, dry sheet and should be able to store his wet map sheet separate from the dry map sheet. Later the field work of both sheets can be collected on one map sheet.

The materials used must not warp out of shape or split. The metal parts, if metal is used, must not be of iron or steel. No bright finished metal should be used, in order to avoid sun glare.

The map sheet holder must be adapted for use as a plane table in addition to being used as a tatum holder in the hand.

Often when proceeding along the strip the compass-man has opportunities to sight upon lakes, spurs of ridges, and other controlling points of topography at one side of his line. He can take a compass sight to the point and plot the compass bearing using the standard compass as a protracter. But this takes time. If the compass-man can quickly mount his map sheet holder on a Jacob staff the sights can be taken and plotted with greater speed and with as great accuracy. Again, a strip may end at the edge of a steep cliff or rim of a crater. The timber cover may not call for an estimate. The compass-man may find it profitable to traverse the rim using the map sheet holder as a plane table. He can locate points of horizontal control below him by intersection and obtain vertical control with an Abney level. At any time the compass-man must be able to convert his map sheet holder into a plane table and vice versa.

The following difficulties are encountered. The compass-man must be able to dismount the plane table and prepare to carry it between stations with ease and speed and with as few manipulations as possible.

The extra weight of the Jacob staff, which must be carried, is unavoidable.

With the above mentioned requirements in view an attempt has been made to design a plane table-sketching case to accommodate the standard reconnaissance map sheets of the Forest Service. The complete field equipment of the compass-man would call for the following:

1. Jacob staff.
2. Forest Service Standard Compass with staff mountings.
3. Plane table-sketching case.
4. Abney hand level with aneroid, if desired.
5. Tally register.
6. Pencils and map sheets and eraser.

With this equipment the compass-man can do triangulation in addition to getting the data gathered by the old methods. If the conditions do not allow such work, the Jacob staff can be left in camp.

The following is a description of the plane table-sketching case as designed:

The plane table-sketching case is to be constructed of aluminum and hardwood strips and veneers. The total thickness of the plane table does not exceed one-half inch, and the total weight as designed will not exceed two and one-half pounds. The entire plane table with staff mountings attached can be carried slung over the shoulder suspended by raw hide laces or carrying straps. When sights are taken at each station the compass-man picks the plane table from the Jacob staff and throws the straps over his shoulder. The Jacob staff is carried in the left hand. The Forest Service standard compass is carried in its case or in the pocket.

The plane table-sketching case is designed to afford protection to completed and unused map sheets. The space below the upper aluminum plate is for this purpose. An extra paraffin paper envelope of a size to enclose about six map sheets is slipped into this drawer or space. When a sheet becomes wet the wet sheet is placed outside of the wax paper envelope but inside the drawer. Thus dry sheets are always separated from wet sheets, and both wet and dry sheets are protected from injury.

Only one map sheet is exposed and mounted at one time. The cover clamp when raised opens the drawer containing the map sheets at the same time releasing the finished map sheet. The new sheet is withdrawn from the envelope and the finished map enclosed. By laying the clean sheet upon the board and snapping down the cover clamp the map sheet is held down fast without marring the surface with thumb tack holes. At the same time the drawer is automatically closed against dirt and moisture.

Clean, dry map sheets are kept separate from the wet map sheets by closing the dry sheets in a water-proof paper envelope. Wet map sheets are slipped into the drawer.

The materials cannot warp. The two thicknesses of veneer are added to give stiffness to the lower aluminum plate to which is attached a brass plate holding the staff head. These veneers are glued with water-proof cement and the grain of each piece is at right angles to the grain of the other. The warping tendency of one would counteract the warping tendency of the other.

The aluminum and brass metal parts are designed both for strength and lightness. The thickness of the aluminum plate, .065 of an inch, is sufficient to give all the stiffness desired for the upper plate. The lower plate having the greatest strain is reinforced by the veneers.

The aluminum plates are of dull finish metal. This frosted surface will not reflect bright sunlight and the surface is durable. A varnish would wear off. No iron or steel has entered into the construction of the sketching case.

This instrument has been designed to meet both the requirements of Jacob staff-plane table and a map sheet holder. It is equipped with straps, so that it can easily be held in the hand. In addition, a brass plate is fitted to adopt the staff mountings of the Gurley Forest Service Standard Compass No. 335. This brass plate is thin and not in the way when the case is held in the hand. When desired the case can be mounted as a plane table by simply screwing the Jacob staff mountings of the Forest Service Standard Compass into the brass plate for the purpose.

A water-proof case can be made for the plane table-sketching case to protect the instrument from wear when it is not in use.

The advantages of this design over previous designs lie in the provisions for safe-guarding finished and unfinished sheets, its lightness and adaptability for a two-fold purpose.

The plans have been sent to a reliable firm, which estimates the cost of constructing a sample board at not more than $25.

CURRENT LITERATURE.

The Theory and Practice of Working Plans (Forest Organization.) By A. B. Rencknagel. New York, Wiley and Sons. 1913. Pp. 235. Price $2.

This volume comes from the press too late for the present issue of the QUARTERLY to receive such detail review as it deserves; but it is only fitting that such important contribution to American forestry literature should receive at once a book notice, a fuller discussion to follow.

The work is divided into two parts; besides an introduction. The first part discusses Foundations of Working Plans in three chapters on 134 pages, the second part discusses Practice of Working Plans in two chapters, the first describing practice in Europe (50 pages), the second, practice in America (36 pages). The claim in the Preface, that theory has been subordinated to practice is therefore, as far as space is concerned, not sustained, and that, we believe, to the advantage of the book. The author has, however, constantly kept in mind the possible application of the well developed theories of forest organization at home. As far as the theoretical discussion goes, the work is naturally based on German precedent, the author having had the advantage of personal study on the ground of their methods, and it appears to cover the field quite fully.

A mere glance through the book will satisfy one that it is not a mere compilation but is written by one who has mastered the subject and has the gift of clear and direct statement. The discussion of procedure so far developed in this country in elaborating working plans is particularly welcome.

B. E. F.

Review of Forest Service Investigations. Volumes I and II. U. S. Department of Agriculture. Washington, D. C. 1913. Pp. 68 and 92.

This is a new, very useful periodical, issued as needs arise, instituted by the Forest Service to keep the men engaged upon investigative work in touch with each other and to publish more or less incomplete or minor investigation results. It fills about the same place as the Mitteilungen of the German Forest Experiment Stations.

The first volume merely clears the deck for action, describing in considerable detail the organization and the various problems of investigation in which the Service is engaged or proposes to engage.

The organization is a mixture of collegiate and bureaucratic method: a committee of investigators in each of the districts into which the field is divided under the direction of a supervisor discussing the projects or program from year to year, these then to be reviewed and passed upon by the Chief of each branch at the central office to which the subject belongs, and submitted to the central investigative committee of three to co-ordinate the work, and finally to be sanctioned by the Forester. This is much machinery, but it has the advantage which many heads have against one, a great advantage where inexperience and variety of purpose might lead to questionable procedure. There are six district committees of four and the central committee of three to concoct the program.

There are four classes of investigations grouped under Dendrology, Grazing, Products, and Silviculture. Some few peculiarities in the distribution of subjects under these four heads may be pointed out, which are probably due to administrative considerations. Mensuration and Management studies, Forest Influences and Utilization studies might have been differently assigned.

The second volume brings short reports from each of the four fields. In Dendrology, the observation that *Chamaecyparis nootkatensis,* which elsewhere shows an annual fruiting form, in Alaska (Chugach Forest) seems to be of biennial fructification like the Cupressus genus, from which Chamaecyparis is differentiated in part by the fruiting habit.

From the Grazing section, failure of the sowings of various grasses of general use under range conditions is reported, and trial with native forage plants recommended, a method of collecting and of using the seeds of *Erodium cicutarium* is described.

Other articles discuss the results of grazing on seedlings and the practical inefficiency of herding goats over chapparal for the destruction of the same, when the financial interest of the goat herder and not merely the silvicultural result is considered.

In a report on a study of the character of mechanical failure of wood, the interesting statement is made that in tension tests moisture conditions have no influence. In spite of the fact that this confirms the findings recorded in Bulletin 8 of the Forestry Division, the reviewer remains a doubting Thomas and finds the explanation in the almost impossibility of devising a true tension test in wood.

A somewhat doubtful formula for determining the relative value of fuel wood compared with coal, makes the cost of wood, $c = \frac{abx}{2000}$, in which a is the cost of coal; b, the heating value of wood as compared to that of coal, a table for a number of Arizona species being given, and x, pounds of wood per cord; the 2000 being the weight of a ton of coal.

Interesting statistical data are brought regarding the production and market conditions of the hardwood distillation industry, bringing out the fact that the smaller by-products of distillation find no ready market; only two plants report selling tar or tar products, namely one selling wood oil for 8.5 cents and wood creosote and wood tar at 4.5 cents per gallon, the other, unspecified products at 8 cents a gallon.

An investigation into the effect of sowing poisoned wheat with tree seed to keep down loss from birds, furnished mainly negative results. Treating seeds with red lead, the usual method in Europe, was also found ineffective. Screening with wire screens, which is effective, is too expensive.

The beneficial influence of brush on natural regeneration by conserving soil moisture is one of those matters which is most difficult to prove, since so many other variables enter the problem.

The question of locality of seed supply, which is now so thoroughly investigated by European Stations has also been subjected to inquiry with *Pinus ponderosa* seed. The method of this experiment is not convincing, and when the conclusions are at variance with conclusions from other experiments they must be taken with great caution. It must not be forgotten that all experiments of this nature made in the Western Mountains with their very varying and trying weather conditions can only give answers in a very long series of trials before conclusions are permissible. Hence, if the germination per cent. of northern seed was the poorest, and if the weakest plants were produced by southern seed, this may be explained by other reasons than the place of derivation. The recommendation, however, to avoid shipments of Yellow Pine seed from one latitude to another may be accepted as a safe one.

Several other papers on reforestation of Yellow Pine and Douglas Fir add to the great variety of subjects treated on the 92 pages.

The reader is left with the impression that some of these data were not yet ripe for printing; nevertheless, to let the professional world know what trend the investigations are taking is also a desirable object of this publication. B. E. F.

Meddelanden fran Statens Skogsförsöksanstalt. Häftet 9. 1912. Pp. 267 +.

One of the most active and productive stations, doing most excellent work in forest investigations is the Swedish State forest experiment station, now directed by Gunnar Schotte, which publishes its results in the forestry journal, Skogsvardsföreningens Tidskrift, one of the best published technical journals, and also in separate volumes, the ninth having just appeared. To make results more accessible, the gist of important articles is given in the German language.

A triennial report for 1909-1911, shows that the Station does its admirable work with a salary and expense item of little over $4,500 per annum, four to five collaborators being engaged. There are two divisions of the station, the forestal and the botanical. The problems of the first include experimental areas in thinnings, some 67 areas being laid out; increment areas, some 12, to study stem class distribution and production in different forest types; regeneration trials; heath culture (see p. 263 of this issue!); cultures with different spacing; the question of exotics; the seed question; time for sowing and planting in Norrland. Some 800 trial areas are under observation.

The botanical division studies forest types, especially with reference to natural reproduction and soil flora, and to site classification; the difficulty of regeneration in the Norrland open pine forests forms a special series; the problem of the change of forest to moor and of making moor soils available, as well as other soil problems; races of tree species; diseases and damages; distribution of tree species.

The volume, beautifully printed on fine paper, profusely and beautifully illustrated brings separate articles on snow breakage in North Sweden; on results of sowing of pine and spruce from foreign seed; on diseases of the pine in Norrland, with special reference to its regeneration; on the seed yield in 1912; a description of an unusual stand; thinning experiments.

Just as in Canada snow breakage is rare in Sweden, especially North Sweden, because snow falls usually at low temperature, hence is light, while the trees, pine with a thin foliage and branch system, spruce with a drooping habit, do not carry much. Yet, in 1910-11, considerable damage was experienced, mostly in alpine situations. The interesting fact comes out that the areas lately exploited, i. e. thinned out, suffered most.

To the Swedish foresters belongs the honor of having first pointed out or practically realized the significance of the derivation of seed supply, the use of foreign seed in the State forests having been forbidden as early as 1882; in 1888 an import duty being enacted, and in 1899 and 1911 by its increase the importation rendered unprofitable. Yet, upon failure of the home crop, from time to time foreign seed had to be admitted even in the State forests. The somewhat inconclusive trial plantings have shown that the spruce from German seed (probably from Harz mountains) is neither from the point of view of climatic adaptation, nor from that of increment objectionable. Even stands of 50 to 60 years show in no direction any detrimental development. With the exception of pronounced frost situations it is frost hardy even as far north (in one case) as 63° N.

For the pine, however, very different experiences are extant. Even if developing well at first, in the second or third decade the form becomes undesirable, crooked and otherwise defective. It is, however, questionable whether this refers to German seed, or seed secured through German sources, the derivation of which is unknown. Owing to a longer leaf period, earlier sprouting and longer growing, the shoots are liable to frost; poor wood and other deficiencies are charged, especially greater liability to the destructive attacks of the pine fungus, Dasyscypha, than the native trees. Since about 50,000 acres of such plantations from the German seed exist, the damage must be considerable.

The article on thinnings does not bring results, since the sample areas are only ten years old; but the whole history of thinnings and various methods are described. A new classification of stem classes for experimental areas is proposed, namely in part by the place in the crown cover, in part by the form of crowns, and in smaller part by the form of the stems themselves. The height to which crowns reach the author calls "crown-layer." The crown-layer of the subordinate stand as a rule has been found to lie at about 50 per cent. in pine often 60 per cent. of the height of the dominant. The upper half or two-fifths of the height may then be divided into three, about equal layers, corresponding to dominant, codominant and dominated tree classes.

The wavy outline of the cover of a regular stand is due mainly to the two upper layers, which are formed by groups or single trees in mixture. In experimental areas, if the upper layer I sinks to the height which in the rest of the stand was occupied by layer III, this must be recognized as the sample area limit. The crown layers III and IV sometimes, especially in light needing species like pine, merge so into each other that it is difficult to differentiate, nevertheless, where possible the differentiation is of use. Crown layer I, then, is formed by the highest stems; II, by the somewhat lower stems with less fully developed crowns, and not rarely slenderer trees, the height coming to about 5/6 of that of I; the layer of III reaches to about 2/3 of I, indicated by shortened leaders—laggards; the suppressed trees reach up to 50 to 60 per cent of the layer I, and to these are assigned also trees of the same height standing in openings. Besides, there may be recognized overholders, single trees more than 40 years older than the main stand; and underwood, whatever is below half the height of I.

Each crown layer is then according to crown and bole development distinguished into *tree* classes, reserving the designation *stem* classes for diameter distinctions. The tree clases then are: *a*. one sided crowns; *b*. predominant, broad-crowned ("wolves"); *c*. very crooked or branchy, or double leaders and other faulty forms; *d*. generally narrowed-in and hence damaged crowns; *e*.

diseased trees; *f.* dry, broken, bent trees. This classification permits, where needful, notation of the precise nature of the specimens, as II*d,* a codominant tree but with a damaged crown; and notation of the character of the thinning, as "severe thinning in the dominated" = removal of III and IV and class *a—f* of I and II; "moderate thinning in the dominant" = removal of classes *e* ad *f* in all groups, and of *a—d* in groups II and *b—d* in group I.

While it is easy to carry out this classification in pure and even-aged stands and to designate beforehand what is to be taken in the regular thinning, it is more difficult to handle it in mixed and uneven-aged stands. Yet, while here the Danish method of Heck's prescription alone can be applied the classification is useful in describing what *has* been taken. A number of tables exemplifies the procedure, which show to the study of what details this system of classification invites.

This classification, the author suggests, may also advantageously be used on strip surveys, and wherever sample tree methods are in place. Especially for Canadian foresters who in the Eastern Provinces deal with conditions not unlike the Swedish, it would pay to acquire the language in order to follow this literature in detail. B. E. F.

Forest Conditions in Louisiana. By J. H. Foster. Bulletin 114, U. S. Forest Service. Washington, D. C. 1912. Pp. 39.

The author divides the State into six topographic and forest regions, namely the shortleaf pine uplands, the longleaf pine region, the alluvial region, the bluff region, the prairie region, and the sea-marsh region. The short leaf pine uplands occur mostly in the northwestern portion of the State, although there is a relatively small region east of the Mississippi river and south of the Mississippi State line. The shortleaf pine occupies the higher and more hilly portions of the State, where the soil is for the most part a sandy loam. The pine is in pure stand on the ridges, while the lower slopes and creek bottoms support various oaks, red gum, ash, hickory, beech, maple, and yellow poplar. On the intermediate lands, these species are mixed with short-leaf and loblolly pine. The greater portion of the shortleaf forest has been culled. In the older lumbered districts small operators are cutting second growth. Where first-class pine remains, the stumpage value is $5 per thousand feet. The amount of standing shortleaf and loblolly pine is estimated to be 15.2 million feet.

The longleaf pine region is separated by the wide alluvial bottoms of the Mississippi river into two areas. The larger extends through the central and western portions of the State from the short-leaf pine uplands on the north to the prairies on the south, and from the alluvial lands of the Mississippi river on the east to those of the Sabine river on the west. This area is divided by the alluvial bottoms of the Red River, with the larger portion on the south side of that river. The second and smaller area of longleaf lies east of the Mississippi river and occupies the corner north of Lake Pontchartrain to the State line. Together, the two areas comprise some 7.5 million acres and contain the largest compact body of longleaf pine timber remaining in the United States. Most of the pine is on rolling, well drained low hills, although it occurs on poorly drained flats. The soils of the region are sands and clays, with an impervious clay sub-soil. East of the Mississippi river large areas of cut-over pine lands have been transformed into productive truck farms. The stumpage value is about $4 per thousand feet. The holdings of many companies exceed 200,000 acres and several mills have a daily output of more than a half million feet. Three-fourths of the yellow pine produced in the State (2.7 billion feet) is from the longleaf, and the amount of standing timber of this species is estimated at 52.5 billion feet.

The alluvial region of Louisiana covers some 23,000 square miles, or nearly one-half of the State. Along the Mississippi river throughout the State the alluvial bottoms have an average width of from 30 to 40 miles, and they average 10 miles wide along the entire course of the Red river. During the flood season from March or April to June or July the greater portion of this vast region is inundated. It is estimated that 5 million acres now subject to overflow could be protected and brought under cultivation by levee building. The character of the forest in the alluvial region is determined by the drainage. There are three principal types. Deep swamps overflowed throughout the year, containing stands of cypress, tupelo, and occasional water ash and red maple. The second type is composed of level or slightly undulating bottoms subject to overflow only during the flood season, where red gum and tupelo together form approximately 40 per cent. of the stand; red oak and white oak, 35 per cent., and cypress, ash, elm, hickory, hackberry and cottonwood form the remaining 25 per cent. The third type is formed by the narrow sinuous cane ridges, usually rising above the water level, covered with a stand of oaks, hickory, red gum and other species, usually of inferior quality, and containing a dense undergrowth of cane and briars.

Commercial cypress has been stripped from the alluvial region in the northern two-thirds of the State where the cypress swamps contain only polewood cypress but often heavy stands of tupelo. In the lower Mississippi parishes cypress stumpage is worth from $6 to $8 per M feet. The purchasers of stumpage are usually allowed 10 to 30 years to remove the timber, and thus the seller loses the increase in value of the stumpage during the cutting period. The annual cut of cypress in Louisiana is 608,000 M. feet, or 63 per cent. of the total cut in the United States. The present stand of cypress in the State is estimated to be 15.7 billion feet.

The bluff region is mostly under cultivation or in pasture land. Only small woodworking industries prevail. The prairie and sea-marsh regions are without commercial timber.

The outlook for forest management in Louisiana is not bright and will not be until there is a change of attitude toward forest fires and grazing in the forest. Fire runs over the pine lands nearly every year to the almost complete destruction of the possible future stock. Some 3.5 million acres of the 7.5 million acres of pine lands have been cut over and owing to repeated fires the area is producing nothing of value. The large companies are so heavily bounded and have such heavy operating charges that they can take no thought of future production on the same area. The only hope of conservative management is apparently with the smaller and more permanent operator.

C. D. H.

The Composite Type on the Apache National Forest. By Harold H. Greenamyre. Bulletin No. 125 U. S. Forest Service. Washington, D. C., 1913. Pp. 32.

The composite type with which this bulletin deals occurs on limited areas at approximately 9,000 feet elevation in the White

Mountains and Blue Range in east central Arizona and is unusual in that it contains western yellow pine, Douglas fir and Colorado blue spruce in mixture. The mixture of Douglas fir and yellow pine is quite common in the southwest but the occurrence of blue spruce with the former is out of the ordinary because the requirements of spruce vary so markedly from those of western yellow pine.

One of the most notable facts brought out by the report is that western yellow pine makes a faster and greater growth in the composite type than in pure stands—there being an increase of 16 to 25 feet in clear length and 5 to 7 inches in diameter growth in 250 years. This is due chiefly to favorable light and climatic conditions, the source of light being overhead rather than from the side, due to the density of the stand. Moreover, the spruce on account of limbiness and extreme tolerance forces an early cleaning of the other species.

The type is important economically in that it makes possible a more complete utilization of the forest area and yields an average of 14,100 board feet per acre as against the typical western yellow pine yield of 4,000 to 7,000 feet in this locality.

The composite type is chiefly valuable as a source of saw timber, although stulls and mining timbers may be exploited when the area becomes more accessible. For a system of management the author recommends a selection cutting in order to insure the continuance of the mixture, with a second cut in 40 to 50 years. Rotations of 120 years for yellow pine and Douglas fir and 140 years for spruce are prescribed and in general a piling and burning of brush.

C. W. McK.

Report of the Minister of Lands for the Province of British Columbia for the Year 1912. Victoria, B. C. 1913. Pp. 360.

Unlike most Government reports, this one is distributed to the public within a few weeks after the close of the year. It consists of four parts—the reports of the Department of Lands proper, the Forest Branch, the Water Rights Branch, and the Survey Branch.

The report of the Forest Branch (pp. 61-101) is necessarily largely a statement of its general policy and the work planned, since the Branch had been in existence but a few months, following the passage of a model Forest Act earlier in the year.

The forests of British Columbia are estimated to cover some 100 million acres, of which about two-thirds is considered absolute forest land capable of carrying commercial timber. The stand is estimated at about 300 billion feet. The present output is about a billion and a quarter feet, much less than the annual growth.

The forests provide one-quarter of the province's yearly revenue. The forest revenue for 1912 was $2,753,579, of which $1,937,194 was license rentals, and $489,377 royalty. The total expenditure of the Forest Branch, including fire protection service, was but ten per cent. of this revenue.

The Forest Branch has already made a good beginning in attempting to educate the people of the province regarding the fire evil, and towards the carrying out of the protective provisions of the Forest Act. During the close season, May 1 to September 30, some 9,400 burning permits were issued by the fire wardens, and of the fires set only eight escaped. About 300 donkey-engines were inspected for compliance with the regulations regarding fire-preventive devices and fire-fighting equipment. In addition, the regulations relating to spark arrester equipment of all mill plants, and safeguards around sawmills, mines, camps, and waste-burners were brought to the attention of those concerned. The Forest Act does not require the logger to burn his slash, but the department hopes to undertake an educative campaign of slash-burning this season; as well as the disposal of debris on right-of-way. Most of the railways in British Columbia are under Dominion charter and hence come under the well-known regulations of the Board of Railway Commissioners. The provincial lines come under the provisions of the Forest Act, which are similar.

The patrol force in 1912 consisted of two supervisors, 16 divisional wardens, and 149 district wardens, with some 48 extra patrolmen temporarily engaged during the height of the danger season. This force protected 125 million acres, one-half of it real forest land, at a cost of about one-seventh of a cent per acre. During the season about 160,000 acres were burned over and about 200 million feet of merchantable timber killed, the total damage being about $300,000. The greatest immediate needs are the permanent employment of the patrol force to raise the personnel, and the extension of trails, roads and telephone lines. Already both the Coast and Mountain Lumbermen's Associations have appointed committees to co-operate in an advisory capacity with the Forest Branch toward the development of greater efficiency in fire protection.

During the season many forest surveys were carried on, especially on the Okanagan lake watershed, the Nicola plateau, the North Thompson watershed, the Salmon river valley, and the Upper Columbia. This is the beginning of a plan to acquire exact information as to the character and condition of the timber resources of the province as a basis for their development and to determine the administrative needs. A start was also made in the policy of disposing of isolated stands of timber by sale after examination by the department.

Studies are also in progress with a view to the building up of industries to reduce the imports of manufactured wooden goods; to encourage the pulp industry; to increase the utilization of low grade material, and lessen the mill and logging waste; and to develop minor forest industries.

The province is to be congratulated on the progressive beginning of its administration of a resource with which her material welfare is so largely bound up. J. H. W.

Report of the Director of Forestry for Year ending March 31, 1912. By R. H. Campbell. Forestry Branch, Department of the Interior. Ottawa, Canada. 1913. Pp. 269.

The Forestry Branch has charge of forest reserves in western Canada aggregating some 16 million acres, mostly situated on the east slope of the Rocky Mountains. During the season reported upon considerable attention was given to forest surveys, the Forestry Branch being virtually the organization responsible for the classification of Dominion lands and the exploration of the federal timber resources of the country. The timber survey of the Hudson Bay railway route was completed, with the stand of timber as poor as the first season's work indicated. Investigation of the territory adjacent to several of the Reserves showed the desirability of additions, especially to the Porcupine Hills and the Prince Albert reserves. New reserves were recommended in the Lesser Slave lake country and the Porcupine Hills in Alberta. Two parties completed the delimitation of the boundary of the Rocky Mountains Forest Reserve. Special investigations were made into the question of reproduction following fires and logging on the east slope, and the rate of growth of Douglas fir in the coast district.

During the year 438 fires were reported, of which 117 were chargeable to railways, 115 to hunters and travellers, and 55 to land-clearing operations. The protective service consisted of 129 fire rangers, an altogether insufficient number of the territory involved. To the Forestry Branch falls the duty of protecting from fire the Dominion lands as well as the forest reserves.

The tree planting division at Indian Head supplied 3,300 applicants with over 2,600,000 trees for prairie planting. Although the station comprises some 67 acres of nursery, and 78 acres of permanent plantations (on which growth measurements are made regularly), it has been found necessary to open a new establishment at Saskatoon.

The report contains as appendices the individual reports of the various officials, as also an account of a shipment of reindeer from Newfoundland to Mackenzie river. J. H. W.

Forest Conditions in the Rocky Mountains Forest Reserve. By T. W. Dwight, M. F. Bulletin 33, Dominion Forestry Branch. Ottawa, Canada. 1913. Pp. 1-62.

The Rocky Mountains Forest Reserve comprises some 11.6 million acres, lying between an altitude of approximately 4,000 and 7,000 feet (timber line) on the eastern slope of the Rocky Mountains. The data for the present bulletin were gathered in the southern portion of the reserve in the Crowsnest and Bow River Forests. From data gathered there and from other sources of information, the author estimates that not more than one-fourth of the area of the Reserve is covered with mature timber. The rest has been burned at various times, mostly within the past fifty years, so that several age classes exist, areas covered with second growth too small for saw timber and only occasionally large enough for mine props or cordwood. The yield of the approximately three million acres of mature timber is estimated to run from 5.000 to 20.000 feet per acre. The timber trees are furnished mostly by three species, namely Lodgepole Pine, forming about 60 per cent. of the stands; Englemann Spruce, forming 35 per cent.; and Douglas Fir, forming 5 per cent. About one-half of the mature forest is composed of mixed stands of these three species. The remaining half is made up of approximately pure stands in which Lodgepole Pine covers three-fifths and Engelmann Spruce two-fifths of their area.

The author divides the mature forest into three site classes. Site I includes the smooth slopes on the border of the prairies, the bottoms of the valleys, and the lower gentler slopes in the mountains. The soils are comparatively deep and well drained. Formerly more or less extensive stands of Douglas Fir existed along the margins of the prairies, but, having been subjected to repeated fires, they are now much reduced and are not of relatively great commercial importance. The stands here are usually open and park-like, but the volunteer growth is fairly good when not kept down by fire or grazing. In most valleys of the foothills and farther up in the mountains, Site I is occupied by pure stands of Engelmann Spruce, frequently interspersed by scattered Lodgepole Pine, Douglas Fir, Balsam Poplar, and Alpine Fir. The spruce stands are occasionally replaced by those of pine, but this can be traced to the influence of fire. The crown cover of the spruce stands is usually rather dense, casting a heavy shade and consequently the woody undergrowth is sparse, but the large amount of soil moisture leads to a luxuriant growth of Sphagnum and other mosses. The volunteer growth of the spruce is found chiefly in the more open places in the stands.

Site II includes the slopes above Site I, and it extends as high up the slopes as the soil remains moderately deep. The ground is drier than in Site I and the more open character of the crown cover, especially where pine predominates, leads to a better decomposition of the humus, and thus reduces the raw soil condition prevailing in the Alpine habitats of Site I. This site class apparently occupies the largest area of the mature forest. In this site mixed stands of pine and spruce or pure stands of each species are in control. Douglas Fir is a more frequent associate of the spruce here than in Site I. The Alpine Fir, of inferior quality and size, is regularly mixed in with all of the stands. The forest as a whole is even-aged and uniform in character, doubtless originating from fire. The boles of the trees are slender and comparatively free from branches and they can furnish a larger proportion of clear lumber than the trees of the other sites.

The steeper slopes above Site II, where the dryness and thinness of the soil, and other factors, make the production of merchantable timber impossible, or very limited in extent, are classed as Site III. The forest for the most part consists of even-aged, very dense stands of Lodgepole Pine with only the largest and best trees over ten inches in diameter. On the northern and eastern exposures, however, mixed stands of pine, spruce and Alpine Fir frequently occur. The latter species is the commonest associate of the pine and its reproduction forms the largest proportion of the volunteer growth under all of the stands.

As stated above, three-quarters of the forest area of the Rocky Mountains Reserve has been burned one or more times and is now occupied by second growth, over 90 per cent. of which is Lodgepole Pine of various age classes, the remainder being mostly Engelmann Spruce, or in the foothills, poplar. The predominance of pine reproduction after fire is due to the persistence of its cones, coupled with the long continuance of the germinating capacity of the seeds, thus leading to an accumulation of seeds for the seedbed which the fire prepares. The fire also acts directly by accelerating the opening of the cones. In general, the heavier the fires, the more rapid and denser the reproduction, since the seeds are brought to the ground more quickly and the soil is more completely exposed. In the case of spruce, on the other hand, the fire kills the seed both on the tree and on the ground, and the seed-producing tree is more readily killed than the pine. The spruce reproduction takes place on the moist humus covered sites, which escaped the full effects of fire from seed trees left alive, or from seed blown in from an adjacent green forest. When a fire in a pure spruce stand kills all of the seed trees, and when no pine seed trees are present, the grass which temporarily occupies all burned over areas becomes permanent and a meadow is formed.

In regard to silvicultural methods in the mature forest, the author suggests for the pure spruce stands the strip system and the selection system. The present regulation of cutting nothing below the ten inch stump-diameter limit, even when observed, does not leave enough trees effectively to seed up the area, and those left are usually wind-thrown. In many cases where cuttings were made 25 years ago, practically no reproduction of the original spruce has taken place. It is suggested that clear cuttings be made in strips not over 100 feet wide, leaving an equal area of timber uncut in alternating strips, the strips being located according to topography and exposure to protect from windfall. The cutting of the left over strips should not be made until the young trees on the first cut strips become thoroughly established and preferably not until they are bearing cones abundantly. The selection system should be operated in the less uniform stands. Its advantage would be that while reproduction was taking place on the ground trees would be left to occupy a portion of the growing space without materially retarding the reproduction, and the older trees, on account of the increased light afforded them by the cutting, would grow more rapidly. This method would obviate the period of little or no volume increment during the juvenile period of the strip system.

Since the pine stands are mostly even-aged, the strip system is recommended for them. The splendid and often too abundant reproduction of pine after forest fires suggests the use of that instrument to secure reproduction on clear cut areas by burning the brush broadcast after the logging operations. This method, however, naturally has extreme dangers in operation, and it cannot be recommended until greater experience in brush burning is acquired. In the mixed stands either the selection system or the strip system is suggested according to the dominance of pine or spruce.

The author also discusses marking rules and methods, brush disposal, timber sales, and contracts. It is recommended that, wherever possible, brush be burnt, preferably in round piles when the snow is on the ground, and the cost should be kept below 20 or 30 cents per thousand feet, board measure. The points to be noted under contracts are: the time limit, regulations as to cutting individual trees, brush disposal, availability of workmen to fight fires, damages by fires due to carelessness of the operators, authority as to supervision, interpretation of the provisions of the contract, final settlement of disputes, and penalties for non-observance of the regulations.

The suggestions as to the management of the Reserve and the silvicultural methods to be employed are based upon a careful and detailed study of the silvicultural characteristics of the principal trees. A discussion of the results of this study cover fourteen pages of the bulletin. This is an indication that the Forestry Branch intends to profit by the mistakes of other forest services, which have wasted much money in installing methods of silvicultural practice without the preliminary knowledge of how the trees behave themselves under natural conditions. It is to be hoped that the Forestry Branch may be speedily furnished the financial means and the trained men to carry out the suggestions and recommendations contained in this bulletin, as well as to carry on further investigations along the same lines.

The bulletin is a landmark among the previous publications of the kind in Canada, and the author is to be congratulated upon his keen appreciation of the necessities of the situation, upon the style of presentation, and the clearness of his ink.

C. D. H.

The Rocky Mountain Review. Volume I, Number 1. Calgary, Alberta. April, 1913.

This is the first issue of a quarterly published at the office of the District Inspector of Dominion Forest Reserves for Alberta, and is similar to corresponding publications from the western districts of the United States national forests.

It is intended "to serve as a directory of members of the service, to act as a news letter, so that each Reserve may know what is being done on the others in the District, to act as a medium for exchange of ideas, to act as a periodical catalogue of accessions to the district library, and to maintain a feeling of unity and solidarity among the members of the District force." It is also planned to run a department for contributed articles from the rangers and forest officers.

This issue takes up each reserve in detail, giving full information as to personnel, improvement work, and the miscellaneous activities. It closes with sundry news and notes from various sources, of interest to Canadian foresters.

We congratulate the forest officers of the Rocky Mountains Forest Reserve on their progressive spirit. J. H. W.

The Important Timber Trees of the United States. By S. B. Elliott. Houghton Mifflin Co., Boston and New York. 1912 Pp. 382. Price $2.50.

This book carries the subheading "A manual of practical forestry for the use of foresters, students and laymen in forestry, lumbermen, farmers and other land owners, and all who contemplate growing trees for economic purposes."

With this object in view the book is divided into two parts. Part I, occupying about one-third of the volume, is a simply written compendium of information on artificial regeneration practice and treatment of misused forests. Part II, forming the bulk of the book, deals with the important American trees. These are taken up consecutively, each being fully described, together with the qualities and uses of the wood and the biological characteristics of the species.

The book is plainly written, free from technical discussion with no attempt to introduce the theory of scientific forestry. It is essentially a handbook for the layman who wishes to help himself. J. H. W.

Kiln Drying Douglas Fir and Other Northwestern Woods. By H. B. Oakleaf. Reprint from the Pacific Lumber Trade Journal, Seattle, Wash., March 15, 1913. Pp. 13.

This study was undertaken by the U. S. Forest Service to procure information on processes and apparatus used in kiln drying Douglas fir, western hemlock, Sitka spruce, western red cedar, and western yellow pine. A detailed study was made of the methods employed at the various kilns in order that the results obtained at the various kilns could be compared and analyzed. The conclusions drawn from the results of the project are as follows:

1. Kilns operated with no draught from outside air and little or no ventilation produce lumber which is more uniformly free from checking and warping.

2. Kilns using temperatures between 200 and 230 degrees F, are producing excellent lumber with no appreciable discoloration or brittleness, except where the boards are allowed to get too dry. Higher temperatures (up to 300 degrees F.) produce surface discoloration which does not seem to be harmful, for it disappears in machining and the lumber is not noticeably brittle.

3. The degree of heat and the method of piling to enable the

heat to enter the load are the essentials of rapid and uniform drying.

4. Preliminary steam baths are of great value in reducing checking, casehardening and warping; for drying in no case should be permitted to proceed unless conditions are such that the moisture will be brought from the interior of the board as rapidly as it is removed from the surface.

5. Artificial circulation greatly accelerates and equalizes the rate of drying in flat piled loads.

6. Vertical stacking greatly accelerates and equalizes the rate of drying in kilns relying upon natural circulation by affording uniform distribution of heat.

7. Rapid or appreciable exchange of air in the kilns for carrying away the evaporated moisture, or condensing apparatus for disposing of this moisture, is not essential to quick drying, even at temperatures 10 or 20 degrees below the boiling point.

8. The practice of using wide pieces of flooring strips for stickers should be abandoned, for they greatly retard drying in that portion of the board covered by them. Flooring strips so used, often being manufactured, frequently shrink at the points where they were in contact with other boards, giving manufactured board incavated edges at such points.

9. There is room for improvement in the method of binding vertical stacked loads, in which there is a small amount of warping.

10. The time required for drying lumber at nearly all kilns visited may be greatly reduced by one or more of the following means: More open piling, vertical stacking, higher temperatures, conservation of heat, constant temperature, separation of species, and discontinuance of the practice of drying lumber to an unnecessarily low moisture content.

11. All factors which tend toward uniformity in drying conditions on the two sides of the boards and throughout the truck materially increase the efficiency of the kiln.

S. J. R.

OTHER CURRENT LITERATURE.

Mechanical Properties of Woods Grown in United States. (Preliminary summary of tests of small, clear, green specimens of forty-nine species of wood.) Circular 213, U. S. Forest Service. Washington, D. C. March, 1913. Pp. 4.

Tests of Packing Boxes of Various Woods. By J. A. Newlin. Circular 214, U. S. Forest Service. Washington, D. C. 1913. Pp. 23.

The tests described in the circular were made in co-operation with the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, Ninety-six boxes were tested of which 24 were nailed, 32 were wire bound, and 40 were dovetailed. The work completed covers but a small part of the field of box construction.

Effect of Forest Fires on Standing Hardwood Timber. By W. H. Long. Circular 216, U. S. Forest Service. Washington, D. C. 1913. Pp. 6.

The aim of this leaflet is to point out some of the direct and immediate effects of light fires in a forest. Though the study upon which it is based was made in the Ozark Mountains of Arkansas, the results are applicable to other hardwood regions.

Three ways in which forest fires damage standing timber are discussed:

(1) By producing fire scars through which worms enter.

(2) By opening a passage through bark and sapwood for rots to reach the heartwood.

(3) By weakening trees with hollow butts till they either burn down, die from fire girdling, or are blown over by strong winds.

Wood Turpentines: Their Analysis, Refining, and Composition, Based upon Experiments at the Forest Products Laboratory at Madison, Wis. By L. F. Hawley. Bulletin 105, U. S. Forest Service. Washington, D. C. 1913. Pp. 69.

Forestation of the Sand Hills of Nebraska and Kansas. By C. G. Bates and R. G. Pierce. Bulletin 121, U. S. Forest Service. Washington, D. C. February, 1913. Pp. 49.

Mechanical Properties of Western Larch. By O. P. M. Goss. Bulletin 122, U. S. Forest Service. Washington, D. C. January, 1913. Pp. 45.

The National Forest Manual. Regulations of the Secretary of Agriculture and Instructions to Forest Officers relating to Water Power (Act of February 15, 1901) and Telephone, Telegraph and Power Transmission Lines (Act of March 4, 1911). Washington, D. C. 1913. Pp. 63.

The National Forest Manual. General Laws, Parts of Laws, Decisions, and Opinions Applicable to the Creation, Administration, and Protection of National Forests. Washington, D. C. 1913. Pp. 97.

National Forests—Location, Date, and Area, January 31, 1913. Washington, D. C. 1913. Pp. 6. Map.

There are 160,193,996 acres, of which approximately 13 per cent. is alienated by states and individuals. In addition there are two National Forests in Alaska aggregating 26,748,850 acres and one in Porto Rico of 65,950 acres, making a total for the 163 Forests, of 187,008,796 acres. Ten national monuments situated in National Forests have been created under the Act of June 8, 1906, for the preservation of objects of historic or scientific interest. The area of these is 1,424,940 acres. Two national game preserves, viz: Grand Canyon and Wichita, situated wholly or in part within National Forests, have been designated under special Acts of Congress for the protection of wild animals. Their area is: Grand Canyon, Arizona, 1,492,928 acres; Wichita, Oklahoma, 57,120 acres.

The Microscopic Determination of Soil-Forming Minerals. By W. J. McCaughey and W. H. Fry. Bulletin 91, Bureau of Soils. Washington, D. C. March, 1913. Pp. 100.

The Utilization of Acid and Basic Slags in the Manufacture of Fertilizers. By W. H. Waggaman. Bulletin 95, Bureau of Soils. Washington, D. C. March, 1913. Pp. 18.

Studies in Cactaceae: I. By N. L. Britton and J. N. Rose.

Contributions from the United States National Herbarium, Volume 16, Part 7. Washington, D. C. 1913. Pp. 239-242.

Chalcidids Injurious to Forest Tree Seeds. By S. A. Rohever, Technical Series No. 20, part VI, U. S. Bureau of Entomology. Washington, D. C. 1913. Pp. 157-163.

The Dispersion of the Gypsy Moth. By A. F. Burgess. Bul*letin* 119, U. S. Bureau of Entomology. Washington, D. C. 1913. Pp. 62.

The Persian Walnut Industry of the United States. By E. R. Lake. Bulletin 254, U. S. Bureau of Plant Industry. Washington, D. C. 1913. Pp. 110.

The Destruction of Cellulose by Bacteria and Filamentous Fungi. By I. G. McBeth and F. M. Scales. Bulletin 266, U. S. Bureau of Plant Industry. Washington, D. C. 1913. Pp. 50.

Report of the National Forest Reservation Commission for the Fiscal Year ending June 30, 1912. House Document No. 1158, 62nd Congress, 3rd Session. Washington, D. C. 1912. Pp. 16.

International Trade in Farm and Forest Products, 1901-1910. By E. Merritt. Bulletin 103, U. S. Bureau of Statistics. Washington, D. C. 1913. Pp. 57.

National Reservations for the Protection of Wild Life. Circular 87, U. S. Bureau on Biological Survey. Washington, D. C. 1912. Pp. 32.

Data for Use in Designing Culverts and Short-span Bridges. By C. H. Moorefield. Bulletin 45, Office of Public Roads. Washington, D. C. 1913. Pp. 39.

Report of Forest Commission, Maine, 1912, with a Report on the Wood-using Industries of Maine. By J. C. Nellis. Augusta, Me., 1912. Pp. 188.

Report of the New Hampshire Forestry Commission for the Years 1911-12. Concord, N. H. 1912. Pp. 132.

Taxation of Forests: Papers and discussion at a conference, July, 1912, under the auspices of the Society for Protection of New Hampshire Forests and The New Hampshire State Forestry Commission. Concord, N. H. 1913. Pp. 80.

Second Annual Report of the New Hampshire State Tax Commission. Concord, N. H. December, 1912. Pp. 109.

The Wood-using Industries of Vermont. By Hu Maxwell, U. S. F. S., in co-operation with the Department of Agriculture and Forestry of the State of Vermont, A. F. Hawes, Forester. Vermont Forestry Publication No. 11. Rutland, Vt. 1913.Pp. 119.

The Artificial Use of the Brown-Tail Fungus in Massachusetts with Practical Suggestions for Private Experiment, and a Brief Note on a Fungous Disease of the Gypsy Caterpillar. By A. T. Speare and R. R. Colley, under direction of F. W. Rane, State Forester of Massachusetts. Boston, Mass. 1912. Pp. 31.

How to Plant Shade Trees. By J. B. Mowry. Leaflet No. 7. Office of Commissioner of Forestry of Rhode Island. 1912. Pp. 2.

Prolonging the Cut of Southern Pine, Part I, Possibilities of a Second Cut, by H. H. Chapman; *Part II, Close Utilization of Timber,* by R. C. Bryant. Bulletin 2, Yale Forest School. New Haven, Conn. 1913. Pp. 39.

Wood-using Industries of Connecticut. By A. H. Pierson. Bulletin 174 (Forestry publication No. 7), Agricultural Experiment Station in co-operation with U. S. Forest Service. New Haven, Conn. 1913. Pp. 96.

Special Report of the Conservation Commission of New York on the Efficiency of the Top-lopping Law. Albany, N. Y. March, 1913. Pp. 12.

The common objections to the efficiency of the top-lopping law are considered in detail and shown to be for the most part un-justified. Recommendations are made for the improvement of the law by giving the Commission some discretion in its enforcement to meet peculiar conditions.

The Reforestation of Cut-over and Idle Lands in New York. Bulletin Ia, Series XIII, New York State College of Forestry. Syracuse, N. Y. February, 1913. Pp. 16.

Forester's Manual. Part I. General Instructions, Outline for Annual Report, Instructions upon Forms. Pennsylvania Department of Forestry. Harrisburg, Pa. 1912. Pp. 30.

Biltmore Doings, 1909-1912. Biltmore, North Carolina. November, 1912. Pp. 172.

The monthly reports of the class presidents to the Alumni for the last three years are here collected.

Alabama Bird Day Book. Department of Game and Fish.

Written for Bird Day, May 5th. Study of birds and their helpful relationship to mankind. Montgomery, Ala. Pp. 84.

Clearing Pine Lands. By E. B. Ferris. Bulletin 159, Miss. Agricultural Experiment Station, Agricultural College, Miss. 1912. Pp. 12.

Fifth Annual Report of Forest Conditions in Ohio. Bulletin 254, Ohio Agricultural Experiment Station. Wooster, Ohio. December, 1912. Pp. 155-206.

Forest Taxation. Address delivered before the Sixth National Conference on State and Local Taxation, Des Moines, Iowa. September 4, 1912. By F. R. Fairchild. Pp. 31.

Twenty-sixth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. By S. A. Forbes, 1911. Pp. 160.

Includes figures and descriptions of some of the important insects of Illinois shade trees and shrubs.

Timber Land Bonds Analyzed as Investments for Banks and

Trust Companies. By C. L. Poole and Co., Chicago. 1913. Pp. 80.

Report of the State Forester of Wisconsin for 1911 and 1912. Madison, Wis. 1913. Pp. 102.

Minnesota Forestry Board: Second Annual Report of the State Forester. Duluth, Minn. December, 1912. Pp. 61.

Sixth Annual Report of the Clearwater Timber Protective Association. Orofino, Idaho. 1912. Pp. 25.

The past year has been the most successful in the history of the association. Nine fires were reported; eight caused by lightning and one of unknown origin, but only 17,500 feet of white pine timber was destroyed. Eleven miles of old wagon road were improved and three miles of new road were built at a cost of $1,741.37. In addition 357 miles of old trails were cleaned out and improved and 37 miles of new trail built, giving access to practically all of the timberland within the area under protection. The Association also constructed 21½ miles of new telephone line at a cost of $819.72, and 18 miles of line in co-operation with the Forest Service at a cost of $394.75. Including the 20 miles of line constructed in 1911 the total is now 59½ miles. It is planned to construct during 1913 about 40 miles of telephone line to connect with the various lookout stations.

Fifth Annual Report of the Washington Forest Fire Association, 1912. Seattle, Wash. 1913. Pp. 23.

Fourth Biennial Report of the State Forester of California. By G. M. Homans. Sacramento, Cal. 1912. Pp. 148.

A Report on the Re-cruise of about Fourteen Thousand Acres of Timber Land Belonging to the Agricultural College ond Scientific School Grants. By G. L. Clothier. Pullman, Wash. 1913. Pp. 20.

The lands sold by the State before the re-cruise amounted to 1,000 acres and the price received was $12,269. Prof. Clothier estimates the amount of timber on this land at 87,587,000 board feet worth $106,795.55, or nearly nine times what the State received for it. He strongly recommends that the sale of all the college timberlands be stopped pending re-cruising and re-valuation and makes other suggestions preventing the giving away of valuable property.

The Railroads and Forestry. Forest Fires. Papers and Discussions at a Forest Conference July 12, 1912. Society for Protection of New Hampshire Forests. 46 pp. 50 cents.

Contains eight papers of useful information, mainly on problems of protection against fire.

Detail Surveying and Exploration in Relation to the Management of Eastern Timberlands. By C. F. Hinkley, Bangor, Me.

Contains some useful practical hints.

The Sierra Ranger. Volume 3, number 1. Headquarters of the Sierra National Forest, Northfork, Cal. April, 1913. Pp. 17.

Proceedings of Forest Fire Conference, Western Forestry and Conservation Association. Seattle, Wash. December 2-3, 1912. Pp. 50.

Contains: Report of Forester; Patrol Associations' Work and Experiences in 1912, by States; Similar Reviews by Forest Officers; Safeguarding Logging Operations; Slash Disposal; Railroad Coöperation; Trail and Telephone Building; Possibilities of Wireless in Fire Work; Men, Tools and Supplies; Developments in Patrol Efficiency; Proven Principles in Forest Legislation; Publicity in Promoting Forest Protection; Practical Forestry Education; Resolutions.

First Report of the Board of Commissioners of Agriculture of Porto Rico for the Period from July 1, 1911, to January, 1912. San Juan, P. R. 1912. Pp. 61.

Includes "A Preliminary Report on the Forest Problems of Porto Rico," by L. S. Murphy, U. S. Forest Service.

Some Observations on Hawaiian Forests and Forest Cover in Their Relation to Water Supply. By W. M. Gifford. Joint Committee on Forestry, Hawaiian Sugar Planters' Association, and Board of Agriculture and Forestry. Honolulu, Hawaii. January, 1913. Pp. 24.

Report of the Division of Forestry for the Biennial Period ending December, 1912. By R. S. Hosmer. Board of Agriculture and Forestry, Honolulu, Hawaii. 1913. Pp. 99.

Farm Forestry. By E. J. Zavitz. Bulletin 209, Ontario Agricultural College. Ontario Department of Agriculture, Toronto. February, 1913. Pp. 30.

A revised edition of an earlier bulletin on the treatment of farm woodlots and waste land.

Forest Products of Canada, 1911: Lumber, Square Timber, Lath and Shingles. By R. G. Lewis and W. G. H. Boyce. Bulletin 34, Forestry Branch. Ottawa, Canada. 1913. Pp. 35.

Forestry Products of Canada, 1911: Poles and Crossties. By R. G. Lewis and W. G. H. Boyce. Bulletin 35, Forestry Branch. Ottawa, Canada. 1913. Pp. 18.

Experimental Farms: Report for Year Ending March 31, 1912. Department of Agriculture, Ottawa, Canada. 1913. Pp.

Contains notes on insects affecting forest and shade trees, pp. 180-182.

First Quarterly Progress Report on Timber Research Work in School of Forestry, University of Cambridge. By E. R. Burden and A. P. Long. Cambridge, England. 1913. Pp. 11.

In November, 1912, the Board of Agriculture and Fisheries authorized a grant in aid of $2,500 a year for two years to the University of Cambridge, to enable the conducting of research work in timber—either indigenous trees or such exotics as are of particular importance in the United Kingdom. Work was begun the first of this year on the growth and utilization of Scots pine. The main object of the inquiry is to ascertain to what extent this tree can be profitably grown, to investigate the quality of the timber produced under various conditions in different districts, and to judge of its suitability for many purposes at present filled by imported pine.

Note on the Distillation and Composition of Turpentine Oil from Chir Resin and the Clarification of Indian Rosin. By Puran Singh. Indian Forest Records. Vol. IV, Part I.

Note on Some New and Other Species of Hymenoptera in the Collection of the Zoological Branch of the Forest Research Institute, Dehra Dun. By P. Cameron. Indian Forest Records. Vol. IV. Part II. 1913. Pp. 33.

Note of Useful Exotics in Indian Forests (No. 1 Prosopis juliflora). By R. S. Hole. Indian Forest Records. Vol. IV. No. III. 1913. Pp. 28.

Note on Albizzia Lathamu. By R. S. Hole. Indian Forest Records. Vol. IV. 1913. Pp. 6.

Note on the Utilization of Bamboo for the Manufacture of Paper-pulp. By R. S. Pearson. Indian Forest Records. Vol. IV. No. V. 1913. Pp. 121.

Note on Ligno Protector as a Possible Means of Preventing Timber from Splitting while Seasoning. By R. S. Pearson. Forest Bulletin No. 13. Imperial Forest Service, Calcutta, India. 1913. Pp. 10.

Experiments were made to ascertain the value of a patent substance known as "Ligno Protector" which, it is claimed, prevents timber from splitting. Ligno is a light brown plastic substance of the consistency of thick paint, and is applied in a fairly heavy coating, about 1/10 inch thick, to both ends of the log. The conclusions arrived at from these experiments which covered 2½ years are as follows:

(1) The seasoning process is without doubt very considerably retarded, a very desirable circumstance.

(2) Ligno Protector by no means absolutely prevents timber from splitting, and, though effective in some cases, it is absolutely incapable of protecting such species as *Quercus incana* from doing so.

(3) Before any definite opinion can be formed as to its commercial value it will be necessary to give it a trial on a large scale and under natural conditions.

A Further Note on the Relative Strength of Natural and Plantation Grown Teak in Burma. By R. S. Pearson. Forestry Bulletin No. 14, Imperial Forest Service. Calcutta, India. 1913. Pp. 21.

"The object with which these experiments were carried out was to ascertain whether *plantation-grown* teak was as strong as that from *natural forests*. The answer is without doubt in the affirmative."

Notes on the Technical Properties of Timber with Special Reference to Cedrela Toona Wood while Seasoning. By R. S. Pearson. Forestry Bulletin No. 15, Imperial Forest Service. Calcutta, India. 1913. Pp. 5.

Results of the first of a set of experiments to ascertain the relative amount of shrinkage which takes place in different species of timber while seasoning. Describes a new testing machine devised specially for the purpose.

Progress Report of Forest Administration in Coorg for 1910-11. By H. Tireman. Bangalore, India. 1912. Pp. 26.

Fünfundzwanzig Jahre Karstaufforstung in Krain. By K. Rubbia. Bericht der Aufforstungs-Kommission f. d. Karstgebiet des Herzogtums Krain-über die Tätigkeit vom Jahre 1886 bis Ende 1911. Lubiana. 1912. Pp. 97.

Die Naturwissenschaften. Wochenscrift für die Fortschritte der Naturwissenschaft, der Medicin und der Technik. Herausgegeben von Berliner und Thesing. Berlin. 1913.

A new journal of promising exterior, discussing in short articles the newest developments in natural especially biological sciences and their application.

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FOREST GEOGRAPHY AND DESCRIPTION.

Richest Swedish Stand.

Gunnar Schotte describes in detail with magnificent illustrations a stand of mixed conifers in Södermanland belonging to the municipality of Jönaker, which is believed to represent the maximum of production in workwood. The stand was 140 years old in 1909, and is supposed to have originated after agricultural use ("rye-burn") of the soil. It is a mixed stand of pine and spruce, the latter being in subordinate position, representing 14 to 24 to 30 per cent. The pines are clean boles to nearly 50 feet, and green branches start only at from 65 to 80 feet; crowns therefore are small. Four sample areas have been measured, the details of which are tabulated, varying from 12,000 to 21,000 cubic feet per acre with 378 to 710 trees to the acre, an average diameter of 11 to 13 inch, and height 95 to 96 feet. If, however, the spruce is excluded, which numerically represented 40 to 60 per cent. but in volume only 11 to 28 per cent. with diameter of only 6 to 9.5 inch and heights of 65 to 75 feet, the pines average 15-16 inch with heights of 105 feet, and the maximum volume 18,700 cubic feet, which may be translated into not less than 100,000 feet B. M., over 133 cubic feet or, say, 700 feet B. M. per acre per year.

At least 50 to 60 per cent. of the trees are well formed, but *Polyporus pini* has put in his work and would considerably reduce the output. A comparison with other maximum yields from Germany and Switzerland would make this the largest on record.

Classifying the trees according to the new Swedish schedule (see p.   of this issue) it is shown that 30 to 48 per cent. of all pines (30% of basal area) were injured by neighbors for lack of thinning. From the fact that the pine shows a basal area of 500 to 600 square feet and on limited areas up to 1,000 square feet, the author deduces that the pine under favorable soil conditions is more tolerant than it is given credit; and the sparser the spruce the larger the volume. The basal area per cent. on the poorer sample is 30 for spruce and 70 for pine, on the better area the latter participates with 76 per cent. That such large trees of pine can stand so dense the author thinks unique. The value of the stand on these sample areas, leaving out any deductions for rot, is stated as around $1,000 per acre.

Sveriges virkesrikaste skogsbestand. Skogsvardsföreningens Tidskrift. 1912. Pp. 195-210.

Finland Forest Administration.

The State forests of Finland, about 31 million acres, are divided into two classes, namely definite forest reservations, some 5 million acres, and public forest domain not yet disposed of, which may or may not be changed into reservations or crown forests. Both these properties are under a central forest direction at Helsingfors in the resort of the Economic Department of the Imperial Senate, to which latter all important questions are submitted.

The Senate appoints the officials from a list of eligibles (three for a place) which the forest direction submits, designating its preference. The financial budget is also voted by the Senate, separately for salaries and for other work. The funds for the latter, some one million dollars annually are spent at the discretion of the administration; but all larger sales of wood and any disposition over the public domain ("crown excess soils") are decided by the Senate.

The constitution of the administrative office is collegiate, consisting of a director, two counsellors, and an inspector (Forstoberrevisor), the director being only the presiding officer, but having the deciding voice in case of a tie, and dealing with small questions independently.

There are 16 other persons employed at this central office, besides clerks, draftsmen, etc.; the total number amounting to 48; the expense to $36,000.

The appointment of the director is made by the Czar, who is grand duke of Finland.

The total forest area is divided into 8 inspectorates, each presided over by an Oberforstmeister, having several Forstmeister or supervisors to administer the reviers, of which there are in all 82. Under the latter there are in each revier one or more underforesters, educated at a foresters' school of two year course, acting as assistants. Besides, some 798 forest guards, and sometimes additional guards, look after the protection of the property.

A special working-plan corps of 12 forest revisors, with assistants, makes and every ten years revises working plans. Moreover, four forestmasters devote their entire attention to the study and application of methods of culture of moor soils.

For the purpose of utilizing less valuable products the administration runs three small sawmills, besides several cord-cutting mills.

The total cost of the forest administration amounts to about $225,000. The small personnel is explained by the fact that the wood is mostly sold on the stump, to be removed by the purchaser in two years, the trees to be cut being marked. Only the small amounts needed for the State mills is cut under direct supervision of the foresters.

The net revenue resulting amounts at present to around 2.5 million dollars.

Besides the large forest property, the State owns a considerable number of farms, which are rented, and the woodlots are managed under working plans mostly by area allotment. Although the cutting is inspected by foresters of the government, much abuse is being complained of, especially where permission is given to thin out by selection cutting with a view of securing or improving pasture. A seed tree management is mostly in vogue, which, on the whole, where properly carried out is satisfactory enough.

The export of forest products has continually increased in the last 25 years, namely from a little over $8 million yearly average in the quinquennium 1886-1890 to $37 million in 1906-10, and to $48 million in 1912.

The main items of export are, of course, wood and manufactures of wood with nearly $35 million, and woodpulp and paper with $13 million, leaving about $300,000 for other products, charcoal, tar, etc.

Finska Forstföreningens Meddelanden. January, February, 1913. Pp. 50-55; 106-109.

Forests in Chili.

Estimated area of national forests is about 7 million acres, in addition to this there are about 30,000 acres of planted forest. The Government is taking measures to stop destruction of timber and to plant regions where little wood of any kind exists now. Most of the Chilean woods are heavy and will not float. This and the lack of railroad facilities has stood in the way of exploitation.—Hardwood Record.

BOTANY AND ZOOLOGY.

Insects and Fungi on Oak.

The rapid death, or severe injury, of oak stands in Western Westfalia since about August, 1911, is called to attention by Baumgarten. Suppressed trees, as well as dominant ones, fell a prey, the dead sapwood being quickly destroyed by beetles. The injury is attributed to the oak *Tortrix (T. viridana)* followed by the oak mildew. While neither alone is serious, the injury is severe when they work together.

In 1911 the insects were active to the end of June. In early July the trees had begun to leaf out again when they were attacked by the mildew. The attack was so severe that many thought the oak did not leaf out the second time. The trees then remained bare after August.

It is stated that the American red oak is immune to the mildew, and almost so to the oak Tortrix. The authors think the fungus not of American origin, but spreading from the Iberian peninsula, crossing over to the oaks from some other host.

Insekten -und Pilzschäden an den Eichenbeständen der Provinz Westfalen. Zeitschrift für Forst. u. Jagdwesen. March, 1912, 154-161.

Detection of Heart-Rotten Trees.

Diseased trees frequently do not produce fruiting bodies to indicate the fungus working in their heartwood. Duesberg seeks some method for the detection of such trees so they may be removed in thinning processes and thus gradually the disease be eradicated. In the case of the European pine affected by *Trametes pini* he states after considerable field experience, that infected trees can usually be located by the presence of diseased branch spots which have a brown mycelium beneath the bark at these points and heal differently from normal unifected wounds.

To test the ability of the ordinary woodsmen to seek out diseased trees several were trained in the detection of the spots and, armed with long "pokers", they went through the pole forest in strips, examining each tree, laying suspected spots bare, and blazing diseased trees for removal. It was found that mistakes were rarely made in knocking off sound calluses.

After several years the process must be again repeated in order gradually to secure freedom from disease.

The cost of the operation was about 2½ cents per tree.

Das Aufsuchen von Schwammbäumen in Kiefernbeständen vor der Ausbildung von Fruchtträgern. Zeitschrift für Forst. u. Jagdwesen. Jan. 1912, pp. 42-43.

Tree Irrigation.

In transplanting larger trees, often insufficient root-system is secured to keep the tree alive; such trees sometimes leafing out the first year but succumbing the second. Even assiduous watering may not have the needed effect if hot and dry weather sets in.

Dr. Kellerman reports the success of a novel way of supplying the water to a newly transplanted cherry tree which had begun to wilt. He bored a hole nearly one inch deep in the foot of the tree, closed it with a cork through which a glass tube was introduced, connected with a rubber tube attached to a vessel with a water jug up in the crown of the tree.

The vessel was kept supplied with water, of which at first rapidly several liter a day were taken up, later less and less till finally hardly any, when the treatment was discontinued. The effect was immediate; the rolled up leaves unfolded and the tree recovered.

A newly transplanted apple tree treated the same way also recovered, but was killed by bark beetles.

Behandlung von frischversetzten grösseren Bäumen. Praktische Blätter für Pflanzenbau und Pflanzenschutz. February, 1913. Pp. 16-17.

SOIL, WATER AND CLIMATE.

Ohio Peat Bogs.

The measurements of the physical factors of the habitat, according to Dachnowski, have not made clearer the nature of the absorption, tolerance and resistance of plants in peat bogs. The daily evaporation in a bog forest is about the same as that in a beech-maple forest, while in a bog meadow the evaporation is less than on the open campus of the State University. The differences in temperature, acidity, osmotic pressure, position of the water table, and the amount of available food salts in the various zones are not sufficient to limit the distributional relationships.

The author thus summarizes his findings:

Physiological investigations of peat soils have brought out clearly the fact that the character of the obligate bacterial flora and the nature of the organic compounds produced, form a very important factor in the relative fertility of peat soils, in the causes of vegetation succession, in the distributional and genetic relationships of associations, and in the characteristic xeromorphy of both ancient and modern bog vegetation.

In view of the widely differing behavior of agricultural varieties in a bog water solution, and the interesting observation that plants of the same species respond differently to the same solution, the conclusion is inevitable that here the source of the difference must logically be looked for, not in the solution alone, but in the conditions of the plants as well.

Since certain of the organic compounds eventually penetrate the protoplasmic membrane of absorbing organs and inhibit growth, it is evident that much importance must be ascribed to the influence exerted upon the plasmatic membrane, to the consequent differences in its diosmotic properties, and to the pathological changes induced, which accompany the absorption of the injurious substances. The phenomena of absorption and tolerance, however, deal plainly not with osmotic pressure relations so much as with considerations of the permeability of the absorbing protoplasmic membrane, its power of endurance, and its ability by enzymatic action either to absorb and assimilate or to transform injurious bodies into insoluble, impermeable compounds.

The organic disintegration substances in peat soils, while inhibitory to agricultural plants, have little or no effect on certain xerophytic plants. These organic substances play the differentiating rôle and are a cause of the infertility of peat deposits even when the amount of air and water in the soil is abundant and the temperature and humidity conditions are favorable to growth. These facts have an important bearing on the value of peat land to agriculture.

The Nature of the Absorption and Tolerance of Plants in Bogs. The Botanical Gazette. December, 1912. Pp. 503-514.

Forest Influences on Soilwater.

Dr. Bühler has published interesting investigations of the detail of forest influences. Under 100-year-old beech in a year only 75 per cent. of the precipitation in the open was measured; under 20-year-old fir only 20 per cent., and under spruce, 32 per cent.

Placing the water percolating through sand as 100, loam will allow 76 to 87; clay 84 per cent. to percolate; but loam with a litter cover percolated 147, sand with moss 134 of what sand uncovered did. On the other hand, on loam soil with spruce only 70; on loam with beech, 50; on loam under very dense beech 60 per cent. of the water percolated of what uncovered loam would produce.

A constant relation between water contents of the upper (8 inch) soil layer and the lower (12-16 inch) does not exist; relations are much more complicated than at first appears. On the whole, the lower strata were found only 2.3 per cent. moister than the upper; sometimes, however, the lower strata were drier than the upper.

As to evaporation from soil under forest cover, former findings are confirmed. Leaf and moss cover reduced evaporation by 30 and 35 per cent.; but 100-year-old oak reduced it by 53; a low stand (25 feet) of Douglas Fir by 75 per cent., the shade effect being superior to the mulch effect. The character of the soil seemed to make no difference, except that a humose soil reduced evaporation considerably.

An interesting fact is that a *small* opening of 30 *qm* in a beech stand did not show any less reduction than the full stand, namely 45 per cent. of the water evaporated in the open field; especially was there no difference in the hot summer months.

The temperature of dry and wet soils was also carefully studied; the soil kept constantly wet was found 1-2° colder than the dry or occasionally wet soil, sometimes the difference rising to 4-6° *C.*

Mitteilungen der Württembergischen Forstlichen Versuchsanstalt. Allgemeine Forst- u. Jagdzeitung. March, 1913. Pp. 95-96.

Quebec Pulp Wood.

On the basis of the sub-division into forest types by Fernow, Mr. Ellwood Wilson measured out the distribution of Quebec forest country as follows:

	Square Miles.
a. Northern Subarctic,	91,442
b. Southern Subarctic,	112,644
c. Laurentian,	79,408
d. Lower St. Lawrence,	2,511
e. Settled,	17,830
Total,	303,855

The area of type *a* is entirely out of reach of markets. That of type *b,* according to Piche, is not over ten per cent. timbered, along water courses. Of the Laurentian area 33 per cent. is burnt, muskeg and water and partially lumbered.

The author then gives an estimate by watersheds of timbered area and cordage:

Location.	*Forest Type.*	*Total Area.*	*Per cent. Timbered.*	*Sq. Miles Timbered.*	*Cds. per Acre.*	*Total Cords.*
James Bay watershed,	Southern Subarctic,	11,233	60	6,740	3	12,940,800
James Bay watershed,	Laurentian,	1,824	60	1,094	4	2,800,640
Ottawa Assumption, St. Maurice and Saguenay Rivers,	Laurentian,	63,852	67	42,780	8	219,033,600
Lake St. John, Northern Tributaries,	Southern Subarctic,	17,027	59	8,513	4	21,793,280
Northern Shore of the St. Lawrence,	Southern Subarctic,	38,612	20	7,722	3	14,826,240
Northern Shore of the St. Lawrence,	Laurentian,	12,188	40	4,875	4	12,480,000
St. Lawrence,	Lower St. Lawrence,	2,511	50	1,255	5	4,016,000
Total,		147,247		72.979		287,890,000

Of this the subarctic area might as well be cut out, leaving around 250 million cords available, if the average figures hold out.

Pulp and Paper Magazine of Canada. May 1, 1913. Pp. 293-4.

The Conservation of Snow.

Prof. J. E. Church, Jr., University of Nevada, has been making some interesting studies upon the influence of mountains and forests on the conservation of snow. The investigations were conducted on or near Mount Rose, Nevada. This mountain is situated between the heavily forested main chain of the Sierra Nevada and the scantily forested ranges of the semi-arid Great Basin, and so forms the natural headquarters for the study of both. An observatory has been established on the top of the mountain at an elevation of 10,800 feet, with sub-stations about half way up and at the base of the mountain. At these stations many measurements have been made in regard to the depth, density and evaporation of snow, and especially the factors which influence its depth and time of melting.

Some results of these investigations may be given. Comparison of bare and forested mountain tops at an elevation of 9,300 to 10,800 feet. Measurements made in April, 1910. 47 stations. *Unforested talus slope* (3 sites). (a) Cornice below observatory: Snow, 52.5 inches; equivalent water, 25.1 inches. (b) Wind swept slope: Snow, 78.1 inches; equivalent water, 35.1 inches. *Forested slope:* Snow, 88.6 inches; equivalent water, 41.1 inches. It will be seen from the above, that the snow of the forested slope contained an average water content one-fifth greater than the unforested but protected slope, nearly twice as much water as the cornice at the apex of the mountain, over fourteen times the moisture conserved by the wind swept slope, and more than twice the average water content of the three unforested areas combined.

Measurements were also made to compare conditions on a treeless meadow, beneath an open stand of pine and fir, and beneath a fir forest of medium density, and it was found that, although the treeless meadow had the maximum store of snow at the beginning of the season, at the end the fir forest still retained one-fourth of its total store after the meadow had been bare for a week. The more open forest of pine and fir, which at the height of the season possessed the maximum store of snow, at the end retained but one-twentieth of it. The ideal forest for the conservation of snow is one of medium density or a dense forest with a maximum number of glades. The author recommends the making of these glades artificially in dense forests by the simple operation of cutting, the diameter of each glade being so proportioned to the height of the trees around it that the snôw in early spring is effectually screened from the sun. He also recommends the planting of tree screens at strategic points on exposed slopes to increase their capacity to store snow. The investigator believes that there can no longer be any question of the direct influence of forests in delaying the melting of snow, and thus in retarding stream flow at the very time when floods normally occur. A forthcoming bulletin by Prof. Church, giving the results of detailed investigations on this timely subject, will be awaited with interest.

Scientific American Supplement. September 7, 1912. Pp. 152-155.

SILVICULTURE, PROTECTION AND EXTENSION.

Light in Forest Management.

Dr. Beck in an inaugural address before the Tharandt forest school sums up in a complete, lucid and interesting manner the function which light plays in tree development and forest management.

Vegetation is determined primarily by climate, soil being a ruling factor only within climatically equal regions. Warmth and light are among the most important factors of climate, and have for a long time been subjects of investigation. On account of the ease of its measurement and observations in the work of plant ecologists, temperature has been given more prominence than light.

While the significance of the latter has been recognized for a long time, its use as a factor of management has rested more on instinct and practice-won skill than on exact knowledge of its influence. But of late years, especially in the past three decades, the work of such men as T. Hartig, H. Wiesner, and more recently Prof. Cieslar and M. Wagner, has furnished much useful information on the subject.

The subject is discussed from two standpoints, viz: the physiological and managerial significance and use of light.

It is known that light plays a very important role in growth and form relations, volume and value production of both individual trees and stands, but it is difficult to correctly gauge the share of light in this, since it is but one of many factors, such as temperature, moisture, soil, etc., acting in combination. But light gains its great significance from the fact that it is the only manageable factor of them all—it is the lever with which all others are set in operation. The effect of light depends on its kind, intensity, and direction of its working. As to kind, we distinguish direct and diffuse light. Direct light is chiefly valuable in the formation of leaf and flower buds, hastening development of leaves and producing a more vigorous, plentiful leafage. That too strong direct light may be harmful is shown by the presence of protective devices in exposed plants. Diffused light is the more important in general growth of plants. However, it is not so much the kind but the intensity of light that is important. Each species—each plant—has an optimum—a definite sum total—of temperature and light supply, in which it thrives, varying with latitude, altitude, soil, age, and development of plant, etc. In regard to light this optimum, while difficult to determine, lies in the upper half of total useful light supply. There is more danger in overshading than overlighting for all species, though not in equal measure.

The direction of light rays influences its form building power. We distinguish outer, inner and floor light. Outer light is direct, diffused or mixed light, striking the outside crown. Inner light is all light of value inside the crown. It is chiefly diffuse. Its intensity is important in bole cleaning or the formation of inner leaves. Floor light is that which reaches the soil through the crown cover. It is very important in operations concerned with care of soil, reproduction, etc. Its intensity depends on species, being in inverse ratio to crown density, and is indicated by the condition of the soil flora.

We recognize that light exerts a profound effect on increment. Diameter increment is in direct ratio to light supply. But for height increment the influence varies with the species. Monopodially crowned species, like larch, spruce, fir are stimulated by open position. The opposite is true for species inclined to spreading crown, as the broadleaved, and pine. Yet with pine, there may be exceptions, as is shown by the latest records of Saxon experiment stations, where 40 year pine, with wider spacing, showed increase of mean height. Also, Schwappach found on an experimental area opened up freely according to Wagener's prescription that well lighted stands from 30 to 45 years, i. e. within

15 years, showed a mean height advantage of .8 meters, (about 1 yard), over closed stands.

Volume increment depends on amount and energy of the leaf apparatus. Both are induced by increasing the growing space. As to amount of foliage, dormant buds and young sprouts are stimulated, especially in deciduous trees, where the light in spring reaches buds both in the periphery and interior of the crown. This is shown by Prof. Cieslar's example of 60 year beech where in 10 years the trees on the thinned half showed 8 times greater leaf development than that of the unthinned half.

The energy with which assimilation takes place varies with light, warmth and soil. Minerally poor soil produces a mis-relation between increment and leaf apparatus. R. Hartig opines for beech, oak and spruce that the light on trees set free calls forth more leaves than are necessary for the manufacture of food. Such leaves work sluggishly even in full enjoyment of light; hence such trees can afford to lose some foliage by pruning or natural clearing, without detriment to increment. Light alone does not do it. Hartig found the increment for spruce on minerally good as against poor soil to be as 2 to 1. Therefore, the growing space or thinning practice should be related to the character of the soil. Only on good soils does severe thinning pay. On poorer soils the increased increment due to thinnings often declines after a few years. R. Hartig and Hornberger say this is on account of the using up of the humus stock, of which there was only enough for temporary stimulation.

The greater part of increment, as high as 90 per cent., falls to the dominant trees. Comparing the work of the leaves of dominant as against oppressed trees, R. Hartig found that for spruce on best soil on dominant trees 1 *kg.* needles produced *cdm.*, on oppressed 1 *cdm.*, showing only one-fifth as much wood produced for the latter. Such relations are more significant in determining light influence than absolute amount of increment, the latter being dependent, *ceteris paribus,* on the assimilation energy and amount of foliage of the particular species. Both factors can compensate in their influence. For instance, Lubimenko found that with vertical light at 35° *C.*, one gram of leaves de-on best soil on dominant trees, 1*kg.* needles produced 5 *cdm.*, for pine 7.5 *ccm.;* for larch 11.5 *ccm.* These figures exhibit the smaller energy of fir and spruce as compared with pine and larch.

Only the greater amount of foliage of the more tolerant trees offsets their lesser assimilation energy, the general rule being that foliage amount is in inverse ratio to energy of assimilation.

From a managerial standpoint light is all potent. The problem is to increase the yield or shorten the rotation for the same yield, or both. The solution is to make a greater use of light influence in the care and regeneration of stands.

With suitable form, value increases with volume, i. e. diameter, almost ad infinitum for such species as oak, ash, beech, larch, pine, etc., but only up to a certain diameter for others as spruce, etc. In general then, our aim should be to attain satisfactory volume production. For this, only the vigorous promising better shaft-formed trees should be favored by increased growing space. This idea of favoring selected trees by earlier or later lighting is already old, but in spite of its excellent results its advocates have made no noteworthy school. If to-day we take a middle position between open stand and closed stand management, we have to thank chiefly the knowledge given us by forest experiment stations. A practical knowledge of the light question is possible only through sufficiently long, systematic and result-compared experiments in regard to the different methods of handling stands. The publication of the results of such experiments, especially those of Schwappach and others in Prussia has advanced very much the valuation of light influence. The highest value production is not in close crowned, densely stocked stands and long rotations, but in stands of fewer and more vigorous stems with crowns .3 to .4 of total height, which will form equal annual rings to a greater age. Max Wagner says each light beam idle because not rightly guided means a loss of power. We may go farther and say that the light should be devoted only to trees producing usewood. Of course, too severe thinnings which favor the humus exhausting soil flora must be avoided; but the procedure of allowing loss of power by keeping full crown cover during the entire life of the stand, is very unsatisfactory. And even if the volume production is uninjured, e. g. for spruce and pine, the value production suffers. Growing stands in open position cannot, to be sure, produce more total increment, but putting it on fewer stems means quicker diameter and value increase and therefore greater profits. For oak and beech, the most important broad-leaved species, the same holds in even greater measure because of their higher and longer persistent increase of value with diameter. Therefore, the management of these species strives for greater diameter growth. This can be obtained without too high rotations only by open position. On better soils, the broad-leaved trees, with their greater ability of reacting to light, guarantee a persistent "light increment," which means that a close stand for oak and beech causes more or less value loss. Schwappach says that in beech stands handled according to the regular rule of thinning the sub-dominant growth suffers serious value and volume loss. E. g., on the first three site classes open stands showed increased production in timberwood of 15 per cent. for 100 year rotations, and 19 per cent. for 120 year rotations, as compared with the closed stands.

What do we understand by light intensive stand management? Differences of biological characteristics of species, differences of site, and of objects of management prevent an answer applicable for all cases. But in general we should take the middle course between extremes. Borggreve's reform ideas in selection thinning—to cut out the stoutest stems in order to stimulate the rest—are not always practicable. If too old, the remaining stems are unable to take advantage of the increased light supply. The advance growing and generally dominant trees not infrequently have poor forms, e. g. beech and pine, and hold back a number of neighbors still capable of development. The timely removal of such trees means a final total increase in usewood increment and value. The value of this "Hochdurchforstung," thinning in the dominant, as opposed to the Niederdurchforstung or thinning in the sub-dominant, especially for trees of spreading habit like beech, oak, pine, has been proved in the Danish and Heck's forests. Early but moderate thinning in the dominant is advocated by Schwappach, to be followed by setting free the best stems for oak in the 50 year; by severe thinning in the sub-dominant for beech in the 70 year.

Removing dominant trees means retaining a greater number of stems in the young and middle age classes than is customary with the old-fashioned Niederdurchforstung. One great advantage of this is the prevention of spreading crowns and short boles. Further, until the stand has separated into height classes it is difficult to predict the ability of individual trees to use a larger growing space to best advantage. So until then it is wise to keep a rather higher number of stems than is warranted, for the eventual thinning in the dominant. Besides giving greater scope for future stem selection, they promote bole cleaning and protect the soil.

We are still unaware of the optimum stem number or basal area per acre, and even if we know it as Schwappach determined for beech that the basal area after the 60 year should remain between 20 and 25 square meters per hectar, practical experience and observation will guide the manager more often than such standards, which are expensive to use. But for doubtful cases such standards are indispensable and excellent guides.

Light management in its pure form is justified only for such persistent species as oak, with which Wimmenauer reports from the Hessian experimental areas "light management" produced in 150-160 year rotation diameters of 18 to 24 inch, i. e., stem wood of first and second classes with a 2.5 per cent. interest rate on production capital. Evil effects of too severe thinning are shown by Endres, who points out the danger of lowering returns by leaving too few trees; and Borgmann found that for spruce a very moderate opening gave the maximum soil rent. But proper thinning or free spacing, while it lessens wood capital, does not necessarily or at least seriously lessen wood increment. Therefore, the volume increment per cent. persists proportionately longer at a satisfactory rate. Current increments and soil rent culminate later than under the usual care, and do not sink suddenly but very slowly so that if desirable the rotation may be extended one or two decades beyond culmination of the soil rent without loss. Just as the poor results of our old close stands are not the fault of the trees but of the method of treatment, so also are the low rotations of the soil rent management not a characteristic of the system of management, but granted that a low rate of interest is allowable, they are the result of unsuitable treatment of the stand.

A more intense utilization of light influences time in two directions. The quicker attainment of favored stems to the desired diameter shortens the rotation. The higher and more persistent growth production delays culmination and gives more freedom in determining the rotation.

Besides in thinnings, light influence is taken advantage of in "overhold management" and in cutting for natural regeneration.

On overholders the increment may be considered by itself or in relation to what overholders prevent by shading of the under stand. Sometimes this outweighs the increment gained by the overholders. In regeneration fellings, too, the opposite interests of the young stand may make the light increment of the mother trees illusory. But here the latter is to a certain extent incidental. Where it becomes the object of management the young stand may easily lose what the old trees gain.

Regarding the amount of light desirable for regeneration, in general for young plants full light is favorable, modified by the necessity for protection against frost, drouth and weeds.

In regard to soil, the matter is less simple. Dry turf (raw humus) in dense beech and spruce stands on the one hand, and weeds and heather on clear cut or open stands on the other show the danger of both extreme darkness and extreme light. The optimum lies between the extremes. For unhindered unlocking of soil food is necessary a combination of light, air, warmth and precipitation.

Regulating the light supply in the stand, i. e. rearing the stand is just as difficult and important as establishing the stand. The ability to regulate the growing space of the usewood-producing trees for the highest value production is more important and takes more skill than the operations of culture and regeneration which are principally matters of money.

The knowledge required for this ability lies largely in the results of the many investigations into thinning and lighting.

Finally, the speaker concluded, students, in your future capacities don't be mechanical. Strive always to use more and more freely in the woods the productive powers of nature, not the least of which is light.

Licht ist Leben!

Das Licht als Produktionsfactor in der Forstwirtschaft. Tharandter forstliches Jahrbuch. 1912. Pp. 4-28.

Fire as Means of Culture.

In Sweden the burning over of heaths as a precedent for cultivation has been condemned as deteriorating the soil, besides endangering the neighboring stands.

The Experiment Station has for a series of years investigated the question by means of a number of experimental plats (26) which are located on gravelly moraines on gneiss, which are covered with heather. Some of these had been repeatedly burned, so that in this location the heather cover was short and thin, interspersed with Polytrichium, the "fire moss"; others—a second location—with a denser cover of longer heather and mainly Hylocomia moss. Pine, spruce and birch were used in planting these plats, but pine was almost alone successful.

The result of all the observations in these and other areas is the finding that the burned areas produce from the same amount of seed double the number of trees in the first location, the reverse in the last location. Similarly height growth was stimulated by the burning on the first, the opposite on the last location. "The effect of burning depends on the thoroughness with which the substratum is attacked, which in turn depends mainly on the time when it is done and on the water conditions of the soil."

Early firing in spring rarely, or not at all, burns the soil itself, which is then frozen or at least cold and wet. After such burning the roots of the heather grow on undamaged and new shoots sprout out the first season. After 3-6 years the ground has the same appearance as before the fire. Burning of this kind helps mostly a pine sowing; there is a little ash fertilizer and competition for water is reduced; the humus is all left, hence, especially on poor soil, the burning has been an advantage. Besides, the work on such burned areas is easier and cheaper.

Yet, on loose sand soil even such light burning is not advisable, as well as on very shallow soil, which needs all the soil cover and shade it can get, nor where the soil cover consists of lichens or fire moss. On wet soils the value of burning is reduced or may be a damage.

The principal objection to burning is what is not necessary, the burning of the soil itself, which deteriorates the soil. Hence the time of burning is of greatest importance, and the deteriorating influence of involuntary fires during the hot season is explained. Such undesirable fires also change the character of the vegetation. Just as the frost is out, after a sunny or windy day is the best time to burn.

Mowing the heather is not advantageous, as it simply induces more dense sprouting of the stocks, the heather grows merely higher and denser. The amount of seed to be used on plats is reduced on burned ground from 70-150 seeds per plat to 50 seed.

Om Ljungbränning för Skogskulturen. Meddelanden fran Statens Skogsförsöksanstalt. Skogsvardsföreningens Tidskrift. Heft 1 and 2. 1911.

Geists' Soil Grubber.

The extensive planting of waste lands in Prussia has lately stimulated the inventive genius of foresters to design efficient planting and cultivating tools. Among the latter the "Geist Kähler Wühlgrubber" (see F. Q. vol. VII, p. 339; vol. X, p. 521) has been submitted by Schultz to comprehensive trials. Its function is to stir the soil and at the same time dissect and mix in the surface raw humus, which, as Dr. Moeller has proved, if so mixed in, produces remarkable growth of pine.

The machine consists of a rotating drum with 24 cutting projections 26 inch in length; it can work to 20 inch depth, and 20 inch width. It runs over rocks and stumps; cuts roots up to 3 inches and tears out thicker ones and stones. The price is $375, to be had from Heinrich Kähler at Güstrow, Mecklenburg.

The first trials were made on gravelly sand with stones and glacial rocks, with a light grass or weed cover and single heath plants. It was drawn by 8 small horses (six better ones would suffice), and worked in the average one acre in two hours into strips 3 to 4 feet apart, 16 inch deep, costing $2.45 per acre, transportation to the field included. Over rocks and small stumps the grubber slides readily, and small stones up to 12 inch diameter are thrown out. Even on slopes the machine is remarkably stable.

The loosening of the soil was perfect and the humus was well mixed with the mineral soil. In the following spring, the strips are evened with a harrow and sowed and firmed by machine. The difference in the resulting plants from ordinary sowing on hoed soil is remarkable.

Similar to waste land, the machine works on forest soil wherever such a machine can be drawn, low stumps being no objection.

But on strong sod and soil covered densely with huckleberry, etc., there must be preparatory work done, for which another machine was constructed, which cuts first the sod or brush, for

90 cents to $1.50 per acre. The entire soil preparation on most unpromising ground was done very satisfactorily for up to $8 or $9 per acre; all these prices being high because being first trials. In most cases the cost would not exceed $3 per acre and up to $5 with double cutting of brush; and the results in growth of plants amply repays this cost.

Der Geist-Kähler'sche Wühlgrubber. Zeitschrift für Forst- u. Jagdwesen. February, 1913. Pp. 92-103.

Seed Supply.

An interesting and practically important contribution to two questions of collecting and extracting seeds from Scotch Pine is furnished by Dr. Busse, on what he admits to be a rather limited amount of data and experiments, detailed in tables.

Collecting cones by means of scissors on poles from marginal trees, i. e. pruning branches back he expected that next year's and following crops would be poorer or at least smaller. The contrary was experienced for three years. The cones were not "Notzapfen" (distress cones), but bore seed of good quality. Similarly the cones from young 10-20 year, thickets, which have usually been considered signs of senility and undesirable, compare well with normal cones. The author comes to the conclusion that age has nothing to do with quality of cones and seed, disposition of the individual pre-determines size and weight of cones, and the proportion of infertile seeds. Hence, the easy collection of cones from young stands which Schwappach had already advocated (see F. Q., vol V) is declared not objectionable.

The second question touched is the experience that in extracting seeds often many cones do not open completely or remain closed altogether. It has been experienced that late gathering reduces but does not entirely overcome the loss. Referring to the process as it occurs in nature, the author points out that in the artificial operation the alternate heating and wetting, which takes place in nature through dew and rain, is omitted. This led to soaking the cones after the first heat and the result in output was astonishing.

The cones, all of them, were after the first heat, placed in water of room temperature for one-quarter of an hour then again placed into the oven with reduced temperature from the original 50° *C.* to 40° (wet cones being more sensitive to heat than dry). First, the cones close tightly, then, when evaporation begins, they open freely and completely. The expectation that the second heating would produce a larger per cent. of sterile seed was also agreeably disappointed.

Not only was the number of full seed only slightly less, but the germination per cent. practically the same and the story, that the cones or scales which do not open contain infertile seed disproved.

Zur Frage der Kiefernzapfengewinnung. Naturwissenschaftliche Zeitschrift für Forst- u. Jagdwesen. December, 1912. Pp. 563-573.

Unusual Weather Damage.

Details of losses to plantations suffered in Prussia during the summer of 1911 continue to be reported by Splettstoesser from his revier.

Rohrwiese, which lies in West Prussia some 80 miles south of the Baltic and 125 miles east of Berlin, at an elevation of 80 to 150 meters above the sea has an area of 4,850 ha. (12,125 acres); the soil is sandy, the stand Scotch pine. The forest lies too far inland to feel the influence of the sea and in summer hot days and cold nights are the rule. Agriculturally, the region is declining due to such conditions as were especially marked in 1911. Less than eight inches of rain fell in six months of the growing season (April to September); the sun shone and winds blew, burying arable soil in sand; ponds dried up; potatoes barely yielded the amount planted; rye froze in flower; serradilla was burned out entirely.

In the woods the trying season upset many theories and revealed the insufficiency of many practices developed under more favorable site conditions. Disasters such as these teach convincingly that woods practice must be determined by conditions during the worst season, not the average.

Two frosts (May 20 and June 10) severely injured pines up to a meter high especially such as grew in depressions or surrounded by older stands. Areas aggregating considerably more than 250 acres were thus set back. Young stands from sowing and from planting suffered alike.

After June 10 the summer was hot and very dry. Pine plantations survived on bare soils where no heath or other weeds demanded a share of the soil water. Where heath covered the soil densely not only were the pine seedlings burned out but finally the heath too followed it.

The heath is a serious curse in the forests of this part of Germany. It takes foothold wherever openings in the crown admit sunlight to the soil, and it spreads as fast as the fall in crown density permits more light to pass. In the course of nature heath is the first plant to colonize abandoned farm land and it is succeeded by pine. It does not occupy cultivated land directly after abandonment but only after the fields have lain fallow several years and the soil becomes sour. When once in possession the heath develops to form a dense soil cover and a very dense though shallow root system which dries out the soil and prevents the penetration of summer showers.

In such regions as these, pine plantations can only be established with the complete success necessary for their proper development into clear timber by the entire removal of the heath either by fire, grub-hoe or plow. The preparation of planting strips is not sufficient; it is necessary to work over the whole area and relieve the young trees from all struggle for soil moisture. Such preparation must be made in autumn and the planting site be fallow through the winter so that the rains can enter, penetrate and be retained.

The expensive removal of heath should be avoided by planting abandoned farm lands before the heath is established while the soil is still sweet. Where large accessions of poor farm land cannot be reforested immediately it is worth while to let out portions at a nominal rental that such use may forestall heath development.

Das Jahr 1911 in der Oberförsterei Rohrwiese, Regierungsbezirk Marienwerder. Zeitschrift für Forst- und Jagdwesen. December, 1912. Pp. 778-783.

Causes of Winter Killing.

One type of winter injury to forest trees, according to Hartley, affects for the most part young growth, especially by injuring the tips of the young branches, killing the trees in the more severe cases. A second type is the "chinook" injury, which kills both reproduction and mature trees. In some places in Dakota four to five per cent. of the mature stand, largely *Pinus ponderosa,* were killed in 1909, injury being greatest at the higher elevations and on northerly exposures. The effect was more severe on older needles, or older parts of the needles. In some cases buds were injured. The selective injury to the needles is ascribed to inability of the older ones to supply transpiration of water. In the case of *Picea canadensis* the less vigorous branches were killed; while the latest growth of birch and aspen was considerably injured.

The injury appears to be due to very low temperatures, followed by a strong warm wind with rise in temperature up to 57° F., resulting in rapid loss of water while the limbs and trunks were still frozen.

Similar injury occurred in Colorado and many other places, and notes are also given on the winter-killing of different species in Nebraska during 1909-10, in which the effect was entirely different from the "chinook" injury.

Notes on winter-killing of forest trees. University of Nebraska Forest Club Annual. April, 1912. Pp. 30-50.

Chestnut Blight and Insects.

Investigations by Craighead of the Bureau of Entomology during the summer of 1912 on the spread of the chestnut blight show that certain insects destroy many of the pycnidia and perithecia of the infesting fungus. Five species are noted, among which is the chestnut borer *(Agrilus bilineatus)*. In some localities 50 to 75 per cent. of the pustules were eaten, and on certain badly diseased trees practically all were destroyed. The author believes that the insects are acquiring a taste for the fungus which may play an important part in controlling the disease. Nothing is said, however, as to the role they play in carrying the spores about on their bodies.

Insects contributing to the control of the chestnut blight disease. Science. December, 1912. P. 825.

Oak Mildew.

Queritet sketches the development of the epidemic of oak mildew in Europe since its beginning in 1907. While the disease occurs in nature largely on the native oaks, beech, elm, ash, maple, birch, elder, and mountain ash are said to be susceptible, at least to artificial infection, while alder, chestnut, and American oak have so far proved resistant. The native *Quercus robur* is said to be less susceptible than its close relative *Q. pedunculata,* on account of its thicker coriaceous leaves.

The development of the disease from spores in the spring is described, the injury resulting from stunting and premature death of the foliage and inability of the immature twigs to withstand winter freezes. One to two year nursery trees may be killed outright or lose their commercial value. Under such conditions, finely powdered sulphur has been found most efficacious in controlling the disease. Certain sprays are also noted.

The drier climate of Central Europe may account for the slow spread of the disease in that region.

Regarding the question of overwintering of the fungus a Dutch article by Poeteren has recently been translated into French. This throws further light on the subject and supports and modifies Neger's theory that the organism survives the winter in the buds in the mycelial stage. The number of shoots bearing infected buds is variable, but relatively small. Such shoots are termed "mother shoots," as it is found that they serve as the primary source of spring infection, the fungus developing with the bud. Upon these few newly developed shoots conidia form which spread the secondary infection to other parts of the tree.

Upon this method of hibernation protective measures are based. These involve the removal of "mother shoots" at the time the buds open, so as to avoid the secondary infection. This can probably be carried out in nurseries, also possibly on coppice oak, and supplements spraying, which is so commonly employed against the disease.

Le blanc du chêne. Bulletin Société centrale forestière de Belgique October, 1912. Pp. 577-588.
De overwinteringen bestrijidng van eenige meeldauzwammen. Tijdschr. over Plantenz. 18, 85-95 1912 and *Le blanc du chêne.* Bul. Soc. cent. forest. Belg. December, 1912. Pp. 750-759.

Damping-off Fungi.

Pythium debaryanum is said by Hartley to be the most dangerous parasite in western nurseries, although *Rhizoctonia, fusarium* and probably *Trichoderma lignorum* also cause damping-off. Rhizoctonia loses its parasitism in culture, and the different strains vary greatly in virulence. Soil sterilization against Pythium by the use of such chemicals as corrosive sublimate, acids or copper salts, followed by lime, are not effective in the west on account of reinfection of the beds before the seedlings are old enough to resist. Good results were secured by treating the soil before seeding with sulphuric acid and formalin, and on alkaline soils with zinc chloride and copper sulphate. Careful watering, however, is necessary in order to prevent chemical injury to the germinating seed.

Damping-off of coniferous seedlings. Science. 15 Nov., 1912. Pp. 683-4.

Fire Protection in Prussia.

That even in Prussia fire protection is not perfected, is shown by the government instructions which followed the severe fires of 1911 (an unusually dry summer). These fires were often quite large, as witness the one of September 3 and 4, 1911, near Schwerin, northeast of Hamburg, which completely destroyed the forest on 3,774 acres. The instructions include the erection of fire outlook towers equipped with telephone and with a device for locating the fire. Other points are the providing of torches (pieces of "lightwood") at each ranger station for back firing; the equipping of fire fighting crews with tools; and even occasional drills of local workmen in methods of fire fighting.

A. B. R.

Massnahmen gegen Waldbrände. Allgemeine Forst- und Jagd Zeitung. January, 1913, P. 34.

Smoke Damage.

The smoke nuisance is an ever present source of trouble to the Saxon forester on account of the large number of factories. Scarcely a revier in the whole state has not suffered from sulphuric or nitric acid poisoning.

Two forms of damage may be distinguished altho the distinction seems somewhat arbitrary and the same tree may have both the acute and chronic form. In the latter the tree does not lose its leaves quickly but there is evidently a derangement of the processes of assimilation. The acute form is characterized by rapid browning of the leaves and consequent defoliation.

Spruce, the most abundant species in the forests of Saxony, has proved very susceptible. Hence, the danger of smoke damage is another argument for the mixed stand. As a rule the hardwoods seem more resistant than the conifers. Very little advance has been made in devising effective means of dissipating the noxious gases so that the smoke problem is likely to remain a subject of concern to foresters.

Forstwissen schaftliches Centralblatt. Nov., 1913, pp. 565-575.

"Nun" in Saxony.

The loss from the Nun Moth in Saxony first became serious in 1909. Prompt measures were at once taken in the state forests and the destruction of the butterflies and lining of the tree produced excellent results. Unfortunately nothing was done in the communal and private forests until some time after the government started preventive measures. Consequently the loss was greater than it should have been. The artificial methods employed, however, were not nearly so effective as the natural enemies of the Nun Moth in finally reducing the damage done. Among these the diseases of the caterpillars (flacherie) has been most deadly.

The main lessons to be drawn is the need for concerted action against insect enemies. While the Saxon state officials were doing all they could the private and communal forests were not properly handled. Furthermore, the neighboring state, Prussia, declared preventive measures to be useless.

Forstwissen schaftliches Centralblatt. Nov., 1913, pp. 565-575.

MENSURATION, FINANCE AND MANAGEMENT.

Border Cuttings System of Management.

Professor Schwappach has the following review of Professor Wagner's latest volume "Der Blendersaumschlag und Sein System" in the "Deutsche Literaturzeitung" issue of February 22, 1913:

"In the year 1907 Wagner published his method of border cuttings ("Die Grundlagen der Räumlichen Ordnung im Walde")* or selection strip method which in tech-

*See Forestry Quarterly, Vol. VIII, No. 3, p. 366 and Vol. X, No. 4, p. 699 for review.
See also Proceedings, Society of American Foresters, Vol. VII, No. 2, pp. 145 to 152.

nical circles aroused so much interest that in 1911 a second edition appeared. Whereas this book dealt especially with the silvicultural side of Wagner's method, the new work deals more with the management side. Although in the first chapter the method of border cuttings is again explained from all standpoints, stress is laid on the second chapter, which deals with the systematization of management by border cuttings. In this chapter Wagner seeks to answer the question: "How must the forest be organized, of what form must the management be, if a lasting application of the proposed method of regeneration shall be possible?' A third chapter deals with the conversion of present methods of management into those of border cuttings.

"Whereas the forest management of to-day is built upon a single stand which exhibits a uniform character according to age, and growth, Wagner puts in its place cutting series which in the direction of border (regeneration strip), in general in the direction from east to west, are even-aged; but taken for the whole area are always uneven-aged, showing a decreasing age in the cutting direction of north to south.

"The single even-aged parts within each cutting series are very small, the width varying according to conditions, and averaging perhaps 20 meters (65.60 feet). 1 hectare (2.47 acres) of cutting area would, therefore, have to have a length of 500 meters (1,640 feet). Wagner apparently desires just about the same length in the direction from east to west. A forest with an annual cut of 10,000 cubic meters (approximately 2,300,000 feet board measure) and an average yield of 200 cubic meters per hectare (34,000 feet B. M. per acre) would, therefore, require 50 places of cutting per year, of which, however, several could be in the same cutting series. Since the system provides that the cut shall be repeated on every area after an interval of five years, there would have to be 250 cutting areas for a forest of from 2,000 to 2,500 hectares (4,940 to 6,175 acres) in size. This enormous number of cutting areas must not only be managed on the ground, but, for purposes of regulating the yield, must be booked, measured and entered on maps. I will pass over the difficulties of timber sales under such conditions.

"The more I have gone into this work, which proposes to answer all questions and all objections in advance, the more improbable seems to me the carrying out of this system in general practice. The forest management of to-day is too extensive to allow of applying Wagner's methods without undue sacrifices of profitable administration."

In a personal letter, Professor Schwappach says further: "I do not question that border cuttings as a method of natural regeneration of certain species, namely, of spruce and fir, will bring good results; that, the regeneration direction from north to south has advantages. But I cannot see the expediency of applying this method to all species, nor the possibility of carrying out the method as one of regulated management."

Professor Wagner himself upon receipt of a reprint of the article on "Border Cuttings a Suggested Departure in American Silviculture" in the Proceedings of the Society of American Foresters, Volume VII, No. 2, wrote:

"I am very eager to know how my proposition will be taken up in America and what results it will have. A colleague in America has informed me that there too regeneration is easiest on the north border of a stand, and my own meteorological studies seem to indicate that in America, in average latitudes, the climatic conditions are similar to ours, and that the most important rain storms in America, also, come from the southwest and west.

"Entirely different, of course, are the conditions of marketing the crop. However, I believe that these will approach more and more to those prevailing in Europe. The only pity is that the conversion from virgin forests to managed forests everywhere, even in Europe, is of such a kind as to mean great loss in forest productivity. If the entire net work of roads and of logging ways could be built up before cutting begins, this loss could be avoided, which unfortunately is not now possible." A. B. R.

Management of Mountain Forests.

Dr. Dieterich reviews Kubelka's recent work: "Die intensive Berwirtschaftung der Hochgebirgsforste"* (the intensive management of high mountain forests) which is based on long experience in Austria. The book is filled with the spirit of Wagner's ideas as contained in the latter's book on Border Cuttings (See Forestry Quarterly, Vol. VIII, No. 3, p. 366 and Vol. X, No. 4, p. 699).

*W. Frick, Graben 27, Vienna, Austria, Price 2 Marks (48 cents).

Kubelka urges the opening up of the forest resources by establishing means of communication, the return to natural methods of regeneration and freedom from the repression of the Period Method of regulating the yield.

The first chapter deals with the influences of logging methods on forest organization and on methods of management. Kubelka demands the complete opening up of the forest to its uttermost accessibility, if losses in quantity and quality are to be prevented; that this can best be done by steam logging devices, the necessarily greater investment being covered by prevented loss through deterioration and if necessary, by heavier cutting in the overmature timber. Only where a complete system of transportation has been installed can the annual cut be properly determined and distributed. (How true of American conditions!)

The second chapter takes up the tasks of forest organization. Kubelka would confine the forest organizer to determination of the yield 2 or 3 decades in advance, leaving the distribution of the yield—i. e. the choice of cutting areas—to the administrative officer in charge of the forest, in order that the regeneration may proceed according to the silvicultural needs of the stand.

The Application of Silvicultural Systems, Chapters IV and V, is perhaps the most interesting part of the book. Kubelka claims that the strip selection system* is the one best adapted to the peculiar exigencies of high mountains. This system departs from Wagner's "border cuttings"* primarily in the greater width of the cutting strip. Kubelka justifies this departure because of the increased logging cost on steep slopes. Kubelka is fundamentally opposed to clear cutting and shelterwood cutting over large areas. In the strip selection system which he recommends, the strips run obliquely across the slope, each strip has a maximum width of about 50 yards. When regeneration is well under way, there are three strips side by side—the outermost (earliest) is in state of final removal cutting, the next in that of freeing the reproduction according to its needs, and the third (innermost and latest) in seed cutting. (From the description the system is evidently neither true selection nor true shelterwood, but on the borderland between the two: shelterwood—selection or "Femel.")

This method results in an unevenaged, mixed stand which has

†Plenter—or Femel—Streifenschlag.

‡Blendersaumschlag.

the maximum resistance to storm, snow, frost, insect depredations, etc. Especial attention is to be given to the selection of the seed trees both as regards species and individuals.

Berwirtschaftung der Hochgebirgsforste. Allegemeine Forst- und Jagd Zeitung. March, 1913. Pp. 93-95.

A. B. R.

Form Quotient in Hardwoods.

Schiffel's law, which he formulated as the result of his work in the preparation of volume tables for Scotch Pine, larch, Norway Spruce, and Silver Fir, that trees which have the same diameter breast high, the same height, and the same ratio between diameter breast high and diameter at the middle height of the tree must have approximately the same volumes, has been tested in several other countries. A Swedish forester, Maas, has proved the same law for Swedish Scotch Pine and a Russian forester, Tkatchenko, has proved that the same law holds true of the conifers of northern Russia. Mr. Tkatchenko, however, went even further than Schiffel and Maas. Schiffel was of the opinion that his law applies only to the conifers which have a more or less symmetrical form but would not apply to the hardwoods which do not follow any defined symmetry. Mr. Tkatchenko tested this law on a number of hardwoods grown in the prairies and found that it applies very well also to the hardwoods. The article is devoted to a review of the results obtained by Schiffel and Maas and a comparison with the data obtained by Tkatchenko on the Scotch Pine in the northern provinces of European Russia and with the volumes of hardwoods secured in southern Russia. As a resumé of the work of his predecessors and the development of their ideas further along the same line, this article deserves the most serious attention of American foresters, since in this country we are now preparing volume tables. Although a large number of such tables have been prepared for the most important species, yet the work is hardly begun as in order to be of practical application the volume tables must be local. There is a great field, therefore, for testing this law on the American species as the gain if this law proves of practical application will be very great in this country.

We call attention to the work of Dr. Judson F. Clark in this direction on the Balsam Fir as reported in F. Q. vol. I, p. 6-11.

Das Gesetz des Inhalts der Baum stämme etc. Forstwissen schaftliches Centralblatt. Aug., 1912. Pp. 397-419.

Precision Calipers.

Still another caliper is now to be had, the main aim of which is accuracy. It is constructed by Mr. Philip Flury, Assistant in the Swiss Experiment Station, and is designed to combine easy manipulation and easy reading, with solid construction, greatest amount of lightness and highest accuracy. It can be had in sizes of 35, 60, 80 and 100 *cm.*, from Pfenninger Co., Zürich. Its high price, however ($12.80 for a 30 inch caliper) will prevent its very general use except in scientific investigations.

The rule is of wood, with brass linings; the scale is read from an inclined celluloid plate with a definite index and various devices for distinct reading. The moveable arm is made of aluminum in a single piece, which avoids temperature and moisture influences; the handles of the arms are covered with leather, to protect against cold. To insure parallelism, only two points of the guide diagonally placed touch the rule, while a spring is inserted on a third (interior) point to prevent slack movement, and and adjusting screw working on a metal plate over a strong spring permits exact setting of the arm. Such a caliper was kept two hours in water and then exposed for an afternoon to rain: the slight change in volume which followed could be easily eliminated by the adjusting screw.

Eine neue Messkluppe. Schweizerische Zeitschrift für Forstwesen, March, 1913. Pp. 89-91.

UTILIZATION, MARKET AND TECHNOLOGY.

Chemical Wood Industries.

Dr. Schwalbe in a comprehensive address points out that the chemistry of wood is still poorly understood, and hence all industries which work chemically with wood, i. e. by means of changes or decomposition of wood substances are handicapped. This is due to the fact that the materials, under which the collective name of lignin form with cellulose the wood substance, are colloids, non-crystallizable, hence difficult to study.

The author then gives a rapid survey of conditions and problems of the chemical wood technology.

The problems of wood impregnation are to find out the distribution of impregnating fluids and their possible secondary decomposition or solution and the depth of their penetration.

The problems of dry distillation, which besides charcoal, furnishes wood vinegar, wood alcohol and aceton as basis for a long list of chemical products—such as colors and varnishes, are in part solved, since the importance of accurate temperature regulation has been recognized and attended to. While these products are mainly secured from hardwoods, there is a possibility to secure from conifers other valuable products, such as spirits of turpentine and rosin, which find application in the varnish industry, artificial camphor, and in the paper industry. The problem is to extract these materials without injuring the wood fiber, so that it can be used for paper pulp which needs non-resinous woods.

In the latter industry which in Germany produces 700,000 tons of cellulose valued at $30,000,000 a number of problems remain unsolved, especially how to utilize the spent liquors.

In the soda process the recovery of the alkali, which has a relatively high value, is connected with the production of evil smelling gases, which makes it objectionable in civilized communities. The sulphite process is not applicable to resinous woods, and in allowing the liquor to run away into rivers not only are these polluted but many tons of organic substance as there has been produced cellulose are lost.

To find use for this enormous amount of waste material is the great problem. In Sweden for a few years alcohol is recovered from this liquor 60 liter to the ton of cellulose, but this represents only 8 per cent. of the dry contents of the liquor, or 1 per cent. of the liquor itself.

Another use is as binding material for ore briquettes and coal briquettes, but the high cost of evaporating the liquor, the increase of ashes in coal briquettes, and their inconstancy under the influence of weather prevent this use. Attempts to use it either for feed or fertilizer deserve full consideration, for here large amounts could be utilized. Mixed with nitrates of lime and

Thomas slag, such materials, can be used to make poor soils more active, the organic contents stimulating bacterial growth.

If the liquor of present processes cannot be utilized, other liquors might be invented which may be useful as feed or fertilizer. This would, of course, revolutionize the whole paper pulp industry and therefore is not to be expected at once. In the leather industry, while the liquor does not have tanning values, it can be used as a filler.

The author then discusses the mechanical pulp industry when only 10 to 20 per cent. of fiber is lost, and the brown pulp made from steamed wood which produces a stronger fiber, and if the steaming has not been carried too far yields a similar output, saving much loss as against the chemical fiber. A better adaptation of the cooking operation to the species involved is also a problem. It appears that aspen is now so much used that an Italian factory has begun to make plantations of it. Again the question of the use of wood offal, especially with the bark on is a problem unsolved, although beginnings have been made in the United States, needing, however, an improvement in removing the bark which is done by hot water in rotating drums. If this use of offal is made practical a loss of 25 to 40 per cent. of the wood consumption for pulp could be saved.

The problem of the use of sawdust is then taken up. So far neither dry distillation nor making feed or cellulose has been practically successful, but may become so.

Incidentally, it is mentioned that in Germany at present over a million pounds of silk, worth one and a half million dollars is made from cellulose. A ton of wood worth $10 yields 880 lbs. of cellulose, worth $20, from which can be secured 750 lbs. of silk worth $850—an enormous value increase.!

This silk, as well as a film material, cellophan, is made by treating cellulose with carbon bisulfide and caustic soda, which turns it into a substance soluble in water, from which transparent threads and skins can be formed, which in forming lose again the solubility.

Wood cellulose can also be worked into nitro-cellulose for explosives, and celluloid, but the product is less valuable than that made from cotton—probably due to the admixtures in the wood cellulose. If these can be overcome, an enormous gain for the nations which cannot produce cotton as regards war materials would result.

Finally, a substitution for cotton as a textile is not excluded. Certain methods of cooking produce a very strong tough fiber which by itself or with a little addition of cotton can be made into yarn, called "xylolin" or "textilose," which replaces jute.

The ultimate aim must be to utilize the wood to the last rest—to be sure, this is still a Utopia.

Die Verwertung von Forstprodukten auf chemischem Wege. Zeitschrift für Forst- u. Jagdwesen. February, 1913. Pp. 72-80.

Utilizing Wood Waste. It is interesting to note the progress in a few specific instances of utilizing the wood that was formerly wasted in both the logging and milling operations.

A company near Cadillac, Mich., was first to utilize its waste wood for charcoal and its by-products. Two charcoal burners were installed and after considerable experiment the small pieces of wood and sawdust were converted into charcoal, and in 1901 this was commercially profitable. The next step was to recover the waste gases as acetate of lime and wood alcohol. Only the unmerchantable timber was used. More carbonizing plants were added and an iron company was induced to use the charcoal on the spot for smelting ore. This resulted in a plant with a 100 ton capacity of pig iron daily.

Another company owned 25,000 acres of hardwoods, of which only 40% were used for merchantable timber. Eventually the remaining 60% was converted into charcoal and its by-products, while the ashes were sold to potash works.

A turpentine company was formed a few years ago in nothern Michigan to obtain turpentine from pine stumps. Two dollars a ton delivered at the mill was paid for stumps; this price paid the farmers for clearing their land. The stumps were ground up, the turpentine extracted, and the residue ground into wood fiber for commercial purposes. By-products such as rosin, oil of tar, and acetic acid were obtained. The investments were justified by the results.

Another company, owning mines, sawmills, furnaces, and chemical plants, estimates a saving of 8,000,000 board feet annually. The unmerchantable material is converted into charcoal and the by-products recovered. Experts are kept busy studying methods and systems of utilizing waste. They ascertain by careful records the yield of all products from each 10 acre tract.

The direct utilization of small pieces, instead of converting them into some other chemical form, is illustrated by an Oshkosh, Wisc., firm, which formerly sold its waste pieces for $1.25 a load, containing about 800 board feet. Short lengths of pine were sold to a match company, and the other pieces were used for making checker-boards, blind slats and various small articles. Then the advent of veneered doors made a market for a great deal of lumber that was formerly waste.

At Grand Rapids, Mich., the modern gluing and veneering processes save enormous quantities of small waste pieces that can now be used in furniture making.

A toy company started at Sheboygan, Wisc., with the intention of utilizing only waste wood, but the supply was not sufficient so it began using merchantable timber for making toy carriages, dolls' houses, etc. It eventually worked out a system of utilizing all the small pieces so that now little more than sawdust is left as waste.

At Cadillac, Mich., a handle company makes broom handles of beech and maple. At first there was considerable waste which for a time was worked up into window shade rolls and later the longer pieces were sold to toy companies, while the shorter ones were worked into handles for dippers. A plant near the handle factory uses the waste for shoe lasts. There is now forming a company to utilize the waste by making toothpicks, clothes-pins, ten pins and nail keg headings.—Woodcraft.

Uses of Paper Birch.

The most important of the minor industries which are dependent upon Paper Birch is the spool industry. 20,000,000 board feet are cut every year for this purpose and of this 4,000,000 feet are shipped to England in the form of spool bars. Great accuracy is required for the different size spools, and Birch is used because it holds its shape perfectly after thorough seasoning. Also it turns nicely on the lathe and presents a smooth clean surface. No satisfactory substitute has been found.

Another industry which uses nothing but Paper Birch is that manufacturing shoe pegs and shoe shanks. A considerable amount is exported to Germany and Japan.

The toothpick is another article for which Paper Birch is used almost exclusively. A single mill in Maine uses 2,000 cords yearly for this purpose alone. Dowel and novelty mills, bobbin and shuttle manufactures use birch largely for their work.

Although Paper Birch is a transcontinental tree in its distribution, the industries which use it exclusively are confined to Maine and New Hampshire. The great stands of Birch now used are probably the results of burning over by the great Miramichi fire of 1825 and other smaller fires of about that time. —American Lumberman.

Treated Hardwood Railroad Ties.

At a recent meeting of the Michigan Hardwood Manufacturer's Association it was reported that many tests of treated ties proved the superiority of beech, birch and maple for this purpose. Several of the largest railroad systems have adopted them. Since 1907 there has been a great increase in the employment of these species for ties; now beech and maple ties constitute 7% of all treated ties used.

When treated with zinc chloride they last longer than untreated white oak and when treated with creosote they are as durable as white oak with a similar treatment.—Lumber World Review.

Pole Treatment.

A method for preventing decay at the base of poles has been devised by a New Jersey man. A cylindrical form is sunk two feet into the ground around the pole, after the decayed portion has been removed and a treatment of creosote applied. Then the casing or form is filled with hot pitch. The mould is removed after the pitch has hardened. The process costs little compared to the expense of replacing a pole and, it is claimed, will add 7 or 8 years to the life of the pole.—American Lumberman.

Okume Wood.

Okume wood, "Gaboon" or "African Mahogany" is being boomed in Europe. The tree belongs to the family Malvaceae. Great quantities are found on the west coast equatorial region of Africa from where it is shipped through the ports Libreville and Lopez. The forestry authorities of the French Congo and Kamerun have reduced the cutting limit from 75 cm. to 60 cm. with an immediate effect of an immense amount of the smaller stuff appearing in shipments. Logging to the streams is difficult and the streams uncertain. Decay and insect work on the logs is rapid. Shipment, generally to brokers, is generally in round logs, only occasionally in square-hewed pieces. The wood is soft and strongly patterned, and since it is cheaper than our white wood, and poplar is replacing them in veneers and boards.—American Lumberman.

Wood in Uruguay.

Very little lumber is used in Uruguay; the principal construction material is stone. What lumber is consumed comes from Eastern South America or Norway, and costs about $75.00 per thousand. An ordinary door manufactured in United States for $1 sells for $16. The native woods consist of scrub pine, a eucalyptus, and the umbo, the national shade tree. In the northern part there are some extremely hard cabinet woods.—Timberman Jan'y., 1913.

STATISTICS AND HISTORY.

Wood Prices in Germany.

During the 20 years from 1893 to 1912 log prices on the Upper Rhine drives have increased just about 20 per cent., namely from 15.3 cents per cubic foot to 18.4 cents. This is 2 per cent. per annum on the original price or somewhat below 1.5 per cent. compound. Several times during this period prices amounted to 19 cents and more.

Square timber at Mannheim in 1912 brought near 32 cents for perfectly square material, with reduction for wany squares down to 27.5 cents; farther down the Rhine these prices increase by nearly 10 per cent. But it seems that from year to year the proportion between the markets is not maintained; for instance in 1909 prices at Mannheim ranged from 26 to 29 cents, while on the Middle or Lower Rhine they ranged from 29.6 to 33.7 cents.

Das Wirtschaftsjahr 1912. Centralblatt für das gesammte Forstwesen. March, 1913. P. 144.

Waste Land Planting in Prussia.

During the years 1911 and 12 the acquisition of waste lands and their recuperation in Prussia has progressed satisfactorily. On October 1, 1910, there were in possession of the government around 48,000 acres of waste lands. To this were added by purchase or exchange in the two years 19,000 acres, and there were planted around 30,000 acres, so that on October 1, 1912, there remained on hand to be planted 37,000 acres. Repair planting had to be done on 16,000 acres during these two years.

Zeitschrift für Forst- u. Jagdwesen. February, 1913. Pp. 134-5.

Game in Prussia.

A Socialist leader in the Prussian legislature has recently attacked the administration of hunting privileges in the state forests. These are now the prerogatives of the forestry officials and of wealthy landowners. In the communal forests, on the other hand, an annual rental of 10 cents to $1.20 per acre is obtained by a leasing system. Were the same procedure adopted on the state forests there would be a considerable increase in the returns from the state forests.

Another argument for depriving the foresters and landowners of their ancient prerogative is that under the present system too much attention is paid to game. If the foresters were to consider the game like the other resources of the forest and not as a personal prerogative, there would be no danger of their thinking more highly of the young deer than of the young trees, a charge which has been preferred.

Die Jagd in den preussischen Staats forsten. Forstwissenschaftliches Centralblatt. Nov., 1912. Pp. 505-508.

Saxon Statistics. The total area under state forest management is 172,512 hectares or approximately 400,000 acres. This is divided into 109 ranger districts, hence on the average a ranger has to cover a little less than 4,000 acres.

Of the total annual yield of 864,965 fm, 84% was saw timber, so large on account of the large area devoted to pure spruce stands. The net yield was $5.30 per acre, or 60 per cent. of the gross yield. The wood capital of $250.00 per acre yields an average return of 2.19%.

Forststatistisches aus Sachsen. Forstwissenschaftliches Centralblatt. Nov., 1912. Pp. 542.

OTHER PERIODICAL LITERATURE.

Forest Leaves, XIV, 1913,—

Forestry Chronology in Pennsylvania. Pp. 27-29. From 1681 to 1912.

Top Lopping. Pp. 29-30.

The Botanical Gazette, LV, 1913,—

The Climax Forest of Isle Royale, Lake Superior, and Its Development. II and III. Pp. 115-140; 189-235.

The Ohio Naturalist, XIII, 1913,—

The Characteristic Plants of a Typical Prairie. Pp. 65-69.

Bulletin of the American Geographical Society, XLV, 1913,—

The Dwarf Forests of Southern California. Pp. 13.

Canadian Forestry Journal, IX, 1913,—

St. Maurice Valley Forest Protective Association. Pp. 35-37.

Utilizing Sawdust. Pp. 43-45.

Quarterly Journal of Forestry, VII, 1913,—

Forestry in the Spessart. Pp. 85-108.

Forestry in the Carpathians. Pp. 125-139.

The Gardeners' Chronicle, LIII, 1913,—

Brown and Green Oak Timber. Pp. 171; 209.

NEWS AND NOTES.

Soon after the organization of the Pennsylvania Chestnut Tree Blight Commission, claims were made by various parties that they could cure the blight. In order to give an opportunity to test these reputed remedies and protect the public from spending money uselessly, an orchard of 400 trees, nearly all of which were affected with blight, was selected for their trial. From three to fifteen trees were treated by each person submitting a remedy, and check trees were left untreated in all parts of the orchard. A Board of Reviewers was appointed, consisting of Dr. Mel T. Cook, State Pathologist of New Jersey, Professor Howard S. Rankin, Forest Pathologist of New York and Mr. George H. Wirt, of the Pennsylvania Department of Forestry. After the remedies were applied the results were carefully watched by Mr. R. C. Walton of the Blight Commission, and measurements of the growth of the cankers were made at regular intervals for a period extending, in most cases, over a year.

The Board of Reviewers examined the trees, on March 20th and May 20th, 1912, previous to the application of any of the remedies, and verified the records showing the degree to which they were affected by blight. On April 16th, 1913, they again examined the trees and verified the records showing the progress made by the disease. Fifteen preparations were tested and no favorable results were found. There were variations of the growth of the fungus on the trees, but similar variations were noted in the checks. Most of the persons submitting remedies failed to take into account the nature of the fungus or the physiological requirements of a remedy, so that a failure could be almost certainly predicted. However, some of the remedies gave unexpected results in other directions; for instance, the application of iron filings around the base of chestnut trees produced noticeably darker foliage within a few weeks.

Spraying experiments have been started by the Commission to further test the effect of Bordeaux mixture as a preventive. Favorable results were obtained on the DuPont estate at Kennett Square, Pa., by cutting out the cankers and then spraying from eight to fourteen times during the season with a 4-4-50 Bordeaux mixture. The Bordeaux mixture was effective in a majority of cases in preventing a recurrence of the disease around the wounds where the cankers were removed and new infections elsewhere on the tree. The Bordeaux mixture, however, is useful only in killing the spores which rest on the outside of the tree and has no effect whatever on the fungus which is growing beneath the bark. Dr. Caroline Rumbold has carried on extensixe experiments to test the effect of various toxic substances when injected in the tree. She has been successful in getting various liquids to circulate throughout the sapwood of the tree, but no chemical has yet been found which will kill the blight fungus without also killing the tree. However, the results obtained by Professor Bolley of North Dakota in ridding plums of black knot indicate that there is a possibility of a cure for the blight, eventually being found by this method.

On April 14th officials of the U. S. Division of Forest Pathology, the Forest Service, State Forestry officials from Connecticut, New York, New Jersey, Pennsylvania, Virginia, and West Virginia held a conference to discuss the results of the investigation now being conducted by the Forest Service on the utilization of blight-killed chestnut. Valuable information was presented by the Forest Service from the data already collected and the situation was gone over in detail, state by state. It was found that the market for poles, ties, lumber and staves was good and that in some instances prices had increased. The difficulty lies in the disposal of the cordwood. So far as the effect of the blight upon the value of the wood for various purposes is concerned, it has been the general observation that there is no harmful effect, the wood being similar to that from chestnut which dies from other causes.

The foresters and lumberman in attendance at the Fourth National Conservation Congress at Indianapolis in 1912, held several informal sectional meetings. Out of these grew a plan for promoting intelligent public sentiment regarding forestry and lumbering, and for collecting, compiling and disseminating authoritative data and general information on subjects of broad interest. After various conferences during and after the

Indianapolis meeting the two fundamental handicaps of responsibility and finance were disposed of.

The first essential of providing a representative organization to be responsible for the work, has been provided for by President Charles Lathrop Pack offering the endorsement and facilities of the National Conservation Congress, and constituting the regular forestry committee of the Congress a body to direct and correlate the work of Sub-committees. To these Standing Committees, which are broadly representative, has been delegated the work of collecting reliable information on the subjects assigned, and of working it up into concrete reports. The Forestry Committee of Congress will receive and pass on all Sub-committee reports, and also from them select papers for the general sessions of the next Conservation Congress. Important reports involving broad questions of policy will be brought before the Forestry Section of the Congress for endorsement, and after acceptance given publicity through various channels.

The second essential, that of finance has been liberally provided for by a special fund donated by the American Forestry Association for the use of the Committee, part of it coming from personal contributions of public spirited members. The American Forestry Association also offers its magazine and influence in giving publicity to the Committee's findings.

The Forestry Committee of the Congress as appointed by President Pack, consists of Henry S. Graves, Chairman, J. B. White, E. T. Allen, W. R. Brown and E. A. Sterling. The last named will act as Secretary of the Committee in order to relieve the Chairman of details and follow up the work of the Sub-committees.

The Sub-committees are made up of men representing the best knowledge on each subject assigned. Their work will be outlined definitely to avoid repetition of endeavor, and directed and correlated by the Forestry Committee. The sub-committee subjects are as follows: 1 Publicity; 2 Federal Forest Policy; 3 State Forest Policy; 4 Forest Taxation; 5 Forest Fires; 6 Lumbering; 7 Forest Planting; 8 Forest Utilization; 9 Forest School Education; 10 Forest Investigations.

At the conference of investigators and specialists of the Branch of Forest Insects of the Bureau of Entomology, U. S. Department of Agriculture, held at Washington, D. C., February 26 to March 1, the following subjects were discussed: Methods of conducting investigations in the field and laboratories; methods of disseminating information based on the results of investigations, including popular and technical publications, correspondence, etc.; field demonstrations and instructions on the practical details of controlling and preventing depredations by tree-killing and wood-destroying insects; methods of promoting the science and practice of forest entomology; the services already rendered by the Branch of Forest Insects, the services to be rendered in the future, and the relation of the Branch to other branches of the public service and to private interests.

In the discussion of results so far attained it was shown that information on the habits and life history of the Dendroctonus beetles (a group of the most destructive insect enemies of living timber of North America) has been determined and that the practicability of the methods recommended for their control and the prevention of their ravages has been proven by a large number of successful demonstrations conducted during the past six years in co-operation with private owners, the Forest Service, and the Department of the Interior. It was also shown that the published information on the relation of insects to North American forests covers a wide field, both in the line of general information on the entire subject and specific information on the more important insects and problems. It was estimated that a general application of the information already determined and disseminated would save tens of millions of dollars annually to national and private interests in the prevention of waste of forest resources and manufactured crude and finished forest products. It was also shown that the results of original investigations, as published in the technical series of bulletins of the Bureau, have secured for the Branch of Forest Insects favorable recognition and comment among entomologists of this and other countries. In the discussion of the interest manifested it was stated that twenty years ago there was practically no interest in the subject and the idea of any practical means of controlling the depredations of insects in North American forests was not only foreign to the thoughts of foresters and private owners but any suggestion of such a thing was ridiculed. At present there are probably no forest officials who do not know something about the importance of forest insects and the need of protection from their ravages, and the private owners of forests and the public are beginning to take an active interest in the subject, especially in sections of the country where any attention is given to forest conservation.

In discussing the services to be rendered in the future it was concluded that the greatest present need is in the line of further systematic and economic investigations of the more important injurious and beneficial species and the orders, families, and genera of insects which are represented by species of economic importance, and that specialization by experts should be a primary feature in the policy of the Branch, as applied to systematic and economic investigations and practical details in application.

Following the discussion of the relations of the Branch of Forest Insects to other branches of the public service and to private interests, it was agreed that it is that of the scientific investigator and technical advisor on insect foes and friends of the forest and on methods of preventing unnecessary waste of forest resources. It was shown that a representative of the Branch rendering assistance to another branch of the public service—federal or state—or to private interests—organized or individual, great or small—does so with the idea of rendering a public service through the results of practical application by the beneficiary. Therefore, no direct assistance should be required of such a representative unless there is assurance from the beneficiary that there will be an equivalent return in results which will further the interests of the nation, the state, or a community of local interests.

The present organization of the Branch of Forest Insects, with Dr. Hopkins Chief of Branch, includes four field stations: Station 1 at Missoula, Montana, for Montana, northern Idaho, Wyoming, Colorado, and South Dakota, with Josef Brunner in charge; Station 5, at Placerville, California, for California, Nevada, Arizona, and New Mexico, with H. E. Burke in charge; Station 6, at Ashland, Oregon, for Oregon, Washington, Utah, and southern Idaho, with W. D. Edmonston in charge; and Station 8 at Falls Church, Virginia, for the eastern states, with S. A. Rohwer in charge. These stations do not represent administrative divisions but are centers for the investigation of local problems and for the conducting of instruction and control projects. In addition to the force of three to five men at each station, there is a staff of specialists at Washington engaged in the systematic investigation of the more important orders of insects and special subjects, as follows: Scolytid beetles—A. D. Hopkins; Forest Hymenoptera—S. A. Rohwer; Forest Lepidoptera—August Busck; Forest Coleoptera (general)—W. S. Fisher; Forest Diptera—C. T. Greene; Forest Isoptera—T. E. Snyder; Cerambycid larvae—F. C. Craighead; and Buprestid larvae—H. E. Burke.

Some of the special field investigations now under way are—the investigation of chestnut insects and their relation to the chestnut bark disease, general; insect damage to telegraph and telephone poles, posts, mine props, etc., by T. E. Snyder; relation of lightning and insects to the death of trees, by W. D. Edmonston; damage to fire and insect-killed timber by wood-boring insects, by B. T. Harvey; damage to forest tree seeds by insects, by J. M. Miller; damage to reproduction of pine by tip moths and pitch worms, by Josef Brunner; the relation of mistletoe and witches broom on living trees to attack by insects, by H. E. Burke.

Experiments are under way to determine the relative immunity of different untreated and treated woods from damage by termites, by T. E. Snyder, and experiments are planned to determine the smallest percentage of an infestation to be disposed of to insure the control of the depredations by the various species of Dendroctonus beetles.

As a sequel of this meeting an organization to be known as the Society for the Advancement of Forest Entomology in America was effected on March 1, 1913, with A. D. Hopkins, T. E. Snyder, S. A. Rohwer, F. C. Craighead, C. T. Greene, and W. S. Fisher, of Washington, D. C., H. E. Burke and J. M. Miller, of Placerville, California, Josef Brunner, of Missoula, Montana, and W. D. Edmonston, of Ashland, Oregon, as charter members.

The object of this Society is to promote a more general interest in the subject of forest entomology and the protection of forest resources from avoidable waste due to the depredations of insects.

Membership is open to persons who manifest an interest in the subject of insects in their relation to the forest resources and the forest products of North America, providing that they are recommended by a member or a responsible person, and the initiation fee of fifty cents and the annual dues of fifty cents are paid to the Secretary-Treasurer.

The following officers were elected: President, A. D. Hopkins; Vice President, H. E. Burke; Recording Secretary, T. E. Snyder; Corresponding Secretary-Treasurer, F. C. Craighead.

Annual meetings will be held at which the economic side of forest entomology will be discussed including the reading of papers on the conservation of forest resources. It is intended to publish Proceedings when the Society becomes established on a sufficiently extensive basis. In the meantime papers and discussions of general interest will be presented for publication to forestry, entomological and timber journals.

Persons interested in this movement should correspond with Mr. F. C. Craighead, Corresponding Secretary-Treasurer, Room 410, Evening Star Building, Washington, D. C.

The Federal Plant Quarantine Act of August 20, 1912, is the most important legislation looking toward the control of plant diseases that has been passed by Congress for many years. In brief, its object is "to regulate the importation of nursery stock and other plants and plant products; to enable the Secretary of Agriculture to establish and maintain quarantine districts for plant diseases and insect pests; to permit and regulate the movement of fruits, plants and vegetables therefrom, and for other purposes."

The power to formulate such rules and regulations as are necessary for carrying out the Act is vested in a Federal Horticultural Board consisting of five members appointed by the Secretary of Agriculture. Of the present organization two each have been selected from the Bureaus of Entomology and Plant Industry, and one from the Forest Service. In addition Mr. E. R. Sasser has been appointed by the Board as Entomological Inspector and Dr. Perley Spaulding as Pathological Inspector.

For the purposes of the Act, nursery stock is defined as "all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits, and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots. All woody plants and parts thereof for propagation or planting are included within the term "nursery stock" as used in this act. "Field-grown florists' stock" is all florists' stock which is usually grown outside of greenhouses for all or part of the year."

The importation of all nursery stock requires (1), a permit from the Secretary of Agriculture; (2), a foreign certificate of inspection—or if no inspection service is there maintained, entry shall be at certain ports and inspection by officials of the U. S. Department of Agriculture; (3), notice of shipment by importers, which involves sending a full description of the importation to the Secretary of Agriculture, and also to the authorized inspector of the state to which the consignment is destined, before removal from the port of entry.

If at any time it is deemed necessary by the Secretary of Agriculture to prohibit the importation of any classes of plants or plant products from abroad, or prohibit or restrict their interstate shipment, a public hearing is given for discussion as to the advisability of such a proceeding.

To date, six such "Notices of Quarantine" have been issued, the first one of which prohibits the importation of White Pine *(Pinus strobus* L.*)*, Western White Pine *(P. monticola* Dougl.*)*, Sugar Pine *(P. lambertiana* Dougl.*)* and Stone Pine *(P. cembra* L.*)*. This, of course, is directed at the White Pine Blister Rust, *Peridermium strobi* Kleb. The second Notice quarantines Hawaii with reference to the Mediterranean fruit fly. The third is directed against the importation from abroad of the potato wart disease. The fourth is a domestic quarantine against the gypsy moth in the states of Maine, New Hampshire, Massachusetts and Rhode Island, and the brown tail moth in these states, as well as Vermont and Connecticut. The fifth prohibits importation from Mexico of seven fruits liable to be infested with the Mexican fruit fly *(Trypeta ludens)*. The sixth quarantines certain districts in California, Arizona and Texas on account of two scale insects of the date palm.

The proposed import duty of 5% on coal tar creosote under the new tariff schedule, is giving considerable concern to those interested in wood preservation. Creosote has always been on the free list, and the proposed duty seems not only at variance with the policy of tariff reduction, but comes at an inopportune time. Commercial conditions in the tar distilling industry have resulted in an increase in the price of creosote of about 30% during the past two years; while an actual shortage has developed and several plants have been forced to shut down. The immediate imposition of a duty, even though small, is in effect the last straw. It is also pointed out that a tax on creosote is inconsistent with the government policy of timber conservation. The government is not only the largest individual consumer of creosoted timber, but is also appropriating large sums for forest preservation. Preservative treatment is one of the largest factors in reducing timber consumption, and permits the use of inferior timber which would otherwise go to waste. A duty on creosote will not only affect the large consumers, but check the farmer in his brush and open tank treatment of fence posts and farm timbers.

The Directors of the American Forestry Association held their spring quarterly meeting on the Biltmore estate of Mr. George K. Vanderbilt. The party which assembled from widely separated points, comprised not only the Directors but friends and members of the Association. The forest planting and lumber operations at Biltmore and Mount Pisgah were visited and a public meeting held at Asheville. Dr. Henry S. Drinker, President of the Association, Capt. J. B. White, who may be called dean of the progressive lumbermen, J. E. Rhodes, Secretary, National Lumber Manufacturers' Association, and others made addresses at the Asheville meeting.

A Forest Exhibit, under the auspices of the Pennsylvania Forestry Association, was held at Horticulture Hall, Philadelphia, May 19 to 24. Interesting exhibits were made by State, Federal, Associations and commercial interests, and illustrated lectures given on various subjects. One object, aside from the general educational value, was to call attention to the need of supplementing the State Forestry Department in reforesting denuded land in Pennsylvania. Over 6,000 square miles, or one sixth of the State, is denuded and practically waste land which can serve no useful purpose unless reclaimed by forest growth. While the motive in arousing broader interest is commendable, such extensive reforestation remains a State task, under the present fire danger and small returns to commercial enterprise.

The Austrian government has gone into the lumber business by building a sawmill for the cutting of cross-ties for the State Railway. Its output will be about 1,500,000 ties per year.

Forestry education in Great Britain is developing rapidly. A new chair of forestry was instituted April 1 in the Royal College of Science, Dublin, and Professor Augustine Henry, already known as organizer of the forestry school at Cambridge, was appointed. Prof. Henry is not a forester by profession, having started as a physician, and his approach to forestry work came through dendrological studies, to which he was led by a longer sojourn in China.

On January 16th, a New York State Forestry Association was organized in Syracuse. We use the indefinite article advisedly, for in 1885 such an association was organized in Utica, Ex-President Roosevelt, then a young Assembly man, being in the chair. The meeting, well attended, was brought about by the efforts of the then president and secretary of the American Forestry Association, Judge Warren Higley, and Mr. Fernow. The association, however, was never very active, and as far as we can find out may be considered defunct, leaving free field to the new association.

Measures for protection of forests against fire have never been so energetically pushed as during the last year, especially in Canada. The idea of private effort, so effectively inaugurated by the Western Protective Association has been imitated in Quebec by the organization of the St. Maurice Forest Protective Association. This association is composed of limit holders in the St. Maurice Valley, Quebec. A manager, three inspectors and 50 rangers for patrol work were employed during the past season. As a result, while 97 fires were extinguished, only one attained proportions of any consequence, and this was in an old cutting. In addition to patrol, a start has been made in the construction of permanent improvements such as trails, telephone lines and lookout stations. The cost is met by an assessment upon limit holders in proportion to acreage, aided by a contribution from the Quebec Government, in consideration of the protection of Provincial property.

The western associations last season patrolled 20 million acres, representing fully 500 billion feet, one-fifth of the total stand in the community.

They kept about 450 patrolmen in the field, supplied these with the necessary extra help to handle fires and built hundreds of miles of telephone lines and trails. What is more to the point, they kept the area of merchantable timber burned over down to 14,000 acres, or about 1/16th of 1 per cent. of the area protected. Only about 700,000,000 feet of timber was damaged by fire, and most of this will be logged without loss. The actual destruction was only about 76,000,000 feet, or about 1/70th of 1 per cent. They spent, to make this remarkable record, about $200,000 or a cent an acre for the entire area guarded, although, as it was necessary to protect fully double the area that actually contributed, the cost to association members averaged about 2 cents an acre on their own holdings.

The most important development in this direction of protection against fire is, however, the effort of the Canadian Railway Commission, which through the agency of Mr. Clyde Leavitt, as Chief Fire Inspector, has organized fire protection on around 25,000 miles of railroad, bringing all official agencies at the same time into co-operation.

To give an idea how this big machine is run we print parts of the orders issued by Mr. Leavitt.

To General Manager,—R. R. You are hereby notified that in accordance with the provisions of Order 16570 of the Board of Railway Commissioners you are required to establish upon such portions of the Canadian Pacific Railway and of the lines under its control as are hereinafter described, a force of fire rangers fit and sufficient for efficient patrol and fire fighting duty during the period from April 1st, 1913, to November 1st, 1913, except in so far as you may be relieved in writing from such patrol by the Chief Fire Inspector or other authorized officer of the Board.

Patrols. The details of the patrols required are as follows, it being understood that unless otherwise specified the patrol shall be continuous between the hours of seven in the morning and six in the evening of each day, including Sundays, with a minimum patrol so far as possible of two round trips per day, one in the forenoon and one in the afternoon.

Manitoba Division. On the Fort William, Ignace and Kenora Sub-divisions, between Fort William and Whitemouth, 365.5

miles; on the Arborg Sub-division, between Toulon and Arborg, 36.7 miles; and on the Lac Du Bonnet Sub-division, between Molson and Lac Du Bonnet, 21.5 miles, the patrol shall be a regular part of the work of the section men, who shall be especially instructed with regard to fire work; minimum patrol of one round trip per day, including Sundays. On the Lac Du Bonnet Sub-division, particular care shall be exercised, after the passing of each train in the day time. On portions of the above lines where no trains are operated on Sundays, special Sunday patrol will not be required.

Alberta Division, Laggan Sub-division. Seven men with velocipedes, to be distributed as follows:

Between Bow River Bridge at Mileage 56.2 and Canmore, 14.1 miles:

Between Canmore and Bankhead, 12.2 miles;

Between Bankhead and mileage 89, 9.7 miles;

Between Mileage 89 and Castle, 9.7 miles;

Between Castle and mileage 108, 9.3 miles;

Between Mileage 108 and Laggan, 8.6 miles;

Between Laggan and Stephen, 5.9 miles.

These patrols shall be continuous between the hours of seven in the morning and six in the evening of each day, including Sundays, with a minimum patrol so far as possible of two round trips per day, one in the forenoon and one in the afternoon.

Between Stephen and Field, 14 miles, the patrol shall be by one man, who shall work on foot or ride on pushers, as may be most practicable. This patrol shall be supplemented by tunnel watchmen and section crews.

Lines Under Construction. Kootenay Central. Between Golden and mileage nine south, 9 miles, one man with velocipede, to patrol after each train running over the line in the day time.

Between Fort Steele and the Southern boundary of the Railway Belt, one patrolman on foot or horseback for each ten miles of the line under construction: *Provided,* however, that if a co-operative agreement shall be entered into between the Company and the Lands Department of the Province of British Columbia, whereby the patrol along this portion of the line is to be handled by said Department of Lands, such arrangement shall be considered a satisfactory substitute for the special patrols above enumerated.

Inspection. For the efficient inspection and general supervision over the work of the Company under Order 16570, with special reference to the patrols above specified, the following superior field officers have been appointed by the Board, with jurisdiction as indicated.

E. J. Zavitz, Provincial Fire Inspector, Lands Department, Toronto, Ontario.

E. H. Finlayson, Fire Inspector, care Forestry Branch Customs Building, Winnipeg, Man.

P. C. Barnard-Hervey, Fire Inspector for Dominion Parks, care Parks Branch, Edmonton, Alberta.

W. N. Millar, Fire Inspector for Dominion Forest Reserves in Alberta, care Dominion Forestry Branch, Calgary, Alberta.

D. Roy Cameron, Fire Inspector for the Railway Belt, care Forestry Branch, Kamloops, B. C.

H. R. MacMillan, Provincial Fire Inspector, care Forest Branch, Lands Department, Victoria, B. C.

A number of other officials of the Dominion and Provincial Government have been or will be appointed officers of the Board, and will assist the above-named superior field officers in carrying on this work.

General Provisions. So far as practicable, the work of patrol has been combined with the other regular duties of your employees, but where this action has not been specifically indicated the patrol force is to be a specially organized and a specially supervised body of men, who shall perform, to the exclusion of other duties, the patrol and other fire-protective work indicated in the Regulations of the Board and specified herein.

In every case where special or section patrols are required special instructions must be issued and special supervision must be provided by the Company.

As a matter of record velocipedes patrolmen passing telegraph stations shall be reported the same as passing trains and such records shall be freely open to the inspection of any authorized officer of the Board.

Each foot patrolman shall be equipped with one shovel and one canvas bucket. Each velocipede patrolman shall be equipped with two shovels, two canvas buckets and one axe. In addition to the above, and to the regular section equipment, there shall be stored at the tool house for each section in each patrol district the following emergency fire fighting equipment; one axe, three mattocks and four buckets of not less than twelve quarts capacity each. Equipment for the transportation of patrolmen will also be furnished by the Company as indicated.

The object sought to be obtained by the regulations of the Board and by the instructions issued under them, is the prevention of railway fires. It is desired to avoid as far as possible the imposition of unnecessary expense upon the railway companies, and it is fully realized that the danger of fire will necessarily vary between wide limits during the long season prescribed by the regulations. There is no doubt that a very efficient system of fire patrol can be established at a minimum of expense if proper provision is made for increasing or decreasing the force as conditions may require or permit. To this end, an average patrol force has been prescribed, with which to begin work, and the various Fire Inspectors appointed by the Board have authority to waive the requirements wholly or in part, from time to time, as may be practicable, it being understood that the Roadmaster will restore such patrol upon request of the Board's representative.

In order to make the system properly effective, it is essential that your General Superintendents be authorized and directed to furnish additional men for patrol work from time to time, as requested by the superior field officer of the Board having jurisdiction.

It is essential also that the necessity be impressed upon your employees of complying in the utmost good faith with the provisions of Regulation 14 of Order 16570. In particular, section men shall be instructed that they must give the same attention to fire that they do to the safety of the track. On this basis, it is believed that damage by railway fires can be very greatly reduced in the future, at a minimum of cost to the Company.

Please acknowledge the receipt of this letter.

MEMORANDUM FOR THE INFORMATION OF DOMINION AND PROVINCIAL OFFICIALS APPOINTED OFFICERS OF THE BOARD OF RAILWAY COMMISSIONERS, FOR THE ENFORCEMENT OF ORDER NO. 16570 OF THE BOARD.

The object of the plan of co-operation in effect with the Dominion and Provincial authorities is the prevention and control of railway fires, through the enforcement of Order 16570. To this end, it is expected that the fire-protective work of the Companies will be carefully and constantly checked at all points, as indicated in the various requirements above enumerated.

Each superior field officer should get in touch with each local Railway Superintendent, and should notify him in writing, in advance of the fire season, of the name, title, address, and jurisdiction of each subordinate field officer of the Board who will handle fire inspection work within the railway district in question. The Superintendent should likewise be informed of any changes in personnel affecting railway fire inspection in his district.

Each Divisional Fire Inspector should have some definite station, at which he can always be notified by railway officials of fires occurring within his jurisdiction. The railway officials concerned should be notified of this address. Arrangements should be made at the official station for the prompt forwarding of messages to the Inspector, wherever he may chance to be in his district.

The attitude of the Inspector should, so far as possible, be that of co-operation with the Company, rather than of criticism. The direct decrease in fire losses and damage claims should render the fire-protective work a paying investment on the part of the Companies, assuming that no unreasonable requirements are made of them.

Probably, in most cases, difficulties can be readily adjusted directly between the local Fire Inspector and the local representative of the Company. However, where this is impracticable, the matter should at once be reported to the superior field officer, who will communicate with the appropriate higher officials of the Company, usually the General Superintendent. If the difficulty cannot be satisfactorily adjusted in this way, a report should at once be forwarded to the Chief Fire Inspector, by wire, collect, or by mail, as may be appropriate under the circumstances. In each case, a definite recommendation should be included in the statement, covering the action desired. Where reports are forwarded by mail, a statement should also be included as to the extent to which the matter has been taken up with the Railway officials, and their attitude in the case.

The Inspector in charge of each portion of the organization should consider himself responsible for securing protection from fire within the territory to which he is assigned. In every case, the plan of protection provided in the letter of the Chief Fire Inspector to a Railway Company is subject to any needed change by authorized field officers of the Board, and each Inspector should without hesitation initiate any action necessary to make the plan fit the conditions as they may exist from time to time. In accordance with the Regulations and the instructions issued to the Companies by the Chief Fire Inspector, relief, either temporary or permanent, according to circumstances, should be granted the Company from any requirements which are unnecessary. The constant aim should be to secure efficient protection from fire at a minimum cost to the Company. So far as possible, the administration should be in the field, and matters should be fully taken up direct with railway officials. The Chief Fire Inspector should be informed of modifications made in fire plans when the regular periodical reports are submitted to Ottawa, at least once each month.

Each fire occurring along or near the right of way should be carefully investigated, and a report should be submitted to the superior field officer, covering the cause of the fire, its extent, and the class, amount, and value of property destroyed. Particular care should also be taken to secure a check with regard to the number of incipient fires extinguished, since this is an indication, not only of the efficiency of the patrol, but of the necessity of its continuation and of the intensity necessary.

A statistical report to the Board will be expected at the end of the fire season, with regard to fire damage along railways within the territory under the jurisdiction of each superior field officer of the Board.

In addition to the above, each superior field officer is requested to submit to the Chief Fire Inspector at some convenient time or times during each month of the fire season a brief statement of the railway fire situation within the territory under his jurisdiction as an officer of the Board. This need not be a detailed report, but should cover briefly the general features of the situation, with particular reference to the compliance of the companies with the requirements made of them, the general efficiency of such measures, the general weather conditions, and a general statement as to the amount of railway fire damage since the last report. This action is essential in order that the Board may maintain proper touch with the field situation. To some extent, this action may, if preferred, be taken by forwarding carbon copies of weekly or monthly reports submitted by Divisional Fire Inspectors.

The Board of Railway Commissioners can pay no accounts for fire-fighting work. This is a matter which must be handled between the Railway Companies on the one hand, and the Dominion or Provincial authorities on the other, according to the Regulations of the Board and existing Dominion or Provincial legislation. In cases where co-operative agreements can be made between the Companies and the Dominion or Provincial Department concerned, this will simplify the matter very materially. It is assumed that the first effort will, in any event, be to extinguish the fire immediately, leaving the question of re-inmbursement for the cost to be settled later. It is also assumed that in case of a fire for which the Railway Company is presumably responsible, the railway official will be in charge; and the local officer of the Board will assist so far as possible, but will not take charge, unless so requested by the railway representative.

A careful check should be made in case of every fire, to determine definitely whether trainmen and agents have complied with the requirements of Regulation 14, with regard to notifying railway employees and forest officers of fires occurring along rights of way. Each case of infraction should be reported to the higher officials of the Company, in order to secure complete observance of the Order in case of future fires.

The condition of the right of way should be reported on at the end of each season, but a special report should be submitted whenever immediate attention is needed with regard to any particular portion of the line. Successive reports should then be submitted at short intervals on the progress of the work, in order that the matter may be further taken up with the Company if necessary.

The utmost freedom of suggestion by field officers is invited, with regard to any feature of the work under Order 16570.

The Harvard Forest School has made a very decided change in its program by lengthening the first year of the two-year post-graduate course to run from July 7 to June 20, covering during this time the whole field of forestry studies, and specializing for a second, academic year in one of four directions, namely Operation of Forests, Wood Technology, Forest Entomology, Dendrology.

During the first year, seven and a half months are spent in the woods, and the first option also contemplates largely occupation in the woods. The real forestry student will, of course, elect the first option, when what has been crammed in the first year may be digested at more leisure. It must be considered an oversight that for entrance a B. A. degree is required, without any condition as to the preliminary, fundamental sciences the student should have had for the degree.

From a letter by Major Ahern, we learn that the Philippine Forest School is thriving, the class of 1913 graduating with 28 men.

Mr. Sydney L. Moore, formerly Assistant District Forester in charge of Silviculture in the Denver District, has engaged with the Sizer Timber Company, an investment company operating in Georgia, with Savannah, Ga., 911 National Building, his headquarters.

Mr. Fred. E. Olmstead has severed his connection with Fisher and Bryant, taking up consulting work for himself at 11 Milk street, Boston, Mass.

The Canadian Forestry Association will hold a special convention on July 7-9 in Winnipeg under the auspices of the Provincial Government of Manitoba and the City of Winnipeg.

Farmers' plantations, windbreaks, and other phases of prairie planting will occupy naturally the largest share of the discussion.

The Republic of China is progressive enough to have instituted a Department of Agriculture and Forestry, with Mr. C. S. Choo, a very able man, at the head. Detail of the organization is not at hand.

COMMENT.

Calls for better volume tables have reached the Editor from time to time. The latest inquiry is worded as follows: "I am considerably dissatisfied with volume tables now in common use for estimating spruce pulp in cord feet. I find a prevailing custom of underestimating to a degree that I cannot account for except through inaccuracy of volume tables. At the present time I am using the volume table given in Cary's Manual, but make additions to the figures therein given. Do you know of any more recent volume tables for estimating spruce pulp which I could obtain for comparison."

Will our readers respond!

The disastrous spring floods in the Ohio and Mississippi Valley again bring to the fore the question of reforestation in connection with flood run-off and stream control. Col. C. McD. Townsend, Corps of Engineers, U. S. A., President of the Mississippi River Commission, at a meeting of the National Drainage Congress in April, linked reforestation with reservoirs and levees as one of the possible methods of preventing floods. While it is well known that floods were never known in the wooded sections of the country while the forests were still standing, it is perfectly obvious that in a rich agricultural country, such as is found around the headwaters of the tributaries of the principal streams in the middle West, a forest cover of sufficient area cannot be maintained except at the sacrifice of agricultural development.

The retention of forests on non-agricultural ground is unquestionably the duty of the Federal government, States, individuals, and land owning municipalities, and by the same token the prevention of fire and wasteful, destructive denudation should be prevented on areas already timbered. Several fundamental influences of forests on stream flow are accepted by scientists, despite statements to the contrary made by what should have been recognized authority in the person of the whilom Chief of the Weather Bureau. That good and sufficient reasons were found for his dismissal, indicates that he had good reason unto himself for the erroneous and misleading statements made in reference to the effect of forests on the catchment basins. Fortunately, we now have more conclusive data than heretofore from the results of experiments conducted by the Forest Service in the White Mountains. These experiments show that the run-off from cleared fields and denuded lands is about twice that from the forested areas. These, and other stream investigations, may be expected to throw further light on this question in the near future. Going back to the question of the Mississippi and Ohio river floods, it is recognized that reforestation would be of material help and advantage on drainage basins, but it would require probably thirty to fifty years to produce from seed a forest of sufficient density to materially influence the run-off. Moreover, there is not always direct connection between reforestation and floods, so that whatever is done in the way of planting and protection must be supplemented by the more important engineering works such as storage reservoirs and levees.

The rivalry between the makers of substitutes for wood and the lumber manufacturers continue to wax strong. A town in Texas which passed an ordinance prohibiting the use of wooden shingles on account of fire danger has reversed itself and again permits the roof covering which has been almost universal since settlement began. The fire insurance underwriters and the publicity agents, representing the manufacturers of wood substitutes continue to voice their arguments under a well organized campaign; while the lumber manufacturing associations are now retaliating by calling attention to the drawback on steel cars, composition shingles and other material which takes the place of wood. The opposing activities are purely commercial and each is able to advance rather strong arguments.

In the use of substitutes many apparent inconsistencies arise. A large railroad company, for example, after making a heavy expenditure for creosoting plants and demonstrating that inferior woods could be bought for posts and creosoted for less than 20 cents each so as to last almost indefinitely, suddenly installs miles of fence set with concrete posts, which cost at least twice as much as the creosoted wooden posts. It remains to be seen how well these posts will withstand frost and breakage, but at any rate their use is contrary to the up-to-date policy of developing local communities through furnishing a market, as far as possible, for local products.

Outside of State and Federal timber properties commercial conditions will continue to rule the manufacturing methods and market for wood material. On the one hand, we have a large body of public spirited citizens who preach forest conservation, and in this way they are joined by a considerable percentage of the operating lumbermen. One of the most obvious means of conserving our forest resources is to cut down the consumption of timber. Few, even of those who preach conservation, make a serious attempt to practice it when their personal needs are concerned, and strangest of all, the use of substitutes for wood is vigorously fought by some of the same people who are preaching conservation. The producers of wood at the same time are usually justified in securing as broad and profitable market as possible for their product. One wide awake and progressive lumber trade journal absolutely refuses to exploit, either editorially or in its advertising columns, any substitutes for lumber; yet in its declaration of policy lists forestry, conservation, and wood waste among its tentes. Consistency evidently is a jewel when it does not interfere with the credit balance of the individual.

Lumber goes on the free list in the new tariff schedule despite the argument of forest conservationists who contend that cheap Canadian lumber will keep down prices in the States and prevent close utilization and long time management. Agreeing that intensive forestry is possible only with higher stumpage and lumber values, it is very doubtful whether free Canadian lumber will materially influence the situation. The fast growing western provinces and the export trade are taking all that can be cut in western Canada, and there is little likelihood of the United States being made a dumping ground, even for low grades. In fact, about half billion feet of American lumber went across the border last year. Moreover, spruce is about the only species which is cheaper in Canada than in the United States. Operating costs are about the same and the cost of marketing higher.

The first sale of Appalachian timber acquired by the government under the Week's law, was a bill for seven dollars' worth of logs sold to a farmer. The total acreage purchased for the Appalachian and White Mountain reserves now aggregates about 500,000 acres.

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THE OBJECTS FOR WHICH THIS JOURNAL IS PUBLISHED ARE:

To aid in the establishment of rational forest management.

To offer an organ for the publication of technical papers of interest to professional foresters of America.

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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A PLAN ADEQUATE TO MEET OUR NEEDS FOR WOOD AND TIMBER.*

BY B. E. FERNOW.

The title which Mr. Ayers has chosen for me to discuss is much more ambitious than my remarks will warrant, for I have no special plan to propose or to advocate, and shall not try to do more than to throw out reflections and suggestions on the subject and point out the need of an active campaign in a particular direction.

Mr. Ayers not only furnished the title, but also suggested the subject matter on which I was to talk, namely, on the lack and the need of application of the most important branch of forestry —silviculture, and more particularly on the lack and need of planting operations on a large scale.

There is now probably nobody inside or outside the forestry associations who has not grasped the fundamental idea and object of forestry to be to *reproduce* the forest crop which we have utilized, and, if possible, in better form; Forest production, or technically speaking, silviculture, is the keynote of forestry.

There was a time when this truth was not recognized even in the membership of the forestry associations, and, indeed, we are still suffering from the consequences of the delusions of our friends as to what forestry intends. There is still in the constitution of the State of New York that foolish clause which prevents the State from practicing silviculture on its own lands—except by violating that fundamental law.

Practically, when we look over the whole United States, outside the National Forests there is in comparison with the ex-

*An address delivered at the annual meeting of the Society for the Protection of New Hampshire Forests, Lake Sunapee, N. H., July 23.

tent of utilization of timber little attempt to reproduce excepting as kind nature unaided, or rather impeded, can accomplish.

If, as is claimed by some, we are cutting three to four times as much as the annual growth on our whole forest area, it would appear that something more positive than protection against fire and more conservative use is necessary to supply the future needs of wood and timber. There must be a deliberate effort to catch up with the cut by reforestation of lands now not productive as well as by improvement in the increment of productive areas—the practice of silviculture!

We must realize that our population is still growing at a greater rate than that of other countries, and with it our requirements, and while there is undoubtedly a reduction in the use of wood going to be forced upon us—from the 250 cubic feet which we are consuming now per capita to the 37 cubic feet which Germany can get along with, or even the 14 cubic feet which satisfies the Englishman—it is not readily going to adjust itself to the increment which under present methods we can figure out as probable.

I may here recall from the Report of the National Conservation Commission an attempt to arrive at a production figure. The data in various parts of the report do not agree, the total forest area, for instance, being stated varying from 545 to 700 million acres. Accepting, however, the statement of 580 million acres as probably nearest the mark and making proper allowance for the changes which have taken place since 1907 when the estimates were made, the present condition of this area would be, as far as not turned into farms:

Mature timber, 265 million acres; cut over lands, restocking, 225 million acres; cut over lands, not restocking, 80 million acres.

To this latter area must be added 80-90 million acres of openings, or of scrubby woodland within the mature timber area. Since the mature timber area does not make any new growth we have then more than half the total area non-productive, only 225 million acres of culled area restocking as nature left to itself may do. Nevertheless, on this total area an average annual product of 28 cubic feet per acre is estimated by one writer in the cited report, representing possibly 20 billion lumber feet, or half our present cut. Another estimate makes the growth 72 lumber feet per acre which would about cover our present annual cut.

Considering that the *managed* forests of Prussia, on a very much smaller area (less than 7 million acres) produced in 1850 precisely the amount of 28 cubic feet per acre, we may feel assured that this production by unaided nature is most likely an over-estimate, as far as useful material goes, and that we are justified in believing that our present consumption exceeds at least by more than double the annual growth.

And since, according to the same authority, there is hardly 30 years' supply in sight, the time for delay and dilly-dallying with Nature's good will is certainly past, and positive measures are becoming urgent.

Even if the remainder of uncut timber were all handled under what is called the method of conservative logging, as at present understood, it is questionable whether our requirements for the future can be secured, and the situation much changed.

We should understand the true inwardness of conservative logging. In the first place, it means a more careful utilization of the existing natural crop; secondly, it involves leaving a part of the crop for additional increment by restricting the cut to a certain diameter; thirdly, if applied to the fullest extent, it means leaving here and there seed trees, that *might* help in securing a new crop if nature is kind, but it does nothing to *insure* such a new crop or to assist its development, and since the financial condition of the operation prevents the removal of weed trees, the latter have at least as good a chance, often a better one, to reproduce as against the better species which are the object of the logging and which, by this very fact, are constantly reduced in the composition of the forest. If, then, fire is kept out, the trees left of the original growth will lay on additional increment, and in 20 or 30 years will have grown to desirable log size, permitting the logger to return for another harvest; but there is no assurance that a new, *young* crop will spring up and take the place of the original, nor if such crop perchance, should establish itself, that it will be of the right kind and will in the shade of the left-over trees develop advantageously.

Conservative logging, then, is rather concerned with a more conservative *utilization* of the present crop, and has only a subordinate element of concern in the future crop—of silviculture—in it.

I do not deny that the heart of the lumberman may open more readily to the advocate of conservative logging than to the silviculturist, for the former promises him a better present or short-time financial return, while the latter invites him to invest for a long run; but we must not expect from it much toward a solution of our problem of supplying the future, which can only come from an application of real silviculture.

It is true the practice of silviculture presupposes safety of property, and hence, as long as the fire danger is excessive, the lack of interest in such a hazardous crop, and especially in the expenditure of money in establishing it, can be easily understood. In the last few years it seems, however, that the efforts in subduing the fire fiend promise success, and hence times are better for pressing the need of active efforts at crop production—the practice of silviculture.

Immediately we raise the question as to what methods of silviculture we are to apply, we are in the field of controversy and disagreement among the doctors.

I hope, however, that it can not happen any more, as happened only four or five years ago, that an agent of the U. S. Forest Service would swear in court that the selection forest method is the only applicable one in our mixed and culled forests. Nor will today the sneer and scoff with which a high Forest Service official, 10 or 12 years ago, passed judgment on our nursery at Axton in the Adirondacks as a useless splurgy performance, find an echo.

I hope we have taught enough of the young foresters what the physicians know, namely, that each case can be doctored only after special diagnosis; that there is no universal medicine; and that each medicine has its value in a particular case.

Nevertheless, we must admit that there are at least two distinct types of treatment to choose, and that there are, as among physicians, the allopaths and homeopaths, two schools of silviculture, which have been contending against each other for nearly a century even in the home of forestry, in Germany, namely, the advocates of natural regeneration against the advocates of artificial restocking.

And, as in medicine, the wise man smiles at the one-sided advocates of any one special form of treatment and practices an eclectic system.

Natural regeneration, as the name implies, relies to the largest extent on Nature to produce the crop, the seeds from the existing trees are expected to seed the area to be regenerated, and as the old crop is removed, the new crop takes its place—conservative logging with more consideration of the needs of the young crop. In artificial reforestation, the seeds are gathered and sown by hand or machine, or else, preferably, trees are grown in the nursery and planted out by the use of various tools. As a rule in the former method the old crop is more or less gradually removed; in the latter method, as a rule the old crop is cut clear, and possibly the ground prepared for the new crop.

There are two points of view from which every forestry practice must be tested, namely the biological one and the financial one; does the method produce satisfactory *material* result and at the same time keep the factors of production, especially the soil, in good condition? And, on the other hand, is it as cheap as a satisfactory *financial* result makes it necessary?

In farm practice, each year's, or a few years' crops, give answer to both questions, but in forestry unfortunately the result is seen only after a very long series of years, and hence the possibility of such an unending controversy between natural regenerators and planters.

This long-time element makes, for instance, all finance calculations speculations in futures, without very certain data.

What prices will rule 60 to 100 years hence? What interest rate is proper to charge or expect on the invested capital for such a long time investment? Indeed, will not industrial development perhaps have eradicated the use of wood, or at least of wood of the kind we have set out to grow? This latter question has in the last century been a serious one for the beech forests of Germany. Originally fostered and increased to meet the need of fuel wood, the development of the use of coal made them unprofitable; then having revived as furnishers of tie timber with the railroad development, the metal tie threatened to displace them, and but for the fact of a broad national policy under which both forests and railroads are managed by the German Government, the metal tie would have killed the beech forest industry.

Nevertheless, we must act as if the future were ours, and as if the use of wood is assured forever, for which the vast amount of its present consumption and other arguments give warrant; although the extensive growing of anything but general purpose woods is to be carefully considered.

A few reflections regarding wood prices will perhaps help to clear the situation as to future values. Prices are local, continental, and international or world prices. Eventually, there is for every material of limited supply, as wood must ultimately be, a price level which only distance to market can vary. In the end, also, prices of manufactured or produced goods must at least equal minimum cost of production. At the present time, while there are still large supplies of wood available, the free gift of nature on which no cost of production needs to be charged, prices in this country at least remain below the cost of production, and even in Germany they remain below a fair business charge, because of the competition of these free supplies. The cost of production in the German State Forests at present is at most about $4.75 per M feet, not including interest on the capital involved, and with a reasonable allowance of such interest charges, around $7.00 per M feet.

On over 10,000,000 acres of State Forests, the production of stout wood (over 3 inch) was, in 1910, 73 cubic feet per acre, of which 65 per cent. or 48 cubic feet was log material which may be translated into around 400 feet B. M. The total expense per acre was $2.45 which if the whole is charged against log material makes the cost of production 1 M board feet cut in the woods around $6, from which deducting wood choppers' wages of $1.25 leaves the cost of stumpage $4.75, while the average price per M feet in the woods cut—i.e., of logs, was $16.65.

With us, due to difference in labor prices, this cost of production may be doubled and rounded off upwards to $10 per M. When, therefore, stumpage values have reached the $10 mark with us we may feel assured that the business begins to pay, hardly before.

Is there any likelihood of this value to be reached? Here again we can only argue from past history and from the knowledge that timber supplies are limited. In Prussia, during the last 80 years—and no shorter periods need be considered—wood prices have risen at the average rate per year of one and one-half per cent—that is to say, they have more than doubled. In our own country stumpage of white pine in the last thirty years has quintupled, and in the last ten years doubled, and, indeed, has reached the figure at which it will cover cost of production and leave a profit. And as everyone knows, *all* wood products have for the last two decades risen speedily, as the knowledge of limited supplies has become realized. While for most species the stumpage values are still far from what it would cost to produce them (they are mostly in the neighborhood of $5), it can be safely asserted that the time when this will be the case and when the price level of European markets will be reached will be here before any plantations now made will be ready for harvest.

Hence, we will be justified in assuming for long-time calculations the present European prices as reasonable and very safe expectations.

The interest rate at which European foresters figure their business rarely exceeds 3 per cent; but this does not mean that the business pays that rate on the originally invested capital or investment value, which is not at all known. It means merely that the *sale* value of the wood and soil capital yield a 3 per cent revenue, but as wood prices change so does the value of the capital. If we take the value of the forest capital at any given time in the past as the investment value and compare it with the present net revenue the relation is entirely different. For instance, 10 million acres of State forests in 1900 were valued from their net revenue with a 3 per cent rate as at that time worth $700,000,000 or $70 per acre. In 1910, these same acres brought a net income of $2.78 per acre or somewhat over 4 per cent on the valuation of 1900, but if still earlier valuations are taken the actual earnings would show at much greater rates. For instance, Prussia in 1880 had 6.5 million acres bringing a net income of just about 6 million dollars, which capitalized at 3 per cent would make the forest value $200,000,000, or only $30 per acre. On this valuation the net income of 1910 of $2.78 per acre would represent over 7.5 per cent dividend.

If we can therefore manage as well as Prussia—and there is no reason why we could not—we are justified in figuring our business rate in forestry with present valuations of forest investments at the usual business rates for similar investments.

After this digression we may return to our discussion of the two silvicultural schools.

The advocates of natural regeneration claim financial superiority in that the first cost of starting the crop is avoided.

This, however, is only seemingly or partially so, for with the exception of the strip method—which clears the ground in one operation as in the case of artificial restocking—every natural regeneration method requires a more or less *gradual* removal of the old crop and entails, therefore, the logging of a larger area for the same budget and return to the same area as well as more careful operation to save the young growth and hence involves greater expense in harvesting. Moreover, the financial result is not decided by the first cost alone, but by the final outcome. Success in establishing a new crop by natural regeneration is to the largest extent dependent on the good will of nature, or the luck which the manager has in getting the combination of favorable weather conditions with a satisfactory seed year, a good seed bed and proper light conditions for the young crop.

Even the best judgment and skill in securing a good seed bed and proper light conditions—which are the human contributions to the production—can not force success if the seed year fails or the weather is unfavorable.

The further development or progress of the crop also depends upon the skill of the silviculturist in gauging light conditions as the crop needs them—and this is by no means an easy or inexpensive task. In the end, almost invariably time is lost in the establishment and progress of the crop; the naturally regenerated crop as a rule comes to maturity later than the artificially started one.

It is then highly questionable whether finally the financial advantage is not after all in favor of the planted crop, although it requires a direct outlay. There is, however, one favorable biological feature of the natural regeneration processes, which is undeniable, namely, the continuous soil-cover which prevents soil deterioration. This, however, also is not infrequently more a theoretical and limited effect than a practical one, for, if after the opening is made, the young crop is not at once established, there is to some extent at least the same liability to deterioration as in the clearing and planting method.

Nevertheless, this feature remains the best argument for the natural regeneration, and vice versa, the fact that in the artificial method the soil is bared and that the planted crop on account of expense is less dense and closes up to shade the ground considerably later than in a successful natural regeneration, is the most valid objection to the planting method.

We must, however, not overlook that the need of soil protection is not everywhere prominent, and moreover, can be secured by advance planting before the old crop is removed, and by dense planting, perhaps with a cheap nurse crop. Planting undoubtedly costs money, requires a direct outlay, but its advantages are many, namely, avoidance of damage to the young crop in the operation of harvesting, independence of the harvest from the process of restocking, a gain in time, the possibility of the choice of species, the completeness of the stand which can be forced. If properly conducted it is a cheap and reliable method.

There are fashions in methods of operation as well as in clothes; natural regeneration was in fashion in Germany 80 to 100 years ago. This is the reason, so writes an authority from Württemberg, that the age class of 80-100 in the State forests is deficient. The fact that the beech area in Germany has since 1820 been reduced to about one-half of what it was is also in part at least ascribed to the failure of natural regeneration, this species being supposed to be capable of being reproduced by that method alone. Nature is still more obstinate than foresters, says a prominent writer in comment, and usually remains in the right; the cost of the quarrel falls to the loser.

By 1840, planting had become fashionable, especially in the pineries. In the 80's, under the leadership of Gayer, a reaction set in, and natural regeneration came again to the front, at least in theoretical teaching, while in practice a larger and larger share was given to artificial restocking, so that now over 60 per cent of German State forests are managed under a clearing and replanting system. So anxious have the adherents of natural regeneration become that last year they saw the need of forming a special association for the advocacy of their hobby—an economic joke!

Meanwhile, magnificent stands have been produced by planting in the Prussian pineries and Saxon spruce forests, which are convincing. In the State forests of over 10 million acres, now, over two and one-quarter million dollars are paid out annually for planting.

Coming now, nearer home and admitting that intensive methods of silviculture may not as yet, even in State and National forests, appear to be practicable—although viewed from the standpoint of the future we hold they are—we may at least inquire what the conditions are that should direct our choice of method.

Thirty years ago a very wise nurseryman, Thomas Meehan, of Philadelphia, whose firm is still one of the best in the country, a keen biological student, did not hesitate to express his opinion that the only promising method of restocking our woods was by planting. At that time I was myself still imbued with Gayer's doctrines and stood up for natural regeneration. I am not now as radical as Mr. Meehan was, but I have come to realize the truth upon which he based his opinion. In our mixed woods, with species of unequal value, the culling process in many cases leaves weed patches, the weed trees regenerating in preference to the valuable species which are reduced in number by the logging operation. Unless, therefore, a way is found of subduing weed trees first, the new crop will not be of desirable composition. In many cases the accumulation of duff and litter on the ground is such that a satisfactory seed-bed can only be secured by artificial means. Thus the spruce in the Adirondacks, shedding its seed after the fall of the foliage of its broad-leaved associates, finds on this dry stratum poor chance for germinating and still less chance of reaching the mineral soil with its delicate roots.

Finally, our climate in many sections is not favorable to natural regeneration. We must not forget that the result of the tempered and humid climate of the Pacific Coast, where any method of restocking would be successful, or the example of the equally temperate climate of France, where methods succeed that in Germany are a failure, can not serve as a model for our Eastern States or dry Rocky Mountain sites.

From the experience of the Forest Service with the broadcast sowing in the Black Hills—which is as near an imitation of natural regeneration as can be, we may learn the lesson of what to expect.

The sowings of 1905, an exceptionally wet season, were a success, although even then the result was quite uneven; in 1906 the result was poor; in 1907, again good; in 1908, poor; in 1909, unsatisfactory, although apparently weather conditions were favorable. In 1910 the extraordinary drouth of the season caused total failure. Out of five years three failures!

While, in the Eastern States, weather conditions may not be as severe, they are certainly as uncertain, and a successful natural regeneration is largely a matter of luck.

While then still confessing myself an eclectic, willing to employ any method that promises satisfactory results, I have come to the conclusion that Thomas Meehan was not so far wrong for a large part of our territory and conditions. We may try our luck first with natural regeneration, but if not successful at once, instead of tinkering with nature we should, like wise men, force the luck by planting. I wish then to go on record as holding the opinion, that our needs of the future will not be satisfactorily and adequately provided for until we take recourse to planting operations on a large scale.

This conclusion, based on observation of biological conditions, is also borne out by a statistical inquiry.

Referring again to the forest area condition we will find that, if we go on as at present, within 20 years we will have reached the point when our virgin timber, in which natural regeneration methods might still be practiced, will be near its end, for we are cutting now at the rate of 10 to 12 million acres per annum.

Our needs then must be filled to the largest extent from the so-called second growth and volunteer growth of our cut-over lands, and the area capable of restocking only by artificial means will have increased to probably 250,000,000 acres, over half of the then remaining forest soil. We shall, indeed, be forced to plant, whether we believe in the method or not!

Before now discussing the elements of a plan of procedure it is needful to point out that it is useless to expect private enterprise to undertake the task, at least not without considerable assistance from the State. On account of the long time to maturity—not less than 60 to 100 years—private interest cannot be expected to be keen in engaging in such business, which is profitable only in the long run.

That in the old countries, France and Germany, private forest management has, in part and with many exceptions, been successful, can be explained by historical development and by special economic and political conditions. Among these is the institution of the so-called Fideikommis, *i. e.*, trust property—private property placed by some previous owner under State control in order to prevent mismanagement, exploitation or disposal by his successors, under which institution nearly one-quarter of the private forest area of Germany is kept in producing condition, besides 30 per cent of the private area which is under State control for other reasons, so that over half of the private forest-area experiences State control.

The other half is very frequently mismanaged, exploited and destroyed, and it is decreased by the State governments buying it up and reforesting. Over one million acres were thus acquired by the States during the last two decades, Prussia alone having spent some $25,000,000 in that direction.

It is only long lived corporations, municipalities and governments that can afford and can be expected to carry on a persistent conservative policy and spend money and tie up capital which is not returning interest for many decades. Such large persistent corporations as railroads needing a continuous supply of ties, or those engaged in paper manufacture whose business run with expensive plants is based on continuity of forest supplies may embark successfully on growing their raw material. The small farmer, who does not count his time, may also in a very small manner contribute toward eking out supplies. But in the end, I am afraid, we will have to abandon the democratic dream of individual endeavor and learn the lesson that communal interests must be attended to by the community. In the end, only the State and municipality can be expected to provide for a distant future! There are some foolish notions abroad as regards the distance of that future, the length of time it takes to grow a log tree. We may not go at length into this subject, only stating that with most species in most localities nothing can be expected in less than 60 to 100 years. An adequate plan, then, for supplying the future needs of timber at least must rely upon State activity and upon planting on a large scale.

As I stated at the outset I have no cut and dried plan for setting in motion machinery to execute such planting propositions, except to set every State forester, forestry commission, and every State forestry association thinking on the matter, to make them realize that their business is not only to conserve or secure conservative use of existing resources, but to create new ones, which shall flow when the existing ones are exhausted; to recognize that this is a more serious matter than can be met with by the desultory distribution of a few thousand plants to private planters, or the haphazard planting of a few acres; that it requires *systematic procedure on a large scale.*

Each State forester should make a canvass of his State as to the acreage which should be replanted, classifying it as to which may be confidently left to private enterprise; which to municipal concern; which to direct State enterprise; which to be taken in hand at once; which to be left to future work.

He should then work out a plan of State co-operation which might take the form in the case of municipalities, besides furnishing plant material and advice, of pledging the State's superior credit for raising the necessary funds by bond issues for acquiring plantmaterial and advice, of pledging the State's superior power for the State.

For New England, municipal enterprise is perhaps the best and most promising, although in general direct State control may be preferable.

An example may illustrate the method of procedure.

Let us assume that a town has 5,000 acres of waste lands, which it could secure for say $15,000, borrowing the money from the State at 3%; the 5,000 acres to be planted in a 25 year campaign; that is at the rate of 200 acres per year, at a cost of $8 per acre; the annual outlay of $1,600 also to be furnished by the State from year to year, when the interest charges will be $450 on the original investment and a series of interest payments of $48, increasing annually by $48. The loans will then, in the 25th year, have accumulated to $55,000 and the interest accumulations to $26,870, or $1,075 average per year, and the highest last annual charge, $1,650—amounts not difficult to raise!

After the planting is finished the annual interest charge remains stable at $1,650. Now each year 200 acres may be thinned and every five years the thinning repeated. A net result of $2 per acre for the first thinning (at that time wood prices will be higher!) $3 for the second, and $3.50 for every subsequent thinning, would be a reasonable assumption. In other words, for the next five years after loans and plantings have been completed the interest charges are met to the extent of $400, in the second quinquennium to the extent of $700, and in the third quinquennium a surplus begins to appear. Now, arrangements for refunding the loan may be made at once, or else merely interest may be continued to be paid out of returns for thinnings, the town receiving small incomes until the sixtieth year, when the first 200 acres may come to harvest yielding not less than $120,000, likely much more at that time, wiping out the loan and leaving a property worth several million dollars producing annual revenue.

And all the State has done is to loan its credit, not one cent is given in charity, and the town has made no expenditure except for the care of the property.

That these calculations are not chimerical may be learned from the experiences in France.

Here the State reforested during last century 200,000 acres of sand dunes at a cost of $2,000,000. Of this 75,000 acres were sold reimbursing the total cost of the 200,000 acres and $140,000 to boot, and leaving a property now valued at $10,000,-000.

In the Landes, the State, municipalities and private owners planted nearly 1,750,000 acres at a cost of $10,000,000, the value of the recovered properties based on their annual production being now placed at $100,000,000.

Some 200,000 acres of poor land, unhealthy, useless waste in La Sologne was planted up by a private association at a cost of $5 per acre. These lands, which 50 years ago could not be sold at $4 an acre, now bring over $3 annual revenue, being valued at $18,000,000.

Another 200,000 acre tract in Champagne on arid limestone wastes, largely planted by private incentive, costing somewhat less than $25 to plant, is valued at $10,000,000, furnishing a net revenue of $2 per acre.

These are results actually achieved and not fancies or forecasts.

According to the Conservation Commission's report there are in New England 2,225,000 acres immediately ready for planting, and with a little closer scrutiny by the State Foresters, probably twice that amount may be found, for I believe I know that Massachusetts alone contains approximately the whole amount stated by the Commission. A twenty-five year campaign of reforestation would necessitate an annual planting of 200,000 acres. There is some planting done, but in the face of these figures does not what is actually done towards recovery of this lost ground look amateurish and inadequate?

Such an area of 5,000,000 acres, which is twice the forest area of Bavaria and Baden combined, which produces $10,000,000 annual revenue, planted with White Pine at $10 per acre and properly managed would eventually produce annually its 2,000,000 M feet of lumber, which even at present stumpage prices would be worth $20,000,000, and be an ample supply for any population that might be then located in New England.

The same method of engaging the State's credit to inaugurate a plan of preparing for the future and making waste lands productive by municipal planting could be readily extended to the Federal Government assisting the States by loans, if not subventions.

We are now accustomed to have the general Government stand behind large national undertakings, such as the reclamation service, the waterways commission, the good roads movement, etc. If it is desirable for the general Government to spend funds in preparing ground for agricultural use by irrigation works or by draining swamps, why should it not extend its beneficent action to bring waste lands into forest use by inaugurating a systematic financial assistance in loaning its credit to the States for the recuperation of mismanaged forest acres.

It would not be difficult now to elaborate the details of such a plan of co-operation between the general Government, the States and municipalities, and, under special conditions, including private owners of forest land in need of recuperation. If this were done now, by the time our virgin supplies, and second or volunteer growth supplies are used up plantations would have matured and we would be able to supply our annual needs.

The task and the expenditure would by no means be enormous as the following supposititious calculations may show.

We may assume that some plantations now made for the purpose of lumber supply will at best mature when sixty years old, although for most eighty years will be needed. By that time, say 1970, we may fairly assume that not only the total supply of virgin lumber will be consumed, but also the second growth of the cut-over lands, and the population, if we assume an average of fifteen per cent. increase per decade—it has been nearer twenty-five per cent. during the last three decades—will be 225,000,000. We may also assume that by that time—indeed long before, for otherwise supplies would not last so long—our consumption of log wood material will have come down to at least the present minimum of Great Britain's consumption, namely, twelve cubic feet or 100 lumber feet per capita.

This would require the cut of first-class forest growing at the rate of about four hundred feet B. M. for sixty years close to 1,000,000 acres per year, hence to secure a continuous supply 60,000,000 acres must be in that producing condition. The probability is that not less than 100,000,000 acres in part under natural regeneration would have to be maintained to satisfy all needs for wood materials.

We have seen that less than $20 per acre would be required for planting cost and interest account, and hence an annual loan of $20,000,000 for sixty years—two dreadnoughts a year—would be a most ample provision.

Summarizing, then, the elements of my plan are:

(1) Each State to ascertain its quota of planting area, classified for systematic procedure in its recovery.

(2) A co-operative financial arrangement, by which municipalities may secure the credit of the State, and States the credit of the Federal Government for the purpose of acquiring and recovering their quota.

(3) State planting to be done on a large scale.

If I have not developed a very definite and adequate plan to meet our need for wood and timber in the future, I hope I have at least opened up a line of thought which may lead to its formulation.

SOME ASPECTS OF EUROPEAN FORESTRY.

By A. B. Recknagel.

V. Management of Hardwoods in Eastern France

The rolling plateaus of Lorraine and Franche-Comté are covered with fine hardwood forests. Oak (both *Quercus pedunculata* and *Quercus robur)* and beech are the principal constituents, with them occur ash, elm, linden, birch, hornbeam, willow, aspen, etc., giving variety to the stand.

The plateaus of Eastern France vary in elevation from some 700 feet to 1,300 feet, above sea level. They are the result of much erosion as the deep valleys of the dissecting rivers bear witness. The soil is, almost universally, a heavy wet loam of no great depth; it is not a site especially favorable to tree growth, particularly where the impenetrable bed rock is close to the surface.

The climate is typically "continental," that is, the winters, while irregular, are usually long and cold; the summers characterized by periods of drought. Frosts frequently occur even in late spring. The rainfall and snowfall are more than abundant, together averaging from about 23 to 30 inches a year; but the precipitation is not well distributed through the months.

Thus the conditions of tree growth encountered in Eastern France are by no means optimum; the greater credit is therefore due the French foresters for the excellent results accomplished. Up to the early part of the nineteenth century practically all the hardwood forests of Eastern France were managed either as pure coppice (Taillis) or as coppice under standards (Taillis sous futaie). The coppice rotation was often incredibly short (eight years for one forest near Nancy) but ordinarily varied between 25 and 40 years, while the age of the standards was usually some multiple of the coppice rotation and seldom reached 160 years.

Many of the private and commercial forests are still managed under this system, as indeed are also the poorer areas of the State forests or those whose conversion into high forest has not yet been undertaken. The system of coppice with standards is a specialty of the French, satisfying the double needs of fuel wood and larger construction timber; they have a knack of handling this type and of securing good yields even on unpromising sites.

But the French government as early as 1826 conceived it as its economic duty to raise the larger timbers requiring the longer rotations, which the French market demanded but which the private or commercial owner could not afford to raise. Thus for nearly a century France has held to the policy of letting the private or commercial owner raise what he pleases—which is usually small stuff, fuel, low grade lumber and the like—while the national forests are devoted to the raising of the larger timbers. Thus France is in interesting contrast to such countries as Saxony and Württemberg, and in fact in entire contrast to the new school of forest economists in Germany, who claim that revenue is the only correct touchstone in forestry. French Forestry does not stand on a financial basis, solely, but, like Prussian forestry, on the assumption that the forests are a national heritage to be preserved as such for the good of future as well as present generations, aside from whether it "pays" in present dollars and cents.

Proceeding on this principle, the French government early in the nineteenth century began the conversion of these hardwood sprouts into high forest. A gigantic task, truly.

The process of conversion is, briefly, as follows. Instead of cutting the coppice at the thirtieth year as is usually done, it is allowed to grow until the sixtieth year or thereabout. During the last decades it is necessary to free the crowns of the seed-bearing standards from the encroaching coppice. This is done by means of preparatory cuts (Coups preparatoires) at intervals of about ten years. When the coppice is about 60 years old, the regeneration cuttings (Coups de Regeneration) begin. Their object is to open up the stand by cutting most of the coppice, allowing the seed from the standards to regenerate the area. Most of the coppice is cut but not all; for usually some sprouts of the best species (oak, ash) are left. Of course any seedlings already on the ground are most carefully protected. The stand is opened up more for oak, less for beech regeneration because of the relative tolerance of these two chief species. These regeneration cuttings are repeated four or five times at intervals of about five years. During the period of regeneration the cuttings change from:

1. Cut to seed up the area (Coups d'ensemencement) to
2. Several cuts giving light to seedlings (Coups secondaires), and to
3. Final removal cutting (Coup definitive).

Cuts 2 and 3 are chiefly in the standards; at the end of the regeneration period all the standards have been cut, and the cleanings have begun. At first, shears suffice to free the seedlings from encroaching sprouts but by the time the new stand is 30 years old, regular thinnings, as described below, have to be made. These, as well as the preparatory cuts just described are classed as improvement cuttings (Coups d'amelioration) in contrast to the regeneration cuttings.

This process can be illustrated by the following example:

A forest with an average rotation of 160 years is divided into 160 parcels numbered 1-160 in the order of their cutting. Assuming five years as the interval between the regeneration cuttings, the Cutting Calendar would be as follows:

PARCELS TO BE CUT EACH YEAR

		I.	II.	III.	
Years	*Seed Cut*	*Secondary Cuts*			*Final Removal*
1912	Parcel No. 1	Parcel No. . .	Parcel No. . .	Parcel No. . .	Parcel No. . .
1913	" " 2	" " . .	" " . .	" " . .	" " . .
1914	" " 3	" " . .	" " . .	" " . .	" " . .
1915	" " 4	" " . .	" " . .	" " . .	" " . .
1916	" " 5	" " . .	" " . .	" " . .	" " . .
1917	" " 6	" " 1	" " . .	" " . .	" " . .
1918	" " 7	" " 2	" " . .	" " . .	" " . .
1919	" " 8	" " 3	" " . .	" " . .	" " . .
1920	" " 9	" " 4	" " . .	" " . .	" " . .
1921	" " 10	" " 5	" " . .	" " . .	" " . .
1922	" " 11	" " 6	" " 1	" " . .	" " . .
1923	" " 12	" " 7	" " 2	" " . .	" " . .
1924	" " 13	" " 8	" " 3	" " . .	" " . .
1925	" " 14	" " 9	" " 4	" " . .	" " . .
1926	" " 15	" " 10	" " 5	" " . .	" " . .
1927	" " 16	" " 11	" " 6	" " 1	" " . .
1928	" " 17	" " 12	" " 7	" " 2	" " . .
1929	" " 18	" " 13	" " 8	" " 3	" " . .
1930	" " 19	" " 14	" " 9	" " 4	" " . .
1931	" " 20	" " 15	" " 10	" " 5	" " . .
1932	" " 21	" " 16	" " 11	" " 6	" " 1
1933	" " 22	" " 17	" " 12	" " 7	" " 2

Full seed years are few and far between for oak in Eastern France; the statistics for oak seed years show that a partial crop occurs on an average of every eight or ten years but that a full, abundant crop occurs only every twenty years or even more.

But when it rains it pours. The acorns literally cover the ground. It is indeed fortunate that hogs are rigorously excluded from the forest.

The beech is not so difficult of regeneration. Indeed, under this quasi shelterwood system of cutting, the beech reproduces very abundantly for its tolerance enables it to come in before almost any other species. The trick is rather to keep the beech within bounds and to secure a high percentage of oak in the mixture. This means a constant favoring of the oak as against the beech; yet if the preparatory or the seed cuttings are too heavy, the sudden access of light will bring a tangle of grass and weeds sufficient to choke the oak seedlings for which the greater access of light was intended.

This process of regeneration and of maintaining the balance between beech and oak, requires the highest skill on the part of the forester. It is therefore the more to his credit that planting is rarely necessary and only resorted to where the axe has failed; then stout transplants 18 to 20 inches high are used.

The forester's role as mediator continues after the regeneration has been accomplished and the final removal cuttings of the old stand made; for then the more rapid growth of the beech tends to dominate the slower growing but far more valuable oak. At first it is only necessary to clean out the stand—removing the dead and dying and the wolf trees which are taking up more than their just share of space. But after about the thirtieth year the real thinnings begin, moderate at first but becoming more and more intense as the stand grows older. These thinnings are made at intervals of, at most, ten years and are invariably thinnings from above (Eclaircie par le haut). This method of thinning, first developed in France but since then widely copied, is in direct contrast with the thinnings from below (Eclaircie par le bas) usually practiced in Germany. These two methods may be defined:

Thinnings from below aim to remove only the suppressed trees; the undergrowth is not necessarily removed since this is only a soil cover and does not affect the competition in the crowns of the trees.

Thinnings from above, on the contrary, aim to pick the winners in the crown competition and to give them every advantage by cutting the less valuable trees which are apt to cause them damage. No regard is paid to trees already suppressed, i.e. no longer in the dominant crown class.

How does this work out in the practice?

Assuming a forest of oak and beech, the result of natural regeneration as described above, if no thinnings are made at all, the more rapid growth of the beech will result in the gradual suppression of the oak. The final result will be a nearly pure forest of beech. This is also true if, regardless of species, the principles of thinnings from below are applied; for the oaks being of slower growth will be the first to be suppressed and, hence, to be removed from the stand; but in thinning from above the trees of the future,—i.e. the sturdiest oaks are favored throughout, even at the sacrifice of larger beeches, and thus the percentage of oak is steadily increased while the suppressed trees serve as a valuable ground cover and protection from the growth of weeds, grass and briars.

Two phases of these methods must not be overlooked. In choosing the trees of the future a new choice has to be made at each time of thinning; for it is impossible, as experience has shown, to foresee all the eventualities in the life of the stand. This fact in no way lessens the efficiency of the method. The other phase is that the isolation of the "chosen ones" must not be pushed to an extreme but the continuity of the crown cover always maintained. It is interesting to note, finally, that the thinnings from below often result in adventitious shoots on the suppressed and crowded stems while the trees whose crowns are free have no need for such desperate measures.

The following figures serve most interestingly to compare the results of the different methods; a non-thinned area being added for the sake of comparison:

AVERAGE ANNUAL PRODUCTION PER ACRE—1856 to 1904*.

Method of Thinnings	*Species*	*First 27 yrs. 1856-1872*	*First 32 yrs. 1856-1887*	*First 40 yrs. 1856-1895*	*49 yrs. 1856-1904*
		Feet Board Measure			
I	Oak	228	230	252	243
Thinnings	Beech	641	714	899	1,059
from below	Miscell.	44	41	32	027
(Eclaircie par le bas)	Total	913	985	1,183	1,329
II	Oak	306	299	333	372
Thinnings	Beech	666	728	890	957
from above	Miscell.	19	19	17	12
(Eclaircie par le haut)	Total	991	1,046	1,240	1,341
III	Oak	236	230	240	214
Untouched	Beech	804	845	983	1,110
	Miscell.	14	14	7	7
	Total	1,054	1,089	1,230	1,331

This increase in the production of oak under the method of thinning from above is also shown strikingly by comparing the total volume of oak per acre in 1887 and in 1903, as follows:

Average Volume in Feet Board Measure, Per Acre.

	1887	1903
I. Thinnings from below,	2,788 feet b.m.	9,214 feet b.m.
II. Thinnings from above.	3,043 feet b.m.	10,336 feet b.m.
III. Untouched.	2,856 feet b.m.	7,055 feet b.m.

Under such favoring treatment the growth is sufficiently rapid so that the average rotation does not exceed 200 years. However, no attempt is made to adhere to a fixed rotation or to a fixed annual cut; rather everything is made subservient to the silvicultural exigencies of the species involved.

The growth of an average oak is somewhat as follows:

Diameter, breast height, inches.	Age, years
3.94	16
5.91	34
7.87	47
9.84	60

* Obtained through the courtesy of M. Cuif, Inspecteur des Eaux et Forêts, attaché à la Station de recherches de l'École des Eaux et Forêts, Nancy.

Diameter, breast height, inches.	Age, years
11.81	74
13.78	90
15.75	103
17.72	116
19.69	130
21.65	149
23.62	165
25.59	180
27.56	198

Prerequisites to this method of Management are: perfect utilization, excellent market and easy accessibility to all parts of the forest by a complete network of roads. All these exist in Eastern France, where even the stumps sometimes bring a price of 60 cents per thousand feet, board measure, in the ground!

Aside from reasons of political economy, the conversion from coppice into high forests has been a financial success as the following example (the National Forest of Amance, near Nancy) shows:

1814-1826	net income	$1.80	per acre	per annum
1827-1857	net income	$2.36	per acre	per annum
1858-1866	net income	$5.40	per acre	per annum
1867-1876	net income	$5.19	per acre	per annum
1877-1886	net income	$3.91	per acre	per annum
1887-1896	net income	$5.96	per acre	per annum
1897-1906	net income	$3.91	per acre	per annum

Average $4.80 Per Acre Per Annum.

The fluctuations are, of course, inevitable during the period of transition, especially since 1867, when the transforming into high forest began in earnest.

The final result will be practically even-aged stands of oak, ash, beech, etc., oak predominating. In this same Forest of Amance there have been inaugurated experiments aiming to compare the desirability of this even-aged high forest with an all-aged selection forest. It is too early to judge results, but it would seem as if the selection type of forest with its constant process of regeneration and long rotation is more adapted to oak than is a "straight" shelterwood compartment system.

These experiences with hardwood management in Eastern France are of special interest because of the largely similar conditions in the eastern United States. True we are far from having such ideal conditions of utilization, markets, and means of transportation but these are improving yearly. Meanwhile, the silvicultural methods employed in France are directly applicable to the United States; thus the means of favoring the most valuable species, the good effects of thinnings from above and, finally, the experience in converting from deteriorating coppice with standards into valuable high forest, with trees 30 inches in diameter and 90 feet tall, all with no other tool than the axe, should prove of interest to far-sighted owners who wish to raise the standard of their woodlands, even if only for aesthetic purposes.

VI. Natural Regeneration in the Black Forest

The justly famous Black Forest is in reality a low chain of mountains, much like our Northern and Southern Appalachian ranges, stretching north and south as the eastern fringe of the magnificent Rhine Valley. The Black Forest is, therefore, situated in the Grand-duchy of Baden and in the Kingdom of Württemberg.

The topography is typical of a highly eroded sandstone and granite region; long, relatively flat ridges divided by pleasant valleys or rugged ravines. The average elevation is possibly 2,500 feet above sea level; the highest mountain Feldberg, is 5,897 feet high.

The climate is temperate though, of course, subject to heavy winds and much snow. The precipitation varies from 47 to 66 inches per annum. The annual average temperature is about 45 degrees Fahrenheit.

As its name indicates the Black Forest is essentially coniferous. Spruce and fir form the bulk of the stand with occasional beech, birch and other hardwoods in mixture. On the lower sheltered slopes ash, maple, hornbeam, alder and the like occur while on the oftentimes swampy mountain tops *Pinus montana,* that scrubby mountaineer, and Mountain Ash are found. The common pine, *Pinus sylvestris* or Scotch pine, is found in occasional mixture with the spruce and fir. It is most noteworthy that in the shape of crown and bole it here strongly resembles the spruce and fir, though the same species in the plains is generally short-boled, has a quick taper and a bushy, branchy crown.* A very few larch are also found.

The mature spruce and fir of the Black Forest are remarkably large, due, of course, to the favoring site and climate. One of the tallest trees recorded, a fir, was 164 feet high. The longest merchantable log, a spruce, was 137¾ feet long. The average mature height is something like 120 feet with a diameter at breast height of about 20 inches.

The maximum recorded volume of a single tree is some 4,000 feet, board measure; the maximum stand per acre about 60,000 feet, board measure. The average stand per acre is about 35,000 feet, board measure, in the spruce and fir type.

It is extremely interesting to note that until sixty years ago the Black Forest was practically inaccessible, virgin timber land. Prior to 1850 the main body of the Forest was used only for pasturage of cattle, and for the burning of charcoal.

When the Forest was placed under management the cattle were, of course, excluded for at least ten years from areas in process of regeneration; this together with the increasing value of the cattle led to the ultimate cessation of grazing in the Forest.

Along the streams some timber had been driven out since the 17th century as the frequent splash dams evidence, but this made no impression on the main stand.

About 1850 the State undertook the active development of these vast timber resources. Wisely they realized that the first essential was roads and the foundation was laid of the truly magnificent network of macadamized roads which now traverse the Forest in every direction, rendering every stick of timber accessible. Expensive? Yes, enormously so; * but good means

* This interesting phase is discussed in Forstmeister Kienitz' article "Formen und Abarten der gemeinen Kiefer" reviewed in "Forestry Quarterly," Vol. IX, No. 3, page 484-8. It is also touched on in Wagner's "Grundlagen der Räumlichen Ordnung im Walde."

* The road costs average from 50 to 60 cents per acre per annum, of which the majority is for maintenance.

of transportation are the "sine qua non" of successful and, what is usually the same thing, profitable forestry.

Colonies of woodcutters were also established by the State and given free houses and released from taxes.

With the development of the timber resources their value has increased enormously, so has the yield obtained from the forests. The stumpage value is now on an average about $20.00 per thousand feet board measure.

The cost of logging approximates:

Cost of felling $2.00 per thousand feet board measure.

Cost of skidding to roadside $1.50 per thousand feet board measure.

Cost of hauling to market $4.00 per thousand feet board measure.

Total, $6.50 per thousand feet board measure.

Sold at the roadside the timber brings an average of $24.00 per thousand feet board measure (a maximum of $34 per thousand feet board measure for pine) while at the market point, i.e. usually at the mill, the value is an average of $28, a maximum of $38 per thousand feet board measure. And sixty years ago, the value was purely nominal.

Similarly, after the cutting of the virgin stands was completed i.e. since 1888 the production has practically doubled, until now (1912) it is 1 1/3 M. ft. per acre per annum.

This development is the more remarkable since the regeneration of the primeval forest was accomplished only with the axe. But before considering the ways and means of natural regeneration in the Black Forest, a last item must be added to the factors already described, and that is the dangers and enemies to which the Forest is exposed. Fire is practically a negligible quantity; so is drought except in unusual seasons such as the summer of 1911. Insects and fungi are more serious; especially the cancer on fir (*Accilium clatinum*) which shows itself in swelled, gnarly butts and as Witches' broom, necessitating the rigorous cutting out, so far as possible, of all infested trees. There is also very considerable damage through game, i.e. deer, which are especially destructive to the young plants of fir. But positively overwhelming is the damage through snowbreak and windfall—especially the latter. Where the stands are all aged this damage is not quite so severe, though even there it often is 25% of the annual cut. But in practically even-aged stands the damage is enormous, reaching 67% of the total cut.

The forester's first concern must therefore be to moderate the storm damage unless indeed he wishes to become merely an undertaker "burying the dead." As it is, the immense amount of windfall often makes it impossible to carry out the provisions of the working plans.

Three silvicultural systems—or methods—are used in regenerating the spruce and fir stands of the Black Forest. These are:

1. Shelterwood Compartment System.
    A. Württemberg practice of short period of regeneration.
    B. Baden practice of long period of regeneration.
2. Selection System—all aged forest.
3. Border Cuttings (Wagner's "Blendersaumschlag" described in his "Grundlagen der Räumlichen Ordnung im Walde") *

I. The Shelterwood Compartment System, strictly considered, aims to regenerate the stand by means of the seed from a single seed year. Therefore the time which should elapse between the first or preparatory cutting and the final removal cutting should not exceed ten or, at the most fifteen years.

The resulting stand is, virtually even aged. In practice this means that in the vast majority of cases satisfactory natural regeneration is not secured and the area has to be restocked artificially. This explains the expenditure of 38 or 39 cents per acre per annum for planting in the Württemberg portion of the Black Forest in contract to 19½ cents per acre per annum under the Baden practice; for in Württemberg the short period of regeneration has been adopted.

An interesting contrast is furnished by the Baden practice which does not attempt to secure regeneration with a single seed year but stretches the period of regeneration over from 30 to 50 years the average period being 40 years. Thus the Baden practice is not an orthodox shelterwood compartment system, but,

*See article "Border Cuttings, a suggested Departure in American Silviculture," Proceedings, Society of American Foresters, Vol. VII, No. 2.

rather a cross between it and the selection system—what the Germans call "Femelschlagbetrieb." Indeed, the boundary between shelterwood and selection systems is often indistinguishable on the ground. Nor is it possible in the field to distinguish each of the various cuttings—Preparatory, Seed, First Removal, Second Removal, Final Removal, etc. as given in the text books on silviculture. Rather these grade imperceptibly one into the other as occasion warrants. The result is a rather ragged, irregular reproduction for the first few years after the mature trees are removed but as soon as the stand closes, these irregularities vanish and, in the polewood stage, it is hard to believe that the component parts often exhibit an age difference of twenty or thirty or even more years.

While, therefore, not strictly even-aged as the term is usually construed, the resulting stands are so uniform as to be subject to almost the full effect of wind and storm; a point worth remembering when the advantages of the various systems are contrasted.

It is by this method that the virgin stands of the Baden Black Forest have been regenerated and no one who has seen the resulting, uniform, well-developed stands can help marvel at the skill of these old-time foresters whose only silvicultural tool was the axe, and who mastered the enormous difficulties of naturally regenerating virgin stands. Even to-day with all the areas of windfall to be replanted, the amount of fail places is so small that the total cost of plantings in the Baden Black Forest is only $19\frac{1}{2}$ cents per acre per annum.

The trees are marked in almost exactly the same manner as prescribed in timber sales of the United States Forest Service, i.e. the tree is lightly blazed at breast height and blazed through to the wood and stamped with the government mark at the base. Under this system of silviculture the choice of trees to be removed is of the highest importance and is made usually by or under the direct supervision of the forest officer in charge. As the stand is gradually opened up, first beech, then fir, then spruce come in; for this is the order of their respective tolerance. Ordinarily of course all the largest trees are removed first so as to minimize the injury to the young growth when the remaining trees are logged and also because the smaller trees left can put on the maximum light increment.

With such a long period of regeneration it is natural that the cutting is gradual and frequent. This frequency is rendered possible by the magnificent road system and the method of logging whereby the individual logs (usually the entire tree stem) are let down the steep slopes at the end of a stout rope. The progress of the log is governed by giving the rope several wraps around a strong tree which acts as a drum.

The brush is sold or given away as fuel, but where this is impossible it is usually burned which results in excellent reproduction on the burned spot unless the fire was too intense and "baked" the ground. The piles of brush are not burned as they lie, indeed there is no attempt at piling the brush in burnable shape; rather a small fire is started and fed with brush until all the debris has been cleanly consumed.

Formerly when brush burning was too expensive, (it costs on an average of 13 1/3 cents per thousand feet board measure logged) the brush was scattered even as is now done in Forest Service timber sales and for much the same reasons. But it was found that the dense mat-like layer of needles, fallen from the brush, delayed reproduction until the needles had decayed sufficiently to allow the germinating seedlings to reach mineral soil.

II. The Selection System of cutting where, strictly speaking, the forest is all-aged and the period of regeneration is equal to the entire rotation, has been adopted on steep slopes; exposed rocky places, ridge tops and all such areas as approach a "Protection" forest in character. It also offers greater protection from the arch-enemy, wind; for it fosters the independent strength of the individual tree while the irregular canopy breaks the shock of the storms. In Saxony where the storms come almost invariably from the west the necessary protection from wind is secured by means of the "Schneisen" described in a preceding paper, separating the Cutting Series and stimulating the formation of side branches on the border treees as an effective resistance to the West winds. This method is also followed in Württemberg.

But protection from the West alone will not suffice in the Black Forest region. Statistics of the last ten years show that out of fourteen severe storms, two were from the East and though weaker than their western brethren, caused far more damage. In such circumstances the very *structure* of the forest must furnish the requisite protection, and for this, as explained, the selection type is best suited.

Under the excellent road systems and logging facilities of the Black Forest and the perfect utilization of all forest products there, the Selection System resolves itself into a sort of "milking" of the stand. However, a general cutting cycle of ten years is maintained; i.e. the axe visits each stand at intervals of not more than ten years.

The results obtained by the Selection System are splendid. Reproduction promptly follows the cutting and only rarely are there any fail places remaining to be planted. Another gratifying feature is the absence of damage by game in stands regenerated by the Selection System. The extent to which the game ordinarily damages the young growth is hard to believe; aside from browsing goats there is probably no more destructive animal agency. The reason for the selection forest's immunity doubtless lies in the all-aged character of the stands.

III. Border Cuttings where the forest is practically even-aged and the cutting progresses steadily from the North toward the South is not used in the strictly linear fashion prescribed in Wagner's "Grundlagen der Räumlichen Ordnung im Walde"; * for there is no necessity of such elaborate precautions against insolation and drought in a moist, cloudy mountain climate, however justified they may be on drier sites and at lower altitudes. Under the natural conditions in the Black Forest it would be almost impossible to prevent reproduction, except of course by fire. The skill of the forester must show itself, therefore, in directing the course and kind of regeneration.

As applied in the Black Forest, the Border Cuttings accordingly approach the Shelterwood-Selection Cuttings as practiced in Baden. Beginning at some point of vantage such *as* a *road*, the top of a slope or the like, the cuttings progress gradually into the stand (usually towards the south or at least against the prevailing wind direction). The progress of the cutting and the

* See also Article on "Border Cuttings," Proceedings, Society of American Foresters, Vol. VII, No. 2.

regeneration, depends primarily on the degree to which reproduction has been secured and the needs of that reproduction. This progress of regeneration over the cutting area can be likened to the reading of a printed page, where the eye sweeps from top to bottom, line for line, steadily withal, yet halting occasionally until some difficult passage has been mastered.

In Border Cuttings as practiced in the Black Forest, as indeed in the Selection and Shelterwood methods also, of the advance growth of reproduction advantage is invariably taken where it consists of an even-aged group of good shape. Or, even if it is not fit to be incorporated in the final stand, it may be left temporarily as shelter for the expected seedlings. The cutting therefore, sometimes assumes the character of a regeneration by enlarged groups (group system.)

Opinions differ, however, as to the value of seedlings under stands approaching maturity. In the more intensively managed areas this "green carpet" or understory of seedlings is disregarded as if it were so much moss; but instances are not lacking, where this "carpet" has been skillfully preserved by gradual cutting of the old overhead stand and so made the basis of the new. The recuperative powers of this suppressed, lowly "small stuff" are positively astounding.

As adding stability to the stand and improving soil conditions, all foresters are united in the desirability of increasing the percentage of hardwoods, particularly of beech, in the stands. Some are even planting hardwoods and windfirm conifers such as pine or larch in mixture with the spruce and fir in order to increase the wind resistance of the stands. Preferably these windfirm species are planted in strips running at right angles to the prevailing wind direction.

Comparison.

A comparison of the different methods shows:

I. Shelterwood Compartment System	Rotation	Period of Regeneration	Stands
a Wurttemberg Practice	100 yrs.	10-15 yrs.	Even Aged
b Baden Practice	120 yrs.	30-50 yrs.	Nearly even aged
II. Selection System	120 yrs.	120 yrs.	All aged
III. Border Cuttings	120 yrs.	10-30 yrs.	Almost even aged

As an example of the yield in timber and money, omitting the Württemberg Practice as not one of natural regeneration, the following figures for the Murg Schifferschafts Wald, owned by a Dutch Corporation will serve:

Silvicultural Systems: Shelterwood, Border Cutting and Selection. Cut per acre per annum: 153 feet, board measure,

Increment per acre per annum: 170 to 204 feet board measure.*

Gross revenue per acre per annum: $15.625.

Gross expenses per acre per annum: $3.125.

Net revenue per acre per annum: $12.50.

From these figures it appears that only 20% of the gross revenue goes for expenses—*i. e.* maintenance of roads, silviculture, and the like. This is an unusually low figure accounted for largely by the corporate ownership of the forest. Similarly the net revenue of $12.50 per acre per annum is higher than almost anything except the Sihlwald near Zurich in Switzerland. †

The application of the foregoing to American conditions is closer than is usually the case with the intensive methods of European forestry. First, because, with the exception of Württemberg, regeneration in the Black Forest depends almost entirely on natural means. Artificial restocking is resorted to only after natural methods have failed of success i.e. on certain, inevitable fail places, or on the extensive areas of windfall. The methods used in natural regeneration are almost identically those in common use in America (except the Border Cuttings whose trial in America is strongly to be recommended.

But American silviculture is too recent to show the progress of natural regeneration under the forester's directing axe. The parallel is also close in that thinnings play a less important role in the Black Forest than is usual in Europe, being confined mostly to the removal of suppressed and diseased individuals (chiefly cancerous firs.)

Secondly, the lessons of the Black Forest are of importance to American foresters because sixty years ago this too was an

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* This increment according to the Oberforster continues even after 30% of the stand has been removed in reproduction cuttings. The official figures give the increment as 1,27 feet board measure per acre per annum.

†This Forest has now passed into State control.

inaccessible virgin forest. Its development, presumably foreshadows the development of our own primeval stands.

It would not be fair to draw a parallel between the present profits from the Black Forest and the probable future profits from our own forests; for the economic conditions of the two countries are too dissimilar. However in considering the marvelous development of the Black Forest since 1850 a few factors stand out pre-eminent, providing a lesson which we Americans would do well to observe. These are:

1. Absolute protection from fire, without which no system of natural regeneration is possible in forests of this character.
2. Access to all parts of the forest by a network of permanent roads and trails; unless the forest be rendered accessible and adequate means of transportation provided, there can be no forestry.
3. Flexible methods of silviculture. No hard and fast rules or text-book directions can be followed in treating the varied conditions which nature presents. Seen on the ground, the methods grade one into the other; successful results depend on a freedom of management. "Ask the trees" once said a famous German forester, "they will not fail of a reply."
4. Patience in awaiting results. A forest which required some two hundred years to grow cannot be regenerated in a twelve month. Give the trees time and they will respond to the stimulus of the well-directed axe.

VII. Management of Alpine Forests in Bavaria.

In the foregoing Article, on "Natural Regeneration in the Black Forest," the silvicultural systems in vogue there are described, namely the Shelterwood Compartment System, the Selection System, the Border Cuttings.

The Bavarians have evolved a fourth method of natural regeneration especially adapted to the Alpine forests of that country which may be styled Strip-Shelterwood Cuttings. Before describing this system of cutting it is well to sketch briefly the general characteristics of the mountain country in which it is applied at the same time pointing out the peculiar fitness of the method to the local conditions.

Southern Bavaria contains the northern extension of the Tyrolian Alps. The mountains while not very high (9,000 feet above sea level is the maximum, some 6,000 feet the average, while the valley floor varies between 2,500 and 3,000 feet elevation) are very steep and abrupt with many cliffs and ravines.

The valleys—in some of which lie beautiful lakes—are, however, quite accessible. Many of them are tapped by railroads coming from the populous centres of Bavaria.

In general, the climate is typical of all mountain areas. There are the usual marked local variations due to differences in elevation—with the corresponding differences in vegetation. The governing characteristics of the climate as far as it concerns the forest, are the heavy winds and the high precipitation: 50 inches per annum. The wind is usually from the south, southwest or west, and is a direct menace to the forest. The great precipitation is beneficial in so far as the rainfall and high atmospheric moisture are particularly favorable to the growth of spruce, but a direct danger, also, since the heavy snowfall causes bending and breaking of the trees and shortens the vegetative season, especially at high elevations. Furthermore, the immense deposits of snow cause frequent avalanches in spring with their attendant destruction of forest and ground cover.

The forest itself is preponderatingly spruce with an almost universal admixture of fir and, on the lower slopes, of beech. Rarely, and then only in overmature stands, does the fir dominate the spruce. Scattering larch are found; especially young trees; for old larches are comparatively scarce. Scotch Pine occur scatteringly on the lower slopes; they assume a shape strikingly similar to their neighbor spruces and firs.* As subordinate species occur maple, elm, ash, alder and, still more rarely, birch, choke cherry, mountain ash, etc.

The highest elevations are, of course, barren of any vegetation except grass (the pastures above timber line are called "Alps") and scattering, stunted *Pinus cembra*—the *albicaulis* of Europe —which our own *Pinus cembroides* resembles.

In enumerating the conditions which menace the forest, game and cattle must be ranked right after wind and snow. The game —i.e. the deer—are the worst offenders; they bite off the tender

*See Article by Forstmeister Kienitz: "Formen und Abarten der gemeinen Kiefer; Zeitschrift für Forst und Jagdwesen. Jan., 1911 briefed in "Forestry Quarterly," Vol. IX, No. 3, p. 484.

shoots of fir and beech and larch and scarcely hesitate at the prickly spruce. Daubing the leaders with white-wash or paint or tar, or tieing strips of fluttering white cloth thereto, avails little. This explains the avidity with which European foresters have seized upon the almost armor-clad *Picea sitchensis* or *Picea parryana.* When the trees have outgrown the nipping stage they are subjected to the hazard of being "barked" by the stags. These grip the succulent cortex in their teeth and tear off strip after strip of the bark until, oftentimes, a tree is almost girdled. The authorities are somewhat divergent as to whether this destruction by game is the result of natural impulse or simply wilful. Fortunately our deer are not so inclined—or perhaps they are not numerous enough (for in Europe it is often a question whether the forest or the game plays the more important role.) The damage is also accentuated wherever there are large areas of even-aged young growth—more especially of artificial origin: for the natural seedling, especially in Selection Forest, seems to escape. The deer apparently like to concentrate their browsing.

Cattle also browse on seedlings but their chief damage is by tramping. To prevent this, brush barricades are built across cattle trails which lead over cutting areas undergoing regeneration.

Such are the natural conditions in the Bavarian Alps. The methods of management have necessarily been adapted to meet them. The Bavarian forester distinguishes three forest zones:

(1) *Protection Forest,* i.e. the highest elevations consisting in part of entirely untimbered, barren areas, in part of so-called Alpine forests composed of stunted, irregularly scattered, limby, decadent spruce, crippled, old firs, *Pinus cembra,* and Mountain Ash.

The marketing of this material is both prohibitively expensive, and usually impossible without damage to the lower lying stands. Therefore this zone is generally segregated as Alpine reserves and no cutting is allowed there. Furthermore, just below these unproductive areas a corresponding belt of forest is kept intact in order to prevent an increase in the barren areas.

(2) *Selection Forest,* i.e. the zone next below which because of its steepness and scanty cover as well as the uncertainty and expense of regeneration (it is a well known fact that in the Alps the difficulty of regeneration increases with the elevation partly

because of scanty soil and partly because of the shorter growing season) demands a very careful Selection System. In practice, only the oldest, most merchantable or decadent individuals are removed so as to liberate the young growth. Every precaution is taken to retain the cover unbroken in order to prevent rock slides, avalanches and windfall. Finally only such material is taken which can be removed at an actual profit.

(3) *Productive Forest* From the standpoint of profitable management, this is the true forest. Even here cliffs and precipices occur and here too precautions must be taken to prevent too large openings in the stand. Nevertheless, a Shelterwood System of Cutting is not appropriate not even as used in Baden;* for profitable lumbering on such steep mountain slopes requires a concentration of the cuttings. But even if it were economically practicable, the Shelterwood Cutting to pay at all would necessitate a degree of cutting which would expose the remaining trees to almost certain windfall; furthermore, on such steep slopes the subsequent logging of the remaining stand would destroy most of the reproduction already secured or, at least, render it valueless as the basis of the new stand.

Extensive Clear Cutting is out of the question, in view of past experiences. Formerly, on account of readier accessibility and in part because of not spreading the cuttings over a sufficient area, (Cutting Series!) large bodies were cut over with temporary reserve of the usually worthless, inferior material as a protection and to scatter seeds. Each year's cutting usually joined on to that of the previous year. The cut-over areas were generally sown broadcast with spruce and, in part, with larch seed, some immediately after logging was completed, some several years later when natural regeneration failed. The brush was not scattered. Plantations were rare, often made only with natural (wild) stock. The result of this extensive, practically clear cutting was that the areas were largely given over to grass and weeds against which the oftentimes scanty or tardy seeding could not prevail. Where regeneration did follow, the protection of the remaining "scrubs" was often entirely insufficient; snow, wind, game and cattle each demanded their toll and these areas have in large part had to be replanted at great expense.

* See Article VI of the Series, subheading I, B, the Baden practice.

But even clear cut strips * despite their usual advantages are not advisable here since the stands have either passed the seed producing stage—i.e., are overmature, or else, on such steep slopes, the logging of the remaining strips would destroy much of the young growth on the strip already cut. The openings are very prone to grow up with grass and weeds but if, to prevent this (and the game and cattle injury), the brush were scattered on the cut-over strips, it would interfere seriously with the subsequent logging of the remaining strips and a too thick mulch of fallen needles would possibly retard natural regeneration (see previous article.)

Under these obviously adverse conditions, the Bavarians have evolved the Shelterwood Strip Method of Cutting. This method applies the principles of natural regeneration under shelter of the mature stand to long strips running up and down the mountain sides. The progress of cutting is usually from the highest part of the slope to the base thereof. Each of these strips represents a point of attack—each the beginning of a carefully planned Cutting Series. These Cutting Series—as in Saxony—are separated from each other a quarter to one mile or more, depending entirely on the distribution of the age classes. The idea is to have many points of attack, thus avoiding the evils of joining each year's cutting area to that of the previous year which has worked such havoc in the past. As points of attack, advantageous topographic features such as small ravines and the like, are chosen.

The initial strip on which the shelterwood regeneration is begun, has an average width of not to exceed 150 feet; no fixed rule can be formulated, since local conditions often necessitate a greater or lesser width, and this is essentially *not* a "stencil method." For example, the cutting must be more narrow where the slope is steep and sunny and the soil is apt to grow up to grass and weeds. Conversely, on shaded, gentle slopes the cutting strip can be wider.

Where conditions prevent the cutting of an entire strip from top to bottom of the slope in one year, cutting is begun at the top of the slope and extended to the base thereof in subsequent years. It is rarely permissible to log the lower part of the

*See Article IV of the Series: "Management of Spruce in Saxony"—also subheading III of Article VI: "Border Cuttings."

slope ahead of the upper or middle portion thereof; the exception being where the upper part of the slope can be logged later without touching the lower portion and, hence, without interfering with reproduction already secured on the lower slopes; always provided that by logging the lower part first the upper stands are not thereby exposed to wind-fall.

When logging is completed, the remaining brush is usually scattered as uniformly as may be over the cutting area, in order to prevent cattle grazing on the area during the first stages of the young growth.

After cutting the initial strip no adjacent cutting is done, as a rule, for at least six years—that is until the regeneration of the initial strip is *assured.* (This of course requires a large number of "points of attack" and results in the somewhat "chopped up" appearance of the Bavarian Mountain-sides.) Then the adjoining strip on the windward side—i.e. towards the West, Southwest or South, usually is cut. Thus the strip cuttings progress in the direction from which come the prevailing wind currents.

A diagrammatic cutting of a north slope a quarter of a mile wide would, therefore, begin at the East side and move westward, a strip at a time, every six years until at the end of the 54th year, the entire area would have been cut over and, theoretically, the whole regenerated at the end of the 60th year.

Actually and obviously no such schematic method is possible of application, especially in a mountainous country. For example, on sunny, southern slopes the remaining stand must furnish protection to the cut-over strip to prevent drying out of the soil. Here, therefore, the strips do not extend up and down the slope but horizontally or diagonally across the slope.

The three factors which determine the degree of actual application of the schematic method of cutting are the most economic method of logging, the maintenance of the soil's productivity and the securing of reproduction. The last is, plainly, the most important and hence the rule that the adjacent strip can not be cut until regeneration of the initial strip is assured.

The Bavarian aims to secure this regeneration just as far as possible by natural means. Therefore on the cutting areas, all the small stuff, and especially advance reproduction of beech and fir is left as "shelterwood" and as a nucleus for the future stand.

This measure is especially important on sunny slopes, and on steep slopes. In the latter case, where the material is lacking, even large, merchantable beech and fir are left as "shelterwood." Spruce can not be left because it will almost certainly be thrown by the wind. Larch are left where they are available. This "shelterwood" material can usually be logged subsequently in winter or spring on snow without endangering the regeneration and most profitably in conjunction with an adjacent cutting. It is axiomatic that advance growth of all kinds must be carefully protected. In order to induce reproduction by stimulating seed production, preparing the ground and partially freeing the advance growth, Preparatory Cuttings are usually made some five to ten years before the final logging of the strip. Thus the actual period of regeneration is from ten to fifteen years. The Preparatory Cutting aims to remove the defective, the fully mature and over-mature timber. Since Bavarian conservatism has resulted in a marked excess of mature timber, the loss through deterioration until the time comes for cutting this timber is cleverly avoided by very light Selection Cutting of the overmature stands. Of course, this is only done where the logging will not result injuriously to the stand or the condition of the soil.

Theoretically the Shelterwood method would provide for:

Preparatory Cuttings, Seed Cuttings, Removal Cuttings, Final Cuttings.

Under the difficult conditions described, the last two must often be waived. Where it is possible without injuring the young growth, and is profitable, the Shelterwood material is removed gradually in accordance with the needs of the young growth; otherwise (where it is suppressing the young growth) it is felled, or the lower branches of the trees are trimmed off or, in the case of hardwoods, the trees are girdled.

Similarly, the extent of thinning is determined by its profitableness. Thinnings are usually confined to the entirely or partially suppressed trees and diseased trees; they are intensified as the stand grows older thus gradually, grading into the Preparatory Cuttings when the stand is mature.

As stated above, the Bavarian aims to secure natural regeneration just as far as possible. But the universal overmaturity of the stands and the adverse topography often force him to resort to artificial regeneration. Windfall, snowbreak, and avalanches, and the overmaturity of the stands, all conspire to make artificial re-stocking necessary aside from the inevitable "fail places" and the irregularities in stands due to a still imperfect utilization.

This is by no means to the Bavarian's discredit; for as Wagner points out in his "Grundlagen der Räumlichen Ordnung im Walde:" "It is obviously in the very nature of forest management that the local forest conditions often constitute temporary hinderances to the practical execution of a new silvicultural method so that the method, for a long time, does not get beyond the covers of the Working Plan ——— and yet it would be a mistake if, in undue haste, this method were to be forcibly imposed on the forest or else entirely given up and its gradual application abandoned———To impress upon the forest itself the universal stamp of a certain silvicultural method requires time."

Fir, beech and maple usually reproduce naturally; the artificial regeneration centers, therefore, on spruce and larch, aside from the occasional interplanting of pine on favorable sites (southern exposures and any rocky places.)

The artificial regeneration of spruce is either by seeding or by planting. In the former the seed is sown as uniformly as possible over the cutting area in favorable places on mineral soil; undecomposed humus is stirred up with a hoe to accelerate its decomposition. Where, owing to the overmaturity of the stand or for other reasons, sufficient natural regeneration cannot be expected, the seeding is if possible done in the spring succeeding the cutting. The cutting is usually in summer; the hauling on snow in winter and in early spring. After seeding, the area is covered with brush for protection from the elements and from game and cattle. On very steep slopes where, as a result of logging, the bare mineral soil has been exposed, seeding is delayed until after the appearance of a light cover of grass. However, where the area to be sown is densely covered with weeds, seeding is seldom attempted and planting is used instead.

The planting sites are chosen as carefully as in seeding. The spacing is seldom more than $3\frac{1}{4} \times 3\frac{1}{4}$ feet, since game and cattle usually destroy many of the plants. The use of wild stock and of poor stock is carefully avoided. Under favorable conditions, where weeds have not taken possession of the ground, stocky seedlings 2 to 3 years old are used; for weedy sites stronger transplants 3 to 5 years old are used. In order to secure hardy stock and have it close to the planting areas, the seed beds are placed at medium elevations rather than at the base of the mountain.

If seeding fails of results, it is not repeated, but the area is planted. Sometimes the damage by game and cattle is so great that in order to regenerate the area it has to be fenced. Wire fence is used oftener than wood.

The artificial introduction of the larch can be secured either through sowing it in mixture with the spruce seed or by planting, in mixture with other species, on suitable sites, such as fresh, deep soils, on open areas and not under cover or in damp, foggy ravines nor on north, northeast or northwest slopes. Pure stands are undesirable since the larches compete so savagely among themselves that with no other species at hand, gaps will inevitably occur in the stand. Where grazing is heavy and there is much game, no attempt is made to introduce larch.

As for the rotation, it is usually set at over 100 years but, especially in view of the reaction against former ultra-conservatism, this does nor preclude earlier cutting of certain stands which at a younger age reach their highest productivity. No rotation is fixed for the Selection zone nor any of course, for the strictly protection forests of the highest zone.

The lesson which the management of Alpine forests in Bavaria teaches us Americans is the important one of adapting the method of regeneration to the exigencies of the particular case. Despite adverse natural conditions, Bavarian foresters have steadfastly continued to strive for natural regeneration. We too, have regions where natural regeneration is exceedingly difficult but failures need not bring discouragement—there is an "Open Sesame" for every combination!

A second lesson which Bavarian experience brings home to us, is the danger of extensive cutting areas. One after another, the European countries have reached the same conclusions—the cutting areas must not be few and large but many and small—just as many, just as small as the economic conditions will permit.

Finally, Bavaria is a splendid exponent of the evils of over-conservatism. For fear of over-cutting, her woods became stocked with overmature timber. Now every effort is being bent to secure the utilization of this timber before it deteriorates. Furthermore, the overmature stands have to be regenerated artificially. "Spare the axe and spoil the stand" is a safe conclusion!

WHITE FIR IN THE KLAMATH BASIN

A Silvicultural Study

By A. F. Kerr

The region included in this study lies on the east slope of the Cascade Mountains in Southern Oregon. In elevation it ranges from 4,140—the level of Upper Klamath Lake—to about 7,000 feet. The general slope is toward the east, but, locally, every aspect is encountered. A series of high volcanic cones with heavy lateral spurs, and deep narrow canyons furnishes the main topographic features of this region and presents a striking contrast to the broad, flat basin of Four Mile Creek, which, with its tributaries, separates the region from the main crest of the Cascades.

The precipitation here averages about 20 inches annually, largely in the form of snow. The growing season is short, beginning about May 1st, or later. Killing frosts occur as late as July and as early as September, even on the better protected sites. The summers are hot and dry so that fire danger is increased to a maximum. Thunder storms are more or less frequent and the damage by lightning either directly, or through resulting fires, is very great.

The soil is of volcanic origin, and of a medium quality. It varies from fairly deep and loose at the bottom of slopes and in gulches, where it is mixed with decaying vegetable matter, to thin and rocky on upper slopes and exposed points. At higher elevations there are large areas of lava rock, either very thinly covered or entirely bare. The soil is easily pulverized and washes badly where exposed to heavy rains, and, on account of its friable texture, it is especially subject to heaving by frost.

Abies Concolor.

Yellow pine, Douglas fir, White fir and Shasta fir are the species of commercial importance in this region, although Lodgepole pine occurs quite abundantly on limited areas. The undergrowth consists of snow brush, chinquapin, manzanita, etc., and in places a ground cover of squaw carpet, *(Ceanothus prostratus)*, or kinnikinic. After severe burns a more or less dense growth of snow brush usually comes in. This is followed sooner or later by reproduction of tree species, the length of time required to reestablish the forest growth depending on the various factors of site quality, extent of burned area, species reproducing, etc.

Yellow pine and White fir are numerically the most important species and vary in their relative proportions from pure Yellow pine on some of the lower slopes and flats to the pure fir type of the upper slopes where White fir constitutes over 50% of the volume. On the drier sites White fir commonly occurs in pure clumps scattered through the Yellow pine stand. On north slopes, in most canyons and at the higher elevations it grows in pure stands, or as scattered individuals in mixture with other species, the characteristic "clump" type of the lower slopes being absent.

For the region as a whole White fir comprises probably 25% of the total stand, and must, therefore, be considered as one of the important species to be dealt with in the management of the forest.

From the economic standpoint of lumber production White fir is at present considered as a forest weed. On timber sales in this region the primary object in handling White fir is to reduce its volume in the future stand, but in spite of the inducements offered the operator to cut this species, a large percentage of it will be left. In addition to the defective, old timber that remains uncut, there is also a considerable amount of advance reproduction so that it is doubtful whether under the present methods, the volume of White fir in the next stand will be appreciably less than in the present.

So far the only White fir cut has been on the lower slope type where it occurs in relatively small quantities, in mixture with the valuable Yellow pine. On such areas it may be possible to improve the stand. But at the higher elevations which are naturally unsuited to Yellow pine and where White fir forms a large part of the stand, this species must necessarily be retained as a constituent of the commercial forest.

The conditions here outlined are more or less typical of the

White fir regions in Oregon and present at least two silvicultural problems in connection with the forest management. Since in stands where Yellow pine and White fir occur in mixture, the former has so much the greater value, the first problem is, naturally, to find the best means of reducing the White fir volume in future stands of this type. The second problem is to determine by what methods the White fir that must of necessity be retained can be made to approach its maximum rate of volume and quality production.

It was for the purpose of securing silvical data to be used in formulating a definite policy of management for White fir that this study was undertaken.

Measurements for the volume table and growth data were secured in the logging operations of the Pelican Bay Lumber Company and at that of the Utter and Burns Company, near Fort Klamath. Although the total number of trees measured for the volume study was rather small the range of diameters is not great, and it is believed that the growth for the region is very well represented. The other data, including seedling growth and competition of species were secured in an examination of cut over areas, burns, natural openings, brush areas and timber stands of varying composition, density, slope, exposure, etc. This examination was necessarily superficial and lacking in detail, and the results obtained may be considered only as indicative.

Silvical Characteristics.

Habit. White fir has a very straight bole with a fairly rapid, uniform taper. The crown is full and rather dense and in open stands reaches nearly to the ground. Natural pruning in any case is very slow. Even in full stands the green crown extends at least half-way down the bole, and in many cases the lower branches that have been killed by shading persist indefinitely. Trees which have developed in the dense side shade of pure White fir clumps may have a clear length of 40 or 50 feet.

It reaches an average height of 110 to 120 feet and a breast high diameter of about 2 feet at the age of 200 years, which for purposes of management may be considered as its maximum age. On young trees the bark is thin and somewhat resinous, but later becomes very hard on the lower part of the bole, where it reaches a thickness of from 1.5 to 2 inches. Contrary to the usual opinion, the low, dense crown of the seedling growth is not particularly inflammable, and, especially in the heavy clump growth, serves as a protection against fire rather than as a means of increasing the liability to injury from this source.

Local Occurrence. This species does not occur in pure stands over extensive areas, although at higher elevations, on sites where moisture conditions are favorable, it sometimes forms a full stand over areas several acres in extent. One such stand, in Section 16, Twp. 35 S., Range 6 East, at an elevation of about 6000 to 6400 feet, consists of a fairly dense, thrifty growth of merchantable White fir. There is very little reproduction under the stand and the forest floor is quite clean. Practically all of the suppressed class is dead. This tract has a slope toward the east of 10% to 25%. The soil is a rocky loam and has about 1/2 inch of humus. Another tract, in which the site conditions are similar, is located in Section 20, Twp. 32 S., Range 6 East. The stand in this case is just above the pole stage. The forest floor is fairly clean, there is no reproduction, and most of the suppressed trees are dead. Such areas as those just mentioned are not numerous and it is probable that the conditions found in these two are characteristic.

As already stated, the usual manner of occurrence, especially at the lower altitudes is in pure clumps in mixture with the Yellow pine stand. These clumps vary from a few square feet to several rods in extent. A clump usually starts in some protected spot, or on a decayed log where surface moisture conditions are good, and the dense cover, by reducing the rate of evaporation serves to extend the favorable moisture conditions around the border of the clump. This margin is gradually taken possession of by more seedlings and the group thus increases in size. As a group continues to spread, the edges come into competition with Yellow pine and the area growth is checked. During this period of development the older trees at the center of the group are being differentiated into crown classes and a few dominant trees finally secure control. These, of course, continue to develop at the expense of the smaller trees, gradually shading them out, until in the final stage the original clump is represented by two or three or perhaps a half dozen merchantable trees that have survived in the competition for light and moisture and now occupy their natural space in the mature stand.

Where moisture conditions are suitable for it, White fir comes in as scattered individuals and as such competes with the other species with which it may be associated.

Soil, Moisture and Tolerance. For early growth White fir is absolutely dependent on good surface moisture. Apparently any well drained soil is satisfactory although, of course, the rate of growth is largely influenced by the quality of the soil.

At all stages of its development White fir is extremely tolerant. Up to an age of about 20 years seedlings in the open and those in full shade show no very marked difference in the rate of growth. The crowns of the shaded class are, therefore, well developed before the influence of the top shade becomes effective. The foliage is very persistent, so that a seedling in complete shade is able to maintain its vitality until it reaches an age of from 30 to 50 years. If it should be opened up to the light at any time while the crown is still intact there is no doubt but that a seedling would readily recover. There are no data available on this point, however, since the trees which reach maturity are only those which have been in the dominant class from the start.

Reproduction. After it reaches the cone bearing age, White fir produces a fairly abundant seed crop nearly every year. It is claimed by some observers that it begins to bear seed at the age of about 20 years. Certainly, however, this does not apply to the region covered in this study. Of a number of thrifty, open grown specimens examined, on a site where conditions for seed production were much better than the ordinary, the youngest bearing cones was 37 years old. It is probable that in the characteristic clump growth trees do not begin to bear cones until the early stage of competition is past and they are definitely established as the individuals which will make up the mature group. Such trees are probably from 75 to 100 years of age. Trees growing singly undoubtedly bear seed earlier.

The seed is heavy but has a large wing and is scattered to quite a distance by the wind. The percentage of fertility is fairly good and germination takes place on almost any kind of a seed bed. For the development of the seedling, however, good surface moisture is essential. The half shade of chaparral on north and east slopes, the borders of White fir clumps, decayed logs, etc., are favorable. It is not the shade, in such cases, but the surface moisture which is conserved by the shade or other agent, that influences the seedling development. Dense plots of seedlings, only a few inches in height are occasionally found in full sunlight, but an examination will show that they have started on the site of a decomposed log or other vegetable matter where surface moisture conditions were good. That seedlings will not develop in the full shade of a high forest is shown by the fact that there is little or no reproduction under the pure stands of White fir. An interesting illustration of the demand of White fir for surface moisture was noted in the Varney Creek watershed. In this locality two small tracts were examined.

Both were on a very gentle north slope at an elevation of about 4,300 feet. On the first the old stand was a mixture of Yellow pine and White fir. The soil was deep, loose and moist and the ground cover mostly *succulent plants* and weeds. There was very little brush of any kind. The reproduction consisted largely of *scattered* White fir, although there were a few of the characteristic clumps. The Yellow pine reproduction was limited to the drier mounds and more open spots. On the second tract the site and soil quality was exactly similar to the first. The old stand was more open and consisted of Yellow pine with scattering White fir and Douglas fir. In this case the ground was covered by good *grass sod,* and a few Amelanchier bushes. The reproduction consisted almost entirely of Yellow pine seedlings scattered thickly over the whole tract. The few White fir seedlings found were always in the shade of bushes or logs. So far as conditions for White fir reproduction were concerned the two tracts were identical except for the sod cover. The competition of the grass roots for surface moisture evidently accounts for the lack of White fir reproduction on the second tract.

Susceptibility to Injury. White fir seedlings that are exposed to fire are usually badly injured, but they possess an exceptionally high degree of vitality and unless the stem is completely girdled will ordinarily recover. Occasionally a seedling may be found that has been girdled at the base. This is probably done in winter by mice. The tops and upper branches of grown trees are sometimes girdled by porcupines. Neither of the latter are of any commercial importance, however. Damage from fungous diseases has been covered by a special report on that subject and will not be mentioned here.

Because of the unprotected resinous stems of Yellow pine seedlings, and the dry surface conditions of the sites on which they habitually grow, the lightest surface fire will ordinarily kill all young seedlings of this species. On the other hand, the dense cover of the White fir clumps keeps the ground beneath cool and moist at all times, so that a light fire will not run under them but is stopped at the edge with perhaps only a slight damage to the seedlings on the outer border. Scattered individuals would probably be killed, but since in the mixed stands the majority of the White fir occurs in clumps it follows that the damage to such a stand, resulting from a surface fire, is very largely borne by the Yellow pine, and that repeated surface fires must cause a decrease in the proportion of Yellow pine in the stand.

Development. A comparative study of White fir and Yellow pine seedlings emphasizes a number of points that may be of value in handling sale areas.

For germination their requirements are similar although Yellow pine prefers a mineral soil. For its development, however, Yellow pine is dependent on a deeper water supply than is White fir. In this connection a comparison of the root systems is of interest. (See cut at end of article.) The fact that Yellow pine will grow on a rather dry site and that a light shade is beneficial, makes it very well adapted to south and west slopes with chaparral cover. On north and east slopes where surface moisture is more abundant and the chaparral cover more dense, White fir forms the greater part of the reproduction.

During the first few years the height growth of Yellow pine is much faster than that of White fir. After its early period of slow growth, the White fir seedling develops in height at about the same rate as the Yellow pine. In mixed stands, which might follow fire or cutting, Yellow pine on account of this more rapid initial growth, should be able to maintain its lead. Where there is sufficient White fir to develop a heavy side shade it will, by cutting down the crown areas, so reduce the height growth of the Yellow pine that it will sooner or later be suppressed and eliminated from the stand.

As just stated, the early growth rate of Yellow pine in this locality is much greater than that of White fir. At the age of 30, for example, Yellow pine has an average height of 15 feet and a breast high diameter of 2.8 inches, while White fir has a height of only 5.5 feet and a breast high diameter of 0.1 inches.

Yellow pine reaches its maximum rate of diameter growth, about .22 inches per year, in the fifth decade, and falls off gradually thereafter to about .05 inches at 250 years. With White fir the maximum rate of diameter growth, .17 inches, is reached at an age of about 100 years, falling off to .11 inches at 250, thus giving a range of only .06 inches in the rate of diameter growth as compared with a range of .17 inches in Yellow pine. White fir passes Yellow pine in total height at from 70 to 80 years of age, and continues to hold a slight advantage thereafter.

From this comparison of growth in height and diameter it is evident that beyond a certain age the volume of White fir will be greater than that of Yellow pine. From the curves it is shown that up to about 190 years Yellow pine has the greater volume but at this point White fir passes it and continues to increase its lead until at 250 it has an excess in volume of approximately 25% over Yellow pine. It should be noted here that the growth of Yellow pine in the Klamath region is the best found, in a study covering practically the whole state. As compared with the Yellow pine of Eastern Oregon, White fir has a volume nearly two and a half times as great at 250 years.

On account of the scattered and irregular distribution of White fir in the lower slope forests, and the general scarcity of even-aged stands of this species, much time would have been required to secure data of value in regard to the yield per acre of White fir. For this reason it was not attempted.

Economic Aspects.

The study has shown that the silvical characteristics of White fir make it a species which cannot, by any practicable means, be entirely eliminated. The growth data would indicate that in so far as volume production of individual trees is concerned White fir is even better than Yellow pine. And if, as Dr. Meinecke's report on the subject indicates, fungous damage can be greatly reduced by proper silvicultural treatment, it seems clear that White fir is entitled to a more favorable consideration than it has received in the past.

There are several good reasons for the present status of White fir. Of these probably the strongest is the fact that, of the lumber from this species which has been put upon the market, a considerable proportion has been very defective. This is due, perhaps, to the effort to secure close utilization in logging, which forces cull logs to the mill. After drying, much of this cull lumber while possessing a fair appearance is so lacking in strength as to be practically worthless. Of course this lumber must be gotten rid of and it goes to the consumer on its "face" rather than on its merits, resulting in the establishing of a bad reputation for White fir lumber in general.

It is admitted by millmen that some White fir lumber is of excellent quality. A close study of cull logs with special regard to the quality of the finished lumber to be produced will no doubt greatly reduce the proportion of defective material to be marketed and raise the general standard of quality, so that White fir will eventually secure its just rating in the lumber trade.

The idea has been prevalent among loggers that practically all White fir timber is more or less rotten. That this is a wrong impression is proven by actual operations which show a large proportion of sound timber. That this proportion can be considerably increased by proper management there is little question. The fact that White fir is very rarely damaged by mistletoe or by bark beetles should not be overlooked in comparing it with Yellow pine.

Another point which may be commonly overlooked but which, nevertheless, tends strongly to discredit White fir, is the fact that it is associated with the relatively valuable Yellow pine. It is only natural that the value of any species in a mixture should be measured by that of the most valuable. It may not, however, give a true value to the inferior species.

In considering the economic future of White fir it is safe to assume that its market value will increase in at least the same ratio as that of its associates. Logging and manufacturing costs will increase to some extent but the greater part of the increase in the lumber value will be taken up in a higher stumpage value. White fir is at present a little used, and not widely known species, and it is quite probable that new uses for it may be found and a market of its own developed. As the price of other lumber increases, inferior species such as this will be substituted and an additional demand so created. It is not unreasonable then to expect that the value of White fir may increase even more rapidly than that of its associates.

Silvicultural Aspects.

In the management of these stands the first point to be considered, as already mentioned, is the reduction of the White fir volume in the next rotation. It is evident that the prime factor governing the distribution of Yellow pine and White fir in the lower slope type is the difference in their requirements for surface moisture. On south and west slopes it is ordinarily too dry for White fir, although it comes in to some extent in the shade of snowbrush, etc. Yellow pine will continue to form the principal part of the stand in such localities and the present method of management, namely a selection cutting with brush piled and burned, is satisfactory. In moister situations, however, such as in draws and on north and east slopes, conditions for White fir reproduction are favorable and there is usually a good advance reproduction of this species occurring both as scattered individuals and in the clump form. On such sites the present system is not effective so far as reducing the future volume of White fir is concerned. Under these conditions it is believed that a modified system of clear cutting over limited areas, taking out all merchantable timber, with the exception of necessary seed trees, and followed by scattering and burning of the brush would be beneficial. This would, of course, be a radical change from the methods now used in handling Yellow pine, but the problem is not simply one of Yellow pine, and cannot be handled on a strictly Yellow pine basis. That the shade afforded by a selection cutting is not always necessary is shown by the dense reproduction of Yellow pine which frequently follows clear burning. Precipitation in this region is such as to insure sufficient moisture for the establishing of Yellow pine reproduction without special protection against evaporation, and it would seem, therefore, that on selected sites, at least, the reproduction of Yellow pine should be entirely satisfactory under such a system of management. The clear burning would result in a drying of the surface soil to such an extent as to make it unfavorable for White fir reproduction and the Yellow pine stand would be well established before the return of the normal conditions which would allow White fir to start.

The strongest argument against this plan would be the loss of the advance reproduction of Yellow pine. This should be largely offset by the destruction of the scattered reproduction of White fir at the same time. In applying this system care should be exercised in selecting the sites, paying attention among other things to the probability of frost damage, soil erosion, etc.

The second point to be considered in a system of management is the securing of a maximum volume and quality of such White fir as must be left in the stand. The fire protection to White fir which is ordinarily given Yellow pine will practically accomplish this result. Considered as an outlaw, as it has frequently been in the past, White fir has received practically no protection, except such as it may appropriate through its association with Yellow pine.

White fir clumps are often used as the sites of brush piles. In theory this may be good forestry, since it is intended to kill the White fir clump and leave an opening for Yellow pine. In practice this result does not always follow. Unless the brush pile covers the clump, which it frequently does not do, there is commonly left a fringe of badly burned and crippled seedlings. These, on account of the unusual vitality of the species, will ordinarily recover and occupy their place in the mature stand. It is safe to say, however, that a very large percentage of such trees which do reach maturity will be practically worthless as a result of fungous attacks following the fire injury. It is true that the fungi causing the most damage work in the heartwood, which is not formed until after the seedling stage is passed, but the cracks, which follow the killing of the bark and drying out of the sapwood, furnish a ready means of entrance for disease after the heartwood begins to form.

Seedlings on the borders of clumps, which might be damaged in a clear burning system, will, in the natural development of the group, be forced out so that timber which is defective because of this fire damage, will not be found in the mature stand.

From the data which has been secured it would seem that a general plan of management for the lower slope type, such as the following, might be satisfactory.

For the drier situations the present selection system should be continued. On sites where surface moisture conditions are especially favorable to White fir reproduction a modified form of clear cutting and burning over small areas should be used. Under all conditions White fir should be cut to as low a diameter as practicable. White fir reproduction which cannot be completely destroyed should receive the same protection as other species. On upper slopes it may be possible to extend the areas of the pure White fir stands and manage them on a short rotation under a clear cutting system for pulp wood and box material. The operations of the Pelican Bay Lumber Co. would afford an excellent opportunity for experimental work along these lines.

Root System of White Fir (right) and Yellow Pine (left)

APPENDIX

SEEDLING HEIGHT GROWTH TABLE

Height of Seedling

Age Years	*White Fir* *Open*	*Half Shade* *Inches*	*Yellow Pine* *Full Shade*	*Open*
2	3	2	2	3
4	5	4	3	6
6	8	6	5	10
8	10	8	7	13
10	12	11	9	17
12	14	14	10	22
14	16	16	12	27
16	18	20	14	34
18	21	24	16	43
20	24	28	18	53
22	29	33	20	63
24	35	39	22	71
26	45	45	25	78
28	56	50	28	85
30	64	56	31	91
32	69	61	34	97
34	72	66	38	102
36	75	71	41	108
38	76	75	45	114
40	78	79	48	119

RATE OF GROWTH IN DIAMETER, HEIGHT AND VOLUME

White Fir.

Age Years	*Average Diameter at Breast Height Inches*	*Average Annual Diameter Growth at Each Decade Inches*	*Average Total Height Feet*	*Average Annual Height Growth at Each Decade Feet*	*Average Volume Bd. ft.*	*Average Annual Volume Growth at Each Decade Bd. ft.*
10			1.0			
20			2.0	.10		
30	.1		5.5	.35		
40	1.1	.10	12.0	.65		
50	2.3	.12	21.0	.90		
60	3.5	.12	30.0	.90		
70	4.9	.14	39.0	.90		
80	6.4	.15	48.0	.90	50	
90	8.0	.16	57.0	.90	92	4.2
100	9.7	.17	66.0	.90	124	3.2
110	11.3	.16	74.0	.80	174	5.0
120	12.9	.16	80.0	.60	230	5.6
130	14.4	.15	86.0	.60	292	6.2
140	15.8	.14	91.0	.50	362	7.0
150	17.2	.14	96.0	.50	440	7.8
160	18.6	.14	100.0	.40	522	8.2

Age	*Diameter*	*Diameter Rate*	*Height*	*Height Rate*	*Volume*	*Volume Rate*
170	19.9	.13	104.0	.40	612	9.0
180	21.2	.13	107.0	.30	710	9.8
190	22.4	.12	110.0	.30	811	10.1
200	23.6	.12	113.0	.30	914	10.3
210	24.8	.12	115.7	.27	1027	10.3
220	25.9	.11	118.2	.25	1147	12.0
230	27.0	.11	120.5	.23	1270	12.3
240	28.2	.11	122.5	.20	1395	12.5
250	29.3	.11	124.2	.17	1525	12.7

MERCHANTABLE HEIGHTS IN LOG LENGTHS

Diam., inches	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Log length	2½	3	3½	4	4½	5	5½	5½	6	6	6½	6½	7	7	7

VOLUME TABLE

Diam. Breast Height Inches	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Av. vol. All Heights*	*Av. Top dia. In.*
	Number of 16-foot logs								
	Feet, Board Measure								
11	50							50	7.6
12	64	105						74	6.7
13	77	120	175					100	6.6
14	89	137	194					140	6.7
15	100	151	214	303				167	6.9
16	109	164	233	326				204	6.7
17	118	178	255	349				245	6.7
18	127	193	273	367	473			290	6.7
19	138	213	299	402	517			335	6.7
20	151	234	327	437	557			390	7.1
21		261	356	478	615			445	6.9
22		290	385	516	668			507	6.4
23			415	555	720	913		575	7.6
24			448	598	775	983		650	7.3
25			483	651	837	1053	1340	730	7.1
26			520	692	888	1122	1430	818	7.8
27				742	949	1192	1516	910	7.3
28				805	1021	1282	1629	1015	6.9
29				877	1094	1375	1737	1133	7.7
30				959	1175	1473	1850	1260	6.1
31				1045	1261	1570	1963	1398	8.0
32				1115	1362	1664	2080	1540	6.7
33					1483	1791	2202	1685	9.0
34					1610	1932	2328	1840	6.9
35					1745	2060	2460	1990	6.7
36					1890	2190	2590	2150	8.2
37					2028	2328	2724	2320	9.0
38						2465	2865	2498	
39						2602	3032	2675	
40						2748	3185	2850	

This table is based on measurements of 322 felled white fir trees (*Abies concolor*) in vicinity of Pelican Bay and Fort Klamath (east slope of Cascades, southern Oregon). Trees scaled by Scribner Decimal "C" Rule in logs 16 feet or less in length, .2 feet being allowed for trimming; stumps taken as low as practicable; tops used to as low a diameter as deemed merchantable; but not less than 6 inches inside the bark at top of last log. No allowance for defect or breakage. Volumes evened off by curves.

INSECT DESTRUCTION OF FIRE-KILLED TIMBER IN THE BLACK HILLS OF SOUTH DAKOTA *

By P. L. Butterick.

This paper attempts to outline the results of the work of insects following forest fires in the Black Hills of South Dakota; and to suggest remedies for their depredations. It is the result of casual observations of the writer, made while Forest Assistant on the Black Hills National Forest in 1911, and later as Forester for the Lanphere-Hinrich Company, a lumber company operating in the Black Hills. The observations do not pretend to approach completeness; but may be of some value in the absence of more definite data.

Character of the Forest in the Black Hills. Western Yellow Pine *(Pinus ponderosa)* is the predominant tree. It occurs pure over large areas, being the only commercial tree found. The forest tends to be even-aged in groups, but many stands are all-aged or roughly two-storied. The Government manages its holdings by a rough application of the shelter-wood system, the intention being to come back in twenty to thirty years for the second cut.

Enemies of the Yellow Pine. Forests in the Hills have suffered excessively from insects and fire. The chief insect enemy, the Black Hills Beetle is too well known to require description. Its depredations have now been controlled by natural agencies, and by cutting large bodies of infested timber. A close watch is now kept by the Forest Officers for all signs of beetle infestation, and all infested trees are at once cut and the bark destroyed.

A leaf scale, probably *Chionaspis pinifoliae,* occurs, chiefly on seedlings and saplings. Its attacks are sometimes fatal. However, so long as it is not more abundant it need not be regarded as dangerous; perhaps it is slightly beneficial, since it usually occurs in dense overstocked thickets of young growth, where a thinning is badly needed.

The dry climate and the character of the forest operate to ren-

* Reprinted, with permission, from Journal of Economic Entomology, Vol. V, No. 6.

der fires numerous and severe, especially so in young growth where they often burn into the crowns. In old stands, particularly if there is no reproduction on the ground, they are confined to the surface and do less harm. Fires burning through irregular stands where the flames mount into the tops of the smaller trees, kill most of the stand but destroy little timber.

Destruction of Fire-Killed Timber. As a result of fires many thousands of feet of otherwise merchantable timber are killed annually. Much of this is never used. A knowledge of the rate of its subsequent destruction and methods of preventing it would result in saving much of it, thus reducing the drain on the live timber of the region.

Both insects and fungi attack trees killed by fire, their attacks being to some degree interrelated.

Fungi. Von Schrenk has given an account of two important fungi attacking beetle-killed trees, and they are also found on trees killed by fire. One, the "blue" fungus *(Ceratostomella pilifera* Winter,) speedily stains the sapwood; the other, the Red-Rot *(Polyporus ponderosa* von Schrenk,) follows after a longer interval, and causes the wood to decay. Other fungi attack live trees, but are not important here.

Insects The chief insects infesting dead timber are, in the Black Hills, ambrosia beetles and the larvæ of Cerambycid and Buprestid beetles.

Hopkins lists two ambrosia beetles, *Gnathotricus sulcatus* LeConte, and *G. occidentalis* Hopkins, as occurring on beetle infested pine in the Black Hills. It is probable that these are the forms which occur on fire-injured and killed trees. Their attacks seem more apt to be directed towards injured than dead trees.

Ambrosia beetles bore in sapwood and to a less extent in heartwood. They cultivate a fungus in their burrows which stains the adjacent wood. These burrows also serve as a means for the extension of the "blue" fungus. The seasonal history for the species in the Black Hills has not been worked out in detail. The adults, however, seem to fly throughout the growing season, and to hibernate in their burrows during the winter, several generations are doubtlessly produced in a season.

More important than the ambrosia beetles are the deep-wood borers,—the Cerambycid and Buprestid beetles,—whose larvæ make large burrows deep into the wood.

The destructive "Sawyer" *(Monohammus titillator)* of the Southern States seem not to be present in the Black Hills. The chief damage is done by the larva of a Buprestid beetle, probably the Heartwood Pine Borer *(Chalcophora virginiensis)* or one of its western forms *oregonensis,* or *angulicollis montana.* The three forms mentioned do not differ materially. All are large metallic lustered, bronze colored beetles, about an inch long and a quarter of an inch wide. They fly with a distinct buzzing sound.

The larvæ are elongated, whitish, flatheaded, legless grubs. The head is yellowish to brownish, and armed with strong jaws, which can be heard as it excavates in its burrow. The length at maturity is an inch and a half or more.

The adults fly in July, during the third week of that month the woods are full of them, but by the end of the first week in August all seem to have disappeared. The flying season probably lasts from the middle of June to the last of August at the outside.

The eggs are layed in holes cut in the bark by the female, occasionally in living, more often on recently dead trees. They hatch in a few days, and for a few weeks bore in the bark. Under favorable circumstances they may enter the wood within a month; by the end of two months, if conditions are favorable, they may have bored into it for two inches. The larval stage lasts till the following season, and may last for two years. Their activity does not continue after cold weather sets in, and the wood freezes.

Character of Insect Damage. Ambrosia beetles aid in bluing fire-killed timber, but it is seldom that the sapwood escapes bluing even without their assistance. If timber is cut before it is badly infested by the larger borers, the work of the ambrosia beetles is usually removed with the slabs.

The larger borers if abundant will in time completely riddle a log, so that it is worthless save as firewood. In a single season they may reduce its value from thirty to fifty per cent.

Effect of the Season of the Fire. The severity of attack by boring insects varies with the season of the fire. It can of course take place immediately after one only during the season when the adults are flying. The further removed from this period the fire comes the less will be the strength of the beetle attack, since the wood has more chance to dry out and the bark to become detached.

The optimum conditions for attack seem to be following fires occuring early in the growing season. At such times the killing power of fire is at its highest. The moist condition of the wood causes fermentation and a rise of temperature. This favors the rapid growth of the larvæ, giving them time to become well established before seasoning of the wood and cold weather interferes.

On a large area burned about the middle of June, infestation by the last of August was so severe that the ground under the trees was white with the dust from the borings, which could be seen drifting to the ground like a light snow. The gnawing of the larvæ sounded like the croaking of innumerable frogs. An area close by burned in March was much less severely infested.

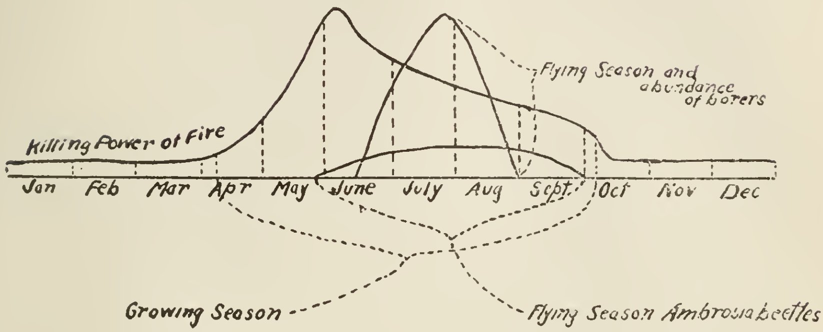
Rate of Destruction. Foresters and lumbermen in the Black Hills recognize the fact that fire-killed timber is generally worthless after it has stood two years. The relation of the season of the fire to the rate of destruction is not so well understood.

Timber killed just before the flying season will be practically worthless in fifteen months, or by the following fall, while timber killed after the growing season may not be as badly riddled after two years and a half. A close study of the rate of destruction would be of great value.

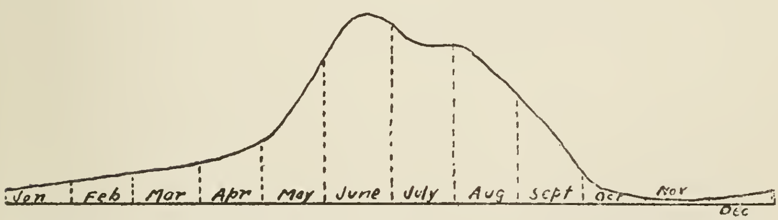
An attempt is made to express some of the facts regarding infestation and destruction graphically. The curves shown are for the most part relative as we do not possess sufficient data to make them entirely specific. The table derived partly from Curve III., would, if accurately worked up, be of value, by showing the time necessary to effect the injury and destruction of timber killed at different seasons.

Influence of Site on Severity of Attack. Wood borers prefer moist wood, and are therefore most frequent in localities where the wood is damp, such as in canyons, on steep north slopes, etc., where there is protection from the sun and winds. On the tops of ridges exposed to wind and sun timber seasons quickly, and infestation is therefore often slight. The writer has ex-

CURVE I.

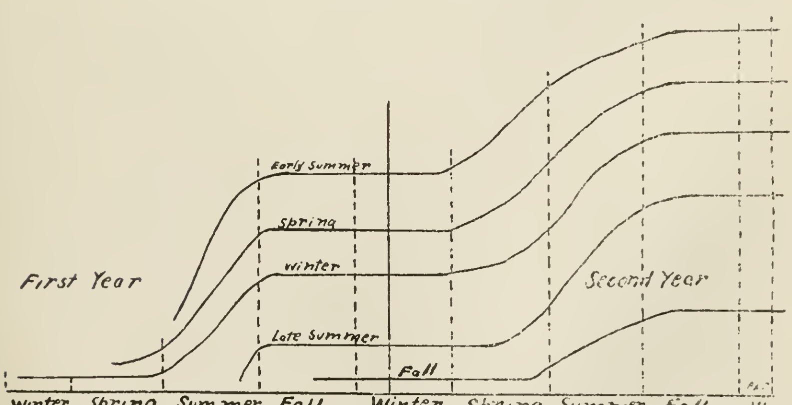


CURVE II



Degree of infestation following fires at different seasons

CURVE III



Probable rate of destruction by borers of timber killed at different seasons amined timber from such localities that was unaffected by borers although it had been dead for several seasons. The proximity of a burned to an infested area is favorable for the spread of the pests.

These facts should be kept in mind in projecting a cutting in a recently burned area to prevent infestation. Timber in damp situations and that near infested areas should be removed or barked first.

Natural Checks. The large amount of dead timber scattered through the Black Hills as a result of the beetle invasion and the numerous fires have given a splendid and not neglected opportunity for wood borers.

It is probable that the pure character of the forest acts in their favor, the same as it does with other insect pests.

Woodpeckers eat many beetle larvæ, and are apt to congregate in burned areas where they are numerous. The Hairy Woodpecker is quite common and is the chief bird enemy of the Buprestid larvæ. Early in September the writer observed many at work in an area burned in June. They seemed to confine their attentions largely to the smaller trees, mostly the saplings fifteen to twenty-five feet high. They dug an inch or more into the wood for the grubs. Other woodpeckers occur in the Hills, but were not observed eating larvæ on recently killed trees. Probably Chickadees and Nuthatches eat the eggs and small grubs before they enter the wood, but are not able to dig into it after them.

Birds seem to serve more in keeping down the numbers of the pests than in saving timber already infested, since after borers are two or three inches into the wood only the larger woodpeckers can reach them, and then only when the wood is partly decayed.

Remedies. The obvious remedy for the destruction of fire-killed timber is of course to prevent fires. This attempt is made on the National Forests and the more valuable private holdings; but, like fires in cities, some forest fires will always occur despite all precautions.

The next best thing is to harvest the burned timber at once. This is often impossible, since it takes time to effect a timber sale on a National Forest, even when a purchaser is at hand.

When roads and camps must be built it may require several months to prepare for cutting. If a fire occurs between June first and August fifteenth, it is almost impossible to get at the timber before infestation commences, much less remove any large bodies of it. However, if it can be cut and sawed within six weeks little damage would be done since the borers would still be near the surface, and would be removed with the slabs.

If timber is killed after the middle of August, there is a longer time for safe removal, although it will be attacked by ambrosia beetles and the bluing fungus till the coming of heavy frosts.

Lumbermen frequently want to know how to prevent the destruction of dead material without at once removing it. It is often proposed to cut and bark it, removing it to the mill at a more convenient season. This if carefully done is effective, but more costly than might be supposed. Barking costs about fifty cents per M feet B. M., which is half as much as felling itself costs. There would be no profit in barking small top logs, since it does not pay to handle these except under the best of conditions. It is doubtful if any large amount of timber could be kept from bluing by this method.

If logs are badly infested and the larvæ are well into the wood, it is doubtful if merely barking them would destroy the pests. In such cases it would be better to build skidways in the open above the surface and pile the logs onto them in such a way that the air could get at them from all sides, so as to facilitate seasoning. Care should be taken not to deck them up in tiers, as this interferes with seasoning. Such a method would be more expensive than letting the logs lie on the ground; but would tend to prevent bluing, and would probably kill all borers.

Another remedy often proposed is to cut dead or infested material and pond it. This not only prevents all infestation, but kills all larvæ already in the wood, and prevents fungus attacks. It is not suitable in the Black Hills, since no natural ponds exist, and the cost of building dams large enough for the storage of large quantities of logs is prohibitive. The running of infested material through a log pond to kill the borers has been suggested. This works if the logs are in the water long enough. The writer has noticed that good sized logs after remaining in the pond at the Lanphere-Hinrich mill for two or three days had live borers at their centers when sawed. Logs would have to remain in the pond until they were thoroughly soaked out, perhaps a week or more, rendering the process slow, and perhaps not possible for any large amount of timber.

If a systematic attempt were made to apply this method, it might be well to experiment with poisonous solutions in the water, such as copper sulphate or mercuric chloride. These might shorten the time necessary for immersion, and would tend to prevent reinfestation, or fungus attacks.

Uses for Infested Material. A lumberman frequently finds himself in possession of an amount of infested timber, which he does not wish to lose. What can he do with it?

It may of course be manufactured into common lumber and sold for what it will bring as number three common and cull. Or perhaps it may be disposed of as firewood. The demand for both of these is small, and no large amount of either can be marketed at one time, moreover the profit is small. For it costs as much to handle burned as green timber, and the price on the finished product is from a third to a half lower, in addition to a greater waste in manufacture.

Railroad ties are sometimes sawed from fire-killed timber, but are not very satisfactory. However, if they could be treated with a timber preservative, they would be more valuable in many cases than green ties. While the larger railroads in the Black Hills have treating plants, they draw their timber supplies mostly from elsewhere. The establishment of a commercial treating plant in the Black Hills would solve many of their problems of wood utilization.

The use of untreated infested material for mine timbers is not usually advisable, since the moist conditions prevailing in most mines allow the continued existence of both insects and fungi, which speedily destroy the timbers, necessitating frequent renewals.

A certain lumberman in the Black Hills has solved for himself the problem of the use of fire-killed and infested timber, by turning it into box boards. There is a large and steady demand throughout the Middle West for them by the large meat packing companies. He has no difficulty in disposing of any fire-killed material, no matter how much blued or infested, so long as it is not affected with red-rot.

This solution of the difficulty is not at the disposal of the small man with a portable mill, for it requires a special outfit to saw and match box boards. He might in some cases sell his burned material to a box mill after sawing it out in the rough.

Summary. Destruction of fire-killed timber is largely accomplished by Buprestid beetles, whose larvæ riddle it. In from fifteen months to two years and a half they, in combination with fungi, entirely destroy it for commercial purposes.

The rate of damage varies with the locality of the timber and the season of the fire, being at its maximum in moist localities, following fires in the early part of the growing season.

Remedies. Prevent fires, cut and remove fire-killed timber at once, if this is not possible, bark burned and infested trees and place them on skidways to season. Ponding is the best remedy, but is not generally possible. Running of infested logs through a log pond would destroy borers if the logs were left in long enough. The use of poisonous solutions in the water should be tried.

Infested material can be used in small amounts for low grade products, and for box boards; but often it will not pay to handle it.

PRELIMINARY TABLE SHOWING RATE OF DESTRUCTION OF FIRE KILLED TIMBER

Season of Fire	*Infested*	*Partially Destroyed*	*Entirely Destroyed*
Spring	In a few motnhs	That fall	Following fall
Early Summer	Immediately	That fall	Following fall
Late Summer	Partially at once fully following season	Following fall	Two years
Fall	Following Summer	Following fall	Two-three yrs.
Winter	Following Summer	Following fall	Two-three yrs.

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THE BEST BRUSH BURNING TORCH

By. Wm. T. Cox

Slash disposal is now a regular part of logging in Minnesota. The loggers, during the past year, have spent in the neighborhood of $300,000 burning brush, or about ten cents a thousand on the cut of three billion feet of timber. Half of this was cut into saw logs; the other half was made into pulpwood, railroad ties, mining timber, telegraph and telephone poles and various other forest products.

The slash resulting from the pine cuttings was practically all burned, and fire lines of different kinds were burned around the spruce and cedar cuttings. Only a very limited amount of "lopping" was done, and this mostly in areas of hardwood. It is evident, therefore, that fire was employed in practically all of the slash disposal work conducted by Minnesota lumbermen.

There are many hundreds of logging camps operating in north ern Minnesota, and it is but natural that a good many different methods of actually doing the burning would be tried out by the numerous foremen. Torches of all shapes and sizes were used; brands were carried on forks from pile to pile; coals were carried on long-handled shovels; wads of birch-bark were thrust into piles and lighted; crude oil and even kerosene were spilled on the brush piles to start them off. No single one of these methods will work better than all of the others in every kind of slash and under the varying conditions; but it developed that in nearly every case a torch is most satisfactory. The cost and difficulty of transportation are against the general use of crude oil and kerosene. Carrying coals and brands is inconvenient where there is much hazel or other brush growth, or where the distance between piles of slash is considerable. Gathering and lighting birch-bark, though quite widely practiced on account of the abundance of birch trees, is a very deliberate performance as carried on by the average lumber-jack. Unless closely watched, there is much loafing on the job.

Now as to the torch itself. Many kinds were found in use. Tight rolls of birch-bark fastened to a stick with hay wire last much longer than one might suppose, and this form of torch worked fairly well in some places. Short and long tin torches were used, but they were not strong enough to thrust into the heavy brush. They would soon become dented or crushed, or by being left a few minutes too long in the fire the solder would melt. The short, heavy iron railroad torch did not work well. Iron torches with four-foot wooden handles, when made strong enough, were fairly satisfactory except for rather frequent burning out or loosening of the handle, especially where slash was being burned as swamping proceeded, and the brush therefore was piled directly onto the torch as it lay on the ground or in the snow.

The torch shown in the illustration is a modification of one used by the Red River Lumber Company south of Bemidji. The one used by the company was more crudely made and too heavy for convenience. This one as improved by one of the District Rangers is, I believe, pretty nearly perfection for slash burning work. It holds about one quart of kerosene, enough to burn, with two inches of wick exposed and hence a good flame for about three hours. By flattening the nozzle and thus spreading the wick, a wider flame can be obtained if desired. There is no danger of breaking the implement; heat does not injure it;

TORCH FOR BURNING SLASH.
Main section or reservoir; Standard Gas Pipe 1½ × 36 inches
Nozzle ¾ × 15 inches. Standard Cap and connection.

refilling with oil and threading with new wick are simply and quickly done. Any blacksmith can make the torch at a cost of from 35 to 60 cents.

This implement is rapidly gaining in favor with the lumbermen of the State, and is certain to save them many thousands of dollars in the cost of burning brush. The Rangers themselves find it very helpful in work which requires the use of fire.

A METHOD OF OBTAINING MAIN CONTROL IN UNSURVEYED TOWNSHIPS.

By William J. Paeth.

Since all maps are sketches controlled by locations, it is essential that the points of control be accurate locations. This applies most strongly to the points of main control. The supplementary control is not so important because all the errors in location are corrected by tying in upon the main control. Although the construction of Forest Service maps does not call for a very high degree of accuracy, it is essential that the main control be obtained with as much technical precision as possible with the methods available. With a good main control a practical accurate map is secured, although the methods employed in obtaining the secondary control may be very rough and inaccurate.

This method of obtaining main vertical and horizontal control is applicable only in high country where triangulation stations can be erected cheaply on high peaks frequently visible throughout the forested area. A township surrounded by prominent peaks, and having some natural prominent points also within its limits, will adapt itself to this method, provided there are small open areas, big meadows, burned areas and barrens. From these points the sights necessary can be secured.

Horizontal Primary Control.

When available the U. S. Rectangular Surveys furnish accurate horizontal main control for the construction of practical Forest Service maps.

It is essential that the character of the control be clearly understood before plotting the control secured from these surveys upon the base plat.

The object of the U. S. Rectangular Surveys is primarily legal land subdivision. The theoretically ideal township is a trapezoid. The eastern and western meridians forming the eastern and western boundaries on the township converge about 65 links to the township in this latitude, 43°N. This error is thrown into the west tier of sections. The errors made in measuring north and south are thrown into the northern tier of sections.

The aim of the survey was to approach as closely as possible to the ideal theoretical township. For the purpose of the topographer it is just as well to lose sight of this object of the survey entirely and treat the whole survey as a system of traverse lines. If this is done the section corners will not be thought of as monuments one mile apart, but will be treated as accurate geometric locations.

The topographer will treat these points upon the base map not as corners of sections, but as points of control accurately located by angle and distance from a definite starting point, *i. e.,* the initial point of the survey. Such a system of points can serve every purpose of a triangulation network.

Accepting this network of control as sufficiently accurate for the purpose of the Forest Service surveys, the primary control can be extended into neighboring unsurveyed townships while working the townships surveyed by the U. S. Rectangular Land Survey.

Mountain peaks can be located accurately, and their location plotted. These peaks now become points of control and they are definitely tied to land corners.

In using this method it is necessary to do all the work in surveyed townships first. By working the unsurveyed territory last a greater number of primary points of control can be obtained. It is obvious that the mountain peaks in the adjoining unsurveyed country will not be visible from every section corner, or more than a few points along the base lines run by the base line crews in the surveyed townships, but the parties rerunning the old traverse line (section lines) of the Rectangular Survey will be able to locate all necessary points of control while completing the work in the surveyed townships. Base line crews can take sights from intermediate stations along the section lines, since all the distances are being accurately measured either by chains or stadia, and the stations are accurate locations. If necessary short traverse lines can be run commanding points and sights taken from these locations.

When the work is to be begun in the unsurveyed township, the topographer has already secured a base plat of the area with some points of control upon it and these points are definitely tied in upon neighboring land corners.

These points will give both vertical and horizontal control if the elevation of the peaks has been determined by vertical angles.

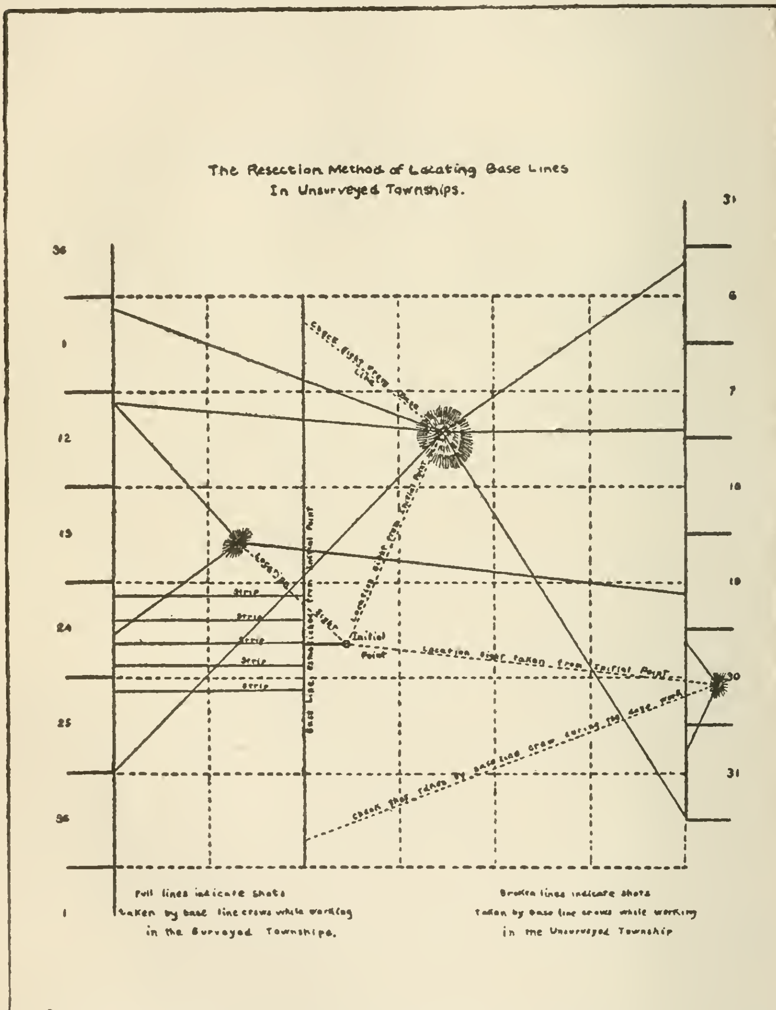
The Resection Method of Obtaining Main Control in Unsurveyed Townships.

The topographer moves his camp into the unsurveyed township to be worked. Under ordinary circumstances he would employ traverse lines entirely for his primary control, extending his traverse lines from the land corners of the surveyed townships. In order to secure vertical control he must carry his elevations by transit line from a B. M. at some distance. Unnecessary transit lines can be eliminated by this method. He sends out his transit crew to establish an initial point for the survey. The field work in establishing this initial point can be performed in a few hours. The vertical control is obtained with the horizontal control. From a convenient strategic commanding point of view the transit man takes three sets of sights upon triangulation points of control already located upon the base plat. The transit plates can be oriented by the compass needle three times, once for each set of angles. The horizontal and vertical angles to triangulation points of control are entered in the note book.

A hub is established to mark the point and the crew returns to the camp. This work can be performed while the camp is being set up by the other men. In the evening the topographer locates this initial point by resection upon the base plat. He then has three solutions for the elevation of his initial point, and he has two intersections for horizontal location. This gives a sufficient check upon the accuracy of the work. The initial point when plotted upon the base plat now becomes a point of primary control, both horizontal and vertical. It can be made a B. M.

The section lines are projected upon this base plat from the neighboring township by means of fine lines.

The topographer draws a meridian through his initial point plotted on the base plat. He then scales the distance along this meridianal line to the nearest projected section line and enters that distance in chains or feet on the sheet of instructions to his transit or base line crew. He then scales the distance along the projected section line from this point of intersection to the nearest projected section corner, and enters that distance in chains or feet on the sheet of instructions to his transit or base line crew.



The base line crew now has complete knowledge of the location of the nearest projected section corner. The crew proceeds so many chains north or south from the initial point and then so many chains east or west to the point where the section stake is established.

Base lines are now run in the ordinary manner.

During the day's work the crew will be able to take sights upon points of primary control. These angles are entered in the notes and the day's work is handed in to the party chief in the evening. The day's work in base line location is then plotted upon the base plat.

If the work of the base line crew has been inaccurate and careless, the sights upon points of primary control will not check. The topographer has at all times a complete check upon the day's work, both in horizontal and vertical location. All errors in base line location are discovered before any further work is done. If the day's work has been unsatisfactory, it is run over the next day, and the error found. No errors will remain undiscovered until after the strip crews have completed much of their work, and errors discovered in the field at an early time, when they are made, are more economical to correct than when they are discovered in the main office. Herein lies one of the advantages of such a system of resection and triangulation.

The field work in obtaining primary control should always be mapped as the work proceeds, and primary control should serve as a check both for the field and office work.

A SHORT-CUT METHOD OF CRUISING TIMBER.

By C. S. Judd.

There was recently brought to my attention a short-cut method of cruising timber or what might be called an easy method of check-cruising which has frequently been used by a prominent timberman on the Columbia River in the State of Washington.

When purchasing stumpage on the basis of an estimate this timberman has made use of this method on occasions when he has desired a better check-cruise than merely his own ocular estimate and has desired to base the results of his field work on some tangible figures.

The timber that he purchases is usually of good quality, uniform in character, and as a rule is found on accessible valley bottoms which are readily reached by wagon roads. He drives along the road carefully scrutinizing the timber until he comes to a spot where it appears to be of average density and average size. Here he begins at any convenient tree picked out at random and estimates and records its diameter outside the bark at breast height. He then looks in all directions and mechanically selecting the nearest tree, irrespective of what direction it is found in relation to the first tree, paces the distance between the first and the second tree and records this distance and the diameter of the second tree.

The process of selecting the next nearest tree and recording its diameter and its distance from the tree just measured is repeated until the diameters of about twenty-five trees have been recorded. Each time the nearest tree is mechanically selected unless, of course, it has already been measured. In other words, the measurement of the diameter of any particular tree and of the distance between it and a tree that has already been measured is never repeated.

The course that is taken in going from tree to tree has no reference to the points of the compass and may be described as a series of connected straight lines, each line varying greatly in direction according to the location of the trees.

The timberman then goes back to his vehicle and carefully not-ing as before the character of the timber as he drives along selects another spot where the size and occurrence of the timber appears to be typical. Here in the same manner he measures about a score more of trees. This is repeated as many times as his convenience will allow.

When he returns to his office the timberman has measurements of the diameter of a large number of trees and of the distance between them in the order in which the measurements were taken. The diameter of the average tree among which he has measured is then determined. Being of a scientific turn of mind, this timberman recognizes the axiom that the volumes of trees vary more nearly as the squares of their diameters than as their diameters. He determines the diameter of the average tree therefore in the customary manner by computing first the average basal area of all the trees and from this the corresponding diameter. The volume of the average tree is then computed either from a volume table or from a log rule, making allowances for height, taper, and thickness of bark.

The next step is to determine the average number of trees per acre. The distances between the measured trees are totalled and this total is divided by the number of measured distances. The result gives the average distance, measured in feet, that each tree is apart from its neighbor. This average distance is then squared to obtain the average area or ground space in square feet that each tree is allotted in the forest. This average area is then divided into 43,560, the number of square feet in an acre, to determine the average number of trees per acre.

The rest is simple. The volume of the average tree is multiplied by the average number of trees per acre and the result is the volume of timber in board feet on an average acre. The product of this average volume per acre and the acreage of the claim gives the total volume or cruise on the tract of land under consideration.

This method of course has many drawbacks which tend to give inaccurate results. An error in selecting an area where the density of the stand and the size of trees is not representative of the whole tract will result in an estimate either too high or too low. No data for the preparation of a map can be taken by this method and the estimate can not be separated by species. It should be used, however, only where there is a large percentage of one species such as Douglas fir in the stand and when the desired result is only one figure for either the average volume per acre or the total cruise of timber on a subdivision of land.

The advantages of this method are many. It is convenient, simple and rapid. In measuring distances no regard need be taken of the cardinal points, hence there is no orientation and no compass or other instrument is needed in the work. No time is consumed in looking up section corners or lines for a starting point or in measuring and laying off the boundaries of a sample plot.

It would be interesting to test the results obtained by this method with those secured by some of the standard methods of estimating timber used by the Forest Service.*

* For refinement of this method see various articles on "space number" in previous issues of FORESTRY QUARTERLY.—ED.

OBSERVATIONS ON THE FUTURE SAWMILL.

By Herbert J. Miles.

In his paper entitled "The Sawmill of the Future," printed in Volume VI, Number 4, of the Forestry Quarterly, Mr. E. A. Sherman, after comparing the work and merits of the large and the small sawmill, concludes that the large sawmill will in the future give way to the small mill. Mr. Burt P. Kirkland, in a paper entitled "Probable Evolution in the Sawmill Industry," presented in the Forestry Quarterly, Volume XI, Number 1, sets forth in detail the superior qualities of the large mill over the small mill, and concludes that the larger mill will be the typical mill of the future. These conclusions are to my mind too general, for I believe both types of mill have and will continue to have broad fields of usefulness, and that neither type will largely supersede the other. The qualities and merits of the two types of mill are fully shown in the papers cited, and it is unnecessary to repeat them here. I wish to state briefly the views of an observer on the respective places of the large and the small sawmill.

The large sawmill must have on the one hand an abundance of timber easily accessible, and on the other large nearby markets for its products, or means of export to large markets, in order to live. This type of mill by its nature must have markets which use varied products, and the means of utilizing, or of disposing for utilization, its wastes. It is in thickly settled communities near ample supplies of timber that these necessary conditions occur, and it is here that the large sawmill will continue to find its place. The more populated regions of the Atlantic and Pacific coasts with growing cities, served by rail and water, means of bringing timber to the mill and of distributing the product, will be the home of the large sawmill. In the cities and towns of Maine on drivable streams are now found mills of this type. In the Interior of New England the large mill is found in the populous communities having railroads, and becomes less prominent as one goes back into the less settled country.

The small sawmill, furnishing a restricted product both in kind and quantity, fills the needs of small communities in sparsely settled regions where the demand for lumber is small and whence there is no way of getting lumber to a larger market. The small sawmill here performs a strictly local service, and will find field for this service indefinitely in rural and mountain districts. A very permanent field for the small mill exists in those mountainous regions characterized by rough topography, where logging units are small and the timber is with difficulty accessible. Here, the absence of drivable streams, and the broken and difficult nature of the country forbids the hauling of logs to a centrally located large sawmill. The large mill with steam machinery for logging and lines of railroad into the timber will not come into these regions until communities grow furnishing extensive markets, or until railroads are built affording means of getting the lumber to outside markets. There are regions of this kind in the New England Mountains, and especially in the Blue Mountains of Eastern Oregon, which will remain sparsely settled for a long time. In the countryside of New England, and in suburban communities, are areas of woodland oftentimes in small, detached bodies, as well as in more extensive tracts. It will hardly be practical for the large mill in a commercial center to reach out hither and yon for these small batches of timber, but the small portable mill can well reach out to the smaller while operating the larger stands. These areas of woodland will never be more extensive, but will, for a long time, remain as they are, and in many regions, it is safe to say, will always be woodland. The reforestation of waste land will extend the field of action for the small mill.

A small mill can be maintained by regulated and sustained yield from timber land of these classes, and I conclude that the small sawmill has and will continue to have a wide range of usefulness for the purposes suggested, especially in the populated section of New England, where woodland is in small bodies.

TAXATION AND FORESTRY.

The Diagnosis of a New England Town.

By P. W. Goldsbury.

The attractions of the great West and the lures of the cities and towns of the East have been the main factors perhaps in depopulating New England hills, but still another factor has been operative in certain sections. Climb with me to the top of a mountain in the center of a certain town which I know and you will see how little that carpet of green forest and bush is interrupted by cleared fields and pastures. One might say that fully 95 per cent. of the land was growing up according to nature's own sweet will. Sprouts and seedlings hasten to cover the scars left by the shearing sawmill, trees choke the pastures and openings and drive out man.

Now I am a physician, and after living some years in the city and endeavoring to diagnose many human ailments, I feel inclined to go myself into the country, where I am fully persuaded I can work better and can follow up my diagnoses with better prescriptions of hygiene. The country without economic, social and other handicaps should be the wholesomest sort of place to work in, yet I have found the town I came to ailing, I have heretofore diagnosed many nervous and mental conditions pertaining to individuals, and now have been led on with a hope that my experience in business and various lines will assist me in diagnosing some community disorders and finding some of their causes.

This town has but one-third the population it had 125 years ago. The state on the other hand has increased its population ten-fold or 30 times that of the town. The farmer of 80 years ago was craft wise, practiced many wholesome economies which labor saving machinery has upset. He could then select trees ripe for cutting and cart his own logs to mill.

Now the machinery owners, manufacturers or powerful interests higher up control in effect the labor, force him to use a portable mill, to cut all the trees or none, interfering with his selective judgment. Outside ingenuity came in to dominate town interests, the sawmill upset local and hereditary economies and thrift. The most remarkable part in the economic history of the town is furnished by its tax assessments.

In 1875, the total assessed valuation of this town was $266,000, in 1910 it was $442,000. Then 20 per cent. of this property was of non-resident ownership, to-day non-residents own 60 per cent. Within that period of time, population has decreased very nearly one-half. It was about 30 years ago that the portable sawmill was introduced into our midst, and sawdust piles show how thoroughly it has visited every section. An immense quantity of white pine has been cut off, it would be difficult to estimate the amount, but the amount of timber which can be cut during the next 40 years will be quite small as compared with what has been cut the last 40 years. The town has very much less timber ripe for cutting now than thirty-five years ago, has declined nearly one-half in population and still the assessed valuation has increased 65 per cent. Prices of commodities have risen, white pine in particular. I was visiting here in 1900 when about as much timber was being cut as at any time, and the farmers seemed to think $2 per M feet on the stump was a very fair price. The first lumber I sold was in 1907 at $8 per M and I have not sold any under that price since. A great deal of the money with its owners has moved away from town, some has gone onto the paternalistic savings bank, and a very little has been put back into the soil.

This town has never carried any debt, it has managed to keep out of this at the expense of the population, and to do this has called for interesting work on the part of assessors. Our scenic or natural topographical beauties have brought very few summer non-residents, we don't have that wealthy class, who might out of their abundance experiment in forestry, instead there are a great many small holders without a generous vision of the future. They want to let the timber grow, and have the taxes, the expense of holding, cut down. Such a spirit is felt within the town as well as outside and operates quite effectively against good schools, good roads, etc., and the effect of this upon the population can easily be seen.

Our own land in sight of town officers has had seemingly a square deal. It is practically all timber, and was assessed for $11 per acre in 1875, $15 in 1895, $19 in 1903, $27 in 1904, and again $19 in 1908, after we had sold $3,500 worth of timber from a part of the whole.

Contrast this with the assessment upon a tract of over 200 acres whose owners received about $30,000 for the lot in 1906. Assessed at $5 in 1875, at $20 in 1900, at $75 in 1906, at $112 in 1907 (sale to timber company at this time helped assessors in estimating its value), was then cut and returned to an assessment of $5 in 1909. Another lot assessed at $3.50 in 1884, at $9 in 1903, at $58 in 1904; timber was cut off in 1909, since which tax has been $3.50 per acre. These last two tracts are 3 miles from town officers. Chart these figures out, and you erect conspicuous monuments to stand-pattism.

The country needs engineers and counsellors to direct and encourage the poor man who would go in there to seek health and a wholesome competence and living. The country must be managed so as not to kill off the golden goose, which in this case is the timber, since the soil is only fit for forest. I am trying to find the right sort of prescriptions for this ailment here. I believe this wild forest crop could be cultivated and attended to so as to give a living to 50 men where one is so employed to-day, in thinning, weeding, and in the right utilization of the product. This would tend to repopulate the town and should help the schools, etc. Our schools are expensive to a large degree on account of the small and scattered population, while in 1850 the schooling cost $2.52 per pupil, to-day, about $50. Cannot the State devise a method of State forestry in such impoverished towns?

SHAKE-MAKING AND TRAY MILLS IN CALIFORNIA NATIONAL FORESTS.

By Swift Berry.

Ever since the National Forests of California were first put under administration, the problem of dealing with the shake maker has been a live one. Split shakes have been used in California since early settlement both for roofing and siding mountain and foothill cabins and other buildings. For a long time they were the only form of roofing material available for use in such localities. Since shake making requires labor skilled by practise, there came to be men in each locality who followed the vocation for a living. It was pleasant work in which one was his own master and the shake makers stayed with it, until now there are in certain localities old men who have no other means of support.

Although shingles are now used for roofing wherever there is transportation, in certain isolated mountain and foothill regions shakes are still the best material available. Also many valley ranchers still desire to use split shakes for roofing and siding hay barns. Another use that has grown up for shakes is for the bottoms of trays used for drying fruits, particularly raisins.

In spite of its necessity, shake-making has been generally condemned because of the waste of timber incidental to it. Anyone who has been in the woods in the vicinity of old shake-making operations is familiar with the large amount of unutilized material left on the ground. Before the days of the National Forests the shake-makers were careless and felled many trees from which only one or possibly no logs were made into shakes. Later, with the administration of the Forests the cutting of trees was not permitted unless it was pretty certain that they would make shakes. Also by requiring payment for stumpage on the basis of a board foot scale, the utilization of all material that would make shakes in each tree was secured. Yet, with the most careful regulation there still seemed considerable waste in shake-making and another and greater disadvantage became evident. Since most of the shakes are made from the most valuable species, sugar pine, and only the best and straightest grained trees will rive, the shake-maker constantly lowered the value of the stand by skimming out the best trees. Consequently, Forest officers have long been desirous of substituting some similar operation for shake-making. This desire seems to be met to a certain extent in the small mill manufacturing tray boards.

In order to admit comparison of the two operations a brief description of each will be given. The first step in shake-making is the selection of the trees. Only straight grained trees which will split easily can be used, and the experienced shake-maker searches through the woods until he sights a tree which in his judgment will work. He then chops a six-inch block from it to determine the splitting quality of the wood. This procedure is continued until a suitable tree is found. With an experienced man usually one or two trials are sufficient.

The tree is felled and trimmed in the same manner as in logging operations. After trimming the trunk is sawed, as far up as it will work, into blocks the length of the shakes. These blocks are then turned on end for bolting. First, circles are marked with crayon at intervals equal to the width of the shakes. Next, the bolts are outlined by marking intersection of radii on these circles. This operation is not so simple as it seems, because all bolts must be marked parallel to the medullary rays and also all knots must be left out of the bolts. After the bolts are marked out they are split from the block by means of a maul and wedges.

The next step after bolting is riving, which consists of splitting the shakes from the bolts. This is done by hand with a "froe" which is an instrument peculiar to shake makers. It consists of a steel blade, six or seven inches long, with a wooden handle at right angles to the blade. The shakemaker places one end of the bolt in a wooden frame on the ground and using the froe and a wooden maul splits it into four quarters. Each quarter is then split into two pieces and each piece into two halves. Thus four shakes are rived from each quarter and sixteen from each bolt. After riving the shakes are piled by fours in crib fashion for drying and when dried sufficiently for hauling, they are bailed with wire in bundles of a size convenient for handling.

Roof shakes are 32 inches in length, 5 inches wide and are usually 3/16 of an inch thick upon the thinner edge. Tray shakes are 24 inches in length, 6 inches wide and ¼ of an inch thick upon the thinner edge. Each roof shake contains about 5/24 feet b.m. and each tray shake about ¼ feet b.m. In making roof shakes from sugar pine an average of 4000 shakes is made from each thousand feet of that portion of the tree actually used. The average for the entire log scale of the tree is about 3000 shakes per thousand board feet.

In the used portion of the tree the shakemaker wastes only the central portion of the trunk containing knots which will not split. So far, his waste is less than a sawmill. However, he cannot utilize the tree into the top as far as a sawmill by three or four logs. In some measurements of shake trees made on the Tahoe and Sierra Forests, it was found that 25% of the sawtimber contained in the trees could not be utilized for shakes.

One reason for the popularity of shakemaking was the possibility it offers of making good wages without great effort. Under average conditions the cost of making sugar pine roof shakes per thousand shakes is as follows:

Felling and trimming,	$0.11
Bucking and bolting,	1.50
Riving,	2.00
Piling,	.10
Bailing (including wire),	.15
Piling debris,	.20
Stumpage,	1.56
Total,	$5.62

The usual selling price of such shakes, at the stump, ranges from $6.50 to $7.00 per M.

Instead of picking selected trees the tray mill operator can utilize all sound trees upon the tract. The operation of felling and trimming is similar to that in a lumbering operation. The trees may be either bucked into blocks in the woods or sawed in long lengths and the logs hauled to the mill where the blocks are cut with a steam drag saw. In straight grained timber the blocks are cut 26 inches in length, but when the grain is twisted they are cut 28 inches or over. These blocks are next split into bolts. The bolts run with the grain and are made from 6 to 10 inches radially and 8 to 14 inches tangentially. In bolting small knots are disregarded but large ones are split out.

At the mill the ends of the bolts are first squared with a circular saw termed a butting machine. Next the bolts are placed in the carriage of the tray machine, which is a shingle saw or machine with the carriage adjusted to cut boards of even thickness. The bolts are so placed in the carriage that they are sawn at right angles to the annual rings. Portions of bolts containing medium sized knots are left unsawn and are used for fuel. The presence of a small knot in a board throws it into the second grade. After leaving the saw the boards are passed by hand through an edger set to cut the following five widths: 4", 5", 6", 7" and 9"; and through a trimmer which makes them an even length of 24". They are sawn 1/2" thick. After being sorted and graded the boards are piled for drying and are later tied with wire in bundles for hauling.

The cost of producing a thousand boards in a representative tray mill is about as follows:

Woods and mill,	$4.73
Piling,	.25
Baling,	.20
Depreciation and maintenance,	.53
Stumpage,	1.13
Hauling to R. R.,	3.50
Total,	$10.34

The average selling price of the output, taking into consideration first and second grades of boards, is about $13.50 to $14.00 per thousand boards at the railroad. Out of the profit the operator must, in addition, cover supervision and interest. The output of the average tray mill is about 15 thousand boards per day.

On an average the tray mill operator can utilize at least one more log in a tree than the shakemaker. The waste in his mill, due to sawdust, edgings, trimmings, etc., is such that on the whole he wastes as much of a tree as a shakemaker. However, he has, as noted above, this great advantage over the shakemaker; all sound trees may be utilized. Consequently, a sale may be made to a tray mill man for an area containing a few million feet and the timber marked in substantially the same manner as for a lumbering operation. For use in trays the boards are probably better than split shakes.

Thus it would seem that from the standpoint of the Forest Service shake sales should be eliminated and tray mills substituted. In most instances this policy may be followed, but in certain localities it would be a severe hardship upon small foothill ranchers if they could not secure shakes for covering their buildings. Also there are a few old men making shakes who have no other way to make a living, and it seems unduly hard to refuse to make small sales which would provide them a means of livelihood.

HOBO'S HANDY HEATER.

By Henry H. Farquhar.

To foresters who, because of temporary work or lack of proper transportation facilities, find themselves in the woods on a cold night with only a tent, their bed, and a supply of provisions, the following description of an excellent substitute for a stove, doing away with the unpleasant necessity of trying to keep warm or trying to cook in the rain by means of a camp fire, will undoubtedly be of interest.

The scheme first came to the attention of the writer in the fall of 1911 while gathering cones on the Kaniksu National Forest. He had never heard of it before, and has spoken to many foresters and others without finding one who had seen it, used, or even heard of it.

Its chief merits lie in its simplicity—an old piece of tin or a five-gallon kerosene can, two or three lengths of stove pipe, and a shovel or axe being the only necessary "materials of construction,"—the fact that it is not exposed to the weather and may be used for interior heating and cooking, and last but by no means least, its rapid construction. That it works admirably, can be attested from personal experience.

Take a five-gallon coal-oil can, cut one end entirely out, and in the opposite end cut a hole near one edge the size of the stove pipe available. If the can is not available, an old piece of tin may be rounded into funnel shape and similarly treated.

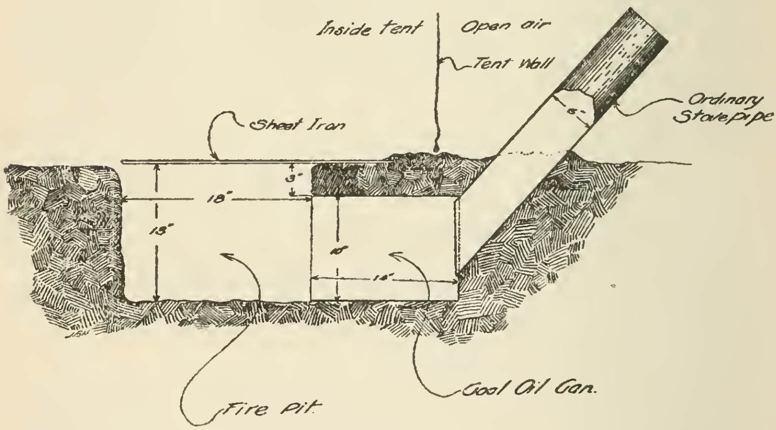
Dig a trench about 1 ft. deep by 1½ ft. wide, and about 1½ ft. long, under one edge of the tent wall, so that a few inches of the length of this trench are outside of the tent, the remainder extending into the tent.

Place the can, hole for stovepipe up, and open end towards interior of tent, lengthwise in the trench so that 5 or 6 inches stick beyond the wall into the open air. This leaves over a foot between the open end of the can and the end of the trench through which the wood can be fed into this fire-box; and with a piece of tin to cover the top of this opening, the draught can be regulated by having a small slit for the entrance of air. This also gives considerably more heating surface and may be used in cooking. Insert stovepipe into can at an angle of about 45°

to tent wall, and fasten top end with wire so that the wind will not shake it about. Replace the dirt completely around and over both stovepipe and can until level with ground both outside and inside of tent. There should be not *less* than three inches of dirt between any part of the stovepipe or can and the tent, since the latter is sure to be scorched if this precaution is not taken.

That is really all there is to this heater, and after constructing it the wood may be placed in the "fire place" and lighted.

HOBO'S HANDY HEATER



Do not expect your fire place to work from the start—before a good draught up the chimney has been created, and before you have properly regulated the size of fire pit and opening for draught. However, with a little practice you will soon be able to have an excellent smokeless fire place, and one that has not taken 25 minutes to construct. The larger the opening inside the tent, the more heat will of course be given off, but the limit here must be governed by the maximum opening you can have without smoking yourself out. With the sheet iron, however, the fire pit can occupy any desired space in the tent, the draught being regulated by means of this cover over the trench. Moreover by raising the "lid" for a moment, mosquitoes and other undesirable and noxious "fearsome creatures" will be quickly persuaded to vacate.

The illustration shows the heater in place.

VALUE OF PHYSICS AND OTHER FUNDAMENTAL SUBJECTS TO STUDENTS IN FORESTRY.

BY HUGH P. BAKER.

In developing undergraduate courses in forestry in the Iowa State College, the Pennsylvania State College and the New York State College of Forestry at Syracuse, one of the first problems was to arrange a program of work, in which there would be a sufficient amount of foundation work to make the courses both well balanced and adapted to the needs of the student. The relative weight of fundamental subjects is measured by time. The question of the relative weight of foundation subjects will be rather a difficult one to settle. How much Chemistry should a forestry student have; how much Physics; what part of his education should modern language claim? Should the forester be a mathematician and follow his elementary mathematics with a course in Calculus, or even more advanced work, or is he sufficiently prepared if he takes Elementary Algebra, Geometry and Trigonometry? Should he follow Physics with Elementary Mechanics and more?

In arranging a program of work for The New York State College of Forestry at Syracuse in 1912, it seemed as if some of these questions might be settled with more reason if their relation to the main subject were more definitely analyzed. A request was made therefore, upon some of the Departments giving this accessory instruction, for a statement as to the value of their particular line of work, for the student in forestry. The following statements as to the value of Physics to the undergraduate student in Forestry are presented largely with the idea of bringing out a fuller discussion. The statements for each course are essentially as submitted by Herbert H. Clark, A.M. (University of Nebraska), Associate Professor of Physics in Syracuse University.

Before bringing out the ways in which Physics may be essential to the student in Forestry, it would seem that a statement of the relative value of high school Physics might be of interest. The problem of this College during the past year has been, not the obtaining of more students, but the determination of methods to limit number who may be admitted to the professional courses, in a way that will raise the general standard. At the present time only those students are entered who can satisfy 13½ out of 15 units of required work. The entrance requirements of the College are as follows:

The subjects and work mentioned, to be of high school grade.

English, 4 years, 3 units. History, 1 unit. Elementary Algebra, 1 unit. Plane Geometry, 1 unit. Solid Geometry, ½ unit. French or German, 2 units. Physics, 1 unit. Science, i. e. Botany, Chemistry, Zoology or Biology, 2 units. Drawing, free hand or mechanical, 1 unit. Electives in Science or Mechanics, 2½ units.*

Under Electives, a student may offer Latin, Physical Geography or Geology, Carpenter Shop or Foundry and extra work in Drawing. Upon entrance certificates, as submitted to the College during the past year, almost without exception students offered high school physics for entrance. In some instances they are so impressed with the value of the High School work that they wish advanced credit for physics. This is seldom if ever given. For several years the Department of Physics in Syracuse University has been preparing careful statistics as to the Physics offered by entering students and they now state that they are convinced that a student does not get a working knowledge of Physics in the average High School. For a time it was thought that the problem could be solved by requiring physics for entrance, but the experience of two years shows that this does not relieve the situation. At present every student entering is required to take an elementary college course in physics regardless of previous training. Columbia, Cornell and Dartmouth seem to have arrived at much the same conclusion as to the nature of physics offered by entering students. A careful census of the present sophomore class in the College of Forestry confirms this same idea.

As proof of the conclusions of the Department of Physics, as to the need of training in physics, for the student in forestry, the following list of forestry courses are given, all of which would seem to presuppose a knowledge of physics. The idea advanced is not to offer a technical treatment of the various phases of physics which would be of use to the forester, but rather to pre-

*A unit is the equivalent of 5 recitations a week for a year in one branch of study. Two hours of laboratory work count as one hour.

sent the subjects as basic principles and thus to give a secure foundation for the purely technical work following. It is probable that Prof. Clark assumes a pretty broad definition for physics. The basic principles involved in these different courses are commonly presented in the teaching of those courses. For instance, in college courses in Botany, the principles of osmosis and capillarity are universally presented. Again in geology, the questions of the results of the effect of freezing on soils and rocks and the formation and motion of glaciers, sedimentation, etc., is presented in the courses on Geology, as taught in our colleges. Some of these last principles are presented also in Physiography and Physical Geography. In Mineralogy, the physical properties of crystals would without question be taught. However, the correlation of the basic principles brought out in the various subjects, in a single subject like physics, is without question of value to the undergraduate student in forestry. It is hoped that the presentation of the outline below, will bring out expressions from other foresters in this country either regarding physics or other foundation subjects.

Forestry Courses That Presuppose Some Knowledge of Physics.

Forest Engineering: Magnetism, use of compass, deviation from the true north and its variation with locality; telephone lines, action of transmitter (variable contacts), and receiver (induction), insulation and accidental grounds; batteries, their use, abuse, care, essential parts and renewal; strength of materials, bending and compression.

Wood Technology: Physical and mechanical properties of wood; density and its determination; the microscope, its use and care, its lenses, the principles involved in the instrument and in a compound lens, and cause for the expense of a good instrument; distillation.

National Forest Practice: Hydro-electric power development; electricity, units involved; basic principles underlying generation, detection and measurement of electricity; fundamental conceptions of the dynamo, the motor, the transformer and the current rectifier; relation of electrical to mechanical power; efficiency; long distance transmission by both S. C. and D. C. systems, at high voltage and at low; loss on the line.

Silviculture: Nature of light (effect on plant growth); evaporation from leaves, from grass covered soil and from bare soil; effect of bodies of water, of barren land and of land producing vegetation, on temperature and humidity; radiation of heat, flow of air, and blanketing effect of clouds (both natural and artificial), as applied to protection of forests from wind and frost.

Lumbering: The steam engine and other prime movers.

Utilization of Minor Forest Products: Evaporation, fractional distillation (vapor pressure).

Farm Forestry: Forest growth, soil protection and water supply.

Zoology: The microscope (see under "Wood Technology)."

Meteorology: Thermometry; humidity; flow of air influenced by changes of temperature, of air density and of topography and forest growth; the barometer, mercury and aneroid, U. S. Gov't form and recording.

Mechanical Engineering: Laws of machines, work, energy, power, efficiency, friction; expansion of gases and vapors; steam, gas and explosive vapor engines (internal combustion.)

Botany: Osmosis; capillarity; nature of light; the microscope (see under "Wood Technology)."

Surveying: Telescope (same points as for microscope); the level; the plumb bob and its eccentricities in mountainous regions; the vernier; drainage; flow of liquids, osmosis.

Geology: Expansion of freezing and its effect on soils and rocks; formation and motion of glaciers; sedimentation; solution, deposition of crystals from solution.

Mineralogy: Physical properties of crystals, effect of crystals on light and optical determination of crystals.

Chemistry: Principle and use of the balance; osmosis, electrolysis; batteries, their use, abuse, care, essential parts, and renewal; the spectroscope, its principle and construction; spectroscopic determination of elements, thermometry, pyrometry.

CURRENT LITERATURE.

Massatabellar för Träduppskattning. By Tor Jonson. Stockholm, Sweden. 1911. Pp. 64, 8°.

Mr. Tor Jonson, Forest Engineer and Associate Professor at the Royal Forest Institute of Stockholm, Sweden, has after many years of investigation and study published a volume table for the Swedish conifers on a new basis. This table has been very favorably received in Europe, and it would be advisable to give the table a test in Canada and the northeastern United States.

The tables give the contents of the whole stem in cubic meter, arranged in twelve form classes up to 70 cm.

On p. 62 is a table giving d.b.h. form factors for different heights and form classes. With the help of this table the volume of trees of larger dimensions than given in the table, may very easily be computed.

Mr. Jonson bases his investigations to a large extent on Schiffel's and Metzger's theories, but does not wholly agree with Messrs. Schiffel, Maass and Tkatchenko, for he measures the "upper diameter" at the middle of the portion of the stem that lies above breast height instead of at the middle of the total height of the tree. This, Jonson thinks is more correct.

For instance; in classifying two conical trees ten and thirty meters high above stump, the diameter at the middle height of the trees will be compared with the d.b.h. at one tenth of the height of the short tree and with the d.b.h at 1/30 of the height of the taller tree (breast height 1.3 meter, stump height 0.3 meters.) This brings the ten meter tree into "form class" 0.56 but the thirty meter into "form class" 0.52, this, though both trees have the same (conical) form. On a tree 2.6 meters high, both measurements will be taken at 1.3 m. which gives us form quotient 1, or cylindrical form, while the tree may really have any form at all without this form quotient being changed. Consequently, trees of different heights must have different form to get into the same form class, which Mr. Jonson considers illogical. These and other inconsistencies disappear almost entirely, Jonson says, if the upper diameter is measured at the middle of the portion of the stem lying above breast height, trees of the same form will then fall into the same form class independent of height, the "stem curve" of all trees within the same form class will show the same curvature, etc.

To find what form class should be used is not difficult on felled trees. The diameter at a point situated halfway between breast height and the top of the trees is measured. If this diameter—in the table called "upper diameter"—is divided with the diameter at breast height, the quotient—called "absolute form quotient"—gives us the form class. According as the upper diameter is 50, 52.5, 55, 57.5, 60, etc. per cent. of the breast height diameter we get in the table form classes 0.50, 0.525, 0.55, 0.575, 0.60 to 0.80.

The upper diameter corresponding to each diameter breast height for each form class is given in the table, which lessens the work considerably. For instance: a tree with a d.b.h. of twenty-one centimeter and an upper diameter of 13.7 centimeter belongs to form class 0.65. If the height of the tree is twenty meter we find its cubic content to be 0.328 cubic meter.

The heights of *standing trees* are measured with the help of special instruments. In this case, to decide what form class should be used is more difficult, however, as the upper diameter cannot as a rule be measured. There are three or four methods described by Jonson for the guidance of the estimator in determining the proper form class.

The method considered most accurate is described as follows:

The position and form of the crown is a very good indirect measure of the form of the bole. It has been proved that the pressure of the wind on the tree crown constitutes a force which compels the tree to construct its stem in such a manner that the same relative resistance to breakage acts in all parts, the smallest possible amount of material being used. * As the concentrated force of the wind strikes a point situated lower or higher on the tree we get larger or smaller taper which means poor or good form class.

With the help of the equation for the stem curve and recognized mechanical laws governing stresses, it has been possible to calculate the normal relation between crown and stem form.

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* See Metzger: Der Wind als massgebender Faktor für das Wachsthum der Bäume, Heft 3; and Studien über den Aufbau der Waldbäume und Bestände nach statischen Gesetzen, Heft 5, 6, 7, Mündener Forstliche Hefte.

As the location of the point of attack of the bending force is determinative of form, this point is called the "form point," and its height is expressed in percentage of the total height of the tree.

When decided on form class the form point, where the wind is considered to exercise its concentrated pressure, is estimated, after which its height in per cent. of the total height of the tree is read off with a special instrument. At the foot of each page in the table is given the form point height corresponding to each form class (see also sketch on p. 4). These figures are intended for volume measurements inside bark or for trees with bark of practically uniform thickness, such as the Swedish spruce *(Picea excelsa.)* Some species, however, have a bark the relative thickness of which increases towards the root by which the outward form of the tree is impaired.

Below the series of "normal form points," Jonson has given a series of form points which should be used for volume measurements outside bark of thick-barked species, such as the Swedish pine *(Pinus silvestris.)*

When estimating the volume of trees with root swelling reaching above breast height, it is necessary to raise the calipers above the swelling or the estimated volume of the tree will be too high.

When a whole stand or type is estimated and an average form class applicable to all trees is looked for, the following table of form class, founded on density is recommended by Jonson:

Poor density	0.575—0.625
Fairly good density	0.65
Good density	0.675—0.70
Overcrowded density (pine)	0.70 —0.725
Overcrowded density (spruce)	0.725—0.75

Best results are obtained if the nearest lower form class is used for the dominant trees, since the codominant and intermediate trees have relatively less crown space and therefore better bole form than the dominant trees.

The highest and lowest form classes are hardly ever used as averages.

In estimating the content of whole stands one can also reach a fair result by multiplying the breast height form factor (see p. 62,) corresponding to the average form class of the stand with the estimated average height of the trees and the total sum of the sectional areas at breast height of all trees in the stand.

An experienced estimator working on felled trees or using the form point method will before very long have gained experience enough to judge the form class by eye, but he should not omit

SAMPLE PAGE
FROM THE
VOLUME TABLE PUBLISHED BY TOR JONSON

Diam at breast height 1.3 meters from the ground	Height in meters	FORM-CLASS												Height in meters
		0 50	55	575	60	625	65	675	70	725	75	775	80	
		CUBICMETERS												
68 cm	16	2 24	2 42	2 51	2 61	2 70	2 81	2 91	3 03	3 16	3 30	3 43	3 60	16
	17	2.36	2 55	2.65	2 75	2 85	2 96	3 08	3 20	3 34	3 49	3 63	3 80	17
	18	2 47	2 66	2 78	2 89	3 00	3 12	3.24	3 38	3 52	3 67	3 83	4.01	18
0 3632														
	19	2.59	2 81	2 91	3 03	3 15	3 28	3 41	3 55	3.70	3 86	4 03	4.22	19
268 inches	20	2 71	2 93	3 05	3 17	3 30	3 44	3 57	3 72	3 88	4 05	4.23	4 43	20
	21	2 82	3 06	3 19	3 32	3 45	3 59	3 74	3 90	4 06	4 24	4 43	4.64	21
	22	2 94	3 19	3 32	3 46	3 60	3 75	3 90	4.07	4 24	4 43	4.62	4.84	22
	23	3 06	3 32	3 46	3 60	3 75	3 90	4 07	4.23	4 42	4 61	4.82	5 05	23
	24	3 17	3 45	3 60	3 74	3 90	4 06	4 23	4 40	4 60	4 80	5 02	5.26	24
	25	3.29	3 58	3 74	3 89	4.05	4 22	4 39	4.58	4 78	4 98	5 22	5 47	25
	26	3 41	3.71	3 87	4 03	4 20	4 37	4 55	4 75	4 96	5 17	5.42	5 68	26
	27	3 52	3 85	4 01	4 17	4 35	4 52	4.72	4 92	5 13	5 36	5 61	5.88	27
	28	3 64	3 98	4 15	4 32	4 50	4 68	4 88	5 09	5 32	5.55	5 81	6.08	28
	29	3 76	4.11	4 28	4 46	4 65	4 84	5 05	5 27	5 50	5 74	6.01	6 29	29
	30	3 88	4 24	4 42	4 61	4 79	5 00	5 21	5 44	5 68	5 93	6.21	6.50	30
	32	4 12	4 51	4 69	4 90	5 09	5 32	5 54	5 78	6.03	6 31	6.61	6 92	32
	34	4 36	4 77	4 97	5 18	5 39	5 63	5 87	6 13	6 40	6 69	7.01	7.34	34
	36	4 60	5 03	5 25	5 47	5 69	5 94	6 20	6 48	6.75	7.06	7.40	7.77	36
	Upper diameter	34 0	37.4	39.1	40 8	42 5	44.2	45 9	47 6	49 3	51 0	52 7	54 4	
Form point	Normal pine	*33*	*42*	*46*	*51*	*56*	*62*	*67*	*73*	*79*	*85*	*92*	—	
	with bark	*41*	*51*	*57*	*62*	*68*	*75*	*82*	*89*	*96*	—	—	—	

Sectional area at breast height

to check his figures by taking measurements on windfalls or felled trees, when opportunity therefor is given.

Mr. Jonson has also published an abstract from this volume table. This table, which is mounted on cardboard, contains only five form classes and is specially adapted for ordinary use in the forest.

To explain how Mr. Jonson reached the conclusions on which this volume table is based would lead us too far. He has published several long articles on the subject, which are extremely technical. H. C. W.

The Forests of Prince George's County. By F. W. Besley. Maryland State Board of Forestry. 1913. Pp. 40. Illustrations and Map.

This is the kind of work that every State Forester should do for his own State, namely a detail description and map of the forest conditions of his State, county by county, until the whole State is described and mapped. Only when such definite knowledge exists can definite plans be formulated for treating the situation. The author, State Forester of Maryland, has here chosen a county which is for the most part in farmers' woodlots, and it is of special interest as it surrounds the District of Columbia.

Three types of forest are recognized: the mixed hardwood type, with a remarkable variety of species (not less than 63, and at least 45 of them of commercial value), upland and lowland, occupying 72 per cent. of the Woodlands; the pure pine type made up by the native Scrub Pine *(P. virginiana)*, occupying 18 per cent. covering the poor lands, and continuously extending its reign over abandoned fields and misused woodlands; and the hardwood-pine type, a hardwood forest into which the Scrub Pine has crept in in individuals in the proportion of 12 per cent.

Oaks, some 14 species, form the main portion in the composition. A number of tables give the detail of composition. An estimate of the merchantable material to be found on the 127,000 acres makes the saw-timber around 108,000,000 feet B.M., or only 1400 feet per acre average, the original woods of which, still 4552 acres, are reported cutting somewhat over 3600 feet. In addition, there are 275,000 cords of Scrub Pine, fit for pulpwood, for which it is increasingly used, making satisfactory sizes in 35 years, growing at the rate of one cord per acre per year. With a reasonable stumpage value ($4.00 per M feet and cordwood at 75 cents), the total forest value is placed at $550,000, while the value of the cut for 1912, at points of shipment, is placed at $162,870, consisting of lumber, staves, shingles, railroad ties, pulpwood, cordwood, poles, piles, mine props, fence posts, and some export timber.

If we assume one-third of this value to represent the stumpage values, ten years will see the exhaustion of this resource. Such deductions and speculations, however, the author does not indulge in; but he gives a few common words of advice as to forest management, which would not lead far in securing application. The selection forest with improvement fellings is recommended for hardwoods, and the strip system for the pines, with a width of strips not to exceed 400 feet, which width would be really not commendable. B. E. F.

Forest Products, 1911. No. 2, *Lumber, Lath and Shingles;* No. 8, *Cross Ties Purchased;* No. 9, *Poles Purchased.* Bureau of the Census, Washington, 1913; also Bulletin on *Production of Veneers*, 1911.

These statistics of consumption of forest products are gathered in co-operation with the Forest Service. It is needful to point out that they are deficient and the unwary is apt to deduce wrong conclusions, for, since the data are gathered by correspondence, they fall even more short of the truth than the Census figures, which are gathered directly by Agents, and there is no basis given for judging the relative value of these data. The reporter admits this, and then proceeds to discuss the figures as if they were really correct.

Perhaps the most complete Census was that of 1909, when the lumber cut from 48,112 mills was reported at 44½ billion feet, 27 per cent. above that of 1899 as ascertained by the Census. The report for 1911 has only 28,107 mills, reporting a cut of 37 billion feet, but there is no reason for believing that there is such a reduction in mills and cut. On the contrary, we are safe in assuming an average increase per annum of at least 2½ per cent, making the cut in 1911 around 47, and for the present year a full 50 billion feet, which may be assumed the decennial average. And there is no question that the cut will rise still further before the real decline in wood consumption begins, so long as there is still virgin timber available in hands of small owners, so that the end of supplies—which, of course, will never quite occur—figured by the Bureau of Corporations as 2800 billion feet will come much sooner than the 60 years which a division of the present cut into supplies suggests.

The present data do not change the relative position of lumber regions and of species, as given in the Census. The five largest producers in sequence of their cut are Washington, Louisiana, Mississippi, Oregon and North Carolina, furnishing 36 per cent. of the total cut; they are followed by Arkansas, Wisconsin, Texas, Minnesota and Michigan, with an average cut of somewhat over 1.5 billion feet, remarkably evenly distributed among these States, furnishing 22 per cent. There are then still five States to be mentioned, each exceeding the 1 billion mark, namely the two Virginias, Alabama, California and Pennsylvania, furnishing 17 per cent. The rest are cutting below 1 billion feet.

While more than a hundred species furnish log material and 29 lumber names, or kinds of wood, are listed, seven species furnish over half the lumber supply. Yellow pine, derived from four species in the Southern States, alone furnishes over 36 per cent. of the total supply, and with Douglas fir and white pine (two species) over two thirds of the softwood supplies; and if we add oak, hemlock, western pine and spruce, we have mentioned the most important species, which furnish three quarters of our lumber consumption and are cut at a larger rate than 1 billion feet.

An interesting table gives the States in which certain species take the lead in the cut, *i. e.* show the largest production.

Arkansas, cottonwood, hickory, red gum; California, redwood, sugar pine, western pine and white fir; Colorado, lodgepole pine; Idaho, larch; Indiana, walnut; Louisiana, cypress, tupelo, yellow pine; Maine, balsam fir, spruce; Michigan, beech, maple; Minnesota, white pine; Missouri, sycamore; Ohio, ash; Tennessee, oak; Washington, cedar and Douglas fir; West Virginia, chestnut and tulip poplar; Wisconsin, basswood, birch, elm, hemlock.

When it comes to the discussion of value, the data are probably as nearly correct as they can be made. The average price per M feet has declined somewhat from that of previous years up to 1906, but compared with 1899 prices, there is a rise of over 35 per cent. or nearly 3 per cent. per annum; the average price being $15.05, for softwoods $14.17, for hardwoods $18.19. The cheapest woods are Douglas fir, white fir in the softwood and red gum and tupelo in the hardwoods, prices running respectively $11.05, $10.64, $12.11 and $12.46; the highest priced are white pine, cypress, sugar pine, the price running $18.54, $20.54, $17.52; tulip poplar, ash, oak and walnut, $25.46, $21.20, $19.14, $31.70 respectively.

Stumpage prices are not given, but if we allow $8 per M for the cost of marketing the softwoods and $9 for hardwoods on the average we have a rough approximation of stumpage values, which would then lie between $4 to 6 for the cheaper woods and $10 to 12 for most of the more expensive woods, with some exceptionally higher; tulip poplar—the substitute of white pine!—being one of them. The consumption of telegraph poles and railroad ties has during the last five years varied in small numbers, with an average of 3.5 million poles, cedar and chestnut furnishing the bulk, and 135 million ties, oak (44%), southern pine (20%), and Douglas fir, with cedar and chestnut being most sought.

The development of preservative treatment of railroad ties in the last five years is striking, namely over 50 per cent. more in 1911 than in 1907. Yet there are still only 23 per cent. of all ties treated. Creosote and zinc chloride by themselves or in mixture, the standard preservative, are the favorites; all others play so far a small role. The treatment is usually extended to the species which in themselves are durable, and hence cheaper woods and cheaper preservatives remain untried.

It has also become customary to paint poles, two-thirds of the total number receiving a treatment, mostly of coal-tar oils, carbolineum and others.

The veneer industry seems to be growing, built-up lumber is becoming a more and more important factor each year because less expensive, less likely to warp and check, and combining greater lightness with strength. Manufacture of light-weight packages, berry cups, fruit baskets, tills, boxes and barrels opens a wide field for shaved lumber. Furniture tops, panels and backs; drawers fronts and bottoms, chairs, trunks; store and office fixtures; packing boxes, vehicle bodies, finish of passenger cars, etc., are fields for employment of glue and veneer. So far not quite a half billion feet of logs are used in this way; and the manufacture is widely distributed, seven States alone reporting over 25 million feet.

Red gum is the principal veneer wood with over one-third of the total, more than the combined amounts of any other four woods. Formerly veneer was made only from fine, expensive furniture woods; but now, there is hardly any species that is not so used, cottonwood, hemlock, Douglas fir, oak, yellow pine are among those cited.

B. E. F.

Herbals: Their Origin and Evolution. A Chapter in the History of Botany, 1470-1670. By Dr. Agnes Archer. Cambridge University Press, 1912. Pp. 253. Price 10s. 6d.

There is no practical, but considerable historical interest in this work, which brings us to the realization that botany, before it became a science, was long treated from the practical point of view. The herbals were the first botanical publications, usually written by and from the standpoint of medical men.

The first herbals, some with excellent illustrations, were printed in Germany in the fifteenth century, but Mrs. Archer's work refers mainly to those in other countries, Italy, Switzerland, the Netherlands and France.

While some of them were full of superstitions regarding the medicinal value of herbs, the herbalists proper were "marked by a healthy skepticism, which was in advance of their time."

Lovers of antiquarian lore will find much entertainment in this work.

B. E. F.

The Indigenous Trees of the Hawaiian Islands. By Joseph F. Rock. Published under Patronage. Honolulu, 1913. With 215 photo engravings. Price $6.60.

There are one thousand or more tree species in the Hawaiian Islands, but only some 300 are native, 80 per cent. of them peculiar to this small group of islands. These the author has described popularly as well as technically, giving also their habitat, uses, properties, legends, and other interesting features.

A number of species discovered by the writer are new to science.

The systematic account of the species is preceded by an introduction of 90 pages giving a detailed description of the floral regions and forest types with ecological data.

This is the first complete Silva of the Islands, and is a well composed book, large octavo, on good paper and with clear print,

B. E. F.

List of Hawaiian Names of Plants. By Joseph F. Rock. Board of Agriculture and Forestry. Honolulu, 1913. Pp. 20.

This is merely a register, alphabetically arranged by the native names, some 800, with the botanical names added, mostly of trees and shrubs; the main object being to preserve these names from the ocean of oblivion into which they are rapidly falling with the demise of the old people of Hawaii.

B. E. F.

Restauration et Conservation des Terrains en Montagne. Direction Générale des Eaux et Forêts. Imprimerie Nationale, Paris. 1911 (nominally.) 3 volumes. Pp. 798.

In 1908 the (French) Chamber of Deputies requested a statement of the expenditures for the control of torrents and reboisement under the law of April 4, 1882. In complying with this request the Director of Waters and Forests transmitted a complete and profusely illustrated resume of the work accomplished by the reboisement service. In the three volumes,, there are three maps and 300 illustrations, many of them of unusual merit. Volume I describes the results of erosion, torrents, restoration work, species used, sowing and planting details, with the classified expenditures from 1860 to 1909. Volumes II and III describe the individual projects under the headings: 1. Description of the basin altitudes; 2. Geological conditions, climate; 3. General administrative situation, area, population; 4 State of the soil; 5. Composition and area of the perimeter of work; 6. Work carried out. Those who are interested in the details of this classic forest restoration should study these volumes.

T. S. W., Jr.

OTHER CURRENT LITERATURE.

Pith-ray Flecks in Wood. By H. P. Brown. Circular 215, U. S. Forest Service. Washington, D. C. 1913. Pp. 15, ill.

Confirms previous observations as to the pathological origin of pith flecks or medullary spots without adding any new information to the subject.

Bibliography of the Pulp and Paper Industries. By H. E. Surface. Bulletin 123, U. S. Forest Service. Washington, D. C. 1913. Pp. 48.

The bibliography contains not only the more formal works and treatises but also the important pamphlets and reprints. References to periodical literature have not been included, except in a few cases where the articles were considered of especial importance. Contains also lists of paper trade periodicals, general reference works, and general reference periodicals. More than 800 books, pamphlets, and reprints, which deal directly with pulp and paper, their raw materials, manufacture and uses, or with closely related subjects, have been published.

Experiments in the Preservative Treatment of Red Oak and Hard Maple Crossties. By F. M. Bond. Bulletin 126, U. S. Forest Service. Washington, D. C. 1913. Pp. 92.

A preliminary report describing treatment of ties placed on a test track for closer comparison of the effect of various treatments.

The Grinding of Spruce for Mechanical Pulp. By J. H. Thickens. Bulletin 127, U. S. Forest Service. Washington, D. C. Pp. 54.

Reports experiments on the influence of various conditions on output and quality of ground woodpulp.

Pulpwood Consumption, 1911. Forest Products, No. 1, Bureau of the Census. Washington, D. C. 1913. Pp. 10.

Slack Cooperage Stock, 1911. Forest Products, No. 3, Bureau of the Census. Compiled in co-operation with the U. S. Forest Service. Washington, D. C. 1913. Pp. 10.

Excelsior, 1911. Forest Products, No. 4, Bureau of the Census. Compiled in co-operation with the U. S. Forest Service. Washington, D. C. 1913. Pp. 4.

Veneers, 1911. Forest Products No. 5. Bureau of the Census. Compiled in co-operation with the U. S. Forest Service. Washington, D. C. 1913. Pp. 8.

Tight Cooperage Stock, 1911. Forest Products, No. 6, Bureau of the Census. Compiled in co-operation with the U. S. Forest Service. Washington, D. C. 1913. Pp. 12.

The Chinese Wood-oil Tree. By D. Fairchild. Circular 108, U. S. Bureau of Plant Industry. Washington, D. C. 1913. Pp. 7, ill.

A Study of the Soils of the United States. By G. N. Coffey. Bulletin 85, U. S. Bureau of Soils. Washington, D. C. 1913. Pp. 114.

Wood Distillation, 1911. Forest Products, No. 7, Bureau of the Census. Compiled in co-operation with the U. S. Forest Service. Washington, D. C. 1913. Pp. 6.

The Conservation of Water Powers. By R. G. Brown. Senate Document 14, 63rd Congress. Washington, D. C. 1913. Pp. 23.

The Secret of the Big Trees, Yosemite, Sequoia and General Grant National Parks By E. H. Huntington. Washington, D. C. 1913. Pp. 24, ill.

Select List of References on the Conservation of Natural Resources in the United States. Compiled by H. H. B. Meyer. Library of Congress. Washington, D. C. 1913. Pp. 105.

The Spread of the Forestry Movement. By Henry S. Drinker. American Forestry. Washington, D. C. 1913. Pp. 175-189.

Wood-using Industries of Virginia. By R. E. Simmons. Commonwealth of Virginia in co-operation with the U. S. Forest Service. Washington, D. C. 1912. Pp. 88.

Fourth Annual Report of the State Forester of Vermont. By A. F. Hawes. Burlington, Vt. 1912. Pp. 59, ill.

Forest Laws of Vermont and Instructions to Fire Wardens and others regarding Forest Fires. By A. F. Hawes. Forest Service Publication No. 12. Burlington, Vt. 1913. Pp. 28.

Ninth Annual Report of the State Forester of Massachusetts, 1912. Boston, Mass. 1913. Pp. 108. Map, ill.

Massachusetts Forest Fire Laws and General Instructions relative to Forest Fires. By M. C. Hutchins. Boston, Mass. 1913. Pp. 87.

Arnold Arboretum, Harvard University. Bulletin of popular information. No. 39-42, 44. Jamaica Plain, Mass. 1913. Pp. 3.

The Reforestation of cut-over and idle lands in New York. Bulletin of New York State College of Forestry at Syracuse University. Syracuse, N. Y. 1913. Pp. 13. Ill.

County, Town and Village. By A. B. Recknagel. Cornell Reading Courses. Ithaca, N. Y. Pp. 145-156. Ill.

Studies of Trees. By. J. J. Levison. John Wiley and Sons. New York. 1913. Pp. 60, ill.

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mission of New Jersey for the year ending October 31, 1912. Union Hill, N. J. 1913. Pp. 81, ill.

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Arbor Day, 1913. By A. Gaskill, T. Cleaveland, Jr., *et al.* Publication of Department of Public Instruction of New Jersey. Trenton, N. J. 1913. Pp. 29.

Thirty-sixth Annual Report of the Connecticut Agricultural Experiment Station .... for the year ending October 31, 1912. Hartford, Conn. 1913. Pp. 531. Ill.

The Large Leaf Spot of Chestnut and Oak. By A. H. Graves. New Haven, Conn. 1913. Pp. 170-174.

Third Annual Report of the Shade Tree Commission of Pittsburg, Pa. By J. L. Grimes. Pittsburg, Penna. 1913. Pp. 35, ill.

Forestry Annual. The Penn State Farmer. Williamsport, Pa. May, 1913. Pp. 143-172. Ill.

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Notes on Diseases of Trees in the Southern Appalachians. By A. H. Graves. Phytopathology. Baltimore, Md. 1913. Pp. 129-139. Ill.

Consumption of Wood Preservatives and Quantity of Wood Treated in the United States in 1912. By O. T. Swan. American Wood Preservers' Association. Baltimore, Md. 1913. Pp. 4.

Proceedings of the Ninth Annual Meeting of the American Wood Preservers' Association held at Chicago, January 21-23, 1913. Baltimore, Md. 1913. Pp. 477, ill.

Partial contents: The production and supply of coal tar creosote, by E. A. Sterling; A comparison of zinc-chloride with coal tar creosote for preserving cross ties, by H. F. Weiss; Notes on analyses and testing of coal tar creosote, by L. B. Shipley; Some experimental treatments with reference to the effect of initial air pressure on penetration of creosote, by R. S. Belcher; The requirements for successful timber treatment, by H. von Schrenk; Preservation of lumber for car construction, by J. H. Waterman; Sap in relation to the properties of wood, by S. J. Record; History of wood preservation, by W. F. Goltra; Some tests to determine the effect upon absorption and penetration of mixing tar with creosote, by F. M. Bond; The transmission of air pressure in cross ties, by C. M. Winslow; Natural and artificial seasoning of Douglas fir for treatment, by F. D. Beal; Treatment of Douglas fir with creosote soil, by G. A. Colman; Efficient handling of ties and material, by A. M. Smith; Preparing timber for treatment in the Gulf State, by R. L. Allardyce; Timber-treating plants in North America. December 31, 1913, by W. F. Goltra.

Tree Planting on Public School Grounds. By Edmund Seacrest. Ohio Agricultural Experiment Station. Circular No. 130. Wooster, Ohio. 1913. Pp. 15-16.

The Future of Forestry in Kentucky and the South. By J. E. Barton. Bulletin of the State Board of Forestry. (Reprint from Southern Lumberman, December 21, 1912.) Frankfort, Ky. 1913. Pp. 23, ill.

Second Biennial Report of the Forest, Fish and Game Warden of West Virginia for 1911-12. Bellington, W. Va. 1913. Pp. 106.

Economy Botany of Alabama. Pt. 1. By R. M. Harper. University of Alabama. Tuscaloosa Co. 1913. Pp. 228. Ill.

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The Eucalyptus Hardwood Trees of California. By A. R. Heaton. Chicago, Ill. Pp. 33, ill.

Inspection of Commercial Fertilizers. Agricultural Experiment Station. Columbia, Missouri. 1913. Pp. 139-177. Bulletin No. 109.

Second Annual Report of the State Forester of Minnesota. By W. T. Cox. St. Paul, Minn. 1913. Pp. 61, ill.

The original forest area of Minnesota was 33,000,000 acres. The area now bearing tree growth comprises 28,000,000 acres, of which approximately 15,000,000 acres are of rough, stony or very sandy land, which will always remain in forest. The annual growth in the forests of the State is probably not more than 2,000,000,000 board feet, being less than the amount cut each year. With better fire protection this yield can be doubled. There are several million acres of young, rapid-growing pine, spruce and other timber in the northern and north central part of the State, and this is the kind of timber which suffers most from fires. The Forest Service, through patrol and otherwise, has reduced the fire risk 40 per cent.

First Biennial Report of the State Forester of Colorado. By B. O. Longyear. Fort Collins, Col. 1912. Pp. 32.

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Annual Progress Report on Forest Administration in the Presidency of Bengal for the year 1911-12. By C. E. Muriel. Calcutta, India. 1912. Pp. 52.

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Report of the Division of Forestry of Hawaii for the Biennial period ending December 31, 1912. By R. S. Hosmer. Honolulu. 1913. Pp. 99, ill.

PERIODICAL LITERATURE.

FOREST GEOGRAPHY AND DESCRIPTION.

Development of Forests of Northern Russia.

The main topic at the Russian Forest Congress held in Archangel, July, 1912, was the development of the forest resources of northern Russia. Their importance may be judged by the fact that they constitute 75 per cent of the forest wealth of European Russia.

At present this whole region is in an undeveloped state. Settlers, railroads, and improved water transportation are needed. Along with colonization must come more intensive forest management. More men must be provided, schools started, better methods of cutting and utilization used, and an extensive program of investigative work inaugurated. In fact, the problems to be solved are similar to ours on the National Forests.

Beschlüsse der XII allgemeinen Russischen Forstversammlung, etc. Forstwissenschaftliches Centralblatt. March, 1913. Pp. 136-143.

Forestry in Trinidad.

C. S. Rogers, Forest Officer for Trinidad and Tobago, describes at length forest conditions in the former island. When the forests were destroyed "streams that formerly were permanent became intermittent. Droughts and floods succeeded one another, increasing in intensity......These disasters, coupled with a scarcity of timber in certain districts, forced the adoption of a forest policy. The problem was broached in 1880; in 1890 and in 1891 a formal report was made by the late J. H. Hart, entitled "Forest Conservancy in Trinidad." Nothing was done, however, until 1900, when F. A. Lodge definitely recommended the reservation of 293 square miles or 16.74 per cent. of the total area. Accordingly the service was organized in July, 1901. The work undertaken has included demarcation of boundaries, description of the local species, and commencing with 1908 plantations "in the cedar forest within the Southern *Watershed* Reserve." Up to 1910-11, 85.5 acres had been stocked with 15,640 trees of cedar, cyp, poui, Honduras mahogany, etc. The history of conservation in Trinidad is but another instance of the influence of forest cover upon waterflow.

T. S. W., Jr.

Forestry in Trinidad. The Indian Forester. April, 1913. Pp. 183-194.

BOTANY AND ZOOLOGY.

Individual Heredity of Trees.

Dr. Zederbauer reports from the Austrian Experiment Station on heredity of *Pinus austriaca* based on 7 years of observation, which yield, however, less valid conclusions than the same studies on the Scotch Pine (briefed in Vol. X, p. 733), which concern themselves with discovering the influence not of constant forms but of small individual differences on the progeny. The seed trees from which seeds are propagated are selected in one and the same locality according to differences of bole or crown, which are determinative in wood production.

Height growth varies less than with Scotch Pine, yet the six-year plants vary from 62 to 91 *cm,* and the seven-year olds between 92 and 130 *cm,* that is to say, the difference is increasing in the yearly shoots. The difference between smallest and largest individuals of the progeny of the same seed tree is considerably greater. The broad-crowned are slightly higher than the narrow-crowned.

Altogether, as with Scotch Pine, it is apparent that the difference in individuals of a stand is not only the result of the accidental site but due to inherent disposition. There are some broad-crowned ones with few but stout branches, forming a loose crown, growing fast and producing more log timber than the small-crowned with many, but slender branches, slow growers.

The progeny of the broad-crowned is also faster growing than that of the narrow-crowned: the habitus is the same or nearly so as the parent tree.

The progeny of very old seed trees is considerably smaller than that of very young, but that of 15-to-100-year-old trees does not show a decided difference.

Versuche über individuelle Auslese bei Waldbäumen II Pinus austriaca. Centralblatt für das gesammte Forstwesen. May, 1913. Pp. 197-204.

Oak Seed Supply Influence.

Hauch reports on the observed striking variations of young oaks of different derivation; those grown from Dutch and French seed showing less developed spreading habit, straighter and slenderer stems and better form than the native Danish. Some 12 different sowings with seed from 9 different localities were made in 1909-1912; the northern oaks show specially stout shoots and well developed buds, the southern have long slender shoots and poorly developed buds. A most striking observation is that the liability to attacks from "Mehltau"—mildew (see Vol. XI, p. 269)—is variously developed, and apparently is in relation to the development of August shoots: the stronger this late shoot development the more insidious the attack of the fungus, since at that time spores are abundant and hence attack the new foliage readily.

In this respect apparently the northern races were somewhat at a disadvantage, although the final examination did not sustain the expectation of relating this liability to the place of derivation. Yet the time of the August shoot may in a secondary degree influence the fungus development. The plants which are not attacked may be those which form no such late shoots. *Quercus rubra* seems to be least liable to the fungus.

Buchen- und Eichenkulturen in Bregentved, Dänemark. Centralblatt für das gesammte Forstwesen. April, May, 1913. Pp. 149-164; 205-222.

Sitka Spruce.

An unsigned note gives account of a plantation in the city forest of Frauenfeld (Switzerland) made 11 years ago of Sitka Spruce on soil so shallow and dry that in the summer of 1911 almost all Norway Spruces and many Scotch and Banksian Pines succumbed. The 15-year-old Sitka Spruce, 5 to 6 feet high did not suffer at all, made good shoots and preserved their excellent green foliage. On the other hand, the same spruce planted five years ago on a drained, somewhat mucky soil look sickly and promise little.

Von der Sitkafichte. Schweizerische Zeitschrift für Forstwesen. May, 1913. P. 175.

Tallest Teak Tree. Iyer is authority for the measurements of a teak tree which is the largest yet recorded. The total height is 192 feet, clear length 114 feet, girth at the base 16 feet, 8 inches, and at b.h. 15 feet, 10 inches.

T. S. W. Jr.

The Tallest Teak Tree in the "Shola" Forest of the South Malabar District. The Indian Forester. April, 1913. Pp. 173-174.

Heat Cracks in Spruce. On account of the heat and drought of August, 1911, thrifty young spruce trees growing in the open with many branches were observed to crack open. The phenomenon was not confined to any one exposure but occurred on all sides of the trees. In some cases the cracks ran from the roots to the top, taking a spiral course on account of the knots. The damage was occasionally so severe as to open the tree so that one could see through it.

Since the cracks were observed during August, frost could not be adduced as a cause. The author's explanation is that the damage resulted from unequal water content in the relatively weak wood of open grown individuals. Trees grown in dense stands with narrower annual rings did not suffer.

It is suggested that this offers the true explanation of the so-called "frost" damage referred to in Dr. Heck's article, "Verhalten-erwachsener Fichten gegen Dürre und Frost," briefed below under the caption, "Effect of Drought and Frost on Spruce."

Hitzerisse an Fichten. Forstwissenschaftliches Centralblatt. March, 1913. Pp. 124-127.

Effect of Drought and Frost on Spruce. The summer of 1911 in southern Germany was a very dry one. In July and August the precipitation was much below the normal. The fall and winter were, however, mild and wet.

The drought in the middle of the summer had no effect upon the width of the annual rings in spruce because the dry weather came after the most active season of wood production had past.

An unprecedented amount of frost damage occurred in the winter of 1911-12, especially with trees standing in openings. The explanation offered is that the mild, wet autumn left the trees in poor condition to withstand the cold winds of winter.

K. W. W.

Verhalten erwachsener Fichten gegen Dürre und Frost. Forstwissenschaftliches Centralblatt. December, 1912. Pp. 600-607.

SOIL, WATER AND CLIMATE.

Forests and Rainfall.

In a very thoughtful and interesting article Mr. Zon discusses on broad lines forest influences and tries especially to establish a specific relation between the forest cover of the southern forest areas and the humidity and rainfall conditions of the central States and prairie region. The argument is based on the fact that the prevailing winds which bring precipitation to the central States and, indeed, the entire Eastern half of the United States, are southerly; on the assertion that seven ninths of the precipitation is furnished not by oceans but by evaporation from the land; and on the observation that forests evaporate more water than any other vegetative cover or free water surfaces.

The north-south direction of the mountain ranges permits the southern winds to carry their influence far north, while the rapid decrease in temperatures from south to north—more rapid than in Europe—also plays a role in causing precipitation. The winds from the west and northwest during winter, fall and early spring are dry and either cold or hot, but the south winds prevail during summer and are moisture laden, and are responsible for precipitation, as they blow into colder air.

"If precipitation over land depended only on the amount of water directly brought by the prevailing humid winds from the ocean, the land would be pretty arid and rainfall would be confined to only a narrow belt close to the ocean. * Fortunately, not all the water that is precipitated is lost from the air-currents; a part runs off into the rivers or percolates into the ground, but a large part of it is again evaporated into the atmosphere. ......

* This is not a necessary sequel!

Hence, the farther from the ocean the greater is the part of the air moisture contributed by evaporation from the land."

The amount of this evaporation from land has been, by Bruckner, calculated for the whole earth as one quarter of the evaporation from water surfaces, and only 7 per cent. of the evaporation of oceans, equivalent to 2.8 inches, according to the same investigator, is carried to land, so that even the land area peripheral to the ocean secures only a little over 20 per cent. of its precipitation from the vapors of the ocean, the balance being secured from the land evaporation, while interior basins rely entirely on the latter.

The moisture which is carried by the winds into the interior of vast continents, thousands of miles from the ocean, is almost exclusively due to continental vapors and not to evaporation from the ocean.

What Bruckner figures for the entire world is found by studies of specific drainage areas, for instance by Nipher for the rainfall of Missouri, the larger portion of the precipitation being *not* returned to the sea but evaporated back from the land to the atmosphere. Lindsay corroborates these conditions for the discharge of the Mississippi in Louisiana.

Observations and arguments for establishing the greater evaporative power of forest areas are then brought, Henry, Höhnel, and Otozky being cited to show that forest areas furnish more moisture to the atmosphere than water surfaces—data which we think are open to doubt. They are believed conclusive at least for forests in the plains.

The practical deductions are especially interesting.

"Forests must be protected not so much in localities which already suffer from lack of moisture as in regions which lie in the path of prevailing winds and are still abundantly supplied with ground water and precipitation", hence the care of forests in the Eastern United States should increase from north to south, and from west to east. In dry regions forest cover may have diminishing effect on available water supply, except along rivers or in the shape of wind breaks. This seems a doubtful conclusion, as well as the following: "Forests must be specially maintained on moist soils because the moister the soil on which forests grow the more moisture they evaporate. For this reason swamps, since they contribute less to the moisture contents of the air than crops or forests and lose considerable water by surface run-off must be drained."

On sandy soils forest cover is needed to evaporate the water, which otherwise would percolate and run off in subdrainage; similarly on steep slopes and rocky ground to prevent rapid runoff. If clearing is a necessity, intense cultivation should follow as, after forest it is field crops which contribute most moisture to the air.

"The effect of forests upon climate, if viewed as a local influence, must necessarily be insignificant." (This seems a strange corollary, for the effect felt at a distance must necessarily be even greater nearby.—Rev.)

The author concludes with a disparagement of local observations to solve the problem of influence on climate, which can only be solved "by rising mentally to a height which opens wide perspectives both to the distant shores of the Gulf of Mexico and of the Atlantic Ocean and to the most interior portions of the continent." B. E. F.

The relation of Forests in the Atlantic Plain to the Humidity of the Central States and Prairie Region. Science, July, 1913. Pp. 63-75.

Forest Influence on Soil.

The noted Russian investigator, Tkatchenko, has studied the influence on soil conditions of plantations 35 to 40 years old, made on black humose farm soil with larch, spruce and oak. The depth of the humus layer has decreased and correspondingly the transition zone from humus to underlying loess increased; the loess soil has, however, been studded with brown humus deposits; the granular structure in the lower two layers has increased, the gravelly formations are observed in all three layers; a nutlike structure is found in the middle layer of the humus zone in dry weather, especially in the oak plantation.

As regards moisture condition, the interesting discovery was made that in a field lying waste for years the upper layer of 2½ feet was drier than the forest soil, but below this layer the reverse was true. Those parts of the loess zone from which the carbonates were leached possessed the greatest humidity, while those which effervesce with a 10 per cent. hydrochloric acid are always drier and harder. The passages in the loess of moles and other rodents, filled with humus, are always moister while those in the humus layer filled with loess are drier than the surrounding soil. Similarly, the brown deposits in the loess formed under plantations are moister and soil taken in the neighborhood of the end of roots is extraordinarily humid. These findings show how difficult it is to secure an average.

Under spruce the soil is drier than under larch and oak.

The varying CO_2 contents of soils cannot be ascribed to forest influence.

Uber die Rolle des Waldes bei der Bodenbildung. Lesnoj Journal, Resumé. 1913. Pp. 194-198.

SILVICULTURE, PROTECTION AND EXTENSION.

Superiority of Heavy Seed.

The market value of any particular lot of pine seeds is determined at present by two factors—source and germination per cent. Weight of the individual seeds is a third factor which has been neglected without warrant. Physiology indicates that larger seed should succeed better and repeated experiments by Bühler, Friedrich, Haack, Eisenmenger and others have established such to be true. The same fact has been firmly established for farm seeds and has already been adopted as a criterion of seed values. That dealers in pine seed have not adopted a similar practice seems to be due to lack of machines for separating light seeds from heavy.

One of the machines used in the separation of farm seeds is known as the Kayser centrifuge and is manufactured by the firm of Hermann Kayser in Leipzig. It has been described repeatedly, one of the best discussions of its value being by Professor J. Rezek. *Preliminary tests by the author with a stock machine gave a separation into four portions, but it was found on weighing that the two upper and the two lower had to be combined so

*Mitt. d. landw. Lehrkanzeln d. k. k. Hochsch. f. Bodenkultur in Wien. Vol. I (1912), No. 1.

that actually two grades were well differentiated. This differentiation was on the basis of weight of the individual seeds.

A batch of pine seeds was then sent to the firm of Kayser. In a few days the seed was returned very satisfactorily separated into three perfectly distinct grades. The improved results had been scured by slightly modifying the separator to suit the pine seeds. The differences in weight between the grades was equal, as is desirable but the yield of the three grades from stock seeds is very unequal, as the following table shows:

Grade	Weight in grams of 1000 seeds.	Percent found in stock seeds.
I	7.13	68
II	5.81	27
III	4.64	5

It is recommended that the first grade be used for field sowing and that the use of the third grade be avoided.

Sprouting tests after ten days and again after twenty days failed to show any significant differences in the results from these three grades of seed. Haack, however, has already shown that grades of seed which differ markedly under field conditions may be indistinguishable when sprouted under the favorable conditions of the testing laboratory.

But if we refuse to be satisfied with the mere protrusion of the radicle and measure instead the length of the root five days after it has burst through the seed coat we succeed in finding a significant difference between grades II and III, but not between grades I and II.

The advantage of control of the number of seedlings per hectare has been recognized of late years as never before, since it has been learned that the production of overdense stands of seedlings is not the best practice. For this purpose the use of the heaviest seeds is completely justified because it increases the probability that every seed sowed will produce a seedling. Lighter seeds are known to produce, on the average, fewer plants per hectare, and the present practice in Prussia is to increase the rate of sowing to compensate under average conditions for this lower value. But conditions are seldom average and favorable circumstances can readily result in heavily overstocked areas by bringing forth a plant from every viable seed. Favorable and unfavorable site and season produce far less variation when heavy seeds are sowed.

F. D.

Busse, Julius: *Ein Weg zur Verbesserung unseres Kiefernsaatgutes.* Zeitschrift für Forst- und Jagdwesen. May, 1913. Pp. 300-313.

Weight and Germination of Seed.

Quite different conclusions from the foregoing are briefed below.

That heavier and larger seed furnishes a better germination per cent. than light seed has been recognized for a long time by silviculturists, excepting Mayr. Dr. Centgraf has examined some 247 germination tests of pine as to the relation of the weight of 1000 grains to their germination and fails to find this relation between weight and germinative energy (ten-day results) or germination per cent:
60% seed varied per M between 5.25 and 8.74 *gr.*
70% seed varied per M between 5.35 and 6.85 *gr.*
80% seed varied per M between 5.25 and 6.56 *gr.*
90% seed varied per M between 5.30 and 6.60 *gr.*

It was remarked that the weight varied considerably from year to year. The years 1908 and 1909 furnished seed by .8 to 1 *gr.* per M heavier than that of the poor years 1910-12, so that the same conditions influence the seed quality favorably or unfavorably. Within the same year's crop, however, high and low germination per cents occur in quite even distribution. The curves constructed show, however, no lawful relation, although apparently within the year's crop *the heavier seed average a smaller germinative energy.* The 35 heaviest samples germinated under 65 per cent. The author attempts an explanation of the slower germination, at least as due to a thicker seed coat of the heavier seed, which determines in part its weight, and which takes up water more slowly, than the thin coat of the light seed. This explanation finds also support in the observation that after 10 days the germination per cent. increases more rapidly with the slower seeds, namely in the time of 11-20 days.

	40%	50. %	60. %	70. %	80. %	90. % seed.
increased	13	11.7	11.5	9.8	4.2	2.3 per cent. in germination.

From this the author concludes that the 10-day-germination period is not a good measure for the seed value; also that slow seed is undesirable.

The reviewer would add, since the germination tests upon which these conclusions are based were merely commercial tests, undertaken with no special consideration of the scientific use to be made of them, and are, moreover, relatively few, the conclusions should be accepted with caution by the practice, the preceding article brief claiming equal attention.

Uber Beziehungen zwischen Tausendkorngewicht und Keimenergy bei Kiefernsamen. Allgemeine Forst- u. Jagdzeitung. June, 1913. Pp. 222-224.

Block Planting.

In an article of over 30 pages, Hauch describes in great detail his experiences with the planting and management of beech and oak in Denmark. The most interesting part is an account of a novel method of planting beech, the so-called Bregentved (named from Hauch's district), or block planting, which is suggestive.

It was introduced some 14 years ago—hence results are visible—to overcome the failure of natural regeneration and sowing or ordinary planting on the cold stiff loam soil, undrained and almost undrainable on account of absence of any fall, the most unpromising field on which every measure had failed, not only with beech and oak but with other species.

The peculiarity of the beech that it requires a thoroughly dense stand in its youth to succeed—such as a natural regeneration if successful shows, about 800,000 to the acre—suggested the need of planting in mass, by which at least 80,000 plants in clumps without too great cost could be set out.

The plant material is grown in nurseries of rich soil to secure a compact root system, sowing in the spring, the ground having been prepared to a depth of 16 inches in the fall. The beech nuts, properly wintered, are sown in furrows or rills made with a special rake of 6 inch width, 6 inch apart, four furrows to the long bed, with 12 inch walks between beds. The nuts are evenly distributed in the rills at the rate of 140 bushels to the acre and covered not quite an inch by using a rake for drawing the soil over them. The next spring the plant material is ready to be put into the field. Instead of taking up the single plants, whole blocks, 6 inch square, with the soil are taken up, cut with straight sides, deep enough to make sure that the roots are fully secured and in no way injured. These blocks are then carried to the area to be planted—the nursery must be near the planting area—and set out, say 50 trees in the block or bunch, in the prepared ground. The planting is done in early spring in the felling areas of the preceding winter under the partial shade of nurse trees, somewhat lighter than the natural regeneration. Deep soil culture is necessary which in the cold clay soil is done by digging interrupted furrows 2 feet broad and 1 inch deep, 2 feet apart, keeping away from stumps and trees. Usually 6 to 8000 feet of rills per acre suffice. Within these furrows, every two feet, holes are dug, 6 inches square, and deep enough for the blocks of plants, which are set in these holes so that they are about 2 inches above the general level of the ground, firming the block but not placing any soil on the block. In this difficult locality, cultivation during the summer, hoeing to keep the ground loose, is required.

The result of this planting has been an astonishing success, not only in securing stands but changing the whole character of the locality.

Buchen- und Eichenkulturen in Bregentved, Dänemark. Centralblatt für das gesammte Forstwesen. April, May, 1913. Pp. 149-164; 205-222.

Oak Culture.

In the same article as the above Hauch relates his experience with oak. He uses the same method of soil preparation as used for the block planting but finds that sowing into the furrows direct is very successful, under the light shade of nurse trees, provided the acorns are good. On this last point he lays great stress not only as to germination but derivation, and goes into greatest detail as to the handling of the seed. While fall sowing would be preferable, the large number of pheasants and game make spring sowing necessary.

It is difficult to judge quality of acorns; the commercial material is apt to be either unripe or already germinated. To avoid gathering unripe acorns is by no means easy, even if the collecting is done late to avoid the early poor stock. The unripe acorns have a greenish tint, hence if self collecting, can be thrown out; but they soon get brown, hence in commercial ware cannot be so readily recognized.

In the humid climate of Denmark germination may begin even while still on the tree. If the germ is not too long so as to be easily broken off, a certain percentage, 10-20 per cent. of germinated seed may be accepted.

Good acorns have a glossy brown color, and the shell is entirely filled by the kernel. Their germination per cent. is ascertained by the knife test, cutting open 200 to 300 square through the embryo. The cut must pass easily through the endosperm, which must be white, without spots or faults. A fine red tint directly around the germ means that the acorn is good but at the same time ready to germinate, hence likely not to winter well.

To winter acorns it is necessary to find a place where they are not exposed to moisture, to drying out, to frost, or to sudden variation of temperature. Before storing for winter, they must be brought to a proper point of dryness by placing them in layers of 4-10 inch on a floor exposed to draft and keeping them stirred or turned over for two to three weeks, until the color has become somewhat lighter than the freshly collected seed and shows no sign of moisture, even if left untouched for a night or 12 to 14 hours. It requires judgment not to have the process of drying go too far.

In winter quarters, into which the acorns are to be brought before frost sets in, the avoidance of sudden and severe temperature changes is especially to be guarded against.

If, in severe winters, the acorns become frosted, their germination per cent. sinks rapidly from 80 or 90 to 40 and even 30 per cent; the germs or parts of the endosperm showing the effect by a dark to black discoloration.

It is not easy to find appropriate winter quarters. Airy, frost-free cellars are usually too dry; an open shed with dirt floor is good in mild winters, but apt to frost in severe winters. Wood floors, cement, or stone are undesirable. The most satisfactory method is Aleman's hut, erected on a dry sand hill, possibly under pine or spruce. A place, 16 by 50 feet is cleared and a layer of soil 20 inch deep dug out, over which a roof is erected of spruce poles, kept together by lath nailed across every three inches; the clear height to the edge of the roof being the height of a man. The roof is covered with sod, a foot in thickness or with straw, the doors at the two ends being similarly covered. In this hut the acorns are spread 10 to 12 inches deep and are stirred daily at first, later two to three times a week, leaving the doors open if there is no frost—the more fresh air the better,—but closing them in frost time.

The amount of seed is determined by the germination per cent, so that about 80,000 plants per acre are secured. If 7000 acorns go to the bushel with a 70-80 per cent. germination, $7000 \times .75 \times 80{,}000 = 19$ bushels are to be used.

Buchen- und Eichenkulturen in Bregentved. Centralblatt für das gesammte Forstwesen. April, May, 1913. Pp. 149-154, 205-222.

Selection System.

Channer calls attention to the excess number of mature trees in forests managed under the selection system on long cutting cycles (or periods) where a diameter limit is applied. The article would have been clearer, had concrete examples from current working plans been given.

T. S. W. Jr.

The True Selection System. The Indian Forester. May, 1913. Pp. 213-217.

Need of Fire Protection.

Fischer continues the discussion, which has aroused so much discussion in India, as to whether fire protection is advisable from the silvicultural and practical viewpoints. He sums up his conclusions:

1. In all forests fires are harmful. (This obviously means in certain directions and not that fires have no beneficial effects at all.)

2. In certain forests, however, fire protection unaided by other operations hinders natural reproduction of the most valuable species.

3. Improvement fellings and cleanings on a sufficient scale suffice to establish natural regeneration. (This does not assert that a sufficient scale is always and everywhere attainable; in fact I expressly admitted that it is not.)

4. Fire protection is essential in: a. Forests required for water-supply or protection against erosion; b. Forests where natural regeneration is secured or artificial regeneration is preferable.

5. Fire-protection to be really effective must be continuous. (This, of course, is qualified by conclusion 2 *supra.*)

T. S. W., Jr.

The Need of Fire-Protection in the Tropics. The Indian Forester. May, 1913. Pp. 225-232.

MENSURATION, FINANCE AND MANAGEMENT.

Selection vs. Timber Forest.

Dr. Centgraf compares in an exhaustive manner two corporation forests in the Black Forest as regards their financial results; the one a coppice of hazel, birch, oak, somewhat over 100 acres, a remnant of mark forest, in the commune of Oberwolfach; the other, in the commune of Schapbach, nearly 200 acres, originally a baronial estate, for at least 80 years managed carefully as a selection forest of fir and spruce.

"Private forest—the professional forester shudders, for he thinks of those sad pictures which so many private forests exhibit in the German fatherland; open, crookedly grown stands, deteriorated by removing the litter—this cinderella of peasant management, compared with an ideal form of selection forest, the love of the peasant."

The decline of the coppice management is demonstrated by a soil rent calculation for 1871 and for 1912, the rents in the latter year for four different stands being one-half to one-third and less than those obtained forty years ago; this is explained by rise in wages which have more than doubled, and by the reduction in sale value of the coppicc wood, by from 25 to 50 per cent. and for some wood by 100 per cent. The highest soil rent for coppice—tanbark coppice—was in 1912 $2.05, while the ideal timber forest figures $3.87, and for a 120-year rotation still $2.50.

Of interest is the record of stock on hand and felling budget in the selection forest for the 73 years as follows, showing constant improvement.

Period	Stock per acre cubic feet.	Felling Budget per acre.	Use per cent.
1835-44	4175	130	3.1
1845-54	3675	165	4.5
1855-62	2731	62	2.3
1863-72	3718	70	1.9
1873-84	5076	61	1.2
1879-88	4318	110	2.6

1889-98	5190	107	2.1
1899-1908	5863	117	2.
Average	4343	103	2.45

The author claims upon the basis of his calculations that the selection forest works with only 56 to 66 per cent. of the timber forest stock capital which he figures at 7846 cubic feet for a 120-year rotation and that it yields a better interest rate, but in his calculations (theoretical) for the timber forest, while the felling budget figures 269 cubic feet per acre per year as against 103 for the selection forest, the use per cent. is 2.42, practically the same as for the selection forest, for which, however, an increment per cent. of 3.6 to 3.9 is figured from stand analyses (235 to 312 cubic feet.)

A soil rent calculation—as all such calculations based on uncertain grounds—comes out more disadvantageously to the compartment timber forest, *e. g.* $4.50 as against $2.70.

The article is replete with tabulations in detail of selection forest stands. Of these, as of special interest, we reproduce the following which may be suggestive for American investigators.

Assortments in close Fir Stands in per cent. of Total Wood Volume.

Assortments.		At age of years.						
		60	70	80	90	100	110	120
Poles		7	2	...	...	...	...	...
Logs	V class	15	6	2	...	...	...	...
	IV "	35	39	34	24	14	8	3
	III "	8	17	26	33	34	29	23
	II "	...	2	5	10	18	25	30
	I "	...	...	...	...	2	6	13
Bark on logs		8	9	9	10	10	10	10
Cordwood split		1	2	4	5	6	7	7
" round		7	7	5	4	3	2	2
Brushwood		19	16	15	14	13	13	12

Net prices for spruce and fir, cut, in the forest, per cubic foot.

Logs I class	14.5 cents
" II "	13.5 "
" III "	12.4 "
" IV "	9.5 "
" V "	9. "
Poles	8. "
Hop poles, 4 classes	5.8 to 8.8
Cordwood, split	3.8 to 8.8
" round	3.2 to 8.8
Brushwood	.9 to 8.8
Tanbark (spruce)	2. to 8.8

Die Privatwaldungen des Wolftales im badischen Schwarzwald. Allgemeine Forst- und Jagdzeitung. March, April, 1913. Pp. ——; 113-129.

Yield from Hardwoods.

Compared with the total cut of softwoods in Württemberg hardwoods are relatively unimportant. They constituted but 7 per cent. of the annual cut in 1910. Of this 7 per cent. oak and beech each made up 3 per cent. and miscellaneous hardwoods the remaining 1 per cent. In value, hardwoods are even less important than numerically, since in 1910 the total value of all hardwoods cut in Württemberg was but 6 per cent. of the total yield. Yet, intrinsically, hardwoods are more valuable, as the following prices for south Germany will show:

For Class I (60 *cm* and over in middle diameter) in log lengths.

Spruce	$30 per *M*
Fir	30 "
Pine	70 "
Oak	122 "
Beech	46 "
Other hardwoods	116 "

One of the most effective ways of increasing the value of hardwoods is by grading the logs before offering them for sale into two classes, the first of which contains the logs that are free from all blemishes. Such a division is made in each size class. Furthermore, better values can be obtained by making smaller differences between the sizes than the usual grading according to volume in cubic meters will allow.

K. W. W.

Die Stärke- und Wertzunahme des Laubstammholzes. Forstwissenschaftliches Centralblatt. February, 1913. Pp. 66-74.

Forest Finance.

Dr. Glaser has lately in various articles analyzed the various forest finance theories and calculations, and elucidated various mathematical formulæ in magazine articles, especially in *Centralblatt für das gesammte Forstwesen,* and in his book *Zur forstlichen Rentabilitätslehre.*

The following passage occurring in a controversial article, states the case so clearly that we translate it. Referring to the current notions on the soil rent theory, he says:

"From the standpoint of profit calculations, forestal or other, the equation $\frac{\text{rent (r)}}{\text{capital (c)}} =$ maximum must rule. If in this equation the capital is figured as a yield (rent) value with a given interest rate p, then the equation becomes $\frac{r}{c} = \frac{r}{\frac{r}{.op}} = \frac{p}{100}$ const., it is fixed once for all by the chosen p. Hence in a correct finance calculation yield or rent values cannot be employed. But the soil rent value and the normal age class forest value calculated according to principles of the soil rent theory is a rent value based on a predetermined p. Every rotation, then, determined according to the prevailing theory, guarantees, therefore, the same profitableness of management at p per cent. Only the capitals involved assume a different absolute—and with variable interest rate also relative—value. Soil and forest, however, possess undoubtedly everywhere a definite single value, while the interest rate with which this is related to the rent can and must be variable." Hence from the standpoint of statics not the formula $x=f(rx,p)=\text{max.}$, but $pxf\ (rx,C=\text{max.})$ must be considered correct.

Die Berechnung des Waldkapitals. Allgemeine Forst- und Jagdzeitung. April, 1913. Pp. 151-2.

Errors of Soil Rent Theory.

In a thoughtful, not too technical article, Ostwald shows up incongruities of the methods of profit calculations advocated by the soil rent theorists. He shows especially that the claim that similarity in principle of the annual and intermittent sustained yield management can be demonstrated on the basis of the soil rent is based on the erroneous assumption that mathematical proofs may at once be considered as proofs from the economic point of view; that a difference in principle between soil management (as in the intermittent management) is not justified in the nature of forest economy; that, on the other hand, similarity in principle of intermittent and annual management can be readily demonstrated on the basis of the forest rent; and that the Faustmann formula must be abandoned, because only mathematically tenable but not economically correct. The suggestive article is worth pondering.

Zur Theorie des aussetzenden und des jährlichen Nachhaltsbetriebes. Centralblatt für das gesammte Forstwesen. June, 1913. Pp. 249-258.

Increasing Net Yields in Alsace-Lorraine.

In spite of similar soil, climate and market conditions, the Province of Alsace-Lorraine has lagged behind the neighboring states of Baden and Württemberg in net yield from the state forests. In 1910 these net yields were as follows:

Alsace-Lorraine	$2.90 per acre
Baden	6.00 per acre.
Württemberg	6.65 per acre.

Lack of a good road system, too large administrative units, and a slightly higher scale of wages make exploitation more expensive in Alsace-Lorraine. The main reason for the low net yield, however, is the poor condition of the forests at the time Alsace-Lorraine became a part of the German Empire. From 1669-1827 the stands of fir were handled on a rough selection system, while the pine and hardwoods were cut clean, with the exception of a few scattered trees left for seed or future development. In the period from 1827-1870 the political disturbances and wars induced reckless overcutting. As a consequence, the forests in Alsace-Lorraine were in bad condition after the Franco-Prussian war, when the Germans assumed control. In the fir stands all age classes were represented, but there were very few mature trees. Likewise the pine stands were for the most part immature. With the hardwoods, too, frequent coppicing made it necessary to return to high forest.

K. W. W.

Die Reinerträge der Staatswaldungen in Elsass-Lothringen, Baden und Württemberg. Forstwissenschaftliches Centralblatt. January, 1913. Pp. 10-20.

UTILIZATION, MARKET AND TECHNOLOGY.

Tapping Pine in Corsica.

De Lapasse, until recently conservator of the French Waters and Forests Service in Corsica and now stationed at Bordeaux in charge of the Landes and Gascogne Maritime Pine forests, writes at length of the results of tapping the Corsican and Maritime Pine in the Island of Corsica.

The 65,500 hectares of pine forests in Corsica are of much greater commercial importance than the 74,800 hectares of balm, oak, beech, cork oak, etc., but their commercial use has been retarded by lack of communication.

During the period 1856 to 1872, only the Corsican Pine was tapped, and in 1871 the officiating conservator concluded that the wood of the trees tapped was made heavier and more difficult to work, that the tapping seriously interfered with their development, and greatly increased the fire hazard. It is now evident, states De Lapasse, that the wounds do not readily heal and that tapping Corsican Pine is inadvisable from the silvicultural standpoint. The group selection system, under which the pine is now worked, is not suited to turpentine operations, the ground is rough and difficult to cover, and De Lapasse is not in favor of tapping the Corsican Pine. On the other hand, the turpentine industry was introduced with success in Maritime Pine forests beginning in 1908-1909. The main problem has been the labor supply. De Lapasse concludes that in the future Corsican Pine will not be tapped, but that the Maritime Pine will be bled where the ground is not too rough, where there are sufficient bodies of contiguous timber, and if the skilled labor can be held. The same tapping rules are followed that govern in the Landes.

T. S. W., Jr.

Le Gemmage des Pins en Corse. Revue des Eaux et Forêts. June 1, 1913. Pp. 321-334.

Fire-proofing Wood and Renovating Mahogany.

Under "Extracts" are given two household receipts for fire-proofing wood and renovating mahogany, which may be of practical interest to American foresters:

An excellent method of rendering timber impervious to fire is to cover its surface with a solution of silicate of soda. When wood treated in this way is exposed to a fierce flame, the heat draws the salt contained in the solution to the exterior of the timber on which it forms a glazed coating, after having been melted by action of the fire. The solution should be generally adopted as a wash for woodwork in houses, as it effectually retards the action of the flame which the resinous nature of the deal commonly used in building is too liable to promote.

To renovate mahogany. Dissolve four ounces of best white wax in 8 ounces of turpentine and 6 ounces of water in a glue kettle over the fire, and while hot add an ounce of ammonia. Stir well together whilst cooling. Remove all dust from the articles; then apply with old pieces of clean flannel and polish. Before renovating, if there are dents in the furniture, cover the places with a damp rag, and iron with red-hot iron and then polish with the following solution: Equal parts of linseed oil, vinegar and water. Put them in a bottle and shake well together; apply with a piece of flannel, and polish with soft cloth.

T. S. W., Jr.

Extracts. The Indian Forester. May, 1913. Pp. 242-243.

Supply of Ties in India.

Pearson makes a strong plea for the trial of Indian species for tie timbers. At present, he points out, *deodar* is the only conifer used and the price has increased enormously during the past twenty years. Formerly, the price for broad-gauge ties was 80 to 88 cents per tie, while at present it ranges from $1.24 to $1.32, and even higher. He views with alarm the recent importation of creosoted Oregon pine ties, which he describes as "fair to good for sleepers (ties) as far as conifer woods go." American exporters would profit by this excellent market.

T. S. W., Jr.

The Supply of Railway Sleepers in India. The Indian Forester. April, 1913. Pp. 169-173.

STATISTICS AND HISTORY.

New Swiss Area Statistics.

The newest area statistics of Switzerland show up a number of peculiarities in the political affiliations, which, for instance, brings it about, that communes belonging to a canton are found outside the boundaries of that canton. No uniformity of subdivision exists. In 18 cantons the political communes are aggregated into districts or circles, but other cantons do not know this districting. The smallest districts are less than two square miles, the largest over 300 square miles. The six smallest communes comprise only 36 to 110 acres, while the largest go over 70,000 acres, but 57 per cent. of the six largest is unproductive.

Taking the whole country, the real mountain region, over 2600 feet, occupies less than 20 per cent., with a little over 4 per cent. alpine and subalpine, the bulk of the lowlands lie below 1800 feet; the lowest situation of settlement is at 650 feet above sea level, the highest at 6360 feet. The ten communes owning the largest forest area are, of course, located on the mountains, with forest per cents varying from 15 to 44.6 per cent of their whole area, and from 22.5 to 59 per cent. of their productive area.

Forest statistics are being carefully collected by the Bund since 1907 under the direction of Prof. Decoppet, the third section referring to the statistics of workwood production having appeared. Workwood production has fallen far below consumption: the import which in 1885 was around 3½ million cubic feet, with an export of over 6 million, had increased in 1907 to over 16.5 million, the export dropping to less than 3 million cubic feet, that is to say the whole wood trade has doubled, and the gross import has become 5 times what it was only 22 years ago.

At the same time with this increase in workwood (lumber) the forest area per capita has decreased from .69 in 1870 to .59 acre in 1910.

Of the total forest area 75.2 per cent. are now recognized as protection forest, 62 per cent. of the state forests, 80.7 per cent. of the communal, and 60.8 per cent. of private forest; that is to say, a very large portion of forest is in the mountains, where the workwood per cent. is hardly 10; although in certain hill land forests, by careful work, the workwood per cent. is brought up to 85 per cent. Difficulties of transportation account in part for this low workwood production. This discovery led to subventions by the Bund since 1903 for roadbuilding, for which in 1910 altogether over $250,000 were spent. The smallness of the private forest properties prevents mostly a rational management for lumber. The desire for lumber has led to change from hardwoods to conifers, the spruce being largely planted, which in the lowlands in pure stands becomes heart rotten (76% of all pure stands!) but remains sound in mixed plantings.

Of the total wood consumption of Switzerland, namely 42 million cubic feet in 1909, 15 million was coniferous, and 22 million deciduous material, a little more than one quarter in each case being imported. It will be noted that the consumption of coniferous material is less than of broadleaf. Yet, according to Decoppet, in the home production, conifers participate with 70 per cent., of which 40 per cent spruce and 20 per cent fir.

Timber forest occupies 91.4 per cent. of the total public forest area of 1.5 million acres, 5.2 per cent. being in coppice, 3.4 per cent. in composite forest, and the other forest areas show similar proportions.

Arealstatistik: Die Gemeinden der Schweiz. Schweizerische Zeitschrift für Forstwesen. April, 1913. Pp. 134-138. *Schweizerische Forststatistik.* Centralblatt für das gesammte Forstwesen. February, 1913. Pp. 77-80.

Rising Lumber Prices in Germany.

Since many decades the lumber market has not seen such advances in prices!

During 1912 lumber prices rose by 3.3 to 8.7 per cent. and were stiff, and in some items to over 17 per cent. in hardwoods and to over 25 per cent. in softwoods. Delivered at rail in the Rhine country the following prices prevailed:

Oak, edged per M feet	$47.60	to	$71.30
Oak, wany	44.24	to	69.40
Beech, wany	24.00	to	39.20
Ash, wany	66.15	to	74.80
Black walnut, wany	135.50	to	173.00
Elm, wany	51.50	to	65.00
Poplar, wany	31.75	to	40.00

The greatest rise in price is that of ash lumber, namely 17.4 per cent. over 1911.

The oak trade particularly was strong in spite of the political and financial troubles, which had not the least influence, especially on first-class material for furniture and car construction.

The coniferous lumber market was not less satisfactory and rising, in spite of a depression in the building trade. In Bavaria and the Black Forest the price for 16 foot, 6 inch boards averaged $17.60; for 12 inch, $21.80; average $19.80, a rise of 4 per cent. over 1911, and 10 per cent. over 1909.

In the Rhine country, these prices must be increased by about one third, the prices for 16 foot edged were running from $25.25 for 6 inch to $27.36; the rise in price over the average in 1911 is here 8.4 per cent; the lack of importations from Austria explaining this remarkable advance. These prices are for common run.

Pine deals, I class, averaged $36.45, an advance of over 25 per cent. over the preceding year; II class brought $33.35 to $35.40, the two classes of better material together having advanced 18.4 per cent.

Spruce deals hovered between $28 and $37, and fir deals about the same, the advances being 19 per cent. for the former and 9 per cent. for the latter.

Comparing the prices for common run boards for the last 20 years, an advance of just 50 per cent. on the average, 60 per cent. for 12 inch, but only 35 per cent. for 6 inch lumber—a significant difference probably due to the deterioration of the import material!

Das Wirtschaftsjahr 1912. III Bretterhandel. Centralblatt für das gesammte Forstwesen. April, May, June, 1913. Pp. 190-194; 238-243; 293-297.

Prussian Budget 1913.

Of the total area of the state forests, 7,483,000 acres, 90 per cent. is devoted to the production of wood.

The expenses are estimated to be $2.56 per acre and the gross receipts are calculated to be $5.17 per acre, so that the net returns will be $2.61 per acre, or deducting incomes from sale of land, net revenue $2.38.

The returns will be distributed as follows:

Sale of wood	89.93%
By-products	4.37
Hunting,	0.46
Peat	0.08
Refunds	0.16
Forest schools	0.07
Sale of lands	4.49
Miscellaneous	1.00
	99.66%

The main divisions of the expenses are :

Administration and protection	74.5%
Educational	0.5
General expenses	9.0
Special expenses	16.0
	100.0%

In the work of administration and protection the main item of cost is the harvesting of the timber cut. This makes up 60 per cent. of the total of this class of expense.

"General expenses" include pensions, insurance, etc.

In "special expenses" the largest item is for the purchase of land, which totals 61 per cent. of this class.

In order to make the figures of the Prussian budget comparable with our conditions a summary statement is given below on an acreage basis:

Expenses and Receipts per Acre.

Expenses.		Receipts.	
Cost of administration and protection,	$2.15	Timber sales,	$4.59
Construction and repair of improvements,	.06	By-products hunting, etc.,	.35
Forest schools,	.01	Forest schools,	—
Purchase of lands and servitudes	.34	Land sales,	.23
	$2.56		$5.17

Etat des preuss. Forst-, Domänen- und landwirtschaftlichen Verwaltung für das Etatsjahr 1913. Forstwissenschaftliches Centralblatt. April, 1913. Pp. 197-212.

Early German History.

Those interested in the early history of forestry in Germany will find a valuable contribution in Dr. Mocker's article, which brings the text and the conditions leading up to it of one of the first, if not the first, forest ordinances, that of 1379 for the city forest of Eger in Bohemia, a city which was in existence before 1061 and on record when King Henry IV handed over a part of the forest to one of his vassals in fief. Later, it became again imperial forest. The ordinance defines the rights of the citizens of Eger in the use of the imperial forest. Such prescriptions as that no building timber is to be cut into cordwood except by special permission of the forester; that all hardwoods with the exception of oak and basswood (bee-trees) were free to cut; that building timber could only be cut under direction of the forester—show that so early as the fourteenth century in some localities at least conservative lumbering was in use. Much can be learned from this article regarding the peculiar economic development of German cities in early times.

Die erste Forstordnung vom Jahre 1379 für Eger und sein Gebiet. Centralblatt für das gesammte Forstwesen. June, 1913. Pp. 258-268.

POLITICS AND LEGISLATION.

Regulation of Communal Forests.

In south and west Germany state regulation of communal forests has three main objects. In the first place, care must be exercised that the proper area is forested. This means a careful balancing of the needs of the community in question against the welfare of the nation. Secondly, the communes have a tendency to reduce their wood capital by overcutting and require, therefore, technical advice as to what may properly be called increment. Lastly, the services of a disinterested party are needed in valuation for tax purposes. The communes are, of course, unfitted to act in the role of both assessor and collector of taxes.

The results of state supervision are generally satisfactory. The cost of the work of valuation is borne by the State, while the commune pays for protection and routine administration.

K. W. W.

Die 13 Hauptversammlung des Deutschen Forstvereins. Forstwissenschaftliches Centralblatt. February, 1913. Pp. 78-91.

Social Improvement of Woodchoppers.

The remarkable socialistic movement in Germany, by which the lot of the laborer is being improved, is gradually being perfected more and more. The latest improvement refers to the woodchoppers in the Saxon forest department, described by Oberförster Dr. Möller. There existed voluntary woodchoppers' aid associations in Saxony long before the imperial care of laborers was thought of, and these continued to function after the latter had been inaugurated. This mixed system had its disadvantages.

With the year 1913, the woodchoppers in the State forests are obliged to join the pension system of the Saxon railroad men. This affects about 4000 workmen who secure an invalid and life insurance, to which the State contributes half the premiums. The laborers are classified in wage classes; they pay and are paid according to this classification and the length of time they have been in the class; the classes within which forest laborers appear ranging from $140 to $300 per annum, as annual wages are figured 365 times the average daily wage, which is based upon the actual earnings of the previous year divided by 300. The cost of the insurance, besides an entering fee of 36 cents, varies from 8 cents to 20 cents for the four wage classes concerned, while the pension may vary from $24 to $143 or up to 50 per cent of the wages.

The widow's allowance after the man's death may rise to one-third the wages, with additions of one-half to one-third for each child up to 15 years.

Usually a membership of five years is necessary to acquire a right to the insurance, but those discontinuing before that term can either continue in the membership or else have their contribution returned. By 1910 the capital of this insurance association was over 3½ million dollars with $250,000 expenses and $350,000 income.

The main objection of the laborers is that their chances of benefiting from the contributions in most cases are remote except what there is in the life insurance.

Neue Bahnen in der sozialen Fürsorge für die Waldarbeiter, etc. Silva, No. 9, 1913. Pp. 97-99.

MISCELLANEOUS.

Prussian Forestry Conferences.

Forestry conferences are the order of the day in the Prussian Forest Service. The purpose of the conferences is to disseminate local experiences and to bring administrative officers together for the discussion of largely local topics. The conferences are annual affairs.

To accentuate the local nature of the conferences, Prussia has been divided into 18 groups. The ranking District Forester in each group takes charge of the Conference, determines the points for discussion and decides on the place for the field excursion.

At most, two days are allowed for the Conference (exclusive of travel time). All officers attending are reimbursed for travel and subsistence. As a rule the Conference is confined to administrative officers lest it become unwieldy.

A Secretary is appointed who must make a detailed report of the proceedings. This report is to be signed by the District Forester and a copy filed with the Minister of Agriculture.

These Conferences are a new departure, ordered by Act of December 6, 1912; they are to be tried tentatively in the years 1913-1915.

A. B. R.

Aus der preussischen Forstverwaltung. Allgemeine Forst u- Jagd-Zeitung. April, 1913. Pp. 137.

NEWS AND NOTES.

Mr. Lincoln Crowell sends the following interesting item: Last winter I had occasion to make some measurements of hewn rock elm export timbers to determine the relation of their volume in cubic feet to the log scale of the unhewn log. Of 110 hewn rock elm timbers, having an average cubic content of 47.5 feet, I found that there was 13 plus board feet S. D. C. log scale per 1 cubic foot of hewn timber. About 12 per cent. of the log scale volume of the merchantable bole (not deducting for defect) was unsuitable for export timber because of pipe rot, ring shake, or black knots.

Coal tar creosote, which was scheduled for a 5% duty under the new tariff law, has been returned to the free list. This was the result of evidence submitted showing the beneficial results of wood preservation as a factor in forest conservation, and the handicap which even 5% would impose.

As shown on another page, preservative processes are more and more widely employed to secure longer life for wooden structures. This increase in the use of preservatives has led to their reduction in cost. The Carbolineum Wood Preserving Company, of New York, announces reduction in price of their preservative to from 90 cents to $1.00 per gallon, according to quantities ordered. This Company also sends out bulletins of information that occasionally go beyond the mere advertising line. One of the latest points out the desirability of supplementary surface treatment of treated timber, after the timber has season-checked, either by brush or spray, the latter method preferably, as it permits reaching splits, checks, joints, that can never be reached by the brush.

No forester in Sweden is found without an increment borer as a steady companion. This borer was originally designed by Pressler half a century ago, but it is only within a few years that a Swedish manufacturer, Mattson, has perfected the instrument by the use of superior material and otherwise, so that it now answers its purpose most efficiently. The use of the instrument is, of course, known to every forestry student. Keuffel and Esser Company, in New York, have the agency for the United States and Canada. They have issued a small pamphlet describing the construction and use of the instrument, which sells according to length of bore (2¼ to 11¾ inch) at from $5.25 to $25 apiece.

Among the means of reducing the enormous fire losses outside of forest fires, the H. W. Johns-Manville Company, of New York, manufacture a shingle which is made out of asbestos and Portland cement moulded into a compact mass under hydraulic pressure. It is claimed that they are not affected by extreme weather conditions, will not rot, warp or split, and withstand the action of the elements indefinitely. Moderate price and artistic design add to their value as a substitute for the wooden shingle.

The efficient work of the Western Forestry and Conservation Association in suppressing the fire danger has led in the State of Oregon to a compulsory patrol law, and the State of California promises to follow suit. It is estimated that not less than $1,635,000 will be spent in Montana, Idaho, Washington and Oregon, of which the Forest Service is to expend 1¼ million dollars, the federal government under the Weeks' law is to contribute $35,000, the States have appropriated $100,000, and the timberowners' association is to contribute $250,000, unless need for larger contribution develops. In 1910 this contribution was $700,000.

Conservation is to have field days on November 18, 19 and 20, when the National Conservation Congress will meet at Washington in co-operation with the National Conservation Association. Special committees have been appointed to shape and present principles and policies to be recommended to our legislators in the National Government and in the States.

A new departure is made by the Montreal Engineering Company, Consulting and Operating Engineers, by making forest surveys a subject of their enterprise besides electrical, hydraulic and general engineering work. Since, at least in the operations of a timber tract, this engineering work comes often into play, the combination may prove advantageous to the employers of such a firm.

In view of the fact that annually some 50 million dollars worth of wooden houses are burned up, due as a rule to the absence of means of efficient fire fighting, every new device to prevent the spread of an incipient fire is of interest. The Adams Fire-fighting and Instrument Company of Washington, D. C., has placed an equipment on the market which is said to be particularly effective.

An important saving in the amount of payments for fire losses along its right of way is reported by the Atchison, Topeka & Santa Fe as the result of a special campaign for improvement in this respect. In 1910, the company had claims for 1,509 fire losses, amounting to $100,605. In 1911 there were 574 fires with claims amounting to $51,000. In the fiscal year 1912 the number of fires had been reduced to 135, and the expenditure for the payment of claims to only $6,000.

In order to secure these results, the efficiency of the spark arresters on locomotives was increased, and a more frequent inspection was provided, to ensure prompt correction of defects. The necessity was also impressed upon section gangs, train men, and other employees, of giving prompt attention to the suppression of fires in their incipiency. The co-operation of all employees was also secured in connection with more efficient destruction of inflammable material on the right of way and the plowing of fire guards in cultivated fields.

The experience of the Santa Fe clearly indicates that efficient fire protection along railway lines is good business policy on the part of such companies.

A circular, "State *vs.* National Control of Public Forests," has been issued by the Conservation Commission of Oregon strongly opposing the movement toward the transfer of the National Forests from the Federal to the State Governments. In this circular, the following points are made:

Private instead of public ownership and control of the National forest resources is the real object of the powerful interests advocating the transfer to the states. The National Forests are the property of the nation and are of vast importance and great value from the national point of view. They should not be transferred to the states unless it can be shown that the public interest will thus be better subserved than at present. The argument that Eastern states have owned and misused the forests within their boundaries and the same privilege should be granted the Western States is not entitled to consideration. In the east, the National Government is now spending large sums for the purchase of forest lands, to repair the mistakes of the past and thus to protect watersheds of national importance. Irrigation in the west, and navigation and power generally, are at stake, and these are national problems. The question of preventing monopolistic control of timber resources is also of national, rather than merely state importance. The expense of protecting and administering the National Forests is about $4,000,000 per year. On account of their location, income from the National Forests will not equal expenditure for probably several years. The individual states can not be expected to bear the burden of extra cost as can the Federal Government, or to proceed as efficiently with the great work of reforestation, and the construction of roads, trails, telephones and other permanent improvements. On the other hand, the states now receive 35 per cent. of the gross revenue in lieu of taxes, so that they are in a distinctly advantageous situation so far as finances are concerned. The conclusion is that every one except those directly interested in profiting thereby has all to lose and nothing to gain by a transfer from nation to state.

The veto by Governor Tener of the bill carrying a $100,000 appropriation for the maintenance of the Pennsylvania Chestnut Tree Blight Commission brings to an end an interesting campaign which has been waged for the last two years. The veto by the Governor was on the recommendation of the Commission, that the amount named was not sufficient to accomplish definite results. In other words, it appears that the extensive work under the $250,000 appropriation served mostly to emphasize the immensity, if not the hopelessness of the task. During the two years in which the Commission was active, field agents to the number of 100 or more investigated conditions and traced the advance of the blight westward through the State. Many groups of trees indicating advance points of infection were cut and destroyed, with results which were at least temporarily effective. Without the expenditure of an enormous sum, the general spread of the totally infected areas could not be prevented.

The Forestry Conference at Lake Sunapee, N. H., July 22-24, was very largely attended by foresters, lumbermen and other interested people throughout the East. The meeting was under the auspices of the Society for the Protection of New Hampshire Forests, with the American Forestry Association, the Eastern Foresters' Association and other organizations co-operating. The meeting was held at Soo-Nippi Park, and in addition to the speeches was varied by local excursions. Among the well known men who had place on the program were Dr. H. S. Drinker, President of Lehigh University and of the American Forestry Association; Dr. B. E. Fernow, Dean of the Forestry School, University of Toronto; Prof. Filbert Roth, head of the Forestry School, University of Michigan; Prof. J. W. Toumey, Director of Yale Forest School; Prof. H. H. Chapman, of the Yale Forest School; Hon. W. T. Haines, Governor of Maine; W. L. Hall of the U. S. Forest Service; Ellwood Wilson, Forester of the Laurentide Paper Company; Dr. J. T. Rothrock and Mr. Elliott of the Pennsylvania Forestry Commission, and others. The Directors of the American Forestry Association held their quarterly meeting during the Lake Sunapee Conference.

During the three days prior to the Lake Sunapee meeting, the Association of Eastern Foresters met at Wanakena, N. Y., where the ranger school and the demonstration forests of the New York College of Forestry were examined and many questions of importance to foresters were discussed. A considerable number of those in attendance went from this meeting to the Lake Sunapee conference.

The Canadian Forestry Association held its annual convention in Winnipeg, July 7-9, which was well attended by foresters from the Dominion and the United States. Among the more interesting papers presented was one by Mr. E. T. Allen, Forester, of the Western Forestry and Conservation Association, on "Cooperation in Forestry," which dealt particularly with the forest fire association work in the northwest; "The Rate of Tree Growth" by W. T. Cox, State Forester of Minnesota, in which were presented surprising statistics on the growth of white and red pine and other species in Minnesota; "Some Practical Aspects of the Forestry Movement" by Vere C. Brown, of the Canadian Bank of Commerce; papers on the interests and work of the Canadian Pacific Railway in forestry by J. S. Dennis, Assistant to the President, and George Bury, Vice-president and General Manager.

The amended Dominion "Forest Reserves and Parks Act," which was recently assented to on June 6th, 1913, added over ten thousand five hundred square miles to the existing area of Dominion Forest Reservations, making a total of over thirty-five thousand eight hundred square miles of reserved forest land in the Western Provinces under federal jurisdiction. Of this reserved area, three thousand, seven hundred and eighty-two square miles are found in Alberta, one thousand eight hundred and seventy-two square miles in Saskatchewan and one thousand one hundred and eight square miles in Manitoba. Over two-thirds of the total area is found in Alberta, owing to the fact that practically all the eastern slope of the Rockies has been set apart as a forest reserve, not only to perpetuate the supply of timber but to preserve and equalize the flow of the large prairie rivers that have their sources in this reserved area.

In the latest report of the United States Chief Forester, the area of National Forests under reservation is given as two hundred and fifty-seven thousand, eight hundred and fifty-five square miles, an area over seven times as great as that of the Dominion Forest Reserves.

Practically all of this land is reported as being non-agricultural and chiefly valuable for the production of timber. On much of it, fires have caused extensive damage, so that the amount of merchantable saw-timber over considerable areas is relatively small. However, in addition to the saw-timber, which in the aggregate amounts to a good deal, there is a large amount of pulpwood and a vast area of young growth which, if protected from fire, will become of merchantable size while other resources are becoming exhausted. The relative accessibility of a great deal of this timber land to the new settlements in the Prairie Provinces makes reservation and protection important.

During 1911, the Commission of Conservation took an active interest in the establishment of the Rocky Mountains Forest Reserve, and assisted materially in securing the large addition which increased the area of Dominion forest reserves from less than 3,000 to about 25,000 square miles.

The Forestry Branch of the Dominion of Canada has followed the example of the U. S. Forest Service in establishing a Wood Products Laboratory in co-operation with McGill University. The work will be in charge of A. G. McIntire, chemical engineer and editor of the Pulp and Paper Magazine of Canada, with experience in pulp and paper mills.

British Columbia possesses one of the few great timber areas of the world. While the countries of the far East have lost all the timber they ever had; while European nations are resorting to the most intensive methods possible to secure continuity of stand and a certainty of yield and are planting trees by hand over great areas to ensure crops in the future; while Eastern Canada and the New England States are clamoring for lumber and viewing with alarm the rapidly diminishing supplies in their country. British Columbia has a vast area of over 65 million acres of timberland, which should produce, according to estimates of experts, at least one hundred board feet per acre per annum, or a total of 6½ billion feet. This would return to the Government over 6½ million dollars every year. The Province is the possessor of a glorious heritage of over 300 billion feet of timber, which is quite half of all that standing in the Dominion at the present time. At the present rate of cutting, the loggers of the Province are taking annually only one-fifth of the amount which is added by the natural processes of growth.

According to the report of the Chief Forester of British Columbia for the past year, over 70 per cent. of the fires which originated in other ways than from lightning were from sheer carelessness on the part of campers, brush burners, land cleaners, etc. There were a great number of conflagrations traceable, it is true, to railways whose lines were not cleared of brush, and sparks from the passing engines set blazes in the debris by the right of way with disastrous results to the surrounding timber.

There were employed last summer over 150 forest rangers, whose sole duty was to safeguard the standing timber and collect and organize fire fighting parties in case of an outbreak. The money expended on the work of these men ran up to $745,000. There was burned over only 116,000 acres, with a total money loss of $300,000.

The report recently issued by the Chief Conservator of Forests in South Africa for the year ending December 31st, 1911, is of considerable interest, and considerable credit is due to the Forest Department for the efficiency already attained by this young union in administration and fire-protection.

The area of the Forest Reserves in the Union of South Africa in December, 1911, was 1,799,550 acres. Besides this, there were also 42,587 acres reserved for growing railway ties, on which railway funds alone were expended, making a total reserved area of 1,842,137 acres. This area is divided into seven conservancies, roughly speaking a conservancy to each province in the Union. Each conservancy, consisting usually of several reserves, is administered by a District Forest Officer and a technically trained Assistant Forester. Under them are chiefs of reserves, forest guards, rangers, etc. The more important positions are all filled by technical foresters, usually highly trained men who have completed their course in the Oxford School of Forestry and in Germany. The organization very closely resembles that of the Canadian Government forest reserves.

Forest surveys are being made for the demarcation of new reserves, and existing reserves are being protected from fire by burning or cutting fire-belts around the reserves and by planting up their perimeters with trees of the less inflammable species. As a result of these precautions, there were burned during the season of 1911 only seven hundred acres or 0.04% of the total area.

On the reserves themselves improvement cuttings are being carried on under the direction of forest officials, for the removal of defective timber and weed trees, and these operations not only have much improved the species composition of the forests but have proved financially justifiable as well.

Replanting is also being extensively carried on in the various reserves, the total area replanted at the end of 1911 being 48,136 acres. Several species of exotics are being introduced with considerable success. Nurseries are maintained and the seed and transplants of forest trees are sold to the public at cost. About six thousand dollars worth of seed was sold by the Department during the year, together with 2,806,402 seedlings, valued at over $42,500.00.

The James Maclaren Company, Ltd., of Buckingham, Quebec, has awarded a contract to survey and cruise their limits on the Lievre River to Vitale & Rothery, Forest Engineers, 527 Fifth Avenue, New York City. The Engineers have 30 men in the field at present, and are planning to complete the work in a year and a half. The limits comprise approximately 2700 square miles in the western part of Quebec Province. A thorough cruise, survey and appraisal will be made, studies compiled of the growing capacity and reproductivity of the tract and other information gathered which will assist in putting the large property on a practical basis for management.

That European foresters are following with keen interest the development of American Forest Organization, is evidenced by a reference in Forstmeister Heger's address on "Forest Fire Protection" before the 56th annual meeting of the Saxon "Forstverein." "Every Working Plan," said he, "serves to secure fire protection, though only as a *subsidiary* purpose ...... whereas in North America the protection of the Forest against fire is made a main point of every working plan."

The Royal English Arboricultural Society has arranged for a summer meeting in Germany during the month of September, starting at Frankfurt am Main, visiting the city forest, the Oberforsterei Mitteldick, Lichtenau and other points in the Spessart, Schonmunzach, Freudenstadt and Pfalzgrafenweiler in the Black

Forest. The whole cost of the tour from and to London is estimated at $60, and the Society gives $200 in five grants ($40) to foresters and assistant foresters, who are financially unable to attend, under certain regulations.

The centennial celebration of the Austrian forest school at Mariabrunn took place on May 8 and 9, 1913. At the same time was celebrated the fortieth anniversary of its connection with the High School for Soilculture, as the institute at Mariabrunn is called, combining agriculture and forestry. The school started as a middle school and remained so for nearly fifty years, and was not very successful, as it attempted to produce *"practical"* foresters, despising scientific basis. In 1867 it was raised to academic position, and Wessely became director. In 1873 the agricultural institution in Vienna came into existence, but the amalgamation of the two not until 1875.

An International Forestry Congress under the auspices of the Touring Club of France, to which representatives came from every continent on the globe and which was probably the largest Forestry Congress ever held, met in Paris in June for the expressed purpose of studying economic and technical forestry problems, and of promoting legislative and administrative reforms in order to secure the conservation of the forests, the prevention of soil erosion and the reforesting of waste lands.

Such subjects as the right of the state to regulate private forest property, or to expropriate misused and denuded forest lands to insure public safety from floods were discussed from an international view-point. This state right has long been recognized in Europe where lands on watersheds can be expropriated unless managed by the owner according to strict Government regulations and an adequate forest cover maintained.

The name of the head of the Chinese Department of Agriculture and Forestry is C. S. Chan and not Choo as reported on p. 312 of our last issue.

Frederick Dunlap, F. E. (Cornell '04), has resigned his positions as forest assistant in the Forest Service, physicist at the Forest Products Laboratory and lecturer in forestry and forest products in the University of Wisconsin to accept the professorship of forestry in the University of Missouri.

COMMENT.

"Nasty" is the proper epithet for the lucubrations, which, in early June, Congressman Humphrey brought forward in the House of Representatives in support of a resolution to have the Forest Service administration investigated—nasty, because, if not lying direct, the speaker did knowingly lay to the door of the Service the blame for transactions for which the responsibility did not belong to the Service, indeed, which, it appears, the Service had strenuously objected to. The arraignment was based primarily upon the abuse in the application of the lieu land law, by which certain railroad companies were allowed to exchange poor lands for good lands. It appears that these exchanges were made before the Service was in charge of the National Forests, and under the influence of the very "gang" to which the Honorable gentleman undoubtedly belongs. The full history of these transactions was effectively presented by Mr. Humphrey's own colleague from the State of Washington, Mr. Bryan, whose speech settled the investigation resolution.

Ill-will and ignorance characterized also Mr. Humphrey's complaint, that the Service is not cutting enough timber, not as much as by its own showing could and should be cut. We dare say that the Service would like to remedy this defect, if it could do so practically in the absence of development of means of transportation. That a lot of dead work must be done and expenditures incurred and time allowed to bring the National Forests into full working order can only be realized by business men, but these are poorly represented in Congress.

At the head of his speech, which has been widely circulated, the following resumé of the charges is printed:

The national forest system is now and always has been to the interest of the railroads, the Weyerhaeuser syndicate, and other private timber owners.

Millions of acres of the best timberland beneath the flag have been given to the railroads, acre for acre, in exchange for barren, worthless land in the national forest reserves.

Every dollar's worth of timber taken from a national forest has cost the Nation $2.

The national forests, containing $1,045,000,000 worth of standing timber, are so controlled that they give a gross return of less than one-tenth of 1 per cent., less than half the cost of administration.

The national forests as administered pay 6 per cent. on a valuation of 17½ cents per acre.

Sixty-five million dollars worth of timber in the national forest reserves is annually kept off of the market and rots in the forest.

At the present rate it would take more than 25,000 years to cut over once the land in the national forests.

The national reserves that contain some of the most valuable forests on the globe have furnished the people, for the last eight years, timber of the value of 1 cent per annum from each acre, and no more.

By the national forest system the State of Washington receives $14,400 annually, and has taken from it more than $7,500,000 each year.

There would be room, no doubt, for improvement of the Service, as there is of any human institution, but it should not be allowed to be made by its enemies or grafters!

In this connection, Mr. Graves has issued an enlightening bulletin explaining the manner, amount and method of timber sales, and showing the absurdity of the fear of overcutting, since the sales in comparison with the estimated stand of timber are still small, and he expresses a hope that the annual business of the Forest Service would soon reach the amount of three billion feet, "which is about half of the estimated annual growth on the Forests."

We do not know how this estimate of growth has been or, indeed, can be made, for, in a general way, we may lay it down as an axiom that in the uncut virgin forest, there is practically no growth, and although not all the National Forests are made up by such virgin forest, the bulk probably is, and here increment depends on the rate of cutting. Be this as it may, in our opinion a much stronger argument for an increased cut may be made by pointing out that the timber now standing ready for the axe does *not* grow in volume (although it does in value), that it is a dead capital which can be made to actually produce only by the use of the axe and silviculture. There are supposed to be only 75 million acres of real timber in existence in the National Forests with a stand of less than 400 billion feet. If the government is to attempt, as we believe it should, a sustained yield management, we might assume an average rotation of 100 years, when the annual cut would be four billion feet of stock and whatever increment occurs (increasingly) on the cut acres, which if silviculture is practised, would, we believe, increase the cut beyond the 6 billion annually for the first rotation at least. But for the present, probably all that is to be done is to increase the cut as opportunity offers to sell at reasonable rates so long as there are preserved the conditions which make a sustained yield management eventually possible.

It is a pity that the National Forest Reservation Commission has recently turned down the acquisition of the Biltmore tract which had been offered for purchase to the Government under the Weeks' law. While the long term timber contract now in force on the property and the desirability of investing the comparatively limited appropriation in sections that are more in need of protection were influencing factors, very probably the fear of public criticism about paying a high price to a rich man played an important rôle in the final decision. Be that as it may, the Commission was ready to recognize the exceptional value which fire protection and road development had given Mr. Vanderbilt's land, although they were afraid that the public might not be able to see it, too.

The experience with the Vanderbilt tract leads one to wonder whether forestry in this country, even in places where the markets are good and there is favorable fire and tax sentiment, is attractive enough to private enterprise, although we thoroughly believe that in the long run a fairly wooded tract could be made to pay if handled for sustained wood yields and the by-products such as waterpower, game privileges, etc.

Although there was strenuous effort made to make the Biltmore forestry enterprise appear profitable from the start, this could be accomplished only by clever bookkeeping, namely by charging to other accounts in part expenditures, which would be required for forest management. It would be difficult to know how much of the large expenditures for road-building on park account should be charged to forest account; how much of the wages of game keepers are chargeable to forest ranger account, etc.

The trouble is that forest management for sustained yield requires invariably outlays in the present, which return interest only in a distant future. The sooner this is realized in this country the better. We have interesting experience, even in Germany, which tends to show that private forestry even there is much more poorly conducted and pays more poorly than the forest management of the States which can much better afford to wait for the long run. Every year the German Foresters' Association publishes the statistics of the forest management of all the State Forests and such communal and private forest administrations as are willing to give information, compiled by Dr. Schwappach. For the year 1911, over 69 per cent. of the communal forests are reported and merely 11 per cent. of private forests. Naturally, at least these latter comprise the larger holdings and the best administrations which are not afraid to come into the light. From these data—which are not estimates but regular book accounts for each unit of administration, giving in detail the material cut, the expenditures and incomes—we have compiled separately the data for State Forests, communal and private forests with the following result as to net yield per acre. State forests (approximately 11 million acres), $2.78; communal forests (1.5 million acres), $2.40; private (1.6 million acres), $2. That is to say, the best private management remains about 30 per cent. below average state management, the communal management being to some extent under state control remaining also below the State's results. This difference is still more striking if we take Prussia alone, where supervision of private forest is less developed. On the 7,400,000 acres (approximately) of state forests the cut was 73 cubic feet, under a conservative, sustained yield management, and the net revenue $2.26; the communal forest, some 1.2 million acres, with a cut of 50 cubic feet, brought about the same net revenue, attesting to good management under fiscal supervision; but 1,125,000 acres of private forest, with a cut of nearly 60 cubic feet netted only $1.70 per acre, showing poorer condition, poorer class of wood and probably overcutting; and we accentuate again that this is the record of the better administrations.

The States which have persistently spent money on improving their property and worked for the long run are reaping the benefit. In the last 20 years alone their net results have more than doubled.

An interesting development of the Lake Sunapee forest conference which was held under the auspices of the Society for the Protection of New Hampshire Forests was the emphasis placed by most of the speakers on the necessity and advantages of greater state activity in forestry matters, and on Federal, State and municipal planting on cut-over and barren non-agricultural lands. The earlier expectations of forestry practice by private owners have not been realized, and under the economic conditions at present existing, or which can be anticipated in the near future, intensive private forestry cannot be depended upon, because unprofitable. There were in attendance at the meeting two men, who for many years have been intimately in touch with the forestry and lumbering developments of the country. One of them was Dr. B. E. Fernow, who has been called the "dean of American forestry," whom the "American Lumberman" recently in an appreciatory write-up called "A veteran internationally famous in the promotion of practical forestry," and the other Captain J. B. White, one of the best known practical lumbermen of the country, who has been called the "dean of American lumbermen." These two men by separate roads, but with the common ground of long experience seem to have arrived, independently, at almost identical basic conclusions, to the effect that extensive forestry operations must be financed by the State or Federal government, and that artificial planting is the most practical method of regeneration. It is a distinct step in advance when authorities agree, and with the progress which has been made during the last ten years, it is not out of reason to expect that another decade will see the development of definite State forest policies adequate for our needs.

Another interesting fact was that as far as opinions were expressed, the proposition of Mr. Fernow that adequate provision for the future supplies should be made largely or solely by artificial restocking on a large scale seemed also to meet with general approval, the argument that natural regeneration at least in the mixed forest with our uncertain climatic conditions in much of our territory was even more unreliable than in Europe, seemed also to find no opposition.

It would, nevertheless, be desirable if, what unfortunately did not occur at the meeting, a broad, professional or technical discussion of opinions on the proposition could be had, and the QUARTERLY invites such discussion.

State control of private forests was declared by Professor Toumey as less desirable than state ownership of forests, and the experience of Europe bears him out. Nevertheless, the State of New York—which does not know enough how to manage its own forests, being prevented by the Constitution from doing so—proposes to go into the business of controlling the management of private forests. There is no other State that has tinkered more ineffectually in forest legislation than the Empire State. The McLelland-Jones bill has passed the legislature—the result of a co-operation of all the amateur associations which are engaged in saving the Adirondacks, some half dozen.

The keystone of the measure is Section 88, which provides for optional State control of lumbering on private lands. This section provides for the filing by the land or timber owner with the Conservation Commission of a plan for the development of such lands and cutting timber upon them in accordance with approved methods of forestry. On the approval of such plan by the Superintendent of Forests all lumbering on such lands shall be under his supervision.

In return for accepting this supervision, the land owner becomes entitled to the privileges provided by Sections 88-b and 89.

Section 89 provides for the exemption from taxation of the growing timber for a period of fifty years, or until the timber is cut. During this period the burden of taxation will be carried by the State, but when the trees are cut the owner shall pay taxes thereon in one lump sum.

Section 88-b provides for reforestation at cost by the State of private lands whose owners have complied with the provisions of Section 88, the cost of reforestation, with interest at 4 per cent., to be paid when the timber is cut. Meanwhile, all cutting shall be under the control of the Superintendent of Forests.

Section 60 provides for a reorganization of the Forestry Department under the Conservation Commission, with a Superintendent of Forests who shall be a technically trained forester of experience and removable only on charges, thus insuring a continuity of policy and removing the Forestry Department from politics.

Section 88-a provides for compulsory reforestation of unimproved non-agricultural lands on the watersheds of the State and within the State parks on which the forest cover has been destroyed, thus providing a safeguard against the action of those who do not accept voluntarily the State control provided by Section 88.

The bill also provides (Section 90) for the re-enactment of the penalty for violation of the top-lopping law and a limitation of its operation to a trunk diameter of three inches and over. It also provides for the purchase by the State of barren lands to be reforested and for the establishment of bird and animal refuges within the forest preserve.

We shall watch with interest the results of this new departure.

The use of Press Bulletins for the purpose of informing and educating the public and to make propaganda for enterprises of various sort is on the increase. The U. S. Forest Service, the Dominion Forestry Branch of Canada, the British Columbia Service, the Forest Commission of Indiana, and several other official departments, the Western Forestry and Conservation Association and other associations are busy in this direction. But the only technical educational institution that uses this means of advertising itself, and keeping itself in the public eyes and advancing thereby public education is the new New York State College at Syracuse University. This institution, successful in securing a $250,000 building and a $50,000 appropriation, in spite of Cornell University, to which one of the bulletins refers as "developing a department of Forestry in the College of Agriculture", appears to occupy every nook and corner of the State as regards forestry matters, with a number of different professional courses at Syracuse, a ranger school in the Adirondacks, a summer school camp, an experiment station in the Catskills; timber testing, paper pulp and destructive distillation plants; university extension courses throughout the State; giving expert advice to the Palisades Interstate Commission, and to every woodlot and timber owner who may apply.

If the deeds will correspond to the words, there is no doubt that the millenium of forestry will soon have arrived in the State of New York—and we wish them full success!—but for a little clause in the Constitution which prevents the State from benefitting of all this activity for its own lands. Perhaps this active education of the public which the College has entered upon, may also accomplish the repeal of that clause.

It is rather interesting to note that one of the bulletins gives Governor Sulzer's justification in signing the Bill appropriating for this College, in which he carefully and studiously avoids any mention of the forest department in Cornell University, which in the meantime drew a $100,000 building through the same Legislature.

Employment for Foresters.

The Allgemeine Forst- und Jagd-Zeitung for May, 1913, repeats the warning against overcrowding in the profession which was briefed in Forestry Quarterly, Vol. XI, page, 121. This warning is especially directed against the private career in which the opportunities for employment are very restricted so that the outlook for remunerative positions is well-nigh hopeless. For every available opening in private forestry there are scores of well qualified applicants so that completion of forestry curricula and all the expenses incident to the academic training may lead to a mere clerkship or actually force well-trained men into other fields of activity.

Even in America there is a similar danger of overcrowding in the profession, and, while a certain amount of competition for positions is undoubtedly beneficial to the quality of incumbents, an overproduction of foresters is to be deplored since it will inevitably hurt the profession, entirely aside from the injustice done young men by encouraging them to spend time and money in equipping themselves for a profession that has no room for most of them.

It is well enough to be optimistic over the possibilities of forestry in this country. It is even better to take heed of actual conditions which confront the neophyte. The cold, one might even say, the chilling facts are as follows:

The estimated number of students annually graduated from forest schools in the United States during recent years is 150 to 200. The number taking Civil Service examinations for the position of forest assistant in the Federal Forest Service was approximately 160 in 1912. The number of men appointed by the Forest Service in 1912, out of a register of eligibles numbering 86, was as follows: Permanent appointments, 35, temporary appointments 21, no appointments 30. Practically all of the 21 given temporary appointments will receive permanent appointments. The policy of the Forest Service is to open a lower or apprentice grade of work to graduates from forest schools, who have passed the Civil Service examination successfully. They are to serve two years, as we understand, under a Forest Ranger with no expectation of promotion until after this period of apprenticeship is completed. By this means the Forest Service will be able to use approximately 60 new men in all each year. Rangers for the National Forests, including those in the White Mountains and in the Southern Appalachians, will be secured locally; some of them will be men technically trained in the forest schools who are in their period of apprenticeship. It is not likely that there will be a large demand for specially trained rangers.

Thirty-four states of the United States have adopted some way of promoting forestry, either through a forestry commission, the appointment of a state forester, the organization of a forest service, or by assisting owners through the state experiment station or agricultural college. Of the fourteen remaining states, few are likely to require a state forest service. Additions of men to state forest services have been very small annually, and in states where the work is now established, no great enlargement is to be expected. For example, take the State of New York and assume that there existed no constitutional provision against cutting timber on the State Forest Preserves, only few technical men would be needed for various positions in the organization required to handle the forests under actual management. The State owns 1,644,088 acres of land. If this area were put on a fairly intensive basis of management, it could be divided into 32 units of forests of about 50,000 acres each. Under an organization similar to but much more intensive than that of the Forest Service in the National Forests, the following force would be required:

Supervisors in charge of forests,	32
Deputy Supervisors,	32
Forest Assistants (technically trained),	32
Expert lumberman and check scalers,	10
Rangers,	540
Total,	646

Of the total of 646 men required, only 106 need be technically trained men. This local demand, when it arises, can easily be met from the men graduating from forest schools as already organized.

Education: Our technical forest schools are well provided with instructing staff. The teaching of forestry courses in the agricultural colleges will require some men; however, there are many such courses already taught, and recently the annual demand in this line has been limited.

Consulting Forestry: The field for consulting foresters in the eastern part of the United States, where there is the best opportunity of building up private practice, is fairly well filled. There are about a dozen firms of consulting foresters in the eastern states, and already there seems to be a lively competition for work and a wonder whence their bread and butter may come.

Lumber Companies: Positions with lumber companies form a relatively untried field, which is opening up slowly. A few men go into the work yearly, but there is no definite basis for concluding that large numbers will soon be taken annually by such companies.

Forestry has developed very rapidly during the last ten years, and, for a time, trained foresters were lacking to meet the demands. The period of very rapid growth seems to be past and a normal but slower growth is in progress. Although the number of graduates going out this year from forest schools will probably find places in the course of the year, the principal forest schools have wisely raised the standard of instruction and of entrance requirements with the purpose of improving quality without regard to numbers of students.

Unless unusual conditions arise there is not likely to be a greatly increased number of forest school graduates required annually in the immediate future. The part of wisdom is to increase quality rather than quantity. Any policy of numerical aggrandizement which will provide "a forester for every tree" is to be strongly depreciated.

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To aid in the establishment of rational forest management.

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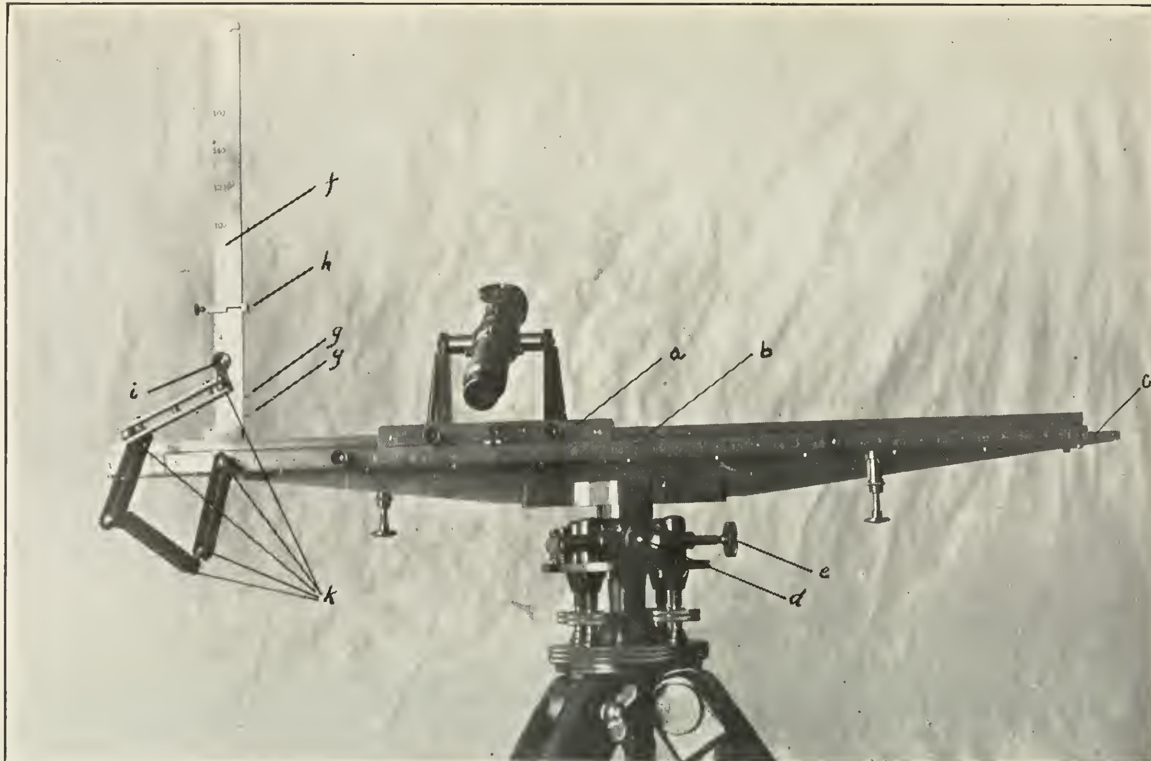

Clark and Lyford's Timber Scale.

FORESTRY QUARTERLY

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A NEW DENDROMETER OR TIMBER SCALE.

By Judson F. Clark.

Every aid to the judgment of the timber cruiser is welcomed by cruisers and owners alike, for at its best timber cruising is far from an exact science.

There is only one measurement that can be made on standing timber under woods conditions that is at once quickly and exactly made, namely the diameter at breast high. But this measurement taken by itself is of little value, for different trees of the same kind and having the same diameter at breast high may vary 100% or more in their merchantable contents, according as they taper more or less rapidly in the log portion of the trunk.

The cruiser sizes up the merchantable length and its top diameter to the best of his ability by his eye and on the accuracy of his judgment depends the value of his cruise. It has always been the custom of the best cruisers to check their ocular judgment by the measurement of whatever windfalls they find on the ground and a most excellent practice it is, where there is no better way. But the occasional windfall in the virgin forest is known not to be an accurate index to the form of its neighbors and at best this check is only better than nothing.

The need for an instrument that would scale the log contents of standing trees as quickly and as easily as if they were felled has led to many attempts at instrument building, but heretofore there has always been some hitch in the practical working out of the problem under woods conditions. In some cases the instrument was built to be used at a certain distance from the tree to be measured, in other cases the distance could be varied but must always be measured, or the instrument had to stand on the same level as the tree measured, all of which conditions will be readily recognized as fatal limitations for effective work. It was also true that in most cases the measurements taken had to be converted into usable data by means of tables or diagrams, which consumed time and implied a large possibility of clerical error.

With a full appreciation of the requirements of a practical timber scale Messrs. Clark & Lyford, in collaboration with Mr. E. L. Kinman, of Vancouver, have designed the instrument illustrated herewith. The chief virtue of the instrument is its simplicity and the fact that it is a direct reading instrument both as regards the height and diameter measurements.

The principle of the diameter measurement is that of two parallel lines of sight. A telescope is mounted on a sliding rider (a) which slides on a bar (b) which bar in turn slides on a base bar (c). This enables the telescope to slide from left to right a total distance of 42 inches and therefore to measure the diameter of any tree of this size or under. Inasmuch as the breast-high diameter is measured with a tape this is a sufficient range for practical purposes.

For the purpose of measuring up a tree or group of trees the instrument is set on the tripod and levelled by means of the levelling head shown in the illustration in the usual way.

On loosening the clamp screw (d) the bars may be revolved so as to bring the instrument in position to measure any tree in plain sight, regardless, of course, of distance from the instrument. When the telescope is brought approximately in range with the left side of any tree the clamp (d) is tightened and the fine adjustment is made with the tangent screw (e). Having brought the cross hairs in the telescope to the side of the tree to be measured, the telescope is slid to the right till the cross hairs reach the other side of the tree, and the diameter of the tree at this point is then read direct in inches and tenth from the scale on the bars, and is, of course, exactly equal to the distance the telescope was slid along the bars.

The device for measuring the height of any point measured for diameter is equally simple and direct reading. The upright standard (f), which folds out of the way when not in use, is provided with two fixed pins (gg) and one moveable pin (h). To measure a tree an assistant places a rod bearing two targets exactly 10 feet apart aaginst the trunk. The cruiser then adjusts the eyepiece (i), which is mounted with eight universal joints (k) which enables it to be placed in any desired position, so as to bring the two fixed pins on the standard (gg) to coincide with the centers of the targets on being viewed through the eyepiece. Having done this the moveable point (h) is moved into a position so as to be in line with the eyepiece (i) and the point on the tree to which it is to be measured. This done the length of the log to the measured point may be read from the position of the sliding pin on the standard.

By the use of this instrument a cruiser and one assistant may scale the contents of about 200 trees in a day, and all readings being direct—the log length in feet and the diameter in inches—the danger of error is practically eliminated.

The chief use of this instrument so far has been to check a cruiser's judgment as to the scaling qualities of the timber on a tract. The scaling of the exact contents of a few hundred trees on each job being the best possible basis for adapting a volume table for use on any particular type of forest. It has also been found most useful in determining the scale of timber cut in trespass where the logs have been already removed and where the tops have been misplaced either during the removal of the logs or by excessive "throw" from the stump in falling, such as always occurs on slopes. In such cases the stumps are carefully measured and the scaling qualities of the trees cut are determined by scaling the taper on the standing timber immediately adjoining the area cut.

SOME ASPECTS OF EUROPEAN FORESTRY.

By A. B. Recknagel.

VIII. Methods of Natural Regeneration in Austria.

In his well-known book on Methods of Regenerating Stands,* Oberforstrat Reuss clearly establishes the thesis that: Since no form of reproduction is adapted to all conditions, the simplest method of producing a crop without sacrificing the soil is the sole criterion between natural and artificial reproduction and between pure and mixed stands.

This is the principle which governs the choice of regenerative methods in Austria.** However, before describing the methods of natural regeneration commonly used in Austria, it seems expedient to review briefly the various methods of silviculture in the light of Reuss' illuminating classification.

In the first place, Reuss distinguishes between regeneration by seed and regeneration by coppice; the former divides into natural reproduction and artificial reproduction.

The methods of natural reproduction schematically divide into:

1. Natural seeding from above, i. e. by means of seed trees left more or less equally distributed over the felling area;

2. Natural seeding from the side, i. e. partial or entire clear cutting.

In the former, the reseeding is by means of seed-trees left more or less equally distributed over the felling area. Where these seed-trees are of all ages, i. e., where all the trees of seed-bearing age take part in regenerating the stand (as in virgin forest) the method is called that of *selection*. Where the seed trees left are approximately even-aged and the merchantable timber is removed in successive fellings at relatively short intervals, the method is that of *shelterwood*. In the selection method the period of regeneration stretches over the entire rotation; the resulting stand

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*"Die Forstliche Bestandesbegründung," Berlin, Julius Springer, 1907.

**Nothing of what follows in this or subsequent articles about Austria necessarily applies to Hungary, since the difference of race and lauguage have resulted in all but the political separation of the two countries.

is all-aged. In the shelterwood method the period of regeneration is definite, theoretically not to exceed 10 to 15 years; the resulting stand is approximately even-aged. In practice the two systems are often combined for greater flexibility (see article VI, the Baden Practice) and then the period of regeneration may be 30 to 50 years. This is the *shelterwood-selection* method (femelschlagbetrieb). Under this head come, also, the modifications such as the *shelterwood-group* method, the method of *border cuttings**, and the *strip-shelterwood* method (see article VII of this series).

The methods of natural reseeding from adjacent stands presuppose a light seed of great carrying power—such as, e. g., pine, spruce, larch, aspen, and birch. This source of seed is often supplemented by isolated seed-trees (of wind-firm species) left on the felling area. An abundance of seed maturing and being liberated over a considerable length of time is also requisite, since unfavorable winds often prevent the seed from reaching the felling area. These requisites restrict the methods to species such as those named, and render them far more uncertain than shelterwood regeneration. The clear cutting of the area induces soil deterioration and a choking growth of grass and weeds, especially where re-seeding is delayed. The unreliability of these methods makes them chiefly valuable as an accessory or precursor to artificial regeneration. The methods are:

Clear cutting in strips—the *strip method.*

Clear cutting in patches—the *"well" method.*

Clear cutting with *scattered seed trees.*

In the first, other things being equal, the narrower the strips the more complete the re-seeding. But this requires more "points of attack" which is turn increase the danger of windfall.

The "well" method takes advantage of any holes in the stand caused by wind, snow or the like, but also opens similar holes thus increasing the danger from these elements. It is used only in uneven-aged stands of resistant species, such as oak, and other hardwoods. The "holes" should not, ordinarily, exceed a quarter acre in size.

Clear cutting with scattered seed trees, is the oldest method of natural regeneration, dating from the fifteenth century. This

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*See Proceedings Society of American Foresters, Vol. 7, No. 2; "Border Cuttings: a Suggested Departure in American Silviculture."

method alone is seldom applicable in regenerating stands since it is too unreliable. Aside from the danger of windfall, the method presupposes species with seed of great carrying power, and a very receptive soil. Its true role is in connection with artificial regeneration,* where the scattered trees not only introduce a welcome variety of species and age into the regularity of the plantation or sowing, but also put on an additional increment greatly accelerated by their free position. Since wind-firmness is requisite, the method is applicable only to species such as pine, larch and hardwoods with winged seeds (ash, maple, etc.) If more trees are left, groupwise or singly, the method approaches that of shelterwood regeneration already considered.

Such, briefly, are the methods of natural regeneration. Their application in Austria will next be considered, but in so doing, the reader should never lose sight of the fact that natural regeneration is none too reliable, even at the best; for it to succeed requires good soil and site. Where seed years are rare and scant, where the soil is unreceptive, where climatic factors are adverse, no good results can be expected. Groups or patches may be regenerated naturally even where conditions at large are adverse; the point is not to expect Nature to supply everywhere the prompt regeneration which the economic necessities of man and the requirement of a sustained yield, dictate. Have patience—or else restock artificially!

The methods of regeneration in Austria vary according to the species and the accessibility of the region. For example, the silvicultural methods in the large pineries south of Vienna are every whit as intensive as those practised in the pineries of Prussia (see Article II of this series). But in the mountain regions—in the Austrian Alps of Western Austria and especially in the long ranges of the Carpathians of Northern Austria—similar conditions are far more extensive than in any parts of Germany or France. The reason is simple—Austria (1900) had an average population of 41 persons per square mile, Germany 63 persons per square mile, and France 44 persons per square mile. Furthermore, Austria's population centers in the cities; the agricultural plains and the mountain regions are sparsely inhabited. The timber in some of these mountain regions, espe-

*See Article III of this series: "Management of Pine in Prussia."

cially in Eastern Austria has been opened up only in the last few decades; virgin timber is still being cut in the Carpathians. Not for the needs of the population—but to supply the world markets have these remote stands been made accessible.

There has never been a general timber famine in Austria, such as that which threatened Germany before the advent of railroads and gave birth to the science of forestry. Austrian forestry is an off-shoot from the German parent stem, but it has developed along its own lines, solving the problems peculiar to the country. It is the very variety of these problems which makes their methods of solution particularly instructive. The small private owner is still practicing his so-called selection fellings (usually over-drawing his forest bank account) or, most fatal improvement, is cutting clear on large areas with indifferent restocking thereof, despite the mandates of the law that cut-over areas must be adequately restocked within a certain period of years. Disregarding these barbaric practices and turning to the methods pursued on government forests and on the large private holdings, these may be summarized as follows:

The selection forest is found intermediate between the protective zone (upper slopes) and the zone of greatest utilization. Cutting must be careful, in order not to invite disaster, and confined to the largest trees, because these alone are profitably merchantable at such elevations. In general the treatment is similar to that described for Bavaria in the preceding Article VII of this series. The selection forest begins at an average elevation of 4,500 feet in the limestone formation, 5,000 feet in the archaic ranges, and is always coniferous.

Not only do the difficulties of natural regeneration increase markedly with the elevation, but it must also be remembered that despite its approximation of nature's methods, the regeneration of all-aged selection forests requires much more care and knowledge of natural laws than does the regeneration of even-aged high forest; for in the selection forest all individuals of seed-bearing age, be they young or old, desirable or undesirable as trees or as species, take part in the process of regeneration. Every effort is made, therefore, to have only the mature, thrifty trees take part in the re-seeding; the stand is kept as dark as possible, not only to furnish the maximum protection, but also to keep the younger and weaker trees from producing seed and regenerating the stand with inferior stock.

The clear cutting in strips, as practiced on the lower slopes in coniferous stands, is done on a far larger scale than one sees it elsewhere. The name "strip" scarcely applies; for it is the placing of each year's felling next to that of the preceding year, until the felling area sometimes is half a mile in width. In the past, and even now in the more remote regions, this was necessitated by the economic conditions—it did not pay to render a certain logging unit accessible, unless the felling areas could be concentrated. But now, as economic conditions are improving and foresters are universally coming to realize the dangers of large felling areas (snow, wind, fire, insects, fungi, etc!) the tendency is strongly toward a narrowing and scattering of the felling strips; a width not to exceed the height of the tree is aimed at.

Of course, with such wide strips—and even with the narrower ones—natural regeneration cannot be relied on, though scattered seed trees are usually left of desirable, windfirm species, to introduce variety into the artificial restocking.. The larch plays a remarkable role in this respect; scattered seed trees of larch can be counted on to produce an admixture of their seedlings on almost every felling area. Sometimes the larch reproduction is actually too dense; for pure stands of larch soon go to pieecs because of mutual over-crowding.

The cutting of the strips progresses against the prevailing wind direction, as determined by careful local observations. After cutting, the brush is burned in windrows, or left to rot in low piles, or scattered. There seldom is a market for these faggots in Austria. After lying fallow for two years (three years if the area is very extensive), the area is restocked artificially by one of the methods described in the following article IX of this series. The scattered seed trees introduce their offspring into the stand, occasional patches of advance growth survive the felling, and soon what looked like a mountain pasture, is a thrifty young stand.

That this process has been successfully carried on over many thousand acres in Austria, is due directly to the freshness of the soil and the greatly favoring climatic conditions such as long growing seasons and much precipitation. In places, large clear areas have even reproduced naturally though this is too fortuitous to be made the basis of a method of management even under the most extensive of conditions.

The system of leaving scattered seed trees to aid in regeneration and for the sake of additional increment, has been admirably developed by the Chief Forester of Prince Liechtenstein, Oberforstrat Wiehl. He leaves 24 to 32 elite trees per acre, choosing only the healthy, straight trees with full, rounded crowns. The trees are chosen from among those whose diameter is less than that of the arithmetical mean trees—i. e. they are smaller in diameter than the average tree. Of hardwoods, oak, linden, maple, ash, beech are the first choice; of conifers, larch, pine, fir and only in very sheltered places, spruce. In order to accustom the trees to their future isolation, they are selected as far in advance as possible, marked by lightly chipping the bark in a ring at breast-height and gradually freed from encroaching neighbors. Despite this preparation, however, wind, snow, frost, ice, sunscald, lightning stroke, fungus and insects levy a heavy toll so that of the original 24 to 32 trees per acre only 10 or 12 usually survive. Nevertheless, experience has shown the desirability of the method in three directions—1, additional increment; 2, stimulated seed-production, (because of the isolated position) thereby assisting in regenerating the cutover area; 3, the partial shade afforded by the reserves is highly beneficial to the young growth, both natural and artificial, up to its thirtieth or fortieth year, when the reserves would naturally be removed. The removal of the reserves has not proved unduly injurious to the young growth, except on very steep slopes. Finally, the leaving of scattered seed trees, singly or in groups adds a peculiar charm to the landscape, greatly mitigating the otherwise desolate appearance of clear cut areas.

However, these good effects depend very directly on the character of the trees selected. Where, under pressure of the economic conditions, only the "scrubs" are left, that is the gnarly, crooked, suppressed, unmerchantable trees, but little good need be expected. True, they will furnish some shade, some increment, and some seed, but the latter function is often directly undesirable. Other things being equal, the soundest seed is produced by the soundest trees; conversely unsound trees produce seed that is, to say the least, undesirable. Just how far mechanical defects are inherited is still a moot question among scientists but it is certain that the tendency towards inferiority is inherited; for like begets like. Only the elite must be allowed to take part in regeneration. (This is difficult enough of determination, since we can determine only the quality of the mother-tree and know nothing of the qualifications of the father-tree whose tendencies are also inherited!)

The hereditary tendencies are interestingly shown in some practical experiments which Dr. Zederbauer of the Austrian experiment station is conducting at Mariabrunn. Following Dr. Cieslar's famous experiments to show the differences in growth of spruce seed from different regions and different elevations. Dr. Zederbauer has refined the problem still further. Within the same stand and site, he selected seed from dominant trees and from suppressed trees of the same species, and sowed the seed in a nursery bed. The resultant plants show the most striking difference in growth and thriftiness, clearly pointing to the desirability of heeding carefuly the qualifications of trees left to re-seed cutting areas.

Important as this point is in choosing the scattered seed trees or "reserves" in clear cutting it is still more important in the practical application of the shelterwood—selection method. For here the entire regeneration aims to be by natural means.

As usually practised in fir, hardwoods, and occasionally pine stands of the lowest slopes and flats, the shelterwood- selection method is confined to two cuts. The first—a combined preparatory and seed felling—aiming to remove from 50 to 60% of the volume of the stand, and a second cut after 10 to 30 years to remove the balance, when regeneration is assured. In obedience to the facts of heredity cited above, the trees left in the first cutting are carefully selected for vigor and thriftiness. All inferior, diseased or otherwise unsuitable material is removed in the first cutting; however, extensive conditions of utilization often render this almost impossible of execution without undue expense. Sometimes though, it can be done even when the ripening seed is already on the trees.

The seed felling is sometimes made *after* the seed has fallen—as, for instance, in the early winter following an exceptionally heavy seed crop. This is especially good under more extensive conditions since it assures having seed from the best trees and also a greater amount of seed than usual. During logging, the seed is worked into the ground and thus protected from frost and rodents.

The degree of cutting aims to reach the happy medium of sufficient shade for protecting the young growth and sufficient light for its thrifty development. In dry sites the Austrians sometimes cut more heavily, so as to ensure the seedlings being reached by the precipitation, at the same time recognizing the danger from weeds and grass if the cutting is too heavy.

As far as possible in logging, advance growth of desirable species is saved, and made the very basis of the new stand; naturally, the subsequent seedlings tend to come up close to these groups. Despite the clumpwise character of the regeneration, it is essentially uniform and, for all practical purposes, even-aged.

Fail places are restocked artificially by methods outlined in the following Article IX. If the soil was not in receptive condition for the first seed crop, a superficial working of the ground just before the next seed year often secures good results.

In order to induce natural reproduction, undue accumulations of litter, humus, moss, weeds or grass are raked or hoed into heaps and burned. Occasionally the whole cutting area is actually burned over, where the accumulation of this ground cover is too great. Ordinarily preparing the soil for the seed by means of hoeing is prohibitively expensive; only in hoeing spots does it find a limited application. Cattle, sheep and hogs are occasionally driven on a cutting area in order to loosen the soil, stir up litter and humus and tramp out weeds and grass.

Austria exhibits some interesting departures in the practical application of the shelterwood method—thus the removal felling is almost always logged on snow, since this minimizes the damage to the young growth.

The brush is sold or given away, where possible; otherwise it is piled, often in windrows, and these burned where not too expensive, or else it is scattered as uniformly as possible. On areas where the brush has been burned, the reproduction of such species as spruce, is often surprisingly good.

The degree of subsequent cleanings and thinnings depends directly on the ability to market the product. In the more remote parts of Austria these operations are as yet impossible.

According as the methods of regenerating stands in Austria are applied by definite compartments, as in shelterwood regeneration, or indefinitely over the whole type, as in selection forest, two main management classes are distinguished. The compartment methods comprises 2/3 of the high forest area; the remaining 1/3 is selection forest.

The yield of Austrian timberland compares favorably with that of far more intensive countries such as Germany and France. The figures of *average annual cut per acre* for the last decade are:

German				
Württemberg	950	feet,	board	measure.
Saxony	910	"	"	"
Baden	899	"	"	"
Bavaria	666	"	"	"
Prussia	607	"	"	"
France				
State Forests (12% of total)	519	"	"	"
Austria				
State and Private Forests	510	"	"	"

This latter figure is the more creditable since only 60% of Austria's timberlands are under organized forest management.

With the possible exception of Norway, Sweden and Russia, the variety of forest conditions encountered in Austria more nearly approaches that met with in America than do the conditions in any other European country. As with us, they run the whole gamut from virgin forest to pleasure parks. The lessons which Austrian experience teaches are, therefore, particularly well worth heeding. None more so than those concerning methods of regeneration. These are:

1. Since no form of reproduction is adapted to all conditions, the choice should fall on the simplest method of producing a crop without sacrificing the soil.

2. Natural regeneration is seldom complete, even under favorable conditions of soil and site; it always requires patience and more or less artificial restocking of the fail places.

3. The stress of economic conditions—accessibility and market—often leads to larger felling areas and a greater per cent.

of the stand removed than is silviculturally desirable. The usual result is much grass and weeds, scattering young growth and the necessity of artificial restocking. This can be avoided by a gradual reduction in the size of felling areas and mitigated by the leaving of scattered seed trees of windfirm species as reserves on areas otherwise cut clean.

4. In Austria, as in America, economic conditions often necessitate the removal of all the best timber and the leaving of the scrubby, diseased, ill-shaped, unmerchantable stuff. The seedlings from such obnoxious parents are unfit to form the future stand and should be used only as a last resort. In their stead the additional increment, partial shade and vigorous offspring of thrifty seed trees will repay leaving them scattered or groupwise as "reserves" in clear cutting; in shelterwood regeneration it is equally important to remove the obnoxious individuals in the seed felling or in preparatory fellings if these are possible.

5. Where, in shelterwood regeneration, a seed year anticipated the seed cutting, the usual cutting can be made to advantage *after* the seed matures.

6. Where natural regeneration fails, despite a good seed year, a superficial working of the ground just before the next seed year often brings about the desired results. A light, patchy cover of grass is no menace to re-seeding but a dense mat of weeds and grass usually precludes natural regeneration.

7. Too long a wait for natural regeneration entails a loss in timber yield and soil productivity. Where this loss approaches the cost of artificial restocking it is poor economy to wait any longer for nature to restock the area.

IX. Methods of Artificial Regeneration in Austria.

As Oberforstrat Reuss points out in his book on Methods of Regenerating Stands, * regeneraton by seed divides into natural reproduction and artificial reproduction. The methods of securing the former are discussed in the preceeding Article VIII. In the present article the methods of artificial regeneration will be treated under the guiding hand of Oberforstrat Reuss who is a

*"Die forstliche Bestandsbegründung," Berlin, Julius Springer, 1907.

recognized authority on the subject, not only in Austria, but in all Europe.

In Austria, as everywhere else, the extent to which artificial methods are employed in regenerating stands, depends on its profitableness. But wherever the increasing prices of wood offset the interest on the initial investment of seeding or planting, there artificial methods of regeneration have crowded out natural regeneration; nature is slow and not so sure, especially on inferior sites.

Economic conditions, therefore, govern the time of introduction and the intensity of the methods of artificial regeneration used. Fortunately, Austria has an abundant labor class to draw on for this work.

For both seeding and planting, the derivation and treatment of the seed is a matter of prime importance. Despite the late Dr. Mayr's divergence * the consensus of opinion ** is that heredity as well as environment must be considered in growing trees. In its practical application this means that only the best seed of the best trees should be used to regenerate stands; what this means in natural regeneration was pointed out in the preceding Article (VIII). In artificial regeneration the practising forester has often overlooked this all important matter and, because it was so convenient and so much cheaper, has contented himself with buying seed of doubtful pedigree, satisfied if the germination per cent. stood at the proper figure. But the germination per cent. is no index to the hereditary quality of the tree; spruce seed from the plains of Bohemia even though of 90% germination, will not be suited for use in the high Alps. Realizing this, the most advanced of Austrian foresters are urging the collection of seed on or near the forest where it is to be used, and only from normal, thrifty sound trees.

The correct treatment of the seed after collection is also vital. The best practice follows the initiative of Prussia (see Article III "Management of Pine in Prussia").†

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*Der Waldbau auf naturgesetzlicher Grundlage," Munich, 1909.

†See also "The Equipment and Operation of a German Seed Extracting Berlin, 1905.

*See also "The Equipment and Operation of a German Seed Extracting Establishment," F. Q., Vol. IX, No. 1, and the article on the same subject in F. Q., Vol. X, No. 2.

The methods of artificial regeneration schematically divide into:-

1. Regeneration by direct seeding: a, Over whole area (broadcast); b, Over partial area (seed spots, furrows, etc.)
2. Regeneration by planting:

Character of Plant Material:

- a. Wild stock.
- b. Nursery stock.
  - (1) Seedlings.
  - (2) Transplants.

Methods of Planting:

- a. Plants with naked roots.
  - (1) Singly.
    - a—In separate holes.
    - b—In furrows.
    - c—On mounds.
  - (2) In twos and threes.
- b. Balled plants.

Direct *seeding* aims to follow nature's methods. But because nature's profligacy in the quantity of seed used can not be followed, the dangers of frost and drought, of heavy rains, dense growth of weeds and grass, seed-eating birds and rodents, etc., are intensified to such a degree that in Austria direct seeding is used, in general, only where these dangers are minimal or the species are especially resistant or are unsuited for planting. Historically, direct seeding represents the step from natural regeneration to planting. The sowing of cones was the first attempt to usurp nature's role. This crude beginning was soon followed by the use of seed which was either sown broadcast on snow or mixed with equal parts of wheat, on clear cut areas after the brush had been burned as it lay. The results were, oftentimes, surprisingly good, probably due in great measure to the freshness of the soil, and the natural seeding in from adjacent uncut stands.

Where applied now, direct seeding is almost always preceeded by soil preparation and is partial rather than broadcast. The seed is sown in spots, or strips, or, in the case of large-seeded species like oak, dibbled in, singly. Partial seeding is preferred because it uses less seed, requires less soil preparation, and offers a better opportunity for the development of the individual plant. To counteract the increased danger of choking by weeds or grass, the seed is never sown up to the outermost edge of the prepared places nor on the prepared strips made less than ten inches wide.

The best practice tends to sow rather large amounts of seed per acre but never more than is necessary to ensure a fair stand; for experience has shown that it is easier, cheaper and better to fill possible fail places from a local excess of seedlings rather than to be forced to an unprofitable early weeding, or cleaning of a too dense stand.

The following table gives the amounts commonly used for the principal species. This is on the basis of broadcasting; for partial seeding the actual area to be sown is calculated and 10-20% of the tabulated amount added since partial seeding is always denser than is broadcasting:

Oak	3.0 to 9.0 bushels
Beech	3.0 to 5.0 bushels
Maple and ash (wingless)	34.0 to 43.0 pounds
Spruce	6.0 to 9.0 pounds
Fir	42.0 to 54.0 pounds
Scotch Pine (P. silvestris)	6.5 to 7.5 pounds
Austrian pine (P. Austriaca)	11.0 to 13.0 pounds
Larch	13.0 to 15.0 pounds

In case the wings have not been removed from the seed 30-50% more is reckoned.

Soil preparation is considered a *sine qua non* for success in direct seeding. With broadcasting, the entire area must be prepared, more or less, whereas in partial seeding the prepared area is much smaller, hence can be prepared far more economically.

As a preliminary step, all weeds, dense brush and grass growth are removed. When dry, these obstacles are sometimes cleared away by lightly burning over the area. The next step aims to remove all mat-like covering of grass-sod, dense mosses, or layers of raw humus. This is usually done by means of a hoe. Where possible, this material also is burned and the resulting ash scattered over the seeding area.

For the actual stirring of the soil, various tools are used; plows and harrows are possible only where the topography and soil are favorable; ordinarily in mountainous or stony country, the hoe is considered the most practicable.

There is divergence as to the best time for soil preparation but the opinion is growing that preparation in the fall is preferable to that in spring; for it allows the soil time to undergo the necessary physical and chemical changes; in this process the winter frosts and absence of weedy growth are especially efficacious. Fall working also brings any insect broods nearer the surface where the winter frosts can penetrate and destroy them.

The sowing itself is universally done in spring; for although nature herself usually sows in fall, she offsets the manifold dangers by an abundance of seed which man can not afford. The sowing is therefore done in March, April or May, the time being gauged so that the seed will not germinate until after the danger of spring frosts is past.

The method of sowing varies with the size of the seed and its requirements. Large seed, such as acorns, are usually dibbled into the prepared ground, singly or in pairs. Small seed, like spruce, pine, fir, etc., is sown as a farmer sows wheat. Where seed of several species is to be sown, each is usually sown separately. A simple instrument much used is the seed horn. For stripwise sowing under favorable conditions Hacker's Rillensäer is sometimes used. Under very intensive conditions on level sites and stoneless soil Drevitz Drill machine is used for sowing pine (see Article III Management of Pine in Prussia) but in the vast majority of cases the sowing is done entirely by hand and the simplest tools are used to cover the seed with soil. This covering of the seed is occasionally done by means of a plow (furrow sowing) or harrow (broadcast sowing); but in general a rake is used for the purpose (partial seeding). Some advocate the driving in of cattle on sowing areas where the soil is rather loose, in order to stamp in the seed. On hard, baked soils the seed must be covered with earth from near-by areas; but the chances of successful seeding under adverse conditions are so minimal that planting rather than sowing is used on such sites.

In order to protect the area after sowing, from sun and wind, brush is most commonly scattered or separate branches are stuck up in rows. Against animals (rodents) the only real protection is the proper choice of site, the adequate preparation of the soil and the hastening of germination by sowing at the right time and in the most favorable manner.

Among subsequent dangers, the most serious is a choking growth of grass or weeds. On broadcasted areas especially, since even the partial weeding of sowing areas is exceedingly expensive. Hence direct seeding of very weedy or grassy sites is never attempted. Where weeding is practiced, the whole plant is seldom pulled out (expense!) but merely the fruiting heads of the weeds cut off, or, where the growth is very dense, the whole mass of weeds cut down with a grass hook.

A necessary adjunct to direct seeding is the filling of fail places, this is due during the 2nd, 3rd or 4th, year after sowing; the necessary plants can usually be obtained from patches that are stocked too densely. Balled plants are much used for the purpose. Where the growth is too dense, the less desirable seedlings are pulled out by hand during the second or third year after the sowing.

Regeneration by *planting* is a later development than seeding. The first impetus beyond that of merely completing sowing sites, was given by the large, denuded areas which resisted all attempts at re-seeding. In Austria, this was at the time of Maria Theresa, about the middle of the 18th century. But it remained for the nineteenth century to perfect the theory and practice of forest planting. This deevlopment was accelerated by the strikingly better results obtained by planting rather than seeding—the failures, patchy character and slower growth of the latter, all contributed to boom the former; the final convincing argument was as usual the economic one—increasing prices for wood made planting profitable and haled in an era of universal planting which has lasted till the present day, despite the soundness of the reactionary arguments for regeneration by natural methods.

The use of wild stock* dates from the earliest days of planting and still exists to fill fail places, as e.g. blank spaces in direct seeding areas, or as material for transplant beds. Plants with

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*This includes cuttings of hardwoods (willow, aspen, etc.) which are used only in willow holts, coppice forests and as a shelter for a better crop. It is never used as a means of propagating high forest.

not too large a crown and root development are chosen. Seldom are plants older than two or three years taken; for after that age the roots have attained too great a depth for successful removal.

For the vast majority of planting operations, nursery stock is used. Every Austrian Forest has one or more nurseries. These are often very unpretentious in appearance but usually very efficacious in results.

Nurseries are both permanent and temporary. The former have the advantages of concentration and are preferred for commercial purposes (or as supply nurseries). But the permanent nursery entails high costs—manuring is necessary to preserve soil fertility, the plant material has to be transported further after it has been grown, but, worst of all, the growth conditions at the permanent nursery are seldom such as to fit the plant for the rigors of the planting site.

These considerations argue strongly for the temporary nurseries near the planting site and explain why small, "wandering" nurseries are so general in Austria.

Similar considerations apply in the choice of sites for nurseries. Rather than select the richest soil and most favorable site, the best Austrian practice realizes that stock grown under such conditions often fails on the poorer planting sites. As Oberforstrat Reuss puts it: "The growing of nursery stock is not an end in itself but merely the means to an end." He illustrates this with the instance of a Bohemian Forest where spruce plantations failed repeatedly due solely to the fact that the material used was too good for the planting site—i. e. the favorable growth conditions at the nursery unfitted the plants for the rigors of the planting site. As soon as the stock was grown under conditions similar to those at the planting site, it succeeded perfectly!

As regards slope and exposure, the best practice in Austria chooses for the nursery a very gentle slope rather than a dead level, because of better drainage. South and East exposures are avoided because of the drying effect of wind and sun; north and northwest are favored. But where all other factors than exposure are satisfactory this point is often waived; for it is of minor importance compared to a suitable site. In determining the suitability of a certain site due weight is given to having the nursery in an open place, i. e. not in narrow canyon—like valley, or near swamps and ponds because of the intensified frost danger.

The requisite area of seed beds and transplant beds is determined according to actual experience in raising stock in the locality, however the following average figures are of interest:

For 1000, 1 or 2 year old seedlings, broadcast sowing, ...	.6 to .7 sq. yds. approximately.
For 1000, 1 or 2 year old seedlings, sown in drills, ...	.9 to 1 sq. yds. approximately.
For 1000, 3 year old coniferous transplants, ...	10 to 14 sq. yds. approximately.
For 1000, 4 year old coniferous transplants, ...	15 to 16 sq. yds. approximately.

The principles of soil preparation are those in common use everywhere, its relation to the development of the tap root has, however, been particularly emphasized, namely, that a loosening of the soil to a *moderate* depth is best since it encourages the development of lateral roots whereas too deep a loosening of the soil merely results in excessive development of the tap roots. As important therefore as it is to work the ground as deeply as possible before direct seeding, in nursery sowing this optimum lies in a moderate depth * Similarly too close a spacing often drives the individual plant to develop tap roots rather than lateral roots.

It is figured that the one year old coniferous seedling requires at least .39 square inches of growing space, the two year old 1.56 sq. inches, and the three year old seedling from 3.51 to 4.68 sq. inches.

There is much contention as to the use of manure in seed beds. Of course it does accelerate growth—this, the opponents of manuring say, is its chief danger; for a plant so pampered is unfitted for the privations of the planting site. It must also be

*Attempts of Austrian foresters to prevent the development of tap roots by means of an artificial, impenetrable substratum according to the methods outlined by M. Levret in his "Note sur deux noveaux procédés ayant pour effêt d'activer le developpment des racines laterales du chêne dans la culture en pepinière" (Paris, 1878), failed of results in tap rooted species, such as oak and pine, which penetrated crevices in the barrier, but worked well in encouraging the lateral development of flat rooted species such as spruce.

noted that manuring affects the development of shoot rather than root. Where temporary nurseries are used, manurIng is seldom necessary because of the inherent freshness of the soil. Indeed, here the practice is to use the areas once as seed beds and, following this, as transplant beds. In permanent nurseries ing is, of course, practical.

The quantity of seed sown in the nursery varies according to local experience; the following figures are approximate:

Species	*Germination Per Cent (Average)*	*Quantity of Seed Sown Per square yd. of seed bed.*	
Oak	80%	4.82 to 5.36 lbs.	
Beech	75%	1.07 to .75 "	
Hornbeam	70%	.60 to .75 "	
Alder	40%	.15 to .18 "	
Maple	50%	.60 to .72 "	with wings
Ash	50%	.54 to .60 "	" "
Elm	40%	.30 to .36 "	" "
Birch	20%	.12 to .15 "	" "
Spruce	80%	.15 to .24 "	wingless
Fir	50%	.18 to .60 "	"
Scotch Pine (P. silvestris	75%	.21 to .24 "	"
Austrian Pine (P. austriaca)	75%	.42 to .54 "	"
Larch	40%	.27 to .30 "	"

Broadcasting in the seedbeds is not customary unless the seedlings are to be field planted directly—i. e. not transplanted. Drill sowing, it is felt, affords a better opportunity to weed and to cultivate, offsetting the cost of the additional space.

The best practice frowns upon the preliminary soaking of seed to encourage germination, since this hurries nature and exposes the seedling to damage by drought in the drier seedbeds.

Overhead covers of brush are used commonly, more than are lath frames—at least in temporary nurseries. Mulching with leaves or moss is usually confined to the space between the drills. Later in spring this is removed, partially at least, and small branches trimmed of their twigs but with the bark on, or small pieces of cull plank, or straw matting or even cheap tiles, are laid between the drills to preserve soil moisture, to prevent weeds and to mitigate frosts.

Since overcrowding in the drills is almost inevitable, an important measure where seedlings are left two or even three years in the seed beds, is thinning out the weaker ones wherever there is overcrowding. By this simple expedient, many thousand seedlings are saved, which otherwise would have perished through overcrowding in the interior of the drills. This thinning in the drills is found advantageous, also, where seedlings are to be set out directly, without preliminary transplanting.

Quite a keen battle rages about the necessity of transplanting. Foresters practising under favorable soil conditions are almost all against transplanting* whereas those who work on unfavorable sites swear by transplanting. The conclusion to which these experiences point, is that for success on poor sites a strong, well-rooted transplant is indispensable. To properly plant a seedling with its elongated root system has been found far more difficult and expensive than where shallow rooted transplants are used, this item oftentimes offsetting the additional cost of raising the transplants.

As with seed beds, the soil is not loosened too deeply; else the development of a deep root system is encouraged. The best practice loosens to a depth of only four to six inches for normal seedlings 1 or 2 years old (especially spruce!). This is the usual age of transplanting**; the seedlings are usually kept two years in the transplant bed; for this period represents the happy mean between the time required for the plant to recover from the shock of transplanting and yet secures the maximum benefits of the isolated position without the unwieldly increase in size if left a third year in the transplant bed. Thus the great majority of plant material is three or four years old (1-2 or 2-2 stock).

The most propitious time for transplanting is considered to be early spring before any vegetative activity begins. The latter

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*Compare Gustav Wagener: "Der Waldbau und Seine Fortbildung," Stuttgart, 1884, who calls transplanting "an expensive, useless, unnecessary trick"!

**Hardwoods which do not keep well over winter such as maple, ash, hornbeam, etc., are gathered in the seedling stage (first year usually) wherever there is an excess of natural regeneration, and are immediately dibbled into carefully prepared transplant beds. Excellent results are secured; especially in the development of a sturdy root system.

part of April is usually chosen since it fills this requirement except for a slight root activity and yet avoids the danger of heavy frost. Nor is there much hesitancy in transplanting even later, especially conifers on favorable sites. Where the rush of other work prevents timely transplanting, it is usual to take out the plants early in March and to heel them in at some cool place. The plants are then covered with moss, brush or some other non-conductor of heat and kept until an opportunity offers to set them in the transplant bed. Occasionally they are placed in regular snow pits. Oberforstrat Reuss cites an instance where he lifted the plants in fall, heeled them in immediately and successfully transplanted them the following spring.

An interesting practice in transplanting is the trimming of the roots to a suitable length. The shoot is seldom trimmed unless as in hardwoods, transplanting is repeated several times. According to Oberstrat Reuss' experiments* this trimming of the roots if carefully done is directly beneficial in creating a compact, shallow root system.

The best practice in transplanting favors fairly wide spacing (4 or 5 inches apart is usual) since experience has shown that narrow spacing results in a tendency to develop the roots downward rather than laterally. For transplanting various boards and other mechanical devices (Hacker's Transplanting machine)** are used but the tendency is away from these and towards the more natural transplanting by hand with only a hoe to help, whereby each plant is assured its proper position. Quantitatively the instruments are superior, but qualitatively the results can not equal those of hand work—this, many think, is well worth the extra price. "Puddling" is being abandoned because it tends to paste the roots together and forces the laterals down too deep in the hole, and because the good effects are equally well secured by a cover of damp moss.

To sum up, the Austrian nursery practice aims to grow stock with a normal root system; for this is prerequisite for successful planting. But even the best of stock can be, and is, ruined by careless, incorrect planting, hence the greatest attention is paid

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*Mitteilungen des Oesterreichischen fortslichen Versuchswesen II. 2. 1879.

**See "Forestry Quarterly," Vol. IV, p. 154.

to this, the most important step in the process of artificial regeneration.

The best planting practice aims to place the roots as nearly as possible in the same position which they occupied in the nursery—i. e. the same dept and lateral spread—in order that vigorous growth may be resumed with the least delay. In lifting and transplanting stock, the aim is always to preserve the root system intact and uninjured.

Although the period of winter dormancy is theoretically the best, yet planting at that season is of course impracticable. Hence early spring before growth begins or late fall, after vegetation ceases, is chosen as the nearest to this ideal. Early spring is preferred to late fall because at the former time the plant enters immediately upon its vegetative activity and hence promptly becomes adapted to the new environment, whereas if planted in fall the plant is subject to all the dangers of the new environment without being able to adapt itself thereto until growth is resumed in the spring. However, late fall planting is preferred to late spring planting since the change in environment is most dangerous during the period of active vegetation.

An interesting experiment made by Oberforstrat Reuss in 1876, proves this. Half of a large windfall area was planted early in March with four year old spruce transplants (2-2 stock). The other half of the area was planted with similar stock end of April.

The intervening weeks were marked by a "second winter" with cold, dry winds. Nevertheless the March planting showed by far the better development and a loss of only 4% in the first year, 2.9% in the second; whereas the April planting showed a loss of 19% in the first year and 7.5% in the second. The height growth of the March planting averaged 2.808 inches in the first year, whereas that of the April planting was but 2.067 inches.

Often, when pushed for time in early spring, the Austrian forester will take the transplants out of the nursery and heel them in some cool place covered with brush or will even place them in a crudely prepared snow pit—merely to prevent vegetation and so to lengthen the period of spring planting. That this heeling in is feasible even in fall and thereby the stock kept until planting time in spring was proven by Oberforster Teynil who in 1884, to prevent winter damage by game, heeled in during the fall 26,000 three year old spruce transplants (1-2 stock). These he planted the following spring and, for purposes of comparison, planted close by 8,000 of the same stock, just removed from the transplant beds. Even to this day no difference can be described in the development of the two plantations.

Hardwoods are almost always planted early in spring; for their root activity continues much later into autumn than does that of conifers.

Much difference of opinion exists as to spacing in planting. Up to late years there has been a marked tendency towards close spacing on the basis that a delayed closing of the crown cover encourages weeds and grass and a general impoverishment of the soil, also that the yield per unit of area is greatest with close spacing. Now the pendulum seems to be swinging back in the direction of wider spacing on the ground that the yield is much greater in the long run even though early thinnings are not possible—or necessary—and that the resistance of the single tree—and hence of the whole stand—to wind, snow, ice, etc., is undoubtedly much greater with wider spacing.

The best practice, however, remains conservative in this respect, preferring to remedy possible crowding by an early cutting out of the offenders to the almost irremediable dangers of soil deterioration. The happy medium is a matter of experience and can not be arbitrarily fixed for a whole Forest nor even for an entire cutting area, but must be varied to meet changing local conditions.

The Austrian Forest Experiment Station at Mariabrunn has experimented with various spacings for spruce and under average conditions a spacing of 4.9 feet, each way, seemed to give the best results.

A strong argument of those favoring wider spacing is the smaller cost; for, obviously, if with a spacing of 6½ feet only 2,500 plants are required for a given unit of area the cost in plant material is only one-fourth that of a spacing of 3¼ feet which requires 10,000 plants for the same area. This fact, together with the lack of market for the products of early thinnings has led to a wider spacing in the parts of Austria where conditions are more extensive.

An important step in planting is the careful culling of all inferior, unsuitable stock. Not only are diseased plants culled but also those whose roots are seriously damaged and abnormally twisted. Such plants, it is felt, have little chance to succeed, or, if they do, the twisted or injured roots would be very apt to die and thus to carry decay into the stem of the plant and so bring about its ultimate death. Where the injury to the roots is only a minor one, the injured part is often trimmed off, excessively long tap roots are also occasionally cut back, but, in general, root trimming is not favored since it is apt to weaken the plant and unfit it for its struggle with the new environment.

In order to avoid undue exposure of the stock, the actual planting operation is usually well systematized. The workmen are divided into three squads, one to dig the holes, another to plant and the third to bring the material to the planters.

Various methods of planting are used in Austria—e. g. the plant is set in single holes, in furrows or on mounds. In all these, the shape of the planting hole is, by the foremost foresters given the greatest attention; for it is obviously contrary to nature to force the normally spreading root system into a small, narrow, pot-shaped hole. Oberforstrat Reuss and other leading Austrian silviculturists urge the necessity of imbedding the plants in a sufficiently large, shallow, dish-shaped hole which allows the roots to be spread out naturally before covering them with earth, and enables the plant promptly to resume its interrupted growth.

The act of planting as practiced by Oberforstrat Reuss is simplicity itself. After choosing the site for the hole, any existing cover of weeds, grass, etc., is cleared away with a mattock and pulled back toward the left so that there is sufficient space for the dirt to be piled immediately next to the planting hole. This exposes the mineral soil which is now loosened by repeated blows of the mattock until all is finely pulverized. It is then pulled out and piled next to the hole, as far as possible on the right site thereof, taking care lest the earth become mixed with any loose bits of weeds, grass, etc., previously removed. The planter then selects from out the basket where it is protected by damp moss,* constantly renewed by the men of the "third squad," a suitable plant and takes it in his left hand. According to the structure of the root system he molds the loose earth at the bottom of the plant hole to correspond. Flat rooted species such as spruce, usually demand a flat topped hillock in the bottom of

*Puddling of the plants is not done, usually, for reasons cited above under transplanting.

the hole whereon the plant may sit and the lateral roots spread in all directions. Assured that all the lateral and other roots of the plant are in their normal positions, the planter with his right hand quickly fills in the earth piled convenient to his hand, until the surface of the hole is level with that of the surrounding area. The plant should then stand at the same depth as when in the nursery; should it be too deep it can be gently eased upward; if too shallow the planting has to be done over again. As a guide to determining the correct depth, new 'hands' are given a "planting stick"—a straight piece of lath some two feet in length which is laid across the hole to mark the level of the surrounding ground.

Convinced that the plant is set in correctly, the planter firms the earth of the planting hole by a light pressure of his flattened palms—and the planting is completed. The whole process takes much longer to describe than to do; it is free from any of the dilettante fussiness which characterizes some of the other systems. The cost of such planting averages about $6.40 per acre.

No pains are taken to remove all small stones mixed in with the dirt but care is given to having an ample supply of suitable earth, even at the expense of bringing it from near-by areas. However, the admixture of any loose bits of weeds or grass is most scrupulously avoided because, despite the beneficial effects of this material when it decays, the very process of decay demands an amount of water which the plant, especially on dry soils, can ill afford to spare.

Oberförster Konjas, in 1887, proved this conclusively by the following experiment. Under exactly similar conditions he planted 4 year old transplants of spruce (2-2 stock) some with pure mineral dirt and some with loose bits of grass and weeds mixed in the earth. Up to June no difference was detectable but after 6-8 days of drought the latter plants began to drop, many died in the following week, whereas of the former plants scarcely any showed ill effects. An investigation of the planting holes showed that the bits of grass and weeds were damp with moisture robbed from the thirsting roots of the plants.

Planting in furrows made about five feet apart is also practiced on favorable sites where it is markedly cheaper than the method just described. In a favorable instance the plowing cost only 40 to 50 cents per acre. The method of planting is the same as that already described.

Mound planting has been used on areas where the soil conditions are entirely unfitted for hole planting i. e. in the soilless weed covered limestone regions of the arid Karst and in very swampy sites. Here it serves the purpose of giving the plant a vigorous start in good earth, safe from the encroachment of choking weeds or well above the ground level of the swamp water. The method is as follows: The site of the mound is cleared of all grass, weeds and debris. On this site is piled earth from the near-by area taking care to avoid all loose bits of weeds and grass. The actual planting is exactly like that already described to lessen the drying effect of wind and sun, and to prevent heaving by frost and washing away by rain, the bits of sod are piled, grass down, around the mound.

The planting of two, three, or more plants in a single hole is a survival of the transition stage between regeneration by seeding and by planting. It is still used occasionally on adverse sites on the principle that if one plant dies its neighbor will probably survive.

The use of balled plants because of the high cost of transportation, is confined to filling fail places in sowing and planting sites where the material is easily obtained, and on exceedingly adverse sites or wherever cost is no object. Two and three year old plants are chosen for the purpose; older plants are too bulky and are too apt to have their roots injured in the process of lifting. A specially constructed hollow spade ("hohlborer") is used to lift the plant and to prepare the corresponding hole in which it is to be placed.

In his book, referred to above, Oberforstrat Reuss inveighs against what he calls the "instrument method" of planting. In this category he places not only the elaborate inventions of recent decades, but even the seemingly innocent and often used expedient of firming the planting hole with the foot. When carelessly done this often injures the tender bark or presses the earth together too compactly, so he will have none of it.

As for the many planting instruments he aptly says: "Without exception these devices are the result of short-sighted endeavors to reduce the cost of planting. They have done great harm to the forest and where ever they have been used they have been judged only from the one-sided standpoint of quantity, of expense, and of per cent. of loss during the first year. * * * Unfortunately their value has never been judged by the true standards of thriftiness and yield; else it would have been clear long since that all these devices fail in the essential of normally planted roots.

"The 'instrument methods' date from a time (the middle of the past century) when the enormous increase of planting had to be justified by a reduction in cost. This reduction the various devices accomplished and the higher cost of planting by hand seemed justified only it it was indubitable that the results were surer and better than by the use of planting instruments. Decades were needed to bring this proof of the superiority of hand planting in the actual stands; during these decades everyone strove for a cheapening of the planting process. Each forest region developed its peculiar methods which, specifically intended for local conditions, never were suited for general application.

"Visualize the processes of planting by means of variously adopted wedges, hatchets, hammers, crow-bars, etc., in all their details! How can these methods possibly secure the natural placing of the roots, the correct depth and horizontal position? Not only are the well-developed lateral roots whose length often exceeds by far the width of the narrow planting hole, forcibly twisted together and wedged in, but also the depth of planting can not be controlled, so that the plant is often buried up to its lowest branches and then belabored with various heavy utensils, by way of 'firming' it. Even the simple workman says 'This can not be good' and he is surely right, but the process is *cheap* and this fact brings it acquittal before the judgment seat of theory and of practice."

In the same work, Oberforstrat Reuss points out clearly the dangers of too deep planting. This error, he shows, is still most common, despite repeated warnings of forestry authors since Von Carlowitz, two hundred years ago, called it "the greatest evil of planting." Aside from plentiful instances of ignorance or carelessness, this error is traceable to the hope that by abnormally deep planting, the roots would be brought nearer the permanent water level and so enabled to survive periods of drought. In a measure this result is secured, but at enormous cost; for the roots set in this sterile, cold and insufficiently aërated stratum soon decay, either carrying the rot into the very stem of the tree which thereby becomes worthless long before reaching maturity or, at best, causing a partial cessation of growth until new roots develop closer to the surface. While especially true of spruce, this also applies to fir, larch, pine and the hardwoods, though in a lessened degree.

Oberforstrat Reuss sums this up as follows: "It is not right to judge the success of plantations by the immediate showing but only by an assured future; stinginess is out of place; for a high initial cost of planting does not affect the income nearly so much as does an unthrifty, unmerchantable stand created at half the cost.

"Where deep planting is combined with violent abuse, mechanical injuries, etc.—as in the case of the 'instrument methods'—there the evil results are most noticeable. Of course even without mechanical injuries, deep planting is pernicious, for though the incipient rot of the lower roots may have quickly healed over it means a temporary cessation of growth at the very time when the struggle for existence is keenest, also it is often attended by serious deterioration of the soil. In the case of the instrument methods' there is the additional danger of fungi and insects attacking the abrased parts. Only the most favorable conditions of soil site and plant material can overcome these drawbacks."

A final word as to the Austrian methods of caring for established plantations may not be amiss. As a protection against frost and drought, pieces of sod or flat stones are laid over the planting hole. This is especially efficacious against frost; in periods of persistent drought it is considered questionable since this covering prevents the access of any precipitation, slight though it be, (dews, fogs, etc.) which may occur.

As a guard against cattle and game stout pegs or branches of brush are driven in on three sides of the planting hole and inclined so as to meet over the plant itself.

Fail places are seldom ascertainable with certainty, before the second or third year; the practice is, therefore, not to fill these up before that time. These fail plaecs offer a welcome opportunity for the introduction of other species into the mixture;

care is taken, however, to choose those of quick growth so that they may "catch up" with the rest of the stand.

Frequently, "nurse trees" such as pine, larch, beech, oak, etc., are planted in with the species of the final stand, merely to protect the main crop or to "fill in." For this purpose natural reproduction of birch and aspen is also welcomed but removed as soon as it threatens, by overtopping or by whipping in the wind, to injure the permanent species. Formerly, in the lower reaches of the Austrian Alps, it was customary to plant pine and spruce together; the latter soon fell behind in the race but after logging the pine, the spruce recovered from its suppression and came into its own on the ground enriched by the pine crop.

The application, to American conditions, of Austrian methods of artificial regeneration, is obvious, still, it may be worth while to review the salient lessons which Austrian experience teaches:

(1). Unless due attention is given to the source of seed and the methods of securing it, the whole process of artificial regeneration will result in the deterioration of the forest.

(2). Methods of direct seeding are necessarily limited to the most favorable sites; even there, success is always partial. Direct seeding is really only a stepping stone from natural regeneration to planting.

(3). The simplest, i. e., the most natural, means of planting are ordinarily the most successful. Normal planting requires normal stock, that is stock of the proper root development and grown under conditions similar to those of the planting site. Pampered stock often succumbs to the rigors of the planting site. The correct criterion of successful administration is not the production of luxuriant plant material but of thriftily growing plantations.

(4.) Transplants alone possess the shallow, compact root system necessary for all but the most favorable planting sites. On very favorable sites seedlings will succeed. It is useless to plant trees with seriously injured or with crooked, or insufficient root systems. It is cheaper to cull these at the nursery than later to fill the gaps they leave in the plantation.

(5). Care in planting is even more important than is care in raising the stock. Planting by hand is surer, and hence cheaper in the long run; for the use of planting instruments, time and labor saving though they are, is prone to result in injuries to the plant and in too deep planting, thus paving the way for insect and fungus attacks (root rot) bringing about the early death of the tree or at least, diminishing its commercial value.

(6). The use of balled plants, of wild stock, of several plants set in the same hole, finds a very limited application. Similarly planting in furrows or on mounds is only adapted to special conditions. The majority of sites require a mattock-made hole of normal width wherein the plant can be bedded by hand in as nearly as possible the same position of roots and shoot as it occupied in the nursery.

EFFECT OF SOURCE OF SEED UPON THE GROWTH OF DOUGLAS FIR.

In 1909 and 1910, the Forest Service sent seed of Douglas Fir collected at different points of its botanical range to Professor Schwappach at Eberswalde, Germany, and Count von Berg in Livonia, Russia. Douglas Fir has attracted the attention of European foresters for a number of years and many plantations have been started, of which some are now as old as forty years. The climatic conditions of central Europe made it, however, necessary to be careful in selecting the source of seed, as the Pacific Coast form was too tender to withstand the frosts of middle Europe, while the Rocky Mountain form was too slow in its growth to justify raising it in preference to the native species. The European foresters, therefore, have been for a number of years endeavoring to find the region from which to secure seed of Douglas Fir which would possess the hardiness of the Rocky Mountain form and the rapidity of growth of the Coast form.

In 1909, the Forest Service sent to Count von Berg seed from thirteen different sources as follows:

Madison, Montana
Absarkoa, Montana
Helena, Montana
Carson, New Mexico
Manti, Utah
Targhee, Idaho
Boise, Idaho
Pocatello, Idaho
Medicine Bow, Colorado
Rio Grande, Colorado
Montezuma, Colorado
San Isabel, Colorado
White River, Colorado.

As the seed of 1909 was of inferior quality, the Forest Service sent new samples of seed collected at twelve different points within its range as follows:

Pike; Sopris; San Isabel; Pecos; Madison; Snoqualmie; Bitterroot; Lolo; Salmon; Colville; Chelan; Tahoe.

The Forest Service requested the results of these trials, and accordingly Count von Berg submitted a report which is of in-

TABLE No. 1—EFFECT OF SOURCE SEED—Pseudotsuga taxifolia.

Results of seed tests made in 1909 by Count von Berg, Sagnitz, Livonia, Russia.

Number.	Name of Forest.	State and Region.		Altitude.	Exposure.	Inches in 1912. Apr.	Aug.	Effect of Winter frost 1910-11.	Effect of Winter frost 1911-12.	Remarks.
1	Pike.	Colorado	Central	7,500	Northwest	4	5-10	All sound	Plants, small and weak	Upright, straight stems
2	Sopris	"	"	7,000	North	4	4- 7	" "	Plants, small and weak	Upright, straight stems
3	San Isabel	"	Central southern	8,000	"	5	5-12	1-2 per cent. brown tops	Growth better than No. 1 or No. 2	Upright, straight stems
4	Pecos	New Mexico	Northern			7	10-20	20 per cent. brown, frozen tops	The greatest luxuriance of growth of group N. M. and Colo.	Upright, straight stems
5	Madison	Montana	Southwestern	7,600	Northwest	6- 8	8-17	Sound		Upright, straight stems
6	Bitterroot	"	Western			7	9-19	"	Best germination and closest growth	Upright, straight stems
7	Lolo	"	"	3,000 3,500		8	9-19	20 per cent. brown tops		Upright, straight stems
8	Salmon	Idaho	Eastern	7,000 7,500	North	6	7-12	Sound	Vigorous but small	Upright, straight stems
9	Colville	Washington	Northeastern	3,500	East side of Cascades	9	9-17	"	Vigorous growth; tall	Upright, straight stems
10	Chelan	"	Northern	2,165	East side of Cascades	12	14-25	1 per cent. brown, frozen tops	Vigorous growth; very tall; excellent	Upright, straight stems
11	Snoqualmie	"	Northwestern	400 500	West side of Cascades	13	9-19	All tops and greater part of plants frozen	The most luxuriant growth 1911	shrublike, slender crooked stems and branches
12	Tahoe	California	Eastern	800	South			Entirely frozen	Luxuriant in 1911; weaker and smaller than No. 11	Coast variety

terest for our reforestation work with Douglas Fir. The results tabulated and illustrated by a series of paragraphs clearly show the marked difference in the general appearance, growth, height, and hardiness of the seedlings raised from seed obtained from different sources. In Table No. 1 are given the results of the tests made with the seed of 1910.*

The seed from the Snoqualmie (sample No. 11), and from the Tahoe (No. 12) represent the Coast form. The growth of seedlings from this seed was faster than that of any of the others but of a quite different type from the rest. Von Berg calls this the "shrubby form" type, as the stems and branches are long but slender and crooked causing them to suffer greatly from snow. The latter often crushes them entirely. The seedlings from all other seed have a straight, upright stem, and resist the pressure of the snow in a remarkable degree. The seed from the Tahoe, California, has been very nearly destroyed by frost during the second winter. The seedlings from Snoqaulmie, Washington, on the west side of the Cascades, have also suffered severely from cold.

The seedlings raised, from seed collected on the Chelan, in the same range of the Cascades as the seed from the Snoqualmie but on the eastern slope, have grown very nearly as high as the seedlings from Snoqualmie but stand upright and have scarcely suffered at all from the frost. Only from one to two per cent. of the seedlings have brown tops. If the seedlings prove resistant to damage by frost in the future, the seed from Chelan Forest furnishes the best variety of all for Livonia.

The seedlings from Colville Forest are very similar to the seedlings from the Chelan, except that the seedlings grow somewhat less vigorously than the Chelan seedlings but appear to be hardier. The seedlings from Colville and Chelan Forests have grown very nearly as vigorously as the Coast from Tahoe and Snoqualmie, but differ from the Coast form by the upright stem and marked resistance to frost. It is possible that the severe winter might damage the Chelan and Colville seedlings in Livonia, but for most of the National Forests removed from the Coast they are probably the most valuable varieties.

The seedlings from Montana and Idaho showed a rather uni-

*The report was accompanied by a series of photographs showing the differences of development, which it is not necessary to reproduce.

form growth and form a transition type to those from Colorado and New Mexico. The seed from Pecos, New Mexico, made about the best growth of any of the seed obtained in New Mexico. The seedlings, however, were damaged; about 20 per cent of them showing the effect of winter frosts.

The seedlings raised from seed sent in 1909—which was of inferior germination—are, on the whole, much weaker and smaller than the seedlings from the seed of 1910. The results of the trials with the seed of 1909 are given in Table No. 2.

Table No. 2—Results of Seed Tests Made in 1909 by Count von Berg, Sagnitz, Livonia, Russia.

If by O is meant no growth whatever and by 5 the best growth, the following list will give an idea of the comparative growth of Douglas Fir raised from seed obtained from different sources. The seedlings on the whole are smaller than those from the seed sent in 1910.

Name of Forest.	*State.*	*Grade.*	*Height in inches.*	*Date of measurement.*
Madison	Montana	3	5- 9	August 2, 1912
Carson	New Mexico	5	9-14	" " "
Manti	Utah	1	4- 5	" " "
Medicine Bow	Colorado	1	5- 6	" " "
Pocatello	Idaho	2	6-10	" " "
Targhee	Idaho	½	3- 5	" " "
Boise	Idaho	½	5- 7	" " "
Absaroka	Montana	2	3- 6	" " "
Helena	Montana	3	5- 7	" " "
Montezuma	Colorado	5	10-19	" " "
Rio Grande	Colorado	4	15-20	" " "
San Isabel	Colorado	4	9-17	" " "
White River	Colorado	3	10-17	" " "

In a letter accompanying his report, Count von Berg expresses the belief that the variety of Scotch Pine growing in Germany is "one of the worst," not because it was originally so, but because all forests are now artificially planted or sown, and the seed bought from dealers cheaply is secured from inferior low trees, grown on poor sands, especially in Southern Germany. The original type of North Germany resembled more the *Pinus sylvestris* of the Baltic provinces of Russia (Riga Pine), which grows on a mixed soil of clay and sand.

R Zon.

A COMPARISON OF YIELDS IN THE WHITE MOUNTAINS AND SOUTHERN APPALACHIANS.

By K. W. Woodward.

Very early in the examination of lands for purchase under the provisions of the Weeks Law it was apparent that the average stand in the White Mountains exceeded in volume the average stand on lands examined in the Southern Appalachians. By reason of the varying degrees of culling and damage which have taken place in the different regions and in different stands in the same region it is obvious that a fair comparison can only be made between unaffected virgin stands. Assuming then that only undamaged virgin stands are to be taken into consideration, the average stand per acre for the Southern Appalachians, including all types is estimated to be 4,600 board feet. This estimate is based on the following data:

Percentage of Area Occupied by Types.

Cove type	5%
Slope type	55%
Ridge type	40%
	100%

Average Stands per Acre in Virgin Stands, Including By-products Such as Ties, Pulpwood, etc.

Cove type	10,000 bd. ft.
Slope type	6,000 " "
Ridge type	2,000 " "

Calculation of average Stand per Acre for Virgin Conditions.

Cove type, 10,000 bd. ft. x 5%	500 bd. ft.
Slope type, 6,000 bd. ft. x 55%	3,300 " "
Ridge type, 2,000 bd. ft. x 40%	800 " "
	4,600 " "

In the White Mountains, on the other hand, the hardwood type occupies 55% of the total area and the average stand under virgin conditions is 15,000 bd. ft. Forty percent of the total area is in the spruce type and the average stand in virgin conditions is 15,000 bd. ft. The remaining 5% of the area is in the subalpine and barren types and contains no merchantable timber. Using these figures, an average stand for virgin conditions in the White Mountain region is figured to be 14,250 bd. ft., over three times the average stand in the Appalachians.

On first thought, nearly every one would be inclined to assume that more timber could be produced in a given period in the Southern Appalachians than in the White Mountains. In the latter region the precipitation is less and the growing season is much shorter. These two reasons would seem to indicate that the Southern Appalachians are more favorably located climatically for rapid tree growth.

In order to determine just what the climatic differences are, a number of diagrams are given which show graphically the precipitation, average temperature, and length of growing season for a number of representative Weather Bureau stations in each region. From these diagrams it is evident that the precipitation is 24% greater on the average in the Southern Appalachians, the temperature 28% higher, and the growing season 41% longer. While exact figures for the amount of cloudiness are not available it is estimated that there is about 25% more sunshine in the Southern Appalachians.

In order to find out the effect of the climate upon tree growth a comparison of the amount of volume which could be produced in a period of 50 years has been made. In the White Mountain region figures are only available for white pine and red spruce while in the southeast the data are restricted to figures for loblolly pine, scrub pine and yellow poplar. Diagrams are given which show for each individual species the number of cubic feet produced per acre in 50 years. Averaging the figures for the different regions it is evident that 34% more volume is produced in the northeast than in the southeast.

Since the main factors of volume are diameter, height and number of trees, it is necessary to compare these different factors in order to determine what causes the difference in volume in the two regions. In order to bring out the differences clearly, diagrams are given for these three factors for each of the species chosen. Averaging these results by regions, the diameter growth in 50 years is shown to be 112 per cent. greater in the southeast. In height growth there is only a difference of 21% in favor of the southeast. In number of trees, however, the northeast leads by 164%.

For corroborative evidence that the average yields in a given time are greater in the northeast than in the southeast, the census figures for the yields of agricultural crops were consulted. These showed that the average yield per acre for corn in the northeast was 186% greater, for wheat 97% greater, for potatoes 92% greater and 29% greater for hay. A comparison of the yields in apples and peaches could not be made on an acreage basis but was made on a basis of bearing trees. The figures obtained in this way are subject to two interpretations. They may indicate that the tree bearing the most fruit has reached the greatest individual development in wood, leaf and fruit production, or that the tree with the heaviest crop has come nearer the optimum balance between wood and leaf production and fruit which would seem to be caused by the same factors that produce heavy yields in field crops. It is a well known fact that the biggest and fullest crowned fruit tree does not always produce the most fruit and therefore the latter assumption seems the more reasonable. Hence the yield of fruit per tree is cited along with the other data on an acreage basis even though it is open to question. The census figures showed that the yield per bearing tree is 66% greater in the northeast for apples and 100% greater for peaches.

While it may be urged that the climatic factors are not the only ones responsible for these differences in yields, the evidence furnished by these data may fairly be taken as corroborative of the conclusions reached from the study of tree growth. While it is impossible to analyze the factors of yield in the case of agricultural crops with the same nicety that can be done with tree crops it is evident that the main difference lies not in the size of the individual plants but in the density per acre and the amount of fruit which each plant yieds. Probably the most striking example of this which can be cited is the difference in practice in corn planting in the two different regions. In the northeast the corn is relatively short but several stalks are grown in each hill, while in the southeast the corn is tall but it is sown in rows and not in hills.

The data given above would seem to indicate that the main factor in influencing the volume which can be produced on a given area in a given time is the number of individuals. This in turn seems to depend primarily upon the amount of moisture available for vegetative purposes during the growing season provided there is not an excess. In this respect the northeast is more favorably situated than the southeast because its moisture is better conserved. While more precipitation falls in the southeast there is much less evaporation in the northeast, transpiration is less active and the moisture which falls in the winter does not run off but is locked up until the growing season.

Assuming the annual evaporation from water surfaces in the tropics at 64 inches, the evaporation in the northeast would be approximately one-third of this and midway between for the southeast. These figures will give some notion of the difference in evaporation between the northeast and southeast. It is evident, therefore, that the precipitation in the southeast must be considerably greater in order to compensate this single factor of loss from evaporation, if the plants are to be supplied with the same amount of moisture in the two regions.

The factors which lead to less active transpiration in the northeast are a lower temperature, less sunshine and a shorter growing season. These all tend to conserve the precipitation and give a continuous supply of available moisture during the period of plant growth.

There is a marked loss of precipitation during an open winter. A cold winter during which nearly all the precipitation occurs in the form of snow furnishes the optimum conditions for the storage of water in natural ground reservoirs. The water from these reservoirs becomes available for vegetative purposes during the growing season instead of running off quickly soon after it falls.

Another important factor which is a direct result of the larger amount of moisture available during the growing season in the northeast is the greater fertility of the soils in the northern parts of the country. This is due almost wholly to the higher humus content which in turn must be ascribed to the greater rapidity of decay in the southeast. In the northeast a large amount of water in the soil, the shorter growing season and the low temperature hinder the processes of decay and favor the accumulation of humus in the soil. This has a favorable effect upon the chemical and physical composition of soils.

It may be urged in opposition to the facts so far presented that the data are inadequate. It is true that there are few adequate yield figures for hardwoods in the different regions. However, comparison of such figures as are available corroborates the evidence furnished by the softwood and poplar yield tables. The dense stands of spruce on the high mountains of the Southern Appalachians may be cited as instances of heavy volume production in the Southern Appalachians. These stands, however, are growing under conditions which are very similar to conditions in the northeast. The growing season is short, the precipitation is heavy and evaporation and transpiration are reduced to a minimum, but even then the stands are not as dense as in the northeast.

Further investigation will, of course, be needed to determine the real causes of the apparently greater volume production in the northeast than in the southeast. Yield tables for the same species in both sections would be the best data. Furthermore, dense tree stands wherever they may occur should be investigated. This would include the luxuriant growths of some types of tropical forests and the heavy stands found in Washington, Oregon and British Columbia.

COMPARISON OF CLIMATES.

(*U. S. Weather Bureau Records.*)

	Total annual precipitation.	*Average annual temperature.*	*Number of days with temperature above 32° F.*
		WHITE MOUNTAINS.	
Bethlehem, N. H.	37.7 in.	42 degrees	117 days
Plymouth, N. H.	42.4 in.	43 degrees	129 days
		SOUTHERN APPALACHIANS.	
Big Stone Gap, Va.	50.5 in.	54 degrees	158 days
Elkins, W. V.	45.6 in.	50 degrees	163 days
Asheville, N. C.	42.6 in.	55 degrees	180 days
Waynesville, N. C.	47.7 in.	54 degrees	170 days
Highlands, N. C.	78.2 in.	50 degrees	152 days
Clayton, Ga.	68.5 in.	57 degrees	186 days
Elizabethton, Tenn.	45.2 in.	56 degrees	179 days
Newport, Tenn.	43.6 in.	57 degrees	198 days

YIELDS OF AGRICULTURAL CROPS.

(Thirteenth Census.)

CORN, bushels per acre.	Northeast	45 bushels
	Southeast	15 bushels
WHEAT, bushels per acre.	Northeast	24 bushels
	Southeast	12 bushels
POTATOES, bushels per acre.	Northeast	177 bushels
	Southeast	92 bushels
HAY, tons per acre.	Northeast	1.3 tons
	Southeast	1.02 tons
APPLES, bushels per bearing tree.	Northeast	1.5 bushels
	Southeast	.9 bushels
PEACHES, bushels per bearing tree.	Northeast	.5 bushels
	Southeast	.25 bushels

COMPARISON OF TREE GROWTH.

	Volume in 50 years.	*Dbh. in 50 years.*	*Total height in 50 years.*	*No. of trees per acre in 50 years.*
	NORTHEASTERN SPECIES.			
White pine (Southern New Hampshire, L. Margolin)	8767 cu. ft.	10 inches	70 feet	510
Red spruce (New England, L. S. Murphy)	5100 cu. ft.	7 inches	54 feet	940
	SOUTHEASTERN SPECIES.			
Loblolly pine Maryland, Sterrett and Hubbard)	6350 cu. ft.	12 inches	87 feet	244
Scrub pine (Maryland, W. D. Sterrett)	4650 cu. ft.	9 inches	63 feet	370
Yellow poplar (Virginia, W. W. Ashe)	5450 cu. ft.	15 inches	83 feet	210

NOTES ON THE DISTRIBUTION OF LODGEPOLE AND YELLOW PINE IN THE WALKER BASIN.

By H. S. Kerr.

During the summer of 1912 an area of approximately four hundred square miles on the Paulina National Forest was covered by extensive reconnaissance. In connection with this work notes were taken on the distribution of Lodgepole and Yellow pine. Some of the ideas brought out by this study are given here.

The topography of this region is of rather an unusual form and, since it is so vital a factor in the matter of tree distribution, should be discussed briefly.

At one time the ocean extended eastward as far as the Blue Mountains. Later the Cascade Range was elevated above its surface. Lava flows took place along the broken folds and spread over the country, now known as the Walker Basin. In the intervals between the later flows, and continuing after they had ceased altogether, were heavy showers of volcanic ash or pumice. This dust cover is thickest near the mountains and gradually becomes thinner as the distance from them increases, until at sixty or seventy-five miles it disappears altogether.

During the time that the Cascade Mountains were forming, the region to the eastward was also rising. However, it was not until the volcanic disturbances had subsided to a great extent that it became dry land, as it is evident that much of the pumice was deposited under water. Gravity, aided by wind, rain and snow, slowly worked the pumice cover down from the lava piles and cinder cones into the depressions between them until, at the present time, the general form of the topography is that of a nearly level plain with many small lava buttes and cinder cones rising abruptly from it. Occasionally also one may find a portion of the old ocean floor which has been thrust up by some local volcanic disturbance. A good example of this is the flat topped butte in Sections 13 and 14, of Township 24 S., Range 13 E. This butte, which covers a half section or more, rises to an elevation of about two hundred feet above the surrounding country. Its top is flat and the sides are very steep, in places nearly vertical. It is capped by a thick layer of lava, which has protected from erosion the old sedimentary rock beneath. On the level areas where the pumice cover is thin, the irregularities of the old flows show through as thickly scattered dykes and piles of broken lava.

The general elevation of this territory runs between 4,500 to 5,000 feet. The precipitation varies from 10 to 15 inches, mostly in the form of snow, and killing frosts occur every month of the year. The soil on the flats is composed almost entirely of pumice, varying in size from rather fine dust to small gravel. There is no humus. In places, as on the lower slopes of some of the buttes, the soil shows a somewhat clayey consistency where exposed by the roots of upturned trees. It is probably due to the accumulation of the finer pumice particles which have worked their way down the slopes.

The drainage is all underground, toward Silver Lake on the east and the DesChutes River on the west. Most of the precipitation sinks directly into the ground, there being practically no surface run off. It is to this condition that the DesChutes River owes its remarkable uniformity of flow in all seasons.

With this general impression of the country in mind, the question of the timber itself may now be taken up.

Lodgepole Pine and Yellow Pine are the only species with which we are concerned, although White Fir *(Abies concolor)* and Mountain Hemlock may be found occasionally as scattered individuals on the higher elevations. The undergrowth consists mainly of chemise brush with manzanita and snow brush *(Ceanothus velutinus)* on burns and more open slopes. Pine grass occurs commonly in Yellow Pine stands at the lower levels, and toward the edge of the desert other species of bunch grass are found in varying proportions. There is very little grass of any description under the typical Lodgepole Pine cover but on recent burns which have not yet restocked, there is often a good growth of the desert bunch grass.

In comparing their silvical characteristics it is noted that a deep, peristent tap root is typical of both the Yellow Pine and the Lodgepole Pine and that a loose, sandy or gravelly soil is best adapted to their growth. Aside from these points, however, the trees differ widely. During their early life either is readily killed by fire, but from the pole stage up the Yellow Pine becomes one of the most fire resistant of the Western pines, while in this respect the Lodgepole changes but slightly in the course of its development.

Yellow Pine may begin to bear fertile seed at from twenty-five to thirty years of age but does not produce abundantly until very much older. The seeds fall from the cones during the early Autumn and germinate at once or early the next Spring. Very few of them hold their fertility over to a second season.

Lodgepole Pine, on the other hand, begins to bear seed at from seven to ten years in the open and even in dense stands produces a heavy crop practically every year after it reaches an age of from twenty to twenty-five years. The cones usually remain on the tree and many of them do not open for years, the seed remaining fertile indefinitely. For its early growth Yellow Pine requires a light shade, but later it becomes very intolerant so that the understory in a pine forest contains little Yellow Pine, except in the openings. While Lodgepole Pine makes its best growth in full sunlight it is able to survive for many years in the shade of a high forest and is frequently found as an understory with Yellow Pine. Both species will grow on a wide variety of sites and soils, but Yellow Pine absolutely requires a *good drainage*. In this respect it is essentially different from Lodgepole Pine, which will grow under almost any condition of moisture from a dry, rocky ridge to the wet swampy borders of lakes and streams.

A striking feature in the distribution of the species in these forests is the distinctness and the regularity of the types. On wide pumice flats there is an unbroken stand of pure Lodgepole Pine. One may travel for miles without seeing the slightest change in the timber cover or topography, but with the first butte comes a change in the forest type. Where the slope breaks, almost on the contour line, Lodgepole Pine gives way to the old Yellow Pine which covers the hill above it; and on every knob or knoll the same conditions are true. Sometimes, of course, Lodgepole Pine may be found on the buttes but in such places it has come in following fire in the Yellow Pine stand. Where there is any mixture of species it is the Lodgepole Pine which has come in under the Yellow Pine on the slopes, and never a mixture of Yellow Pine coming in on a Lodgepole Pine flat.

The cause of this strict conformity of type to topography is the problem with which this paper is concerned.

It has been argued that a difference in the soil accounts for the change in species. There is nothing, however, to show that the soils are essentially different, except in depth, since they are all from the same source and there has been nothing to change them. But, if it is granted that the soils may be different, it does not follow that Lodgepole Pine should be found on one site and Yellow Pine on the other, since both species have practically the same soil requirements.

Another theory is that Yellow Pine formerly covered much of the pumice flats, as well as on the buttes, and that the area has been reduced to its present limits by fire. Just why the Yellow Pine should have been left on the buttes and swept clean from the flats, does not seem clear but it has been suggested that a difference in air currents or the amount of ground litter might account for it. Various other theories have been offered, differing as widely as those just given and very likely quite as correct.

There is one idea, however, that has been suggested which seems to meet quite satisfactorily any points that have been raised against it. This theory is based on the difference in moisture requirements of the Yellow Pine and Lodgepole Pine.

On the flats, it is evident that the water table must be nearer the surface than it is on the slopes. Capillary action holds the ground water close to the top, and the fine, closely packed pumice acts as a mulch which reduces the rate of evaporation. On the buttes, knolls, rock outcrops, etc., the water table is lower, not only on account of gravity, but because of the difference in the structure of the sub-strata, the more porous surface layers, the more exposel situation and, the consequently greater evaporation. Just how much difference there is in the soil moisture content of the two sites or to what extent it affects the distribution of the tree species can only be determined by detailed study, but that there is a difference in moisture conditions and that the tree distribution is very closely governed by some agent, there can be no question.

Knowing that Yellow Pine will not grow in any but *well drained* soil it may not be straining the point too far to assume that the soil of pumice flats is *not well drained* and that for this reason Yellow Pine is not found growing there. On the slopes, where the water table is deep and the drainage thorough, Yellow Pine grows abundantly, its long taproot being able to draw sufficient moisture from the deeper strata.

Because Lodgepole Pine is not at all dependent on drainage this factor should not affect its distribution. That it forms the complete stand on the pumice flats is due to the fact that Yellow Pine cannot grow on such sites and the whole field is, therefore, left to the Lodgepole Pine. On the slopes, where conditions are favorable for Yellow Pine, this species on account of its longer life, greater height and superior fire resistance, is usually able to maintain itself. Lodgepole Pine occurs on such sites but it is either as a scattering understory or as an even-aged stand, following fire. It may have seeded in from the side but more likely has come from an understory of Lodgepole Pine in the old Yellow Pine stand.

On the edge of a bench there is usually a strip of Yellow Pine. For example, along the road leading southwest from Crescent toward Odell Lake. Here Lodgepole Pine forms a pure stand on the level upper bench and on the flat along the river below. The difference in elevation is not over 15 or 20 feet and the soil appears to be identical, but the water table along the edge must be lower than on either bench and it is along this edge that the Yellow Pine occurs. There must be some cause for this and what is more reasonable than to suppose that it is the difference in the soil moisture?

In the Upper DesChutes Valley, in Ranges 8 and 9, East, Lodgepole Pine forms almost a complete stand but further east the percentage of the Yellow Pine area increases until near the eastern boundary of the Forest, in Township 23 S., Range 16 East, there is no Lodgepole Pine whatever. If we assume that the theory just outlined is the correct one this condition is what we should expect since the pumice layer is deepest in the upper DesChutes country and becomes thinner toward the east, until it practically disappears at about the eastern limit of the Lodgepole Pine. Occasionally Yellow Pine may be found on a Lodgepole Pine flat but it is always near the bottom of a slope or where rock outcrops are frequent. It is probable that the pumice cover in such places is thin and that the moisture conditions are similar to those on the slopes.

In connection with a study of the distribution of these species there is also a question as to the possible change in the area occupied by each during the past and what the effect of fire protection is likely to be in the future.

That the area occupied by Lodgepole Pine has been increasing seems very probable. This is indicated in places by scattering understories of young Lodgepole Pine under old Yellow Pine stands and in other places by even-aged stands of Lodgepole Pine on sites which are typical for Yellow Pine. An excellent example of the changing forest type may be seen in Sections 23, 24, 25 and 26 of Township 24 S., Range 11 E. At first this locality appears to be a pumice flat in which there are traces of an old Yellow Pine forest. A closer examination shows numerous slight irregularities in the surface and many small rock outcrops, indicating that the pumice cover is very thin. On this area there are still a very few scattering old Yellow Pine and occasional half rotten logs and stumps, showing plainly that there has been at some time a considerable Yellow Pine stand. The forest at present consists of two generations of Lodgepole Pine: the first standing out distinctly as scattered old trees with dense, widespreading crowns which reach to the ground showing that they have grown in a very open stand. The second generation is much younger and forms a close, rather even-aged stand characteristic of the species. In this instance there is shown a complete change from Yellow Pine to Lodgepole Pine with every indication that the Lodgepole Pine will be the permanent type. It is probable that the Yellow Pine was killed by fire and that the first generation of Lodgepole Pine came in from an understory that was destroyed with the Yellow Pine. The second generation of Lodgepole Pine is the result of seeding from the first scattering stand which came in after the fire.

There are numerous indications that Lodgepole Pine is increasing in other places, but nothing to show definitely that Yellow Pine is restocking any territory. It is not uncommon to find single Yellow Pine seedlings on the typical Lodgepole Pine flats but it is not probable that they will ever reach maturity.

Unfortunately the data secured on this subject are not very extensive but a careful consideration of all available material has led to the conclusions, first, that the distribution of Yellow Pine in this region is dependent almost entirely on the depth of the water table; second, that the distribution of Lodgepole Pine on

Yellow Pine sites is limited only because of the greater age, height and fire resistance of this species; third, that the area occupied by Lodgepole Pine has been increased to some extent in places, chiefly on account of fire; fourth, that it is not likely that Yellow Pine will ever retake any considerable area even on sites suited to its growth because of the great advantages in seeding and in light requirements of Lodgepole Pine.

WINTER RECONNAISSANCE IN THE ROCKY MOUNTAINS.

By George Z. Mason.

Reconnaissance in the wintertime is not thought, by many, to be a practicable undertaking for the reason that the many hardships and difficulties encountered are not compensated by the results obtained. However, it has been tried by the regular force on the Battlement National Forest for the past several years, and the results have been sufficiently gratifying to make winter reconnaissance one of the regular orders of business on the calendar of the year's work.

At first, winter reconnaissance on this Forest was tried, as an experiment, at one of the regular annual ranger meetings held several years ago. Very few of the rangers had had little, if any, experience in estimating timber and several days of the meeting were spent in estimating several sections of timber. The comparative ease with which this estimating was done, and the slight increase in cost, encouraged an effort to make a regular reconnaissance the following winter. Each year since, the work has taught us something new, and given us better ideas how to meet and overcome the peculiar difficulties of winter reconnaissance. Some of the results of this experience may possibly be of assistance to others who are minded to try it.

Careful preliminary preparation and planning are necessary in all lines of Forest Service work, but they are particularly important in winter reconnaissance. The work, under proper supervision, may be done for one-half or even one-third of what it would cost, both in energy and money, under careless supervision.

The time the work is undertaken is a very important factor. It should not commence before the snow has been well settled and formed a good crust. The surface thus formed is ideal for reconnaissance—smooth and hard, with no down timber or other obstructions usually met with in summer reconnaissance. Great speed can also be made under these conditions.

Reconnaissance should not be attempted with a camp more than three to four miles away from the field of operations since too much time and energy would be used in going to and from work which is strenuous enough at best.

One of the principal difficulties encountered was the hauling of bedding and supplies. With a good, hard surface on the snow such as usually comes in March and April in this locality, and with but a slight up-grade, one man could haul on a sled in the neighborhood of one hundred pounds. But when the snow is freshly fallen, sinking in often one to two feet, together with a rather heavy up-grade, from fifty to seventy-five pounds was considered a good load. With soft snow and heavy up-grade, the men found that it was easier work to pack supplies on their backs than to haul the loaded sleds through the snow. This experience taught us to haul, during the preceding fall, all of the supplies it was possible to get in at that time. All of the canned goods and other supplies, except meat and eggs, were sent by team and wagon to the camp from which the work was to be done. The canned stuff and vegetables were buried to prevent them from freezing. Enough wood was cut and hauled into camp to supply the crew while they were there. In this way, one of the greatest problems and difficulties was overcome. One day's work for all sufficed to bring in the rest of the supplies and bedding.

The tying in and checking of distances and courses was another matter that confronted us. Although the snow around the trunks of the trees does not reach the same height as in the open places, it is often high enough to cover up the blazed witness trees of survey corners. It is a very simple matter for the ranger, on whose district the work is to be carried on, to blaze, during the open field season, the several corners, placing the blazes high enough on the tree to be found easily in the snow. This can be done without any extra cost, as the ranger is sure to be on the ground some time during the field season and the finding and blazing of corners is but the work of a few minutes.

The question may very well be brought up as to how, with the snow seven to eight feet deep, can one estimate accurately the diameters of the trees. As mentioned before, even though the snow reaches a depth of eight feet, it very seldom reaches four and one-half to five feet around the bole of the tree, thus allowing the d. b. h. to be estimated.

The tendency to underestimate is perhaps a little stronger in winter reconnaissance than it is under ordinary circumstances. Considering all factors concerned, it appears natural that this should be so. The d. b. h. will be under rather than overestimated, as the diameter will be taken rather higher on the bole than lower. The heights will be underestimated more than ordinarily because of the higher location of the estimator. But the chief reason for the tendency to underestimate lies in the fact that because the snow is held in the branches of the trees, it is more difficult to see, and as a result, not only is the strip narrowed, but a good many trees, especially the small ones, are overlooked. In order to overcome this tendency to underestimate, the following plan was adopted:

During the fall we laid out a sample plot of five acres, carefully measuring every tree on the plot in height and diameter. Before starting the actual reconnaissance work, the men all went over this plot and estimated in various ways. First they estimated 100% of the area by the strip system, then by the 10% strip system, and finally by the quarter-acre circle system, keeping a tally of all the trees. Their tallies were compared with the calipered measurements, thus bringing out the number of trees they had overlooked as a result of narrowing their strips and pure oversight. A comparison of the number of trees in each diameter and height class also determined whether they were under or overestimating. This preliminary practice, which usually will not take more than one day's time, will be more than compensated by the increased accuracy of the work.

With regard to equipment, it has been found that small webs are most satisfactory in dense timber work. A snowshoe of the bear-paw type, made by W. F. Tubbs, of Norway, Maine, size 14"-15" by 28"-30", was found to be most satisfactory. The webbing is of strong, coarse, material with large meshing, and does not stretch to any material extent. A larger shoe is very awkward to use in the timber and is not so handily packed on one's back when the surface permits of walking without them.

SOME SUGGESTIONS ON BRUSH DISPOSAL.

By Elers Koch.

On a large percentage of the Forest Service timber sales fire protection has been insured by piling and burning the slash, which costs usually from 30 cents to 75 cents per M feet. Brush piling, in most cases, is done by the logger, and of recent years the timber sale contract usually requires the operator to burn the brush also. With stumpage prices running from $1 to $4 per M, the cost of brush disposal, which, of course, comes out of the stumpage paid the government, takes a large proportion of the value of the timber. On a big timber sale with a heavy stand per acre, the total amount expended for temporary protection of the sale area reaches a rather alarming figure, and the thrifty forester must, of necessity, cast about for a less expensive means of protection from fire.

Observations made on old slashings indicate that, in from 5 to 7 years, the slash has rotted down and disappeared so as to bring the fire risk back to normal. The problem, then, is to secure protection for the cut over area during the danger period, after which the ordinary protective measures in force on the Forest should suffice. Piling and burning the brush reduces the danger to a minimum, but the expenditure for a few years' fire protection is extremely great.

The fire risk on a timber sale area is generally either from fire starting in an adjoining slash on private lands, or from some human agency such as logging engines, campers or smokers within the area. If a system of fire lines is constructed by piling and burning the brush on strips 100 to 300 feet wide along the danger zones, and combined with a very intensive patrol for about five years after the cutting, it should be possible to reduce the fire risk to a minimum at a fraction of the cost of piling and burning the slash on the entire area. In general, the brush should be piled and burned on a strip 200 feet wide around the border of the area if it adjoins slashing on private lands. A wide strip should be cleared of brush on either side of logging railroads, and narrow strips along the main logging roads would break the area up into blocks and reduce the danger of fires starting at those points apt to be frequently traversed by human beings.

Lopping the tops may prove desirable in some stands where the brush is very heavy, in order to hasten the rotting of the branches and needles. In many cases this is not necessary, particularly on steep slopes where the tops are pretty well shattered to pieces by felling and logging. Recent inspection of slashings near the Lolo Forest where no disposal had been made of the tops, showed that, in the course of five or six years, the slash had practically disappeared in both yellow pine and fir-larch types.

A specific example of a Forest Service timber sale will illustrate the saving which could be made on the present method of brush disposal. A sale made to the Anaconda Copper Mining Company, on the Bitterroot Forest, cutting on which has been completed, covered an area of approximately 3,300 acres, with a total cut of 52,600 M board feet, chiefly yellow pine. The area is located on the edge of the Forest, adjoining private lands cut over by the A. C. M. Co. The brush on this sale was all piled by the logging company and burned by the Forest Service. The brush piling cost, on an average, about 40 cents per M feet. Much of the work was contracted at this figure and it is safe to say that, at any time, the company would have been glad to modify their contract with an increase in stumpage of 40 cents per M if brush piling could be dispensed with entirely. The brush burning cost the Forest Service 6 cents per M, making a total cost of 46 cents per M, or in round numbers, $24,000, total. That is to say, as much money was expended on the special proctection of this 3,300 acres for a period of about five years, as the annual cost of protection and administration of the entire Bitterroot Forest containing 1,154,550 acres. Only the greatest risk could justify the concentration of such a large proportion of the fire protection funds of this limited area; the expense is probably justifiable if no other cheaper means of protection were available. The writer believes that an almost equal degree of protection could have been secured for an expenditure of about $10,000, a saving of about 58%.

The great danger on this area is from fire starting in the adjoining slash on the A. C. M. Co lands. A strip 200 feet wide along the Forest boundary on which the brush is piled and burned would offer a good base of protection from fires of this class. This should be further supplemented by a system of cleared belts along the main logging roads. A total of 10% of the area would provide for a very extensive system of fire belts. As the brush is heavy on this area it would probably have been advisable to lop the limbs from the tops, which could be done for not to exceed 10 cents per thousand feet. The area would then be left in good shape for repelling fires, with all the greatest danger points cleared up. For further protection, until the brush had rotted away, two guards employed for four months in the year would give very intensive patrol. Each guard would have only 2½ sections to patrol and should be able to see every foot of the ground several times a day.

The following summary makes clear the relative cost of the two methods:

Area cut over,	3,300 acres
Total amount cut,	52,600 M. ft.

Cost of piling and burning at 46 cents per M,		$24,000

Proposed Plan.

Cost of piling and burning 10% of brush for fire lines,	$2,400	
Cost of lopping brush on balance of area at 10 cents per M,	4,700	
Cost of patrol, 2 men 4 mo. each year at $75 per mo. for 5 years,	3,000	
		$10,100
Saving by proposed method		$13,900

It is believed that this system of partial piling and burning of brush in the danger zones, supplemented by intensive patrol for a few years, can be applied successfully to most stands in the yellow pine or the fir-larch or Douglas fir types. Further advantages of leaving the brush unburned might be cited. Most of the yellow pine type in this locality occurs on dry south and west slopes. The brush and needle cover would help to retain moisture in these very dry situations and would probably be an aid to securing reproduction. In the fir-larch type there is very often an advance seedling growth, frequently 8 or 10 feet high, besides a large number of poles below merchantable size. Brush burning on an area of this sort must, of necessity, destroy a large amount of seedling and pole growth, besides being so expensive that it often deters a prospective purchaser from buying the timber.

The problem in white pine, spruce and cedar timber is somewhat different. The amount of brush in timber of this sort is so large, and the fire risk in the white pine belt is so great, that, in most cases, extreme care must be taken to prevent fire in the slashings.

In the old, over-mature white pine stands which are characteristic of the merchantable white pine type of the Lolo Forest, the only feasible system which has been proposed for securing natural reproduction is the reservation from cutting of scattered groups, strips or single trees well distributed over the area, constituting 10 to 15 percent of the total stand. If the brush is to be burned in a stand of this sort, it must necessarily be piled, in order to prevent the total destruction of the seed trees. The cost of piling and burning brush on a mixed stand in the white pine type is estimated at 60 cents per thousand feet. In a stand averaging 25 M feet to the acre this involves the enormous expenditure of $15.00 per acre, several times the cost of planting.

The obvious alternative, then, is to cut clean, burn the slash broadcast and plant the burned area with nursery stock. No very accurate figures are at hand for the cost of broadcast burning, with the area controlled by cleared fire lines, but an estimate of 20 cents per thousand feet is certainly conservative.

Let us then take a specific instance and compare the cost of the two methods. A timber sale has recently been made to the Mann Lumber Company on Big Creek on the Lolo National Forest, covering an area of 3,600 acres, estimated at 80,000 M feet, a mixture of white pine, spruce, Douglas fir, larch, cedar, hemlock, and white fir. The contract provides that, except on clean cut areas, the brush shall be piled and burned. The clean cut areas will be practically nil, so that they need not be considered. In this particular case a part of the area is fire-killed timber where there will be no brush disposal; but to make the case typical of average conditions, it will be assumed that it is entirely a green timber stand.

By clearing a system of fire lines one chain wide along the principal ridge tops, thus dividing the area into blocks, broadcast firing could be done safely and cheaply, and the ground would be left in good shape for planting.

The following figures give the relative cost of the two systems:

Area of tract, ...3,600 acres
Total stand, ...80,000 M. ft.

Cost of brush piling and burning at 60 cents per M, per acre, $13.33, ...Total, $48,000
Cost of broadcast burning at 20 cents per M, per acre, $4.44, ...Total, $16,000

Saving by broadcast burning per acre, $8.89, ...Total, $32,000
Cost of planting white pine 8 x 8 ft, per A., $5.22, Total, $18,792

Net saving after burning and planting, per A., $3.67, Total, ... $13,208

These figures, if correct, and it is believed that they can be demonstrated, indicate that, if the contract could be amended to permit the company to burn broadcast instead of piling the brush, the stumpage price could be increased sufficiently to amount to $32,000. The sum of $18,792 could then be devoted to planting the area, leaving a net saving of $13,208. We would then have a well spaced, completely stocked plantation of white pine, or whatever species was deemed desirable, instead of a more or less incomplete, natural reproduction of perhaps 25 to 50 per cent. white pine. The weed trees, the hemlocks, white fir and cedars, would all be eliminated, and there would be prospects for a succeeding crop of timber which would have double the value of the mixed, natural stand. A further advantage, which has not been included in the calculation, is the saving of stumpage in the seed trees. In an over-mature stand much of this will be lost by death of the trees before the end of the next rotation, and the amount of the timber left would probably not justify a logging operation before that time. This item would amount to from $2 to $4 per acre. The operator would also get the advantage of an increased cut with the same improvement investment, as well as the cheaper cost of logging a clean cut area.

The planting cost is figured as follows:

Cost of 3-year old white pine transplants, ...	$3 00	per M
Transportation, ...	50	" "
Planting, ...	4 00	" "
Total, ...	$7 50	" "

Spacing 8 x 8, or 670 per acre, gives a cost of $5.22 per acre.

About a million and a half of eastern and western white pine transplants will be shipped from the Savenac Nursery this fiscal year at a cost not to exceed $3 per M ready for shipment. The planting crew on the Lolo Forest this fall is planting white pine at the rate of 1,000 per man per day. The final cost has not yet been obtained; but it is certain that it will not exceed $4 per thousand plants.

The obvious difficulty in carrying out a policy of clear cutting and planting on Forest Service sales is, of course, lack of funds to handle the planting. The increased stumpage receipts go into the U. S. Treasury and the extra expense must be carried by the regular funds of the Service. It would seem, however, that arrangements must be made to cover this expense, if the Service is to make any pretences to a businesslike administration.

The Forest Service policy is, perhaps, not to be criticised. Increased appropriations are hard to get and the present funds barely cover current work; but the fact remains that an attempt to regenerate over-mature white pine stands by natural methods is an economic waste, which will cost the United States government tens of thousands of dollars within the next decade if the policy is continued.

A NORWEGIAN FOREST FIRE INSURANCE ASSOCIATION.

By J. A. Larsen.

The first annual convention of the Norwegian Mutual Forest Fire Insurance Association, which has already a capital of fifteen million dollars and a reserve fund of eleven million dollars, was held in Christiania, Norway, February 25, 1913. The association is the result of the initiative and concerted action of forest owners throughout the land. It has for its purpose the reimbursement to individual owners for loss sustained by forest fires in immature timber and the prevention of forest fires by means within the scope of the association.

Since this is a mutual association, all excess payments go into the reserve fund which is the property of the members and is to be used in regulating, and if possible, reducing the annual premium payments. In case of a series of heavy losses each member may be called upon to pay assessments amounting to three times their regular dues. No insurance is issued on mature timber but only on young and immature stands which, according to law, must not be cut. This law varies somewhat in different districts, particularly regarding the diameters and heights; but in districts where there is no such law the minimum diameter is put at 15 centimeters (6 inches) and the minimum height at 5 meters (17 feet).

The reason for not including the mature timber is due to the fact that such stands suffer less damage than younger forests, and if burned and accessible they may soon be sold. On the other hand if inaccessible mature stands are destroyed, their future values and the time of cutting would be somewhat problematical. Furthermore, should mature stands be insured the cost would run very high and entirely out of proportion to the value received; in short, it would render the work of the association much less effective.

Advance payment of \$1.25 per \$1.000 of insurance is required in those districts which have enacted forest fire laws, and \$1.75 per \$1.000 where there are no such laws. Valuation is based upon these four general conditions: 1. sizes of the trees up to the dimensions called mature or merchantable, 2. capacity for growth, 3. accessibility, and 4. condition of the stands.

As far as possible owners are asked to list flat rate values for their insurable stands, giving the total estimate in board feet whether this covers ties, poles, saw timber or other material which is convertible into this unit of measure, so as to facilitate calculations for settlement in case of damage by fire.

SPECIFIC GRAVITY AND WEIGHT OF THE MOST IMPORTANT AMERICAN WOODS.

A Study and Compilation.

By Alfred Gaskill.

The following table is the result of an effort to reduce or harmonize the contradictions that appear in all published figures concerning wood weights. Except for the half dozen species which have been carefully studied by the Forest Service the specific gravities here given have been determined more or less arbitrarily. That is, starting with Sargent's figures, published in Vol. IX Tenth Census, comparisons were made with all other data available. Then specimens of every species were carefully analyzed and compared and densities assigned which recognize the inherent characters of the individual species and eliminate manifest absurdities; such, for instance, as giving to *Pinus ponderosa* a density of .47 and to *Pinus echinata* a density of .61, or making the weights of *Quercus alba* and *Larix occidentalis* practically identical.

It is highly probable that many of these figures will be modified by later studies—entirely possible that one average density will not serve for the wood of a species that grows under widely different conditions. The author will be thankful for any data that will make this table more accurate.

No claim to original investigation is made further than may be involved in applying somewhat of silviculture and somewhat of common sense to the "as is" determinations from few, or small, or abnormal specimens.

The figures in all cases are for absolutely dry wood. As any specimen may be ten per cent. heavier, or ten per cent. lighter than the standard without becoming abnormal it is useless to give specific gravities more than two decimal places. For the same reason the cubic foot weights are rounded to even pounds, all being calculated on the basis of a cubic foot of water weighing 62.355 pounds at 39 degrees Fahr.

Name.	*Specific Gravity.*	*Weight per cu. ft. lbs.*
Pinus strobus	.38	24
" monticola	.39	24
" lambertiana	.37	23
" flexilis	.44	27
" resinosa	.50	31
" ponderosa	.50	31
" scopulorum	.49	31
" jeffreyi	.48	30
" contorta	.48	30
" murrayana	.48	30
" taeda	.51	32
" rigida	.54	34
" serotina	.58	36
" virginiana	.53	33
" pungens	.49	31
" muricata	.51	32
" echinata	.56	35
" divaricata	.48	30
" palustris	.62	39
" heterophylla	.63	40
Larix laricina	.62	39
" occidentalis	.66	41
Picea mariana	.45	28
" rubens	.42	26
" canadensis	.40	25
" engelmanni	.36	22
" parryana	.37	23
" sitchensis	.38	24
Tsuga canadensis	.42	26
" caroliniana	.43	27
" heterophylla	.43	27
" mertensiana	.44	27
Pseudotsuga taxifolia	.51	32
" macrocarpa	.46	29
Abies balsamea	.38	24
" lasiocarpa	.42	26
" grandis	.38	24
" concolor	.36	22
" amabilis	.42	26
" nobilis	.46	29
" magnifica	.44	.27
Taxodium distichum	.46	29
Sequoia washingtoniana	.33	21
" sempervirens	.39	24
Libocedrus decurrens	.38	24
Thuja occidentalis	.36	22
" plicata	.38	24

Name.	*Specific Gravity*	*Weight per cu. ft. lbs.*
Chamaecyparis thyoides	.37	23
" nootkatensis	.48	30
" lawsoniana	.38	24
Juniperus virginiana	.49	31
Taxus brevifolia	.64	40
Sabal palmetto	.44	27
" mexicana	.26	16
Juglans cinerea	.46	29
" nigra	.61	38
" rupestris	.66	41
" californica	.63	39
Hicoria pecan	.75	47
" minima	.77	48
" myristicaeformis	.78	49
" aquatica	.73	45
" ovata	.81	50
" laciniosa	.81	50
" alba	.85	53
" glabra	.83	52
" odorata	.83	52
" villosa	.83	52
Leitneria floridana	.21	13
Salix nigra	.45	28
" missouriensis	.61	38
" alba	.46	29
Populus tremuloides	.40	25
" grandidentata	.42	26
" heterophylla	.41	26
" balsamifera	.38	24
" angustifolia	.39	24
" trichocarpa	.38	24
" deltoides	.39	24
" fremontii	.40	25
" alba	.48	30
Betula populifolia	.58	36
" papyrifera	.60	37
" nigra	.58	36
" lutea	.66	41
" lenta	.68	42
Alnus rhombifolia	.44	27
" oregona	.44	27
Ostrya virginiana	.83	52
Carpinus caroliniana	.73	46
Fagus atropunicea	.69	43
Castanopsis chrysophylla	.50	31
Castanea pumila	.48	30
" dentata	.45	28

Name.	*Specific Gravity*	*Weight per cu. ft. lbs.*
Quercus alba	.80	50
" lobata	.74	46
" garryana	.78	49
" minor	.80	50
" macrocarpa	.80	50
" lyrata	.74	46
" prinus	.73	45
" acuminata	.78	49
" platanoides	.77	48
" michauxii	.78	49
" breviloba	.85	53
" douglasii	.94	59
" engelmanni	.94	59
" arizonica	1.01	63
" virginiana	.95	59
" emoryi	.93	58
" chrysolepsis	.85	53
" agrifolia	.83	52
" rubra	.73	46
" texana	.73	46
" coccinea	.72	45
" velutina	.72	45
" californica	.73	46
" digitata	.73	46
" palustris	.75	47
" marilandica	.73	46
" nigra	.72	45
" laurifolia	.73	46
" imbricaria	.73	46
" phellos	.72	45
" densiflora	.73	46
Ulmus crassifolia	.70	44
" pubescens	.70	44
" americana	.65	40
" racemosa	.73	45
" alata	.71	44
Celtis occidetalis	.66	41
" mississippiensis	.70	44
Morus rubra	.59	37
" alba	.64	40
Toxylon pomiferum	.77	48
Magnolia foetida	.52	32
" glauca	.50	31
" acuminata	.47	29
Liriodendron tulipifera	.42	26
Persea borbonia	.64	40
Sassafras sassafras	.50	31

Name.	*Specific Gravity*	*Weight per cu. ft. lbs.*
Umbellularia californica	.65	40
Liquidambar styraciflua	.48	36
Platanus occidentalis	.57	36
" wrightii	.57	36
Pyrus coronaria	.70	44
" angustifolia	.69	43
" rivularis	.83	52
Amelanchier canadensis	.78	49
Crataegus douglasii	.70	44
" crus-galli	.72	45
" mollis	.80	50
" spathulata	.72	45
" viridis	.65	40
Prunus serotina	.58	36
Prosopis juliflora	.68	42
Gleditsia triacanthos	.67	42
" aquatica	.70	44
Gymnocladus diocius	.69	43
Robinia pseudacacia	.73	45
Guaiacum sanctum	1.14	71
Gordonia lasianthus	.47	29
Ilex opaca	.58	36
Evonymus atropurpureus	.66	41
Schaefferia frutescens	.77	48
Acer macrophyllum	.49	31
" circinatum	.66	41
" saccharum	.69	43
" saccharinum	.53	33
" rubrum	.62	39
" negundo	.43	27
Æsculus glabra	.45	28
" octandra	.43	27
" californica	.50	31
Tilia americana	.45	28
" heterophylla	.43	27
Cornus florida	.82	51
" nuttallii	.75	47
" alternifolia	.67	42
Nyssa sylvatica	.64	40
" aquatica	.52	32
Arbutus menziesii	.71	44
Oxydendrum aboreum	.75	47
Rhododendron maximum	.63	39
Bumelia lanuginosa	.65	40
Diospyros virginiana	.79	49
" texana	.85	53
Mohrodendron carolinum	.56	35

Name.	*Specific Gravity*	*Weight per cu. ft. lbs.*	*Name.*	*Specific Gravity*	*Weight per cu. ft. lbs.*
Fraxinus quadrangulata	.69	43	Fraxinus pennsylvanica	.63	39
" nigra	.63	39	" lanceolata	.62	39
" velutina	.68	42	" oregona	.57	36
" americana	.62	39	Catalpa catalpa	.45	28
" texensis	.76	47	" speciosa	.42	26

SECOND GROWTH YELLOW PINE.

By W. H. Gallaher.

Western Yellow Pine *(Pinus ponderosa)* is usually considered a tree of slow but long continued growth whose potential productive capacity is limited by lack of soil moisture, and therefore one whose maximum yield will always be of an unsatisfactory nature. In mixed virgin forest its distribution is apparently determined by root competition for moisture rather than by crown competition for light. Growth studies in such stands have shown a mean annual production per acre which is almost dishearteningly low and an age of maturity which is correspondingly high. Nevertheless, under certain conditions it can and does grow with almost astonishing rapidity, comparing not unfavorably with other fast growing species such as White Pine in the east, Loblolly Pine in the south, or Douglas Fir in the northwest. Such conditions are found in California where a most fortunate combination of natural and artificial factors has caused the development of considerable areas of second-growth forest.

Second growth Yellow Pine occurs on the west slope of the Sierra Nevada Mountains in regions where the early gold rush caused the rapid development of mining centers depending on the surrounding country for fuel and lumber. Here typical frontier towns grew up in the typical manner. The exploitation of the virgin timber, much of which was of a quality unexcelled in the state, was rapid and thorough. But the early mushroom growth soon subsided and the area of heavy cutting was followed by a period of quiescence offering a golden opportunity for the regeneration and growth of a new forest.

Typical stands of second growth Yellow Pine are now found in the vicinity of Nevada City, Nevada County, California, between the elevations of 2,000 and 4,500 feet. This is a region of great fertility. The rich soils originating from the andesitic lavas of the Neocene, the diabase and granodiorite of the Jura-triassic, or the clay slate of the Carboniferous periods, support a luxuriant growth of vegetation. The climate, though varying greatly with the elevation, is in general temperate and is characterized by heavy precipitation during the winter and by dry warm summers. The average rainfall varies from 35 inches in the foothills to 65 inches in the high Sierras. Snow may remain upon the ground for a short time during the winter, the minimum and maximum temperatures being 10° F. and 105° F. The topography is a series of long, flat topped, gently sloping ridges, rising with increasing steepness towards the summit of the mountains and abruptly broken at intervals by deep river canyons. Contrary to rule all arable land lies upon the ridge tops while the narrow river canyons support but scattered trees and brush.

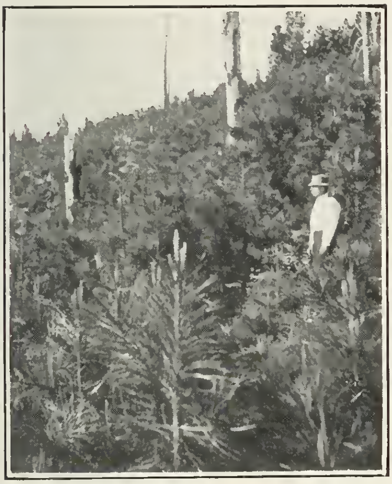
The character of the second growth varies with the elevation. At the lowest altitudinal limits of the type, or about 1,800 feet, it occurs unmixed with other species. At higher levels Incense Cedar, Douglas Fir, Sugar Pine and White Fir make their appearance. Above 3,200 feet pure pine is rarely met with except upon south exposures. Dense thickets of Incense Cedar and clumps of White Fir which were upon the ground at the time of cutting, occupy the area excluding the more valuable species. Reproduction of pine becomes poorer and poorer; brush is found in ever increasing quantities; and the region has the usual appearance of heavily cut over areas. The influence, on the forest, of these physical and artificial factors, is directly reflected in the growth, which becomes progressively slower and slower as higher elevations and less favorable sites are reached. Notwithstanding the greater precipitation it is problematical whether the region can be made as productive as at lower altitudes.

The optimum development of pure second growth pine is found at an elevation of 2,500 feet. Here it commonly occupies the ground to the exclusion of other species with the exception of Incense Cedar which forms an understory to the faster growing, but less tolerant pine. Stands are extremely dense, of exceptional height, and the narrow columnar top so characteristic of Yellow Pine in virgin forests changes to a shorter more conical form.

DIAMETER—HEIGHT TABLE

SECOND GROWTH YELLOW PINE. AGE 50 YEARS.

D. B. H.	*Height*	*D. B. H.*	*Height*	*D. B. H.*	*Height*
3	29	11	79	19	105
4	36	12	83	20	108
5	43	13	87	21	110
6	49	14	91		
7	55	15	94	22	112
8	60	16	97	23	114
9	66	17	100	24	116
10	73	18	102	25	118



Yellow Pine Reproduces Best Upon Burned Areas. Five Year Old Reproduction in the Sierras.

Yellow Pine Prunes Itself Very Slowly. Stand 52,000 bd. ft. Per Acre, 53 Years Old

Second Growth is Little Used Except for Cordwood. Cutting in Stand, Age 51 Years.

Notwithstanding the stands of exceptional density in which fir occurs, second growth pine prunes itself very slowly. Branches are soon killed when overshadowed, but are of such large size that they do not rot away from the trunk for a long time. Even the more tolerant Sugar Pine and Douglas Fir clean themselves more rapidly as they have comparatively small branches. Probably Yellow Pine can not be grown densely enough to make it prune itself well without so curtailing growth through mutual suppression and stagnation that more is lost than gained. Clear lumber can not be produced with a short rotation until the time comes when it is possible to practice methods of tree pruning such as are employed in European forestry. (?) Inasmuch as White Pine abroad has proved in this respect more troublesome than Scotch Pine, and Yellow Pine is far worse than either, it may prove impossible to obtain anything but knotty lumber and second growth or the "bull" pine of the lumberman.

GROWTH TABLE

SECOND GROWTH YELLOW PINE

Age Years	*Volume Per Acre* *Board Feet*	*Volume Per Acre* *Cubic Feet Inside Bark*	*Mean Annual Growth* *Board Feet*	*Mean Annual Growth* *Cubic Feet Inside Bark*
20		900		45
25		1700		68
30	11,000	2800	366	93
35	19,400	4000	554	114
40	28,000	5200	700	130
45	35,000	6440	777	143
50	41,200	7800	824	152
55	46,800	8480	851	154
60	51,800	9220	863	154
65	56,200	9860	865	152
70	60,500	10320	865	149
75	64,000	10780	853	144
80	67,400	11200	842	140

Volume table based on Clark's International Log Rule. Trees considered merchantable to 5-inch top.

It is to be regretted that the growth of stands over 65 years of age could not be determined, since the earliest cuttings date back to 1850 and there are no even-aged stands caused by fires such as are found in the Douglas Fir type in the northwest. The growth from 65 to 80 years of age was therefore based on increment borings in the oldest stands to be found. Beyond this age it is impossible to obtain any indication of the behavior of even-aged Yellow Pine. It is difficult to conceive of typical soil in the Yellow Pine type bearing a stand per acre of over 100,000 board feet per acre, and there can be no doubt but that a great falling off in growth, or practically a standstill occurs after about 80 years. Increment will be balanced by the dying out of many trees. Since not sufficiently large plots for an accurate yield table could be obtained, the table has been made most conservative, and falls far short from showing the maximum yields which were obtained during the growth study. The figures neverthless show that the growth of Yellow Pine in even-aged stands is very rapid, equalling that of White of Loblolly Pine. They show, moreover, that it is by no means impossible that the rotation of Yellow Pine may best be near 100 years rather than the much longer times that have been assumed for this species.

Second growth pine suffers from most of the destructive agents encountered in the virgin forest. The worst damage, however, is caused by snow, which in this region falls heavily laden with moisture causing it to pile immense weights on the trees, rather than sifting through and falling upon the ground. Yellow Pine is well rooted but its rapid height growth in even-aged stands makes it peculiarly susceptible to breakage. The weight of the moisture laden snow proves too much for the trees to bear, and tops 10 to 30 feet in length frequently broken off. Once started in a stand, breakage becomes general and every heavy snowfall is attended with serious damage. For this reason, thinnings will always be attended with great danger to the remaining stand and will necessarily be very light.

Deep soil is essential to the rapid growth and most emphatically to the reproduction of Yellow Pine. The roots must penerate below the surface layers which feel the drying effect of the long summer's drouth. Therefore, any agency lessening the water content may so disturb equilibrium as to render the soil incapable of supporting seedling growth. Areas of insufficient soil depth are characterized by scrub growth upon which pine encroaches with exceeding slowness or not at all. Temporary deterioration of soil quality through various causes is followed by scrub wood in its temporary form. In such cases the ease of regeneration depends upon the degree to which the brush absorbs the soil moisture, hence not only the amount of scrub growth but upon the species represented. In general, the better the soil the more easily will reproduction take place and the more rapidly will the scrub be driven out.

Old settlers in Nevada County affirm that the virgin stand was cut clean, leaving no seed trees. Furthermore, they say no reproduction existed upon the ground at the time of cutting, the forest was open in all directions and was kept in that condition by the Indians in order to have good hunting ground. The two statements are reconciled with difficulty. It is probable that neither is wholly true. Frequent surface fires undoubtedly killed much of the reproduction, but scattered patches of young growth which passed unnoticed in the early days and all seedlings which had sprung up since the last burning were left upon the ground. Secondly, unmerchantable trees were left in larger numbers than by the ordinary lumbering operation of to-day. Such trees acted as seed supply till they were cut for firewood. Nevertheless remarkably good reproduction is found considering the means by which it was secured and it should never be difficult to obtain satisfactory regeneration by natural means.

Though Yellow Pine reproduces prolifically on soil of good quality, cutting in second growth is not followed by restocking to any extent. This is because the trees have, for the most part, not reached the seed bearing age. Some seed is borne at the age of 50 years and a partial regeneration may be secured up to distances of 400 feet from groups of seed trees. Burned areas offer the best seed bed and extremely dense reproduction may often be found in open burns where fire has had the pathological effect of making the unkilled but badly damaged trees produce seed in large quantities.

The most difficult marking for regeneration in virgin Yellow Pine will always be found near the upper rather than the lower limits of the pine belt. Not only will it be found more difficult to keep out brush, but reproduction of other less desirable but more tolerant species occupying the ground will complicate a problem already confused by the constant variation of type and sub-type with every change of slope, aspect and elevation. It is essential to leave a minimum of shade upon the ground and to reduce the area of soil drained by the roots of the older seed trees. Scattered groups of trees which were left upon the ground after the original cutting now have no reproduction within 25 to 100 feet while further away second growth is abundant. Even in the virgin forest reproduction is conspicuously absent near veteran seed bearing trees. The distribution of Yellow Pine in California is probably governed, not by root compeition for moisture between the veteran trees, but by the difficulty experienced by seedlings in getting established on soils drained by the roots of the mature trees, coupled with fire and other adverse factors. Good silviculture, therefore, unmistakably calls for clear cutting with few and scattered seed trees. This will necessarily be modified by the demands of good management and the group selection system will most often be followed. Second growth could be regenerated by clear cutting in strips or large patches and burning over the area thoroughly, killing unmerchantable Incense Cedar and other worthless material. Good marking for fellings will approach as clean a cutting as is compatible with the requirement that sufficient material for a second cutting be left upon the ground.

CURRENT LITERATURE.

Logging. The Principles and general methods of operation in the United States. By R. C. Bryant, F. E., M. A. John Wiley and Sons, New York. 1913. Pp. 590. 8 vo. Price $3.50.

This stately and unique volume is a most welcome and much needed addition to our forestry literature. It is the product of a man who holds the unique position of a scientific specialist in the limited field which the title of the book describes, namely, that of Professor of Lumbering in the Forest School of Yale University. It is worthy of note that he is also the first graduate from an American forest school (Cornell), having gone forth into practical life with the beginning of the century, for 10 years gathering experience in the Philippines and various parts of the United States, preparing for his specialty.

The book is dedicated to the Members of the National Lumber Manufacturers' Association, through the generous contributions of which the professorship at Yale was made possible.

The book is frankly written as a textbook, but will be welcome to many a logger as a reference book, and, while we have called the subject limited, it appears that on the 590 pages only the more important features have been covered, leaving out a description of the innumerable variations in equipment and method which are peculiar to different forest regions, although a chapter is devoted to a general description of them. Altogether, the volume is the most complete single source of information in regard to this specifically American line of business. It is written in clear language, which, as there is necessarily much description, is an important matter. Each chapter is accompanied by a note on the bibliography of the subject of the chapter, which permits ready extension of its study.

The work is divided into six parts, comprising twenty-six chapters. The introduction or general part discusses on 44 pages very briefly the stand and ownership of timberlands; stand, ownership, present cut and prices of commercial timbers; problems of protection of forest property; and financing operations by timber bonds,—the relation of which to the main subject is rather distant. The second part, with 82 pages, refers to the work in the woods, with chapters on forest labor, camps, tools and equipment, felling and log making, and measurement of logs and other forest products. Parts III and IV, on Land and Water Transport, take up the bulk of the volume with 288 pages, nearly 100 pages alone being devoted to railroads. A short chapter of 24 pages, points out differences of procedure in various regions. Another two chapters, of 28 pages, describe two minor forest industries which come under the operation of loggers, namely turpentine orcharding and tanbark harvest. An appendix of 80 pages contains a complete classified bibliography; a terminology; various log rules and tables; log-grading rules; wage lists; stumpage values, and some other information. An Index of nearly 50 pages makes information on every point readily accessible.

Altogether, the volume appears to be a most painstaking piece of bookmaking, both on the author's and the publishers' part. We regret that it reached the reviewer too late for more than this book notice, but we are fortunate in being able to add below the reflections which the book has called forth in the mind of an experienced practical logger, also a former student of the New York State College of Forestry at Cornell University, with ten years experience in logging camps.

B. E. F.

No one can learn to log from a book. Still the greatest need the North American logger has to-day is book knowledge—for the 'ogger is deficient in the knowledge of the doings of others—a knowledge to be gained only by travel or from books.

The logger is made by experience, his own experience or that of neighbors—he needs the experience of other regions, other conditions of ground, timber, climate, men. It is this experience of many conditions which should be recorded in the book which would serve the logger.

There is no class of men the world over so efficient in themselves—and in comparison—so lacking in the efficiency due to breadth of knowledge, as the logger.

Strange as it may seem, logging methods the world over are gradually approaching uniformity—the spruce of Maine—the cypress of Louisiana—the fir of the Coast—the pine of the Inland Empire, in the past exploited by such widely different methods, will, with the broadening knowledge and the improvement of equipment, eventually be exploited by methods almost identical. The railroad will replace the skid road, the stream, the sled road and the wagon. The portable cable-way skidder will replace the skidding team, the high wheels and the donkey engine. The portable car camp will replace the shanty, the log camp, the shake camp. It will then be realized that the day of the old "boss" and "bully" and "push" are gone—that logging is a science as well as an art—that the logger is really an engineer, mechanical, civil and electrical.

There is now needed for the logger a book, or many books, to broaden his knowledge, to bring to him the knowledge of others, to make him equal without expensive errors, to new conditions that may arise.

A book of details is necessary; one to tell him why a Baldwin Geared Locomotive is better for him than a Shay; how to tell Norway iron from mild steel; how to cut for scale with the Maine rule; why a 6x19 rope makes a better loading line than a 9x9x1; which oil burner is best in a donkey; how to test lubricating oils; all the million details that the logger now has to learn by trial and error.

The book the logger needs will perhaps never be written, probably no logger to-day has the breadth of experience making him capable to do such a general book. If he had he would be too busy to write. It will remain for the onlooker to do the writing.

We have in R. C. Bryant the first of these observers to systematically and extensively put down what he has seen and heard of logging. Bryant never has logged, but he has written a book about logging as an outline for forest students. This book will have doubtless a further use than its intention of giving a general idea of logging systems to forestry students. One use will be, it is hoped, that some of the forestry teachers may see the great ignorance most of the so-called foresters have of the major factor in the present management of forests for revenue: "EXPLOITATION."

Again, Bryant may be followed by others who will build upon his work, and, in time, the book of the logger may be produced.

Bryant's book is a good book for its purpose of student instruction—anyone who knows logging, who has tried to impart a little information about it to the students—will see that it takes a lot of work to make such a book.

The North American logger is the greatest exploiter of forests in the world—the most efficient per day's labor. American methods are being introduced the world over wherever undeveloped forests occur. Men, engines, cars, locomotives from the United States are found in the most efficient operations of Siam, Formosa, New Zealand, Philippines, Australia, Borneo, Africa and South America.

Logging is one of the greatest industries of North America. About 55 billion feet of logs are cut annually on the continent, which, figured at an average logging cost of $5.50 per thousand feet, means an expense of 300 million dollars annually.

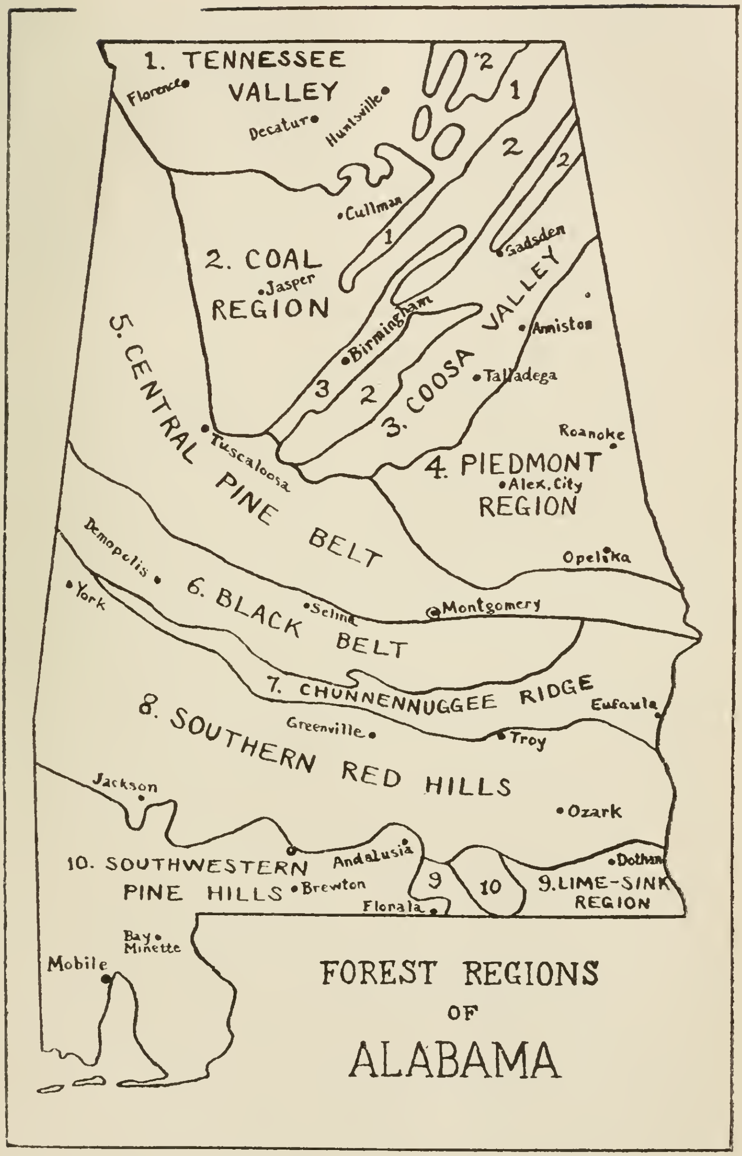
And for this tremendous industry up till now not a single book and only a few score of articles had been written that would be of much service to a manager in the industry. Bryant's book is the first attempt to fill in an acceptable manner at least a part of the large gap.

A. S. W.

Geographical Report on Forests. By Roland M. Harper. Geological Survey of Alabama. Monograph 8. Economic Botany of Alabama, Part I. 1913. Pp. 222.

Topographically the State is divided into two great divisions: the Hill Country and the Coastal Plain, the former occupying two-fifths of the area. The Hill Country, from north to south, is divided into five regions, namely, the Tennessee Valley, the Coal Regions, the Coosa Valley Region, the Blue Ridge, the Piedmont Plateau region. Most of the regions are divided into subregions. Under each subregion are discussed such topics as geology and soils, topography and hydrography, climate, forest types, percentage of woodland and forest products.

The Loblolly Pine leads in the composition (22%) of the forests in the Tennessee valley barrens subregion. The two next highest are Red Oak *(Q. falcata)* and Sweet Gum. In the Tennessee valley proper, Red Cedar leads in composition with 15 per cent. A large number of species (65) are listed for this region, and with the exception of Red Cedar none of them enters into the composition to a greater extent than 5 per cent. Beech,



FOREST REGIONS OF ALABAMA

chestnut and the oaks (13 species)make up the greater part of the forest area, this apparently being the hardwood area of the State. It has the largest number of mills in proportion to the forest area, some 48, with an average cut of 9,000 feet per day. The Tennessee valley occupies 4,900 square miles, 800 square miles of which are included in the barrens. Eighty per cent. of the latter is under forest and this proportion of the subregion is doubtless absolute forest soil. In the Tennessee valley proper, however, only 40 per cent. of the area is wooded and the forest is chiefly confined to rocky slopes and wet bottoms difficult of cultivation.

The Coal Region is divided into two subregions, the plateau subregion and the basin subregion. The plateau subregion, covering 3,000 square miles is underlaid by horizontal sandstones which yield light sandy loam soils. One third of the forest, which covers about three-fourths of the area, is coniferous, Loblolly Pine (16%) and Shortleaf Pine (10%) being the leading species. The region contains over 7 per cent. of the standing timber, but it contributes only a little over 1 per cent. of the State's yearly output of lumber, a condition due to the nature of the topography and to the lack of railroads. In the basin subregion, consisting of 3300 square miles, the rock is mostly shales and the topography is more diversified than in the plateau region. About 80 per cent. of the area is covered by forests, of which 37 per cent. is pine with the Lobolly leading (22%). The lumber industry is well developed, but the farming industry is confined to the bottom lands. There are about as many miners as farmers in the region.

The Coosa Valley Region, the southern extension of the great Appalachian Valley, covers in Alabama about 4,000 square miles. The soils are residual clays, chert and sand, derived from various kinds of crumpled sedimentary rock. The region, like the rest of the great Appalachian Valley, is noted for its long parallel ridges and wide valleys between them. The pine forests occupy the ridges and the hardwood forests the narrower valleys. About one half of the region is forested and 38 per cent. of it is occupied by conifers, the Loblolly, Shartleaf and Longleaf pines comprising 20 per cent., 8 per cent., and 6 per cent. of it respectively. Like the other regions, no single species of hardwoods enters into the composition of the forest to any considerable extent, the leaders in this case being Post Oak, Blackjack Oak and Red Oak *(Q. falcata)*, each with 4 per cent. The region contains more large towns and cities in proportion to its area than any other portion of the State, and the wood-manufacturing industries are numerous and varied. It contains nearly 12 per cent. of the total number of sawmills in the State. The charcoal iron furnaces of the region consume the equivalent of 152 million board feet, mostly pine, a year.

The Blue Ridge Region covers only 400 square miles in Alabama, 90 per cent. of which is under forest cover. The pines compose about one-third of the forest, and no single species of the hardwoods of the 26 listed enters into the composition to a greater extent than 10 percent. The Piedmont Region is composed of granitic, gneissic and schistose rocks, which yield residual red clay, gray loam and shaly soils. The topography is that of a maturely dissected plateau. The region occupies about 5,000 square miles in Alabama, and is about one-half forested. The three pines Loblolly, Longleaf and Shortleaf make up approximately one third, the members of the oak family one-fourth of the forests. About 4 per cent. of the State's wood-working industries are located in the region.

The author divides the Coastal Plain into ten regions, with several subregions. The Central Pine Region, for example, is divided into the Shortleaf Pine Belt (meaning the Loblolly Pine), the Longleaf Pine Hills and the Eutaw Belt. The Shortleaf Pine Belt borders the fall line across the State, and has an area of 5100 square miles. Although the region belongs to the coastal plain geologically, it has much in common with the hill country floristicly, and as a result it seems to have the largest number of species, 77 trees being listed. The soils are sandy and about three-fourth of them are covered by forests. Approximately 20 per cent. of the sawmills and 15 per cent. of the wood-working industries of the State are located in this region, which has only 9.8 per cent. of the area. As the name indicates, the Longleaf Pine Hills are sandy hills, rising about 250 feet above the valleys, covered with Longleaf Pine. They have an area of about 850 square miles. The Eutaw Belt is based upon a geological formation of that name and its forests do not seem to differ materially from those of the Shortleaf Pine Belt.

Although the Black Belt derives its name from the color of the soil, a humus colored clay, derived from limestone, its population is mostly of the same color. The region covers about 4300 square miles and only one quarter of its area is forested. The Chunnennuggee Ridge or the Blue Marl Region rises from the Black Belt to the southward, in a well defined escarpment across the State, and it covers 2300 square miles. The forests occupy one-half of the area, and they consist of the usual dry oak and pine woods on the upland, swamps along the streams and the hammock type of woodland in the ravines and second bottoms. About one quarter of the forests consists of the pines and another quarter of the various oaks. The Post Oak Flatwoods occupy only 335 square miles in Alabama. Although these flats are commonly designated as post oak flatwoods, it would seem from the authors list that the Post Oak consists of only 9 per cent. of the forest, and all of the oaks together only 29 per cent. The pines lead in the composition, Loblolly 20 per cent., Shartleaf 12 per cent., and the Longleaf 2 per cent.

The Southern Red Hills, occupy 8,000 square miles, the largest region, and extend in a broad belt across the State. The hills are somewhat broader than the valleys, and in some places they extend out into plateaus and ridges, standing 200 feet above their streams and about the same distance above the sea. The soil is mostly red loam, although there are frequent outcrops of stand. Most of the ridges are or have been covered with longleaf pine forests, but this pine forms only 10 per cent. of the forest as a whole, *Pinus Taeda* being slightly more common, forming 12 per cent. of the forest. About 60 per cent. of the region is still wooded. The activity of the lumber industry in this region approximates the average for the whole State. The Lime Hills Region covers 1300 square miles, and in spite of the fertility of the soil is about two-thirds forested with Cedar, Redbud and Mulberry on the limestone outcrops, with the various oaks and scattering Longleaf Pine on the drier uplands, and with the magnolias, Beech and Spruce Pine on the slopes.

The forests of the Lime Sink Region and of the Southwestern Pine Hill contain the largest percentage of pine of any region in Alabama, 51 per cent. in the former and 61 per cent. in the latter, and in each of these regions Longleaf Pine leads with 35 per cent. and 50 per cent. respectively. In the Lime Sink Region, which occupies 1300 square miles, nearly all the forest has been severely culled, and it is now rapidly giving place to settlement. The Pine Hills Region, covering 5,000 square miles, is the principal lumbering region of the State, containing 57 mills, with an average capacity of 37,000 feet a day. The largest mill cuts 275,000 feet a day. Although the population of the region has nearly doubled in the past decade, it still averages only 15 to the square mile, and 75 per cent. of the region is forested. The remaining two regions discussed by the author, the Mobile Delta and the Coast Strip are relatively small. The former consists chiefly of swamps and the latter of sand dunes.

The report proper is followed by five appendices in the following order: Scheme of Graphic Representation of the Environmental Factors of Forests of Alabama; Clinatological Statistics; List of Alabama Trees; Statistics Illustrating Present Condition of the Forests, Rate of Exploitation by Regions, and Statistics of Alabama Forest Products. From these we find that 62 per cent. of Alabama is woodland, of which the pines and the oaks each constitute about 20 per cent; average population 42 per square mile; average capacity of mills 16 thousand feet a day. In 1909, Alabama produced 1.691 million feet of rough lumber, valued at 23.9 million dollars. A little over half of this was further manufactured before leaving the State. Pine of the several species constituted about nine-tenths of the rough lumber and two-thirds of the finished lumber. In the same year there were produced 2.8 million gallons of turpentine and 310 thousand barrels of rosin, together valued at nearly 2.5 million dollars. The report contains a forest type map, which we reproduce in outline and some 63 excellent illustrations.

The one aspect of this very thorough-going report which will attract the most attention is perhaps the author's statement that "if it were possible to prevent forest fires absolutely the longleaf pine would soon become extinct" (p. 25). His argument is that fires destroy the broadleaf competitors of the pine, both trees and underbrush, which, when established, would by their shade prevent the regeneration of the very intolerant pine. Thus the periodic fires have kept in check the tendency of the broadleaf species to replace the pine in the forest. Although not definitely so stated by the author, this argument is based on the assumption that the longleaf pine forest is not in a condition of equilibrium in respect to the factors of its environment, that is, it is not a climax type. It is apparent that so far as the amount of precipitation, humidity and temperaure are concerned, the region might support a mesophytic broadleaf forest, but the soil conditions of the region, the low water holding capacity, the deficiency of potash, lime and humus, the relative pauncity of nitrifying bacteria, the dry heath nature of the dead cover, all indicate a xerophytic vegetation as the climax type.

The recrudescence of old theories presents an interesting psychological study. The author refers to a statement of the theory by Sir Charles Lyell in 1846. One finds it stated in almost the words of the present author by Mrs. Ellen Call Long in 1888, namely: "But for the effect of these burnings the pine forests would never have been and but for the continual annual wood firing that prevails so generally throughout the South, the Maritime Pine Belt would soon disappear and give place to a jungle of hardwood and deciduous trees." (Proc. 7th Ann. Meeting. Am. For. Congress, p. 39.) That fire under proper restrictions is a good silvicultural agent has long been held by foresters. That unrestricted forest fires are disastrous to best silvicultural conditions is supported by data and by experience in most forested areas of the country. If the longleaf pine region is an exception to the general rule, it remains to be proven by statistical data.

C. D. H.

Life Zones and Crop Zones of New Mexico. By Vernon Bailey. North American Fauna No. 35, U. S. Bureau of Biological Survey. Washington, D. C. 1913. Pp. 100.

This bulletin follows the general outline of the North American Fauna series of publications. The State of New Mexico is divided into various areas and zones, based upon climate as expressed in their animal and plant life. Reference is made to the economic plants best adapted for cultivation in each area or zone, but, from the nature of the case, discussions of crop zones do not occupy a prominent place in the bulletin. The usual lists of characteristic animals and plants follow the description of each zone.

The Lower Sonoran Area of the Lower Austral Zone enters New Mexico from the south and extends a greater or less distance up the main river valleys, as well as over some of the southern plains. It occupies about 18,000 square miles in the State and its vegetation is characterized by the mesquite and creosote bush. The Upper Sonoran Area of the Upper Austral Zone covers most of the plains and foot-hill country, extending between 4,000 feet and 8,000 feet in elevation, and it aggregates 92,000 square miles, two-thirds of the total area of the State. The rainfall ranges from 10 inches to 15 inches and the temperature is mild without great extremes of heat or cold. The Great Plains division of this area is mainly characterized by abundant grasses and has evidently been kept treeless by ages of sweeping winds and fires. The strong winds often blow the leaves off and cut through the bark of planted trees. In the Great Basin division, the lower, more open valleys and slopes are clothed with scattered grasses, cacti, yuccas and low desert shrubs. The upper ranges of both divisions support scattered trees of juniper, nut pine and oak.

The Transition Zone, extending from 7,000 feet to 8,500 feet on the northeast slopes and from 8,000 feet to 9,500 feet on the southwest slopes, covers 10,000 square miles within the State. This is the zone of Yellow Pine. The greater portion of the National Forests of the State lies within the Transition Zone. The Canadian Zone occupies 2,000 square miles and occurs in irregular strips scattered throughout the State, the largest continuous areas being in the northern portion. It extends on cold slopes approximately from 3,500 feet to 11,000 feet and on warm slopes from 9,500 feet to 12,000 feet. Its forests are characterized by Engelmann Spruce, White Fir and the Aspen, growing for the most part upon elevated slopes difficult of access. Because of its abundant rain, its forests, and their protective influence, this zone is the fountain head of the agricultural wealth of the surrounding country. The Hudsonian Zone and the Arctic Alpine Zone occupy only 300 square miles and 100 square miles respectively. The mountains of the State, their topography, climate and life zones, are discussed separately. Besides the life zone map, the bulletin contains 16 plates of excellent illustrations.

C. D. H.

Forest Atlas. Geographic Distribution of North American Trees. Part I, Pines. By George B. Sudworth. U. S. Department of Agriculture, Forest Service. 1913.

This is a series of maps, each containing the field of distribution of one species, 36 species being represented. The only textual addition outside of a short preface is the statement of the altitudinal range on each map. In the preface the author admits that "our present knowledge and published records of the geographic range of North American trees is still very incomplete." Yet, we think that in some instances it is more complete than appears on the maps. If, for instance, a scalloped outline on the outskirts means a patchy or localized distribution (no explanation is given as to its meaning), and that is all it may mean on a small scale map, then it is difficult to see why *Pinus strobus* should be so outlined and the *P. resinosa* outline appear solid: the two unquestionably behave alike, indeed, they occur almost invariably together in their northern range. In various cases it remains doubtful as to whether a non-continuous field represents really definite information or is merely an indication of discontinuousness. If the former, then the scale of the maps is too small to give to the information much value; if the latter, then many more solid color fields should have been broken. At least an intimation as to whether generalized or specialized information was intended, should have been given.

We doubt very much from the bookmaker's point of view whether the allotment of an entire map of the continent to each species is desirable; at least with such species as *P. torreyana, radiata, quadrifolia, balfouriana, apacheca, muricata,* which can be indicated only by a dart or spot, this is not justified. On the contrary, we believe, interest and value would be increased by combining a number of fields on one map, for comparative purposes, and also by representing merely portions of the map, thus avoiding the unnecessary ballast of useless paper.

As far as a superficial examination discloses, the information is still only very general; what is really much more needed and would prove of exceeding value is the detail distribution on a large scale map, even if it were of only a limited number of species, and especially of their outskirts, when the ecology of the species could be brought out with more satisfaction.

If, however, this publication, as the author hopes, will stimulate interest among the fieldmen to observe and supply this detail information, it will have served a good purpose.

B. E. F.

The Strength of Long-Seasoned Douglas Fir and Redwood. By A. C. Alvarez. Bulletin II, Department of Civil Engineering, University of California. Berkeley, Cal. 1913. Pp. 17, ill.

"The specimens for these tests were selected from the wall studding, floor joists, and underpinning of a one-story frame building erected on the University of California campus in 1874, and demolished in 1911, making the age of test specimens 37 years. The wall studding and floor joists were of 2x4 inch and 2x8 inch Douglas fir respectively, the underpinning of 3x4 inch and 4x4 inch redwood. All the Douglas fir could be classed as of No. 1 grade. All knots were sound; few knots were larger than one inch. The redwood specimens were of similar grade. The smaller pieces of Douglas fir cut for compression and shear tests were clear timber. There was not the slightest indication of decay on any of the material. Age had merely darkened its surface slightly.

"The conditions to which all the material was exposed in service are described as follows: The floor level of the building was about three feet above ground surface. Air could circulate under the floor through occasional latticed ventilators placed on all sides under the water table. The interior finish was of lime plaster on wooden lath; the exterior was painted redwood channel rustic. The building was freely exposed on all sides to light and air. For a period of about four months in the year the ground surface in the vicinity of the building in question was usually very damp, a condition favorable for the decay of the fir floor joists, which were only two feet above ground. Clearly, here, ventilation prevented decay. The weight of the timber as tested clearly shows the extent to which air seasoning took place under these conditions.

"Bending, longitudinal compression, and longitudinal shear tests were made on Douglas fir. The material available allowed of only longitudinal compression tests of redwood.

"The number of tests made was not large enough to justify any sweeping conclusions. However, a large number of tests made on material from just this source, which was the only one available at the time, would not have added materially to the value of the results.

A comparison of averages from the above test results with those given in Table 2, page 21, U. S. Forest Service Bulletin 108, on similar timber air seasoned for two years, shows the following facts:

1. Small pieces of the long-seasoned Douglas fir without defects are 490 pounds per square inch stronger in longitudinal shear than two-year-air-seasoned material, which has an average resistance of 822 pounds per square inch. This represents an increase in shearing strength of about 60 per cent.

2. The modulus of elasticity in bending for the long seasoned Douglas fir is 20 per cent. higher.

3. The fiber stresses at the elastic limit and at the maximum load for the long seasoned material are respectively about 30 per cent. and 13 per cent. higher.

4. The maximum crushing strength in compression longitudinally is 40 per cent. higher for the long seasoned Douglas fir, but its elastic limit is 30 per cent. higher.

5. The longitudinal crushing strength of the long seasoned redwood is 25 per cent. greater.

"In conclusion, the well preserved condition of the floor joists shows that proper ventilation will prevent the decay of timber that is exposed to a damp atmosphere. The absence of dry rot in the wall studding shows that air has sufficient access through channel rustic to prevent it. Under favorable service conditions, such as in the ordinary frame building, sound heart timber in pieces of moderate section gradually gains in strength and stiffness through air seasoning."

S. J. R.

Uses of Commercial Woods of the United States: Beech, Birches and Maples. By H. W. Maxwell. Bulletin No. 12, U. S. Department of Agriculture, Washington, D. C. 1913. Pp. 56.

This publication is one of a series on the uses of woods begun by the Forest Service a few years ago. The first two publications related to the cedars, cypresses and sequoias, and to the pines. This is the first dealing with hardwoods and the three generally are considered together because of their commercial rather than their botanical relationship.

"The woods of all have several points of similarity, such as hardness, strength and susceptibility of fine polish, and in the main their uses are similar. They grow usually in the same regions, and they are often lumbered and milled almost as though they were a single wood, but the resulting lumber is piled and sold separately. It is not unusual in New England, the Appalachian region, and the Lake States for lumbermen to speak of beech, birch, and maple as "the hardwoods," 'thereby placing them in a group by themselves, separate from oak, elm, gum and the rest. This is especially true when beech, birch and maple go to chemical plants manufacturing charcoal, wood alcohol, acetates, and other by-products. These woods in 1909 constituted more than 90 per cent. of all the hardwoods employed in distillation in the United States. They made up, also, a large but unknown percentage of the country's hardwood flooring, material for furniture and agricultural implements, and interior finish for houses. In a variety of small commodities they hold first place."

The important species are considered in great detail. In each case there is first a summation of the physical properties, the data for which are taken largely from Sargent since the Forest Service tests are not yet complete. "Engineers and others wishing to obtain accurate values for the mechanical properties will, of course, not use this bulletin for that purpose."

The supply of material is next briefly considered, followed by summary of the early uses. The remainder is devoted to a well-written, and instructive consideration of the different uses of each wood and the reasons for such uses.

Some of the figures relating to supply are interesting. The total remaining stand of beech in the United States is roughly estimated at from 17 to 18 billion feet. The amount of sweet birch "is probably much under that of beech, and certainly less than sugar maple." "It has been estimated that enough paper birch is in sight to meet visible demands for about 40 years." The entire stand of maple, counting all species is placed at less than 40 billion feet. "Well-posted lumbermen in Michigan are of the opinion that maple in their state will be cut out in 15 years."

S. J. R.

Wood-Using Industries of Virginia. By R. E. Simmons. Published by Department of Agriculture and Immigration of Virginia. 1912. Pp. 88, ill.

The investigation upon which this report is based was undertaken by the U. S. Forest Service in co-operation with the Department of Agriculture and Immigration of Virginia. The statistics were compiled from data collected in 1911, covering a period of one year.

"Besides the 2,100,000,000 feet which Virginia's sawmills produce annually, and 20,000,000 feet cut into veneer, it requires 257,000,000 feet of forest material for the makers of slack staves and heading and 13,000,000 feet for the manufacturers of tight cooperage stock. The aggregate amounts to nearly 2,390,000,000 feet, which does not include the drain on the forests for such products as cross-ties, pulpwood, mining props, and telegraph poles. Arbitrarily fixing the quantity for these at 300,000,000 feet, the total amount of wood contributed annually by Virginia's forests would aggregate approximately 2,690,000,000 feet. Expressed in dollars and cents this amounts to more than $25,500,000, making the value of the annual timber crop to exceed the combined values of the tobacco and wheat crops, and equal to considerably more than two-thirds of the corn crop as reported by the Department of Agriculture for 1910. With agriculture, therefore, Virginia's forests are one of her greatest sources of wealth.

"The wood-using industries take a part of this lumber after the saw mills lay it down, and by additional manufacture further add to the commercial activity and prosperity of the State by making commodities of greatly increased value. This added value is estimated to be more than $10,000,000, making the forest products worth over $35,000,000. In 1911, wood-using factories paid over $20,000,000 alone for their raw material, and according to the last Census their total capitalization, together with the sawmills, amounted approximately to $25,000,000. If the timber is allowed to disappear, the life of these industries, and of the sawmills which are dependent upon the forests for their raw material, is limited; and if measures are not taken to insure the continued growth and protection of the forests, the industries will ultimately have to shut down, and the State will suffer from the consequent loss of business. Nearly every year fire rages in Virginia's forests and the annual loss to the State is not less than $350,000. The forests cover an area of 15 million acres or equal to one-half of that of the State and are estimated to be worth over $100,000,000."

"Of the woods used by the manufacturers only seven were reported as coming entirely from Virginia forests. They were scrub pine, yellow or black oak, white (soft) elm, yellow buckeye, persimmon, sassafras, and silver maple. On the other hand, the entire supplies of rock elm, butternut, and Osage orange come from other states. These woods are cut in Virginia in quantities more than sufficient to meet the local demands, but the manufacturers evidently found shipped-in woods more convenient. It is significant of the growing scarcity of native, eastern softwoods that three species from the Pacific Coast states were called on to meet uses in Virginia in competition with the eastern woods. They were Douglas fir, western red cedar, and sugar pine. Eleven foreign woods were reported, some of them at high prices. * * * Nearly 45 per cent. of the wood used by the Virginia manufacturers was cut from the forests of other states."

"Cherry was the most expensive domestic wood, with an average price of $97.40 per thousand board feet. The Pacific Coast woods had the next highest prices and sugar pine led. It was purchased for $68.38. Of the eastern woods the most expensive was red cedar at $36.48. The price shown for black walnut is surprising. It follows red cedar at an average of $35.85. The cheapest wood was cotton gum, costing $9.65. There is $1.82 difference in the price of cotton gum and black gum. Hemlock is the lowest priced conifer, and white elm next to cotton gum the cheapest hardwood.

"Only a little more than one-half of the material used by the Virginia manufacturers was state grown. This does not mean that the state forests were incapable of furnishing more, because the lumber cut of the Virginia sawmills for 1909 was considerably more than five times that consumed by the wood users. Several conditions, however, favor the use of shipped-in-material Industries near the borders draw their raw material from near-by localities, irrespective of State boundaries. The railroads entering the large consuming centers of Eastern Virginia from the

South, facilitate the use of lumber from Southern States rather than material shipped from the far western part of the State. Virginia sawmills probably secured better markets for their rough lumber in Northern States than at home, while manufacturers on the other hand purchased more advantageously from sawmills farther south.

"Virginia is divided naturally into three-well-recognized regions, according to the characteristic growth of the timber and to soil and surface conditions. They are the Tidewater Region, the Piedmont Region and the Mountain Region. The Tidewater Region is the noted pine section of Virginia, where the first exploitation of the forest began, and from where the largest portion of the lumber credited to Virginia has always been manufactured. Loblolly and shortleaf extensively, and scrub and longleaf pines in infrequent stands, are native to this part of the State. On the lower lands mixed with the pine are gums, water oak, hickory, and in the swamp and inundated areas, willows, cypress and Southern white cedar (juniper) grow. The Piedmont Region presents frequent areas of shortleaf standing on the old fields, and in the northern part of this section the scrub pine *(Pinus virginiana)* prevails. Red cedar, oaks, yellow poplar, chestnut, ashes, and hickories and other miscellaneous hardwoods abound. This region is the principal farming center and the tree stands are confined entirely to farm forests. The Mountain region is mainly a hardwood section and furnishes a large part of the virgin growths still standing in Virginia. The white pine stands belong to this region of the State, but scrub pine is scattered throughout the hardwoods. Red spruce, extending its range from West Virginia, is cut in large quantities in several localities of this region."

S. J. R.

Wood-using Industries of Minnesota. By Hu Maxwell and J. T. Harris. Includes a brief discussion of *The Timber Resources of Minnesota,* by Wm. T. Cox. Published by Minnesota State Board of Forestry, St. Paul, Minn. 1913. Pp. 87.

The study upon which this report is based was made by the U. S. Forest Service in co-operation with the Minnesota Forest Service in the Spring of 1912 and covered the calendar year 1911.

The total area of Minnesota is 84,282 square miles, including a water surface of 5,637 square miles. There are about seven million acres of swamp land in the state, and it is estimated that there are 8,000 lakes. The forested area is approximately 520,000 square miles, or nearly 65 per cent. of the land area.

"Though the mills of the state are sawing nearly one and a half billion feet of lumber a year, their output is not adequate to meet the demand. They are called upon to supply not only the people of Minnesota with their factories in every large town, but likewise surrounding states, east, south, and west. The Dakotas and Iowa have little timber of their own, and for years they have drawn upon Minnesota's forests. They still look in that direction for at least part of their supply. Douglas fir, western yellow pine, western spruce, and western hemlock from the Pacific Coast are, however, appearing where formerly the timber of the Lake States held undisputed control. The western woods have invaded Minnesota itself, and are now sold to factories in the state at the rate of millions of feet a year. Even Louisiana and other southern states are sending large quantities of pine lumber into Minnesota."

Forty-five kinds of woods were used in the state in 1911, of which 42 were native to the United States, and 24 to Minnesota. The total quantity of wood used was nearly one billion feet, worth nearly seventeen million dollars. Of the total used, 828,-655,319 board feet came from the state, while 129,370,079 feet came from the outside. The only woods supplied wholly by Minnesota were aspen, and balm of Gilead.

White pine is by far the most important forest tree in Minnesota. Manufacturers bought nearly three times as much of it as of any other wood, and paid nearly three times as much for it. Red or Norway pine is second in amount used in the state. For many purposes the lumber is as good as that of white pine, but because of its reddish tinge it rates below white pine where color is a consideration. Jack pine which a few years ago was scarcely used at all, was used to the extent of sixty-five million feet, worth $900,000. Of the hardwoods the most important are birch, basswood, balm of Gilead, red oak, white oak, aspen and sugar maple.

To supply the mining industry of the state were required ten million linear feet of mining timber worth $500,000; 82,750 cords of logging, $413,750; 150,000 short ties, $37,500. Approximately 239,676,500 feet of lumber are cut annually in the state for the manufacture of railroad ties, costing about $2,500,000. The average production of cedar posts in Minnesota is 3,700,000; that of poles about 1,270,000. About ten million board feet of piling $250,000 were cut in 1912.

The following table is an estimate of the amount of wood cut annually in Minnesota for fuel:

Farms, 1,000,000 cords.

Cities and villages, 750,000 cords.

Shipped out of the State, 175,000 cords.

Total, 1,925,000 cords.

In addition to this there is shipped into the state from Wisconsin about 25,000 cords.

Minnesota has the greatest forests of any state east of the Rocky Mountains. Over twenty-eight million acres still bear forests of some kind, though much of the area has been logged and still more has been burned over. There are approximately seventy-five billion feet of merchantable timber standing in the woods with a stumpage value of at least $4 a thousand. The enormous value of these forests was recognized by the legislature in 1911, which appropriated $75,000 annually, and thus made possible an organized force of rangers and patrolmen.

"A beginning has been made by the the newly organized forest service to protect the forests from fire, to secure a greater economy in the utilization of forest products, to encourage the use of species of trees other than those now cut, and to differentiate between agricultural and forest land with a view to perpetuating the forests upon land which will produce greater profit in growing timber than in agricultural crops."

S. J. R.

The Wood-using Industries of Iowa. By Hu. Maxwell and J. T. Harris, with Chapters on *"The Timber Resources of Iowa,"* by G. B. MacDonald and *"White Pine in Iowa,"* by N. C. Brown. Bulletin 142, Iowa Agr. Exp. Station, Ames, Iowa. 1913. Pp. 231-304, ill.

The study upon which this report is based was conducted by the U. S. Forest Service in co-operation with the Iowa Agricultural Experiment Station. The statistics were compiled from data collected in the spring of 1912 and cover the calendar year 1911. The chapter on "The Timber Resources of Iowa" and "White Pine in Iowa" were not prepared in co-operation with the Forest Service but are included in the bulletin on account of the close relation between the wood-using industries and the supply of native timber.

"Iowa is essentially an agricultural state, about 90 per cent. of its area being taken up with more than 217,000 farms. Probably one-fifth of the state was forested when white men first reached it, the growth being along the rivers, though the forest often reached back many miles into the prairies. The finest sycamore, walnut and oak were soon cut and timber of that class has almost disappeared. To-day, in fact, practically nothing of the original forest remains. Much timber has been planted, however, some as woodlots and some for windbreaks and shelterbelts.

"Most of the material obtained from Iowa forests goes to supply the ever-increasing domestic needs of the woodlot owners and is not accounted for in this statement of the annual consumption of wood for factory products. Iowa still produces timber, but by far the greater part of the wood used by manufacturers comes from outside. The state's wood-using industries are important and it is giving more attention to plans for protecting and further developing such valuable assets as the woodlot and the industries depending on wood.'"

"In quantity the white pine used by Iowa manufacturers equals nearly any four other woods. In price per thousand feet it is exceeded by 23 species. The highest average price paid for any species was for 5,000 feet of Circassian walnut at $300 per thousand the cheapest was black willow at $14. Compared with prices in most other regions no very cheap wood is used in the state. * * * The average price for the entire quantity of wood purchased by Iowa manufacturers was considerably above the average in most states. This was because Iowa is not in a timber region and also because the kind of manufacturing carried on demands a good class of raw material. Still another reason for the high cost of the wood may be found in the fact that much of it is bought in rather small amounts and retail markets are patronized. The woodworks of Iowa are not generally in the business for the purpose of working up and disposing of an abundance of material that is seeking a market, but rather to supply a market which is active in its demands. Iowa manufacturers of wood products sell largely to home people.

"Less than three per cent. of the lumber and logs used grow in the state. Iowa is an interesting battleground between the southern, western, and lake states manufacturers of lumber, and is so situated territorially that it receives competitive bids from regions on all sides. It draws also from a wide range of species as table I shows. Freight rates from the extreme west to Iowa are not prohibitively above rates from the extreme south. The result is that very interesting competition has developed between certain species of wood for certain purposes. For example, though the average price of redwood in Iowa is about $10 above the price of cypress, yet the California wood is so easily handled in the factory and is so free from defects that many establishments are willing to pay the difference in price. Redwood makes a very attractive appearance in a number of commodities, such as dairymen's and apiarists' supplies, tanks, silos and general mill work. Possibly the western sawmill men are shipping into the state a carefully selected stock, but however that may be, redwood is increasing in favor even with the heavy handicap in price. The quantity of cypress bought in 1911 by Iowa manufacturers, however, was nine times that of redwood. In the same way, Douglas fir from Washington and longleaf pine from Louisiana meet in active competition in Iowa wood-working factories. The southern wood is purchased in considerably larger amounts, but the fir is higher in price, and there is not much difference in the total cost.

"Though from a lumbering standpoint, Iowa is properly classed as a nonproducing territory, probably 25 per cent. or more of the raw material it consumes reaches the factories in log form. This is due to the fact that Minnesota forests supply a large amount of the pine by rafting it down the Mississippi to the large manufacturing establishments at Davenport, Dubuque and Keokuk. One establishment alone receives annually 18,000,000 board feet in log form. These mills, however, which depend on the rivers to bring them logs from the northern forests report a gradual decrease in the supply of logs in recent years. The falling off in river shipments is due to the activities of the railroads and to the diminution of the accessible timber immediately on the water fronts about the upper Mississippi and its principal tributaries.

"Though Iowa supplies its factories with less than 3 per cent. of the wood they use, there is in the state an up-to-date sawmill running regularly and sawing daily 125,000 feet of logs. This shows that the prairie area is a good consumer of raw material in its roughest form. The owner of this large mill reports that he has a great advantage over mills located a long distance from the centers of population when it comes to disposing of waste material, such as slabs, sawdust, odd lengths and inferior low grade lumber. In the prairie districts all such material can be disposed of at more or less of a profit, for kindling if for nothing else, but in a lumbering district proper it finds few buyers, and most of it goes to waste. It can be made profitable, therefore, to transport logs long distances in order to reach a market for what would otherwise be waste.

"The state of Iowa is making rapid progress toward caring for and developing its natural timber resources. The Iowa State College of Agriculture and Mechanic Arts at Ames is well equipped for and is carrying on a large number of experiments for the guidance of those interested in forestry, in anticipation of a time when the region must depend upon itself for a large part of its timber. There are a score or more of important manufacturing centers, including Des Moines, Dubuque, Davenport, Keokuk, Cedar Rapids, Sioux City and Clinton, each of which has a number of large wood-working plants which claim to be in position to compete successfully with establishments situated in remote but heavily wooded districts. It is claimed that the cost of shipping the raw material in the rough form is more than offset by the closer utilization possible around cities located in the nontimbered belt. The Mississippi is a great aid in cheap transportation from the north. Contemplated locks and dams, to be built by the federal government between Illinois and Iowa, should add much to the stream's value in that respect. It is further anticipated that the development of water power, now in process, will grealy stimulate manufacturing."

"According to the best available figures, the timbered area of Iowa amounts to 2,500,000 acres, or approximately 7 per cent. of the total area. The timber is almost exclusively of the mixed hardwood type. The species of most importance are the white oak, red oak, burr oak, yellow oak, and swamp white oak, the pignut and bitternut hickories, white and green ash, black walnut, basswood, white, red and cork elms, cottonwood, black willow, hard and soft maples, sycamore, hackberry, honey locust and coffee tree. The valuable oaks and the walnut were cut especially heavily at an early date. Among the conifers two species have been found in commercial quantities in Iowa, white pine *(Pinus strobus)* and red cedar *(Juniperus virginiana)*. The very limited occurrence of balsam fir *(Abies balsamea)* is only of botanical importance. Small stands of the pine occurring in the northeastern part of the state were early lumbered. The range of the cedar extends to all parts of the commonwealth. Valuable stands which were found along the Cedar and Iowa rivers were early exploited.

"The average woodlands of the state are producing only about thirty per cent. of their possible output of wood products. With little or no protection from fire or stock, the native timber is regenerating poorly and many stands are characterized by the absence of reproduction.

"From early times Iowa has been active in planting timber. The woodlots in most instances were for providing shelter, fuel and repair material. In few cases were the plantings made for strictly commercial purposes. In 1863 the State Census reported a total of 8.360 acres in planted groves and woodlots. In 1867 this area had increased to 14,128 acres; in 1875 to 65,549 acres; and at the present date the estimated acreage in planted timber is 210,000 acres."

"The returns that may be expected from planting white pine vary with the care in planting, the quality of stock used and the soil conditions. One plantation yielded an average annual income of $10 per acre over a period of 35 years; another $12 per acre per annum over a slightly shorter period. In planting white pine, it is not necessary to cultivate the ground after planting but it is absolutely essential to keep out surface fires and stock. Sheep and cattle are apt to nip the tender young seedlings, killing them back or destroying them, and a ground fire will invariably kill the young trees."

S. J. R.

Forest Fires in North Carolina during 1912, and National and Association Co-operative Fire Control. By J. S. Holmes. Economic Paper No. 33, North Carolina Geologic and Economic Survey. Raleigh, N. C. Pp. 64.

The author states that the forest fires during the year 1912 caused more than twice as much financial loss as has occurred in any previous year for which statistics have been gathered (1909 was the first year). In the mountain counties the damage done by fires exceeded the total tax assessed against the region. The total loss in the state is estimated to be in excess of one million dollars. No direct connection could be discovered between the drought periods and the periods of worst fires in 1912. The chief source of fires as reported from about one-half of the counties were "hunters," "incendiary," and those attributed to "loafers, trespassers, etc."

The author reviews at some length the subject of fire protection in the National Forests, National Forest Fire Laws, Federal Co-operation with States, and the history and activities of the more important timberland protective associations. The appen dix contains an article on spark arresters by R. C. Hawley.

R. C. B.

Wood-Using Industries of Ontario. By R. G. Lewis, assisted by W. G. H. Boyce. Bulletin 36, Dominion Forestry Branch. Ottawa, Canada. 1913. Pp. 127.

Ontario is the foremost province in the Dominion in the number and variety of establishments manufacturing merchandise from wood. This bulletin gives a very detailed analysis of the information gathered from some 1200 of such wood-using firms.

These firms last year used more than 800 million feet board measure of raw material costing nearly 20 million dollars; this being home-grown to the extent of some 80 per cent. Of this large quantity the sash and door industry used 31 per cent; the pulp industry 15 per cent; boxes, 9.5 per cent; hardwood flooring, 6.5 per cent ; wth the cooperage, household furnture, agricultural implement, and vehicle industries next in order.

A total of 34 different kinds of wood was reported as being used. Pine and spruce (about equal quantities of each) are most largely used, these two forming about two-fifths of the total. Next in order rank maple, hemlock, oak (largely imported), elm, basswood, birch and beech. A description of each of the woods is given, covering the physical and mechanical qualities, uses, etc.

Thirty-eight tables are given, each referring to the particular industry. These show the relative importance of the different woods used, their average values, and the sources of supply. A discussion of the products follows, giving the qualities desired in the species of wood, the species used for different purposes, and the market.

Tables are also given showing the percentage of the different kinds of wood used in the various industries, and the average prices of these woods in the different industries.

The bulletin closes with a list of commodities manufactured from each kind of wood, and a classified directory of manufacturers.

J. H. W.

Report of the Minister of Lands, Forests and Mines of the Province of Ontario, 1912. Legislative Assembly, Toronto, Canada. 1913. Pp. 110.

The following statistics, in round figures, are of interest. There were under license 18,410 square miles, nearly 1,000 square miles less than the preceding year. The output of pine from these Crown lands was 488 million feet, some 96 million less than in 1911. Other timber species, however, showed an increase of 25 million feet over 1911, pulpwood 50,000 cords increase, while ties aggregated 5,705,000 pieces.

The revenue collected amounted to nearly $2,000,000, covering $540,702 bonus, $1,339,957 dues, $96,262 ground rent, and $8,740 transfer fees. In addition, parks and forest reserves produced $8,878.

Disbursements for fire-ranging are considerable. There were on duty during the summer of 1912 on lands of the Crown 111 rangers, and on railways 193 rangers, with chiefs. This service cost $124,483. The reserves totaling 27,970 square miles were patrolled by 228 fire-rangers at an expense of $83,605, or $3 per mile. In addition, wood-ranging cost $91,753. The licensed lands required 350 rangers, the expense being met by the licensees.

Two white pine berths, each of 258 square miles, on the Jocko river, were sold at the record bonus prices of $13.26 and $12.10 per M feet, in addition to $2 dues. A distinct advance was made in these sales in that the contracts contained a clause requiring the purchaser to dispose of the lumbering debris as directed by the department. J. H. W.

The Earth. Its Shape, Size, Weight and Spin. By J. H. Poynting. Pp. 141, 12°. *The Atmosphere.* By A. J. Berry. Pp. 146, 12°. University Press, Cambridge; G. P. Putnam's Sons, New York. 1913. 40 cents each.

These two little booklets are the latest addition to the Cambridge Manuals of Science and Literature, some 60 now, which enable busy workers in other fields to keep *au courant* with scientific subjects outside of their sphere under guidance of trustworthy specialists without danger of too much popular or too much scientific pabulum being offered.

The contents of The Earth are fully described in the title. The volume on the Atmosphere does not, as one might be inclined to think, lead in the direction of Meteorology, but discusses the chemistry and physics of the atmosphere, after some interesting chapters on the history of the development of our knowledge of the air.

B. E. F.

Lorey's Handbuch der Forstwissenschaft. Volume III. *Forstliche Betriebslehre und forstliches Ingenieurwesen.* Tübingen, 1912. Third Edition.

Eberhard reviews the third edition of the third volume of Lorey's "Handbuch der Forstwissenschaft."* This volume, as in the two previous editions, contains Lehr's Forest Valuation and Forest Statics; Fromme's Forest Surveying; von Guttenberg's Forest Mensuration; Judeich's Forest Organization; Hausrath's Transportwesen; and Schwappach's Forest Administration. Of these, Judeich's Forest Organization alone has undergone noteworthy changes, having been remodelled by Dr. C. Wagner, the editor, himself.

Not only has the sequence of chapters been changed but the resumé of working plan procedure in the various states has been brought to date. This covers the states of Germany and Austria. The latest development in Prussia is the complete abandonment of the "framework" methods of regulating the yield and the substitution of the Age Class Method. The Bavarian instruction of 1911 and the Badensian ones of 1912 are briefed, but the preliminary revision of the Württemberg instructions (1911) is not mentioned.

The chapter on Methods of Yield Determination has been rearranged. Following an interesting historical sketch of the development of the various methods, these are divided into 5 groups:

1. The volume methods.
2. The Normal Growing Stock Methods ("Formula" Methods)
3. The area methods.
4. The period ("framework") methods.
5. The age class methods.

Acquaintance with this volume of Lorey's Classic is to be urged upon those who want first-hand knowledge of the advances in German forest operation (Forstliche Betriebslehre).

Forest Protection in Canada, 1912. By Clyde Leavitt. Commission of Conservation. Ottawa, Canada. 1913. Pp. 174.

This volume represents the first annual report of the Chief Forester of the Commission, whose energies have been largely directed to the problem of protection from railway fires.

The first forty pages deal with the work done along this line. The history of the steps leading up to the issuance of the well-known order of the Board of Railway Commissioners for Canada on 22 May, 1912, for protection from railway fires, is given. The regulations of the order deal with the use of fire protective appliances on locomotives, the establishment and maintenance of a staff of fire-rangers for special patrol, the regulation of locomotive fuel, the clearing of rights of way, the financial responsibility of railway companies for fire damage, and the construction and maintenance of fire guards along railway lines. These regulations easily comprise the most extensive and most efficient provisions in America for the prevention and control of railway fires, by the railways themselves. The railways not subject to the jurisdiction of the Board constitute a minor percentage of the total mileage of Canada, and in two of the provinces (British Columbia and Quebec) these have been taken care of by provincial legislation of a character closely similar to that of the Dominion Board.

For co-operative purposes the Chief Forester of the Commission of Conservation was appointed Chief Fire Inspector for the Board of Railway Commissioners, and, as such, charged with the enforcement of the above order, and with full power to prescribe the exact patrol, etc., to be established. For inspection of the work done by the railway companies, field officers were appointed from officials of the Dominion and Provincial governments, most of them engaged in forestry work.

On the issuance of the order, attention was at once given to the organization of patrol work in the West, conditions there being more urgent than in eastern Canada. On those portions of the lines where the fire risk was small, the regular employees (section-men, track-walkers, etc.) performed patrol duties as part of their regular work. This was particularly the case on portions of the systems where oil fuel was used. Where the fire danger was sufficiently great, special patrols were required of the companies, by men either on foot or with speeder. The local officers of the Board have authority to modify locally the patrol requirements according to climatic conditions.

Owing to the time needed for organization of the work, it was quite late in the season before the special patrols were actually in effect. Fortunately, the season was wet, and fires were not serious. An incomplete list of those occurring adjacent to railway lines in the West shows a total of 200 fires (exclusive of prairie fires), of which 164 were set by trains. In all, some 25,000 acres were burned over, of which 1,300 acres were timber land and 17,000 acres young forest growth. The property destroyed was valued at $88,500.

The question of fire-guards in the prairie sections was largely left over till the next season.

As related to the problem of forest protection, chapters are next devoted to Slash Disposal, Top-Lopping in New York State, and Use of Oil as Locomotive Fuel, respectively.

In the chapter on slash disposal, the menace of lumbering and of settlers' slash is pointed out, with special reference to the situation in Canada. There is urgent necessity for some progressive action on the part of both Dominion and Provincial governments to meet the situation. The various methods of disposal are discussed, mainly from the standpoint of advantages and disadvantages, and the conditions under which each is preferable. The practice in this respect on the United States National forests is summarized.

An account in considerable detail of the working of the Top-Lopping Law in the spruce forests of New York state is given, as a result of a field trip last autumn. The future applicability in Canada is considered.

In the discussion of the question of using crude oil as fuel for locomotives we note that in the United States oil is used exclusively on 20,910 miles of railway line and partially on 4,720 miles, and that already oil is in use in Canada on 587 miles of line (1912). Its use in British Columbia is to be still further extended. A map of the United States and Canada is given, showing the lines using oil and those using coal. There are extracts from reports of the various railway companies using oil, which give their experience as compared with coal.

The remainder of the volume is given over to a brief account, by various authors, of forest planting in the different provinces; and the report of the Committee on forests presented at the annual meeting of the Commission of Conservation. Various appendices are added.

The report is admirably got up, with illustrations that illustrate, and contains much useful information that heretofore was not readily available in Canadian forestry literature. In future reports, we would like to see not only an account of the Commission's work in forestry, but also a chronicle of the year's development in each province, including private enterprise.

J. H. W.

OTHER CURRENT LITERATURE.

Proceedings of the Society of American Foresters, Volume VIII, No. 1. Washington, D. C. 1913. Pp. 121.

Contains: Water Power on the National Forests, by J. B.

Adams; Water Power on the National Forests; Discussion; Forest Types: Symposium; A Standard Basis for Classification, by S. T. Dana; An Anaylsis and Synthesis of the Term from a Geographic Standpoint, by F. G. Plummer; Shall the Physical Conditions or the Dendrological Mixture be the Basis for Forest Typing? by T. T. Munger; Use of Forest Types in the Work of Acquiring Lands under the Weeks Law, by K. W. Woodward; Definition and Use of Forest Types, by B. Moore; Classification of Forest Types, by W. B. Greeley; What is the Proper Basis for the Classification of Forest Land into Types? by G. A. Pearson; Basis of Classification into Forest Types and Its Application to District 1, by F. H. Rockwell; Physical *versus* Cover Types, by D. T. Mason; Physical Factors as a Basis for Determining Forest Types, by C. R. Tillotson; Quality Classes and Forest Types, by R. Zon.

National Forest Timber for the Small Operator. By W. B. Greeley. Separate 602, Reprint from Yearbook of U. S. Department of Agriculture, 1912. Washington, D. C. 1913. Pp. 405-416.

Wood-Using Industries of New Hampshire. New Hampshire State Forestry Commission, in co-operation with U. S. Forest Service. Concord, N. H. 1912. Pp. 111.

Proceedings of the Twentieth Annual Meeting of the Vermont Maple Sugar Maker's Association, held at Burlington, Vt., January 7 and 8, 1913. H. C. Chapin, Secretary. Middlesex, Vt. Pp. 59.

Bulletin of the Harvard Forest Club, Volume II, 1913. Cambridge, Mass. Pp. 42.

Contents: A Volume Table for Red Maple on the Harvard Forest; Fire Protection; Notes on the Chestnut Bark Disease in Petersham, Mass.; Collection of Lodgepole Pine Seed in the Leadville National Forest; Reconnaissance on the Tahoe National Forest; The Art of Pacing; Some Original Data on Waterflow and Forests.

A Working Plan for the Woodlands of the New Haven Water

Company. By R. C. Hawley. Bulletin 3, Yale Forest School. New Haven, Conn. July, 1913. Pp. 30.

Contains a description of property, and present and future management. Prepared after five years of forest practice, 1908-1912.

Sixth Report of the State Forester of Connecticut for the Year 1912. New Haven, Conn. 1913. Pp. 455-507.

Contains a discussion of forest fires, state forests, Rainbow forest plantations, and forest planting in Connecticut.

The Chestnut Bark Disease. By E. M. Stoddard and A. E. Moss. Bulletin 178, Connecticut Agr. Exp. Station. New Haven, Conn. 1913. Pp. 19.

Connecticut's Forest Taxation Law. Forestry Publication No. 9, Connecticut Agr. Exp. Station. New Haven, Conn. 1913. Pp. 8.

A brief discussion of and the text of "An Act Concerning the Taxation of Woodland."

Report of the Connecticut Agricultural Experiment Station, Part V: Report of the Station Botanist, 1911-12. New Haven, Conn. 1913. Pp. 341-453.

Contents: I. Notes on Plant Diseases of Connecticut. II. Chestnut Bark Disease.

Ornamental Trees and Shrubbery. Compiled by G. M. Wiley. New York State Educational Department, Arbor Day Manual, May 2, 1913. Education Department, Albany. 1913. Pp. 56.

Report of the Pennsylvania Chestnut Tree Blight Commission, July 1 to December 31, 1912. Harrisburg, Pa. 1913. Pp. 67.

The Chestnut Tree. Methods and Specifications for Utilization of Blighted Chestnut. Bulletin 6, The Commission for the Investigation and control of the Chestnut Tree Blight Disease in Pennsylvania. August 15, 1913. Pp. 16.

The Symptoms of Chestnut Tree Blight and a Brief Descrip-

tion of the Blight Fungus. Bulletin 5, Pennsylvania Chestnut Tree Blight Commission. May 15, 1913. Pp. 15, pls. XVI.

The Woody Plants of Kentucky. By H. Garman. Bulletin 169, Kentucky Agr. Exp. Station. Lexington, Ky. 1913. Pp. 62.

The Forest Club Annual, Volume V, 1913. University of Nebraska, Lincoln, Neb. Pp. 115.

Contains: Grazing Administration of the National Forests in Arizona, by R. R. Hill; Logging in Southeastern Texas, by F. D. Douthitt; Notes on Forest Conditions in the Central Sierra Nevadas, by W. A. Rockie; A Key to Common Nebraska Shrubs, by W. H. Lamb; Tree Planting in Nebraska, by W. J. Duppert; A Study of the Street Trees of Lincoln, by T. B. Nichols; The Literature of North American Systematic Botany, by C. E. Bessey; Grazing Reconnaissance on the Coconino National Forest, by R. E. Bodley; Notes on Coniferous Seedlings, by R. T. Guthrie; Timber Sales in Selection Forests, by W. J. Morrill; Reforestation in Northern Arizona, by E. W. Nelson; Alumni Directory, University of Nebraska Forestry School.

The University of Washington, Forest Club Annual Volume I. Seattle, Wash. 1913. Pp. 32.

Contains a brief history of the club, organization and development of the College of Forestry, and a roster of students.

A Handbook of Forest Protection, California. Published by California State Board of Forestry. August (1913) issue. Pp. 54.

A booklet containing forest laws; synopsis of game laws; instructions to fire fighters; and a list of state fire wardens, 1913.

Forest Products of Canada: 1911. Bulletin 37, Forestry Branch Ottawa, Canada. 1913. Pp. 73.

The statistics on lumber, pulpwood, cooperage, poles and crossties, previously issued, combined into one pamphlet for convenience.

Forest Products of Canada, 1912. By R. G. Lewis and W. G. H. Boyce. Bulletin 38, Forestry Branch. Ottawa, Canada. 1913. Pp. 20.

Forest Products of Canada, 1912: Poles and Cross-Ties. By R. G. Lewis and W. G. H. Boyce. Bulletin 39, Forestry Branch. Ottawa, Canada. 1913. Pp. 16.

Forest Products of Canada, 1912: Lumber, Square Timber, Lath and Shingles. By R. G. Lewis and W. G. H. Boyce. Bulletin 40, Forestry Branch. Ottawa, Canada. 1913. Pp. 67.

Fourteenth Annual Report, Canadian Forestry Association, 1913. Ottawa, Canada. Pp. 138.

Fifteenth Annual Report, Canadian Forestry Association, 1913. Ottawa, Canada. Pp. 118.

The Production and Utilization of Scots Pine in Great Britain. Part I. Production. By E. R. Burdon and A. P. Long. Bulletin 1, University of Cambridge School of Forestry. 1913. Pp. 46. The first of a series of papers intended to give the results of research into the potentialities of Scots Pine as a timber tree in Great Britain.

The Preparation of Plantation Para Rubber. By B. J. Eaton. Bulletin 17, Department of Agriculture, Federated Malay States. Kaula Lumpur. October, 1912. Pp. 58.

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Progress Report of Forest Administration in the Jammu and Kashmir State for the year 1911-12. Lahore. Statements II. 1912. Pp. 23.

The Forests of the Bellinger River. By E. H. F. Swain. Bulletin 5, Department of Forestry, N. S. Wales. November, 1912. Pp. 18.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Volume II, part 8. Government Printer, Sydney, N. S. Wales. 1913. Pp. 239-265; pls. 77-80.

Annual Progress Report upon State Forest Administration in South Australia for the year 1911-12. Adelaide, South Australia. 1912. Pp. 16.

How to Raise Trees from Seed. By G. A. Wilmot. Bulletin 2 of 1912. Union of South Africa, Forest Department. Pretoria. Pp. 2.

The Protection of Smaller Bushes on the Farm from Fire. By C. W. Chilvers. Bulletin 3 of 1912. Union of South Africa, Forest Department. Pretoria. Pp. 2.

The Seasoning of Blue Gum (Eucalyptus Goldulus) as practiced in California, U. S. A. Bulletin 4 of 1912. Union of South Africa, Forest Department. Pretoria. Pp. 3.

Forestry in Relation to Irrigation in South Africa. By K. A. F. Carlson. Bulletin 5 of 1912. Union of South Africa, Forest Department. Pretoria. 1913. Pp. 18.

Forestry in the Free State. By K. A. F. Carlson. Bulletin 6 of 1912. Union of South Africa, Forest Department. Pretoria. Pp. 8.

Windbreakes for the Dry Farm. By K. A. F. Carlson. Bulletin 1 of 1912. Union of South Africa, Forest Department. Pretoria. 1913. Pp. 8.

Notes on Forestry and Plantation Work in Britain. By J. Sim. Bulletin 2 of 1911. Union of South Africa, Forest Department. Pretoria. Pp. 16.

The Propagation of Trees from Seed. By C. E. Legat. Bulletin 4 of 1910 (rep., 1912). Pretoria. 1912. Pp. 11.

Two Fungal Diseases of Coniferous Trees. By J. Fisher. Department of Agriculture, Union of South Africa. Pretoria. No. 18, 1912. Pp. 4.

A brief description of *Diplodia pinea*, Kickx, affecting pines and *Pestalozzia funerea,* Desm., affecting members of the genera Pinus and Casuarina.

Bulletin, Department of Agriculture. Trinidad and Tobago (July-December, 1912). Port of Spain, Trinidad. 1913. Pp. 129-393.

Contains prices of local forest trees, and notes on rubber culture.

PERIODICAL LITERATURE.

FOREST GEOGRAPHY AND DESCRIPTION.

Woods of Chili.

Chiloe Island, situated off the coast of Chilli, contains 2,450 square miles and is covered with dense forests according to a consular report. A short description of the more useful trees and shrubs follows:

Cypress *(Libocedrus tetragona)* a white, elastic, resinous timber, said to be almost indestructible, abounds in the neighboring archipelago.

Alerce *(Fitzroya patagonica)* very durable light wood, abundant.

Manui *(Saxegothea conspicua)* soft wood not durable, abundant.

Ciruelillo *(Embothrium coccineum)* excellent cabinet wood, slightly pink colored, grows rapidly and is appropriate for parks.

Laurel *(Laurelia serrata)* covers the mountains; is most used and cheapest for inside work where not exposed to the weather.

Luma *(Myrtus luma)*, very large tree, abundant, lumber red and hard, used for carriage wheels and barrels. *M. Meli* is much like *luma*.

Muremo *(Eucryphia cordifolia)* and Tenio *(Weinmannia trichosperma)*, very large trees, abundant, used for foundation timbers and in carriage making. *W. paniculata* is flexible and much used for construction of boats.

Avellano *(Gevuina avellana)* wood cracks and twists if exposed to the weather, otherwise like cirudillo.

Roble *(Nothofagus dombeyo)*, very large tree, abundant, softwood, not durable.

Canelo *(Drinys chilensis)*, large, abundant, lumber is never attacked by rats or vermin used for interior finish.

Arrayan *(Eugenia apiculata)*, red bark tree, hardwood used for carriage construction.

El Tepu *(Tepualia)*, shrub which spreads horizontally on damp places forming impregnable barriers; used for fuel.

Quilineja *(Luzuriaga)*, parasite on trees, used for manufacture of baskets and brooms.

Quila *(Chusquea quila)*, a sort of bamboo, good forage, rich in pulp, suitable for paper manufacture.

Southern Industrial and Lumber Review.

Woods of Brazil.

Of the many different kinds of timber in Brazil the following may be mentioned as of special interest:

Jacaranda tan, reddish color with black grain, and *J. violetta*, violet color with black grain, both are favored for piano construction. They are easily worked with machine tools. There is also a black species of this genus similar to Ebony.

Red Cedar, used for cigar boxes, and White Cedar used in small amounts for light furniture.

Peroba has five species which are hard and are used for interior finish floors.

Vinhatico, a yellowish wood used for furniture occurs in large trees 8 to 10 ft. diam. containing 800 to 1,200 cu. ft.

Putumuju, a yellow wood, and *Anariba*, a brilliant red tone, are used for interior finish.

Genipapo has a fine wood of grayish blue color and is easily worked.

Cangerana and *Copahyba* are waterproof woods and are used for railway ties.

Pao jangada has an extraordinarily low specific gravity, 0.20 to 0.25. It is used for boats and skiffs and furniture; the latter is almost indestructible.

Woodcraft, March, 1913.

BOTANY AND ZOOLOGY.

Darwinism in Forestry.

Mr. Zon points out that Darwin's theory of natural selection was anticipated in a few sentences by a forester, or rather an obscure writer, Patrick Matthew, in a volume on Naval Timber and Arboriculture, published in 1831. Darwin acknowledged this fact in a later edition, which, however, was not known to him when he first published his Origin of Species. Mr. Zon then elaborates briefly the fact that in no other field of nature may the struggle for existence and of natural selection be studied to such advantage as in the forest, and that, indeed, the art of the forester in its silvicultural operations consists in utilizing and controlling and regulating this struggle and selection. We quote:

"The regular decrease in the number of trees on a given area with increase in age forms one of the earliest observations of the foresters, who, at a time antedating Darwin, properly gave this process the name of the struggle for existence, the struggle for the necessary growing space. The foresters have discovered the laws governing this process, a process in which almost 95 per cent. of all trees that start life in the stand perish, and in the form of yield tables have expressed it quantitatively, have measured and weighed it. The have shown how this struggle for existence varies with the species, climate, drainage and soil conditions, and age of the stand; that it is more intense, and consequently the differentiation into dominant and suppressed classes occurs earlier with light-needing species than with shade-enduring ones. In a climate most suitable to the species and on favorable situations this struggle again results in more rapid differentiation into dominant and suppressed trees than when the species grow outside of their optimum range and on poor soils. These are elementary and fundamental facts known to foresters for many years.

"The foresters have not only observed these facts, but they have also furnished an explanation for them. The most favorable the conditions of growth, the greater is the development of the individual trees; the earlier, therefore, begins the struggle for space and the differentiation into dominant and suppressed, with the subsequent dying out of the latter. They have followed this process throughout the entire life of the stand, have established its various degrees of severity, and have discovered its culmination during the period of the most rapid growth in height. This struggle for space and light is the basis of the forester's operations, as only by utilizing and controlling it is he capable of producing wood of high technical qualities, tall cylindrical boles, free of branches, and wood with uniform annual rings possessing great elasticity.

"The forest is a natural breeding place in which constantly only the trees best adapted to the climate and to the situation are allowed to remain. In the forest only the conquerors in the struggle for existence are the ones which produce seed in abundance. During a seed year the dominant and co-dominant trees produce seed in large quantities; the intermediate trees, which may properly be called the candidates for suppression, participate but little, and then only in exceptionally good seed years, while the oppressed and suppressed do not bear seed at all. With what rigidity, then, must the natural selection go on in a forest, if we consider *first* what a small percentage of trees in a stand of the same generation come to be conquerors in the struggle for existence; *second,* the great age reached by trees; *third,* the numerous generations of trees that have succeeded each other in the same forest; and *fourth,* the relatively limited capacity of tree seeds for dissemination. With each generation the forest trees must become more and more delicately adjusted and adapted to the given conditions of growth. The new generation inevitably arises from seed sown by the best developed trees, from those which have withstood the long and intense battle not only against Nature alone, but against Nature in the presence of competitors. Of this possibly only 1 per cent. or less will reach maturity and be able to continue the species. No wonder, therefore, that in spite of search for new species all over the world so few forest trees have been successfully introduced into new countries and so little progress has been made with the artificial improvement of them. So perfect is the natural selection in the forest, so fine is the adjustment between the environment and the forest trees, that it is almost impossible for man to approach it."

The American Naturalist. September, 1913, pp. 540-546.

SOIL, WATER AND CLIMATE.

Climate and Plant Growth.

We characterize the climate of a given region as it expresses itself in the vegetation, but we have no definite records of the reaction of the vegetation to the various climatic components. Livingston makes a plea for a laboratory so equipped that all the main conditions of plant growth may be controlled and altered at the will of the experimenter. Such data would be of great value to the agriculturist and to the forester. The weather bureau is officially a part of the Department of Agriculture, being one of the largest bureaus of the Department, yet its main activities have never been primarily directed towards the relation between agriculture and climatology. The data of precipitation should be linked with data upon soil conditions. Upon the water extracting power of the aerial environment, the climatic data of the weather stations is of no use. For these purposes there should be more rural stations with the recording instruments in other situations than high buildings.

The temperature data in relation to plant growth should be for the frostless season, but actual data of the mean length of the frostless season in the United States have never been published. Compiling data from Bigelow's tables of daily normal temperatures throughout the year, Livingston has summarized the temperatures during the frostless season, taking as a starting point 32° F., and has plotted them in thousand degrees upon a map. The lines of temperature summation divide the country into zones having in general an east and west direction with a southward displacement along the two mountain systems. The temperature indices range from 3,000 to 13,000 degrees during the frostless season. The average daily precipitation (in hundredths of an inch) plotted upon a map of the United States divides the country into north and south trending zones, in general perpendicular to the temperature zones. The amount of mean daily evaporation plotted upon a map also divide the country into north and south belts. The chart indicating the difference between the mean daily precipitation and the mean daily evaporation during the growing season is the most remarkable since it shows that in most of the United States evaporation exceeds precipitation. Of course, the data for the last two mentioned charts are very meagre, and they are put forward by the author simply as suggestions as a proper line of procedure in the study of vegetational characteristics in relation to climate. If further study along these lines should demonstrate that evaporation really exceeds precipitation during the growing season, then we would have a powerful argument for the conservation of soil water.

C. D. H.

Proceedings of the American Philosophical Society. Vol. 52, No. 209, April, 1913, pp. 257-279.

SILVICULTURE, PROTECTION AND EXTENSION.

Deep Planting.

Geist records his observations on the influence of deep setting of plants in the case of Scotch Pine. Pine stands can be kept close to the end of the rotation only when the tracing roots lie close to the surface. The best production is secured, if the upper soil layers consist of good loose soil with humus or raw humus contents, into which stout shallow roots can develop, which in deep position cannot develop, so that the deeper the plants are set the poorer is the growth and the greater the danger in the polewood stage of death. This danger is the greater, the drier and more compact the soil. By underplanting with broad leaf species the soil can be made fresher and looser and a deeper humus layer may be secured.

Welchen Einfluss hat ein zu tiefer Stand der Kiefer auf deren Lebensdauer und Ertrag. Zeitschrift für Forst- und Jagdwesen, September, 1913, pp. 589-596.

Poor Pantations Improved by Pinus rigida.

Dr. Schwappach discusses the frequent experience of promising pine plantations on waste lands failing in the 10-15 year, and beginning to die in groups when 20 years, the soil deteriorating and the whole making a miserable impression. His conclusions are, that this behavior is due to a misproportion of numbers and food material, and especially of water supply. Hence reduction of numbers or additional food and water supply are the remedies. The latter requirement can be most cheaply secured by carefully avoiding in thinnings removal of the lower brushwood, which keeps the upper soil layer moist and by its decomposition, having high ash contents, acts as manure. Otherwise admixture of *Pinus rigida* in single individuals is recommended. This recommendation is based upon experience in plantations 25-30 years old. *P. rigida* grows in the first years on poor soil more rapidly than *P. silvestris,* and with a plentiful fall of needles improves the soil. At 10 to 15 years it is overhauled by the Scotch Pine when *P. rigida* still acts as nurse in clearing its neighbor, until it collapses and again thereby enriches the soil.

Species	Condition of Stand							Periodic Yield of Thinnings				Increment During Last Quinquennium	
	Age	*Stem Number*	*Cross Section*	*Average Diameter*	*Height*	*Timberwood*	*Form Factor*	*Stem Number*	*Cross Section*	*Height*	*Timberwood*	*Cross Section*	*Timberwood*
I. Mixed Stands													
P. silvestris	25	1664	82.98	3.04	24.00	653.51	323	5.18	11.79	21.12	28.6		
P. rigida	27	818	34.67	2.89	19.84	167.31	238	1.49	3.91	17.60	5.72		
		2482	117.65			820.82		6.67	15.70		34.32		
P. silvestris	30	1129	64.46	3.28	25.92	642.07	379	5.34	34.05	26.24	393.25	3.106	76.36
P. rigida	32	536	26.18	3.00	22.40	140.14	234	2.81	8.66	21.12	32.89	.035	1.14
		1665	90.64			782.21		8.15	42.71		426.14	3.141	77.50
II. Pinus silvestris													
P. silvestris	27	1987	109.60	3.20	25.92	988.13	344	5.32	15.13	22.40	68.64		
	32	1451	92.35	3.44	27.52	1061.06	411	5.34	27.80	27.84	311.74	2.112	76.93

Two stands of this mixture are compared with a pure Scotch Pine stand, showing the following data.

The pure stand showed very irregular development, while the mixed stand looked well, with *P. rigida* having declined into underwood, having, however, prevented the Scotch Pine from growing into "wolves," and keeping it in good form.

Bestandespflege der Kiefer auf geringen Standorten. Zeitschrift für Forst- u. Jagdwesen, June, 1913, pp. 370-380.

Border Cuttings.

In Heidelberg, at the congress of foresters from southwest Germany, C. Wagner described at considerable length the system of border cuttings of which he is the leading exponent.

In order to show the need for a new method of regeneration, the disadvantages of the three principal systems now in vogue are set forth. Clear cutting over large areas or in strips leads to drying out and deterioration of the soil and therefore the resulting growth is slow. This is the scheme usually adopted to secure pure stands of spruce and pine by artificial regeneration. Pure stands are now generally recognized as undesirable on account of their incomplete utilization of the soil and light and their susceptibility to insect and fungus attack.

The shelterwood system as developed by Hartig, Heyer and Borggreve protects the soil from drying out and deterioration but favors the development of tolerant species only by keeping shade over the area to be regenerated. Moreover, it is difficult to remove the large trees left for shade or seed production without damaging the reproduction.

The selection system is of value only under extensive conditions where the demand will merely permit the marketing of a few species. The returns are low, tolerant species are favored in the regeneration, and it is well nigh impossible to control the composition of the future stand.

Dr. Wagner's system of border cuttings, described before, may be briefly again described as follows: The cutting takes place in the form of a long strip not wide enough to permit soil deterioration and the logs are always removed through the untouched timber so that the reproduction is never disturbed. If necessary to encourage seed production a preliminary thinning may be made. The composition of the new stand can be controlled by the rapidity with which the area to be regenerated is opened up. To reduce to a minimum the possibility of the soil drying out, the fellings are always begun on the north or east sides of the stands except in the case of hillsides facing north and east, where economic utilization demands that the logs be dragged downhill and that the felling begin at the top or south or west side. However, in such cases the exposure of the hillside reduces the danger from drying out to a neglible extent.

This system marks a distinct advance in silvicultural practice and can undoubtedly be successfully applied in America where market conditions permit. However, its two disadvantages, the need for a complete road system and the slow progress of the cutting, will limit its wide application. K. W. W.

Zwei Vorträge über den Aufbau Forstlicher Betriebssysteme. Forstwissenschaftliches Centralblatt, May, 1913, pp. 226-254.

Private Forestry.

Interesting, from the standpoint of private forestry, is the review of Köhler's eighth brochure in the series "Our Forest Management in the 20th Century." The author deals only with Württemberg where, he points out, the privately owned forests constitute 21.5% of the total wooded area. The net yield per acre of these private woods is only half that of the Württemberg State forests from which it by no means follows that under state management they would be twice as profitable; for this would presuppose that they are by nature equally productive, which does not necessarily follow.

The author regrets the slavish imitation of the pure, even-aged stands on the state forests, entailing departure from the selection system for which the small parcels of private forests are pre-eminently suited. To direct the proper management of private woods, the author proposes that, following the example of Prussia and Bavaria, administrative officers be detailed for this special purpose from the Agricultural Department.

A. B. R.

Aus Württemberg. Allgemeine Forst- und Jagdzeitung. September, 1913. Pp. 32-323.

Advantages of Mixed Stands.

Continuing his discussion of the advantages of mixed stands, Forstmeister Tiemann sets forth the natural limitations in the mixture of beech and spruce. The high mountains are, of course, only suited to the latter species and the forester must be content with pure stands. There are also thin soiled sites at lower elevations where beech cannot be successfully introduced. In such places the disadvantages of pure stands should be minimized by rather open planting so as to encourage thrifty crown and root development. In addition the cutting should always be done against the wind and large openings avoided. As a precaution against fire and storm a good roads system should be provided. Along such openings shrub should be encouraged to prevent soil deterioration by the wind blowing away the litter and excessive evaporation, as a harbor for birds, and for aesthetic reasons.

Besides its value in mixture with spruce, beech is also an excellent species to add to pine stands. The main obstacle to overcome in this connection is the fact that beech seedlings need protection in their early years on the dry sandy soils usually devoted to pine. For this reason a nurse crop of pine or alder is often advisable and sturdy seedlings with good root development must be selected.

The addition of beech to pine is advised when openings have occurred by reason of storms, fire, or insects, as an understory, in fail places of plantations, to supply the deficiencies of natural regeneration, and as one of the component species of a mixed stand planted in open fields which are to be reforested.

Summarizing briefly, mixtures of beech with spruce and pine improve the soil, prevent storm, fire and insect damage, attract birds, and increase the beauty of a forest. K. W. W.

Begründung der Mischbestände, etc. Forstwissenschaftliches Centralblatt. July, 1912. Pp. 345-353.

Growth of Douglas Fir in Germany.

Douglas Fir has proved to be one of the most satisfactory exotics for introduction into the forests of Germany and bids fair to become as thoroughly acclimated as White Pine. The following results from a plantation in southern Germany indicate the possibilities of the species:

Elevation above sea level, 1,700 feet.

Established in 1884.

Thinned in 1907, age 23 years.

Taking out 338 stems per acre with an average d. b. h. of 2″ and an average height of 33 feet.

Leaving 1,560 stems per acre, average d. b. h. 4" and average height 42 feet.

Thinned in 1912, age 28 years.

Taking out 495 stems per acre, average d. b. h. 3" and average height 48 feet.

Leaving 1,064 stems per acre, averaging 6", and average height 57 feet. K. W. W.

Wuchsleistungen von Pseudotsuga Douglasii. Forstwissenschaftliches Centralblatt, July, 1913. Pp. 337-351.

Fire Damage to Teak.

Fischer, continuing the controversy as to the benefits of fire protection in teak forests, gives the results of a sample plot measured in a mixed open teak forest with scanty undergrowth and poor regeneration of the better species, which has been successfully protected from fire for 25 to 30 years. He estimates that only of late years are the beneficial results of fire protection apparent. The plot was taken at an elevation of about 2,900 feet where the average rainfall was 60 inches. Trees 10 inches or less in diameter did not show signs of injury by fire and consequently they apparently started since fire protection commenced. Damage to the mature timber from fire protection was extremely significant.

1 tree showing very slight signs, but the tree is dead.
13 trees with comparatively slight injuries.
13 trees with serious injury, but partly fit for timber.
107 trees seriously injured and unfit for timber and may be unfit for anything but firewood.

This refers to coupe V, Punachi Working Circle, in the Anaimalai Hills of South Coimbatore. T. S. W., Jr.

Damage to Teak by Fire, Indian Forester, September, 1913, pp. 434-435. 435.

Taungya Problem.

A writer using the pen name of Tao Hai discusses in great detail the Taungya problem in the Shan States; namely, whether to allow the sporadic clearance of potential forest land by wandering tribes as a recognized agricultural system of the country. The solution is complicated by the need for local labor and because (if restrictive rules are enforced) the population will move to forests where there are no restrictions. The writer concludes that fire protection, first of all, is necessary; that investigation of native taungya methods is necessary and that this can only be secured by having a special officer detailed to study the problem without interference of ordinary executive duties. T. S. W., Jr.

Notes on the Taungya Problem in the Shan States, Indian Forester, September, 1913, pp. 399-409.

Combating the Nun.

Dr. Max Wolf reports in great detail on trials to combat the Nun, and comes to the conclusion that it is foolish to continuously spend money in combating this pest, while in its ordinary extent of occurrence. Only when a mass of development comes, one is not to be surprised in one's economic arrangement. A means to combat the pest does not exist, hence only curtailment of the regular cut may be practiced to reduce the economic damage which would come from an overcut forced by the insect damage.

Nonnenstudien. Zeitschrift für Forst- u. Jagdwesen, July, August, September, 1913, pp. 405-430; 503-522; 537-586.

MENSURATION, FINANCE AND MANAGEMENT.

Point of Calipering.

The holiness of the D. B. H. is ruthlessly attacked by Oberförster Kandidat Krebs. He points out that this height at which the diameter is measured is often inconvenient for the workmen, and hence, unless very strictly supervised, not realized. Moreover, the author contends that for the end result, the total cross section area, it does not matter. The proof is furnished by five caliperings of the same area of 1 hectar 90-to 110-year beech forest in unusually normal condition. The measurements under I and II were strictly taken from 2 to 2 *cm* (inch classes) at 1.3 *m* (d. b. h.), under III at 1.1, under IV and V from 4 to 4 *cm.* (2-inch classes), the first at 1.3 *m,* the last at 1.1 *m.* The results are as follows:

Diameter cm.	*I*	*II*	*III*	*IV*	*V*
			Stem Number		
12	3	3	2	4	3
14	10	7	7		
16	20	16	19	37	38
18	32	22	27		
20	38	44	37	67	64
22	41	40	46		
24	48	46	51	107	104
26	36	56	44		
28	60	34	43	91	95
30	44	54	49		
32	30	39	38	72	71
34	26	30	30		
36	27	18	16	47	44
38	11	17	20		
40	10	15	7	16	19
42	6	7	6		
44	6	2	6	10	13
46	4	5	3		
48	1		2	4	3
50	2		2		
52				2	2
54	2	2	1		
56	2	2	3	2	3
58					
60	1	1	1	1	1
	460	460	460	460	460
Cross Section Area *square meters*	29,287	29,735	29,671	29,369	29,908

The difference between the two orthodox measurements (I and II) is greater than between I and III! It was also found that in spite of greatest care 2 to 4 per cent. of the stems were not measured (corrected in table!).

The author concludes that the very strict adherence to the breast high diameter leads to no practical result. Moreover, he would throw overboard the whole stemwise calipering method except for very open stands, single trees, etc., under tolerably uniform conditions, substituting estimate by stand tables based on actual felling results, with very careful site and stand descriptions. An example is given.

The reviewer coincides with the author that the exact stemwise calipering has value only for scientific studies, but, to be sure, the construction of such stand tables is after all not a simple matter.

Uber die Massenermittlung ganzer Bestände für Zwecke der Forsteinrichtung. Allgemeine Forst- und Jagdzeitung, July, 1913, pp. 242-246.

Valuation Surveys.

Astounded at the discrepancies between estimate and cut of stands, even where all the trees have been calipered, Krebs, a young working plans officer, tries to hit upon a more practical method than calipering to determine the volume of somewhat abnormal stands. The common practice in German Forest organization in such stands is to caliper all the stems at breast height (1.3 meters) and then to calculate the basal area. This the author considers unreliable and suggests as a substitute stand-yield tables based on results of actual fellings with emphasis on a painstaking description of stand and soil. That is, the yield of a given stand is taken to be the same as that of the one which the description shows to be strictly analogous.

Wimmenauer, mellowed by nearly 50 years of practical experience, tones down the above by commenting that, perhaps, the discrepancies of cut and estimate are due in large measure to inaccuracies in measuring the timber after it has been cut, as well as in making the estimate; that stand-yield tables are no doubt valuable, but require such exhaustive data that calipering is quicker and simpler. A. B. R.

Uber die Massenermittlung ganzer Bestände für Zwecke der Forsteinrichtung." "Bemerkungen zu vorstehendem Aufsatze." Allgemeine Forst- und Jagd Zeitung. July, 1913. Pp. 242-246.

Prices for Heavy Oak.

We have before noted the remarkable prices secured for the old oak timber for which the Spessart mountains are celebrated. In the winter of 1912-1913 several 400 year old oaks were sold at public auction. The timber was divided into nine quality classes according to diameter, soundness, and fineness of grain. 51.18% consisted of saw timber, 12.17% cordwood, and 36.65% small fuelwood. The prices varied within 42% for the best; the highest price paid being $3.43 per cubic foot or $360 per M. bd. ft. (!) assuming for such large sized logs 9 board feet per cubic foot.

On account of the steadily advancing price of oak in the Spessart region the holding over for several rotations of selected individuals has proved financially profitable. The following table gives the prices paid per cubic foot for three representative classes of logs during the period 1860-1912:

AVERAGE PRICE PER CUBIC FOOT

Year	*Class I*	*Class III*	*Class V*
1860	$0.26	$0.18	$0.13
1870	.32	.25	.15
1880	.35	.36	.17
1890	.68	.43	.27
1907	1.05	.74	.45
1912	1.54	.91	.56

K. W. W.

Eichenholzverkäufe im Spessart im Winter 1912-13. Forstwissenschaftliches Centralblatt, May, 1912. Pp. 284-286.

True Selection System.

A. D. Blascheck writes interestingly of what he considers the requirements of the selection system in British India. In order to determine the return in what he terms the "Periodic Selection System," he feels that the merits of felling cycles of different lengths should be governed by the following considerations:

(1) The economical working of the annual coupe.

(2) The average tree must be of a size which best suits the objects of management and the tree of minimum size must not involve a sacrifice through being felled at too early a date.

(3) The cut must be heavy enough to insure regeneration and recur often enough to prevent mature trees interfering with the development of future stands.

(4) The Felling Cycle should be a sub-multiple of the rotation.

T. S. W., Jr.

The True Selection System, Indian Forester, September, 1913, pp. 427-430.

UTILIZATION, MARKET AND TECHNOLOGY.

Wood Waste Utilization.

In an address before the New York section of Chemical Industry, Dr. Teeple reviewed what has been so far accomplished in the utilization of wood waste in a commercial way, the chief conclusion being that there are no mysterious possibilities in wood waste, warranting the expectation of wonderful profits. The constituents of wood waste are few and well known and the fund of information regarding them ample, but only careful and circumspect use of it and of commercial sagacity promises financial success.

Unselected millwaste is now used with success for producing ethyl alcohol, two plants being in operation of 5,000 and 10,000 gallons capacity per day. Other distillation products like acetate of lime, wood alcohol and charcoal; turpentine, pine oil and rosin; tar, tar oils, creosote oils, pitch, light oils, wood oils and gas have long been produced commercially. The production of cattle food by treating sawdust with dilute acid has been successfully and cheaply accomplished in England, and at least one plant is working on this problem in the States.

Destructive distillation of resinous woods is not increasing rapidly. New plants start up frequently, but unless the raw material is cheap and well selected, the plant well managed, and much care given to the preparation and marketing of goods there is not a large margin of profit. Steam distillation for the recovery of turpentine and pine oil is at present conducted only in a few sawmills where all the wood waste is treated and leaves a fair margin of profit.

The most rapid increase within the last two or three years has been in plants extracting turpentine, pine oil and rosin from resinous woods by use of a solvent. At least 8 plants are in operation and a number more under way. The yield is 10 to 12 gallons turpentine, 2 to 3 gallons pine oil, and 400 to 500 pounds rosin per cord. Stumps yield larger amounts. The loss of solvent during the extraction and the rise of price of solvent, due to increased demand, is a serious matter.

Pulp and Paper Magazine of Canada, May, 1913, pp. 349-350.

Lumbering in Wisconsin.

Chapter V of this series of articles gives a brief interesting history of the lumber industry in Wisconsin, this being synonymous with the white pine industry in the earlier days. The first sawmill on record was built in 1809 on the Devil river, east of Depere. This was followed by mills at Kaukauna in 1816, at Menomonie in 1829, at Plover in 1831, with others in rapid succession, so that by 1849 there were 47 mills along the Wisconsin river with some 1,800 men engaged in rafting logs and lumber.

The shipment of lumber from Wisconsin had assumed considerable proportions by 1839, and by 1845 the State was competing with Michigan for the Chicago market. The first development was along Lake Michigan and the Wolf, Wisconsin, Black and Chippewa rivers. The cut on the Wisconsin river rose from 19.5 million feet in 1848 to 149 million feet in 1857; on the Black river from 12.5 million feet in 1848 to its highest mark in 1890, with 243.2 million feet, dropping to 40 million in 1900; and on the Chippewa from 11.3 million feet in 1848 to a maximum of 428 million in 1883, and falling to 176 million in 1900.

The lumber industry acquired great prominence about 1870. By 1880 Wisconsin was outranked only by Pennsylvania and Michigan; ten years later it occupied second place, and by 1900 it stood at the top. The year of greatest production, however, was in 1892, with a cut of 4.1 billion feet. From 1900 the industry declined, the center of production shifting to the south, till in 1909 Wisconsin stood eighth in the list.

For years lumbering with the attendant secondary industries was the dominating industry of the State. Roth estimated the original stand of pine at about 130 billion feet, of which 86 billion feet had been cut and 26 billion burned, by 1898. In 1890 the lumber industry represented one-sixth of the total taxable property of the State. The timber products rose from a value of $1,250,000 in 1850 to a value of $61,000,000 in 1880, falling to little more than one-half of this by 1909.

The method of conducting the operations has resulted in great loss to the State, mainly through mill and logging waste, and destruction by fires. It is estimated that of the forests of Wisconsin not over 40 per cent. of the timber reached the mills. The greatest fire was the Peshtigo fire of 1871, in which 1,000 lives were lost, another 1,000 persons crippled, and 3,000 more ruined, to say nothing of the property losses. In 1908, nearly a million and a quarter acres were burned over, destroying one-half billion feet of merchantable timber, six million dollars' worth of young growth, property worth $150,000, and at a cost of $100,000 for fire-fighting alone. Again, in 1910, some 900,000 acres were burned over with a loss of over $5,000,000.

The evil effects of deforestation and the approach of the timber famine drew attention to the necessity of taking steps to repair the loss. In 1897 a state forestry commission was established by the legislature. The setting aside of reserves began in 1903, with some 40,000 acres. By 1910, the reservations aggregated 340,000 acres. However, there is much room for development in the matters of fire prevention, proper land classification, and in methods of timber land taxation.

Geographical Influences in the Development of Wisconsin, V. The Lumber Industry. Bulletin American Geographical Society. October, 1913, Pp. 736-749.

Oil for Logging Locomotives.

Among the many interesting bits of information brought out at the 1912 meeting of the Southern Logging Association was a paper on oil as a locomotive fuel. The Baldwin Locomotive Works, Philadelphia, has a special pamphlet on fuel oil for locomotives. Experiments made by the Pennsylvania R. R. resulted in the following conclusions, according to Dr. Charles B. Dudley in a paper presented to the Franklin Institute, Philadelphia, which, as it covers the subject fully, we quote almost verbatim.

(1) Less waste of fuel. In a coal-burning locomotive unburned fuel escapes from the stack in the form of smoke, unburned gases and cinders, and it also falls through the grates. In a well-designed and properly handled oil-burning locomotive, however, there should be no losses due to these causes.

(2) Economy in handling fuel.

(3) Economy in handling ashes.

(4) Diminished repairs to locomotives. (Recent experience hardly justifies this claim, as firebox repairs on oil burning locomotives are greater than on coal burners.)

(5) Economy in cleaning engines, due to the absence of cinders, ashes, etc.

(6) Less waste of steam at the safety valves, as the fire can be more easily controlled, to suit the demand for steam, than in a coal burning locomotive.

(7) Economy in cleaning ballast. This is particularly true of stone ballasted roads, where the ballast must be cleaned of cinders to prevent interference with the drainage.

(8) Economy of space in carrying and stowing fuel, due to the fact that a pound of oil does not occupy as much space as a pound of coal, while it is capable of generating more steam.

(9) No fires from sparks.

(10) Absence of smoke and cinders, a special advantage in passenger train service.

(11) Possibility of utilizing more of the heat, since tubes are not choked up with cinders. On this account there is no reason why smaller tubes should not be used on oil burners than on coal burners, and more heating surface thus provided. In practice, however, it is customary to use tubes of the same size for both coal and oil burning locomotives, as the same engine can then be easily equipped for burning either kind of fuel and the problem of repairs is simplified.

The tendency towards the use of oil burning logging locomotives has not increased to the extent that was anticipated several years ago. That the subject is important may be determined conclusively when we consider the disastrous forest fires directly caused by sparks from locomotives. These fires are almost appalling from the standpoint of forest conservation and commercial loss.

From a standpoint of danger from sparks, the ordinary fuels used in locomotives are: (1) wood, (2) coal, (3) oil.

The danger from sparks when burning green cord wood or wet slabs, such as are ordinarily used in logging locomotives, and also when burning coal, is very great, especially when working with heavy loads on grades, or when the wind is blowing hard. The consequence is, that a great number of large and small sparks are blown a considerable distance from the track and help to cause the disastrous fires we hear of almost every week. With a locomotive working hard, it is necessary for the wind to blow only 12 to 15 miles per hour, in order to have sparks become dangerous at a distance of 100 feet from the track. Of course, the danger is remote, unless the sparks fall upon bushes, dry grass, etc. Spark arresters in the front end and in the stack are efficient in various degrees, but the ash-pan sparks are a continual source of danger.

With oil, the danger from sparks is almost absolutely avoided. In 1909, approximately 20,000,000 barrels of oil of different kinds were consumed on the railroads of this country; in the same time, about 100,000,000 tons of coal were consumed. As to the consumption of wood, naturally there is no data available.

1. Less Waste of Fuel.—The ordinary loss by storage and by theft in transit does not occur with oil. When used in the boiler, considerable of the coal escapes unconsumed through the stack in the form of cinders, smoke and unburned gases, and through the grates in the form of unburned fuel. With oil, on the contrary, the combustion is much more perfect, and consequently the above losses are very much less.

2. Saving in Fuel Handling.—With oil, all that needs to be done is to run the oil from the tank car into the storage tanks, causing very little work. Coal, if not handled by hand, has to be handled by some form of conveyor to the storage bins, which costs considerably more than when handling oil.

3. Saving in Elimination of Ashes.—In oil, there is practically no ash, while with coal the cost of handling ashes at terminals is a considerable item in terminal expense.

4. Saving of Time.—The saving of time at terminals and the increased mileage due to less stops for fuel, is also an item, especially on railroads.

5. Labor Conditions.—Up to the present time the oil market has not been affected appreciably by labor conditions, while the coal market is affected so much thereby that it needs no comment.

6. Saving in Locomotive Operation.—In burning oil, there is considerably less waste of steam (which means water) at the safety valve than when burning coal. This is due to the fact that in an oil burning locomotive, the temperature of the fire box can be regulated almost to a nicety—particularly useful when drifting. With coal, on the contrary, it is very difficult to regulate the fire so that considerable water is not lost through the safety valve, while an oil locomotive could work for days at a time with steam very close to the safety valve pressure with no blow-off, which can hardly be said to be true when burning coal. All safety valves, however, should blow-off at least twice a day to make sure they work, as it is not an ornament.

7. Thermal Efficiency.—When burning oil, the thermal efficiency is higher than when burning coal, and as a consequence we get more evaporative value out of one pound of oil than we get from one pound of coal. Roughly speaking, one pound of oil will equal from one and one-half to one

and three-quarters bituminous coal, such as is ordinarily used in locomotives. Tests upon the Southern Pacific show an evaporation of about twelve to fourteen pounds of water per pound of oil from and at 212 degrees Fahrenheit. Coal will evaporate about six to eight, at best, which shows over 75 per cent. greater heat value. Furthermore, the same boiler will evaporate at least 25 per cent. more water when burning oil than when burning coal. In other words, as the speed of a train is limited by the steaming capacity of the locomotive boiler, the locomotive will haul the same train at a faster speed.

8. Clogging.—There is an absence of clogging of the tubes from cinders, especially those toward the bottom of the boiler. With coal, this is a common cause of inefficiency in boiler operation, and unless cleaned frequently, the steaming quality of the boiler is affected materially. With oil, occasionally a slight soot will form in the tubes, due to incomplete combustion in starting or while in operation, which can be removed quite readily by means of a pail or two of sand. This is easily and effectively done by admitting sand through the firebox when the engine is working hard; the draft will carry the sand through the tubes and all soot or possibly tarry deposit will be scoured off by the abrasive action of the sand particles.

Disadvantages in Burning Oil

1. Increased Firebox Repairs.—A coal firebox will last from five to fifteen years (depending upon the water, etc.). Ordinarily, an oil firebox will last two to five years. These figures apply to railway operation, and will be increased when applied to logging locomotives, where the service is much less severe and less continuous.

2. Greater first cost of locomotive.

Kinds of Oil

There are three kinds of oil ordinarily used in oil burning locomotives.

1. Crude petroleum, which is exactly as it is pumped from the ground. It is not good practice to use this oil in its crude state, because of its extreme volatility and the consequent danger from explosion when tanks have to be examined, either for repairs or otherwise. In wrecks, crude oil invariably would be set on fire. Another point is, the extremely nauseous odor, and, further, crude oil is not so economical as reduced oil, because it weighs approximately from six and one-quarter to six and one-half pounds per gallon, while reduced oil weighs about seven and one-quarter pounds. Since the thermal efficiency of any fuel depends upon the weight, it is clear that crude oil has not so many heat units per gallon as reduced oil. Therefore, crude oil in storage will evaporate quite readily, due to the volatile constituents, while reduced oil is not affected at all, practically speaking.

2. Fuel oil or reduced oil, which is used in stationary plants and in some locomotives, is obtained by reducing or refining crude petroleum. The base of crude petroleum varies considerably in the different parts of the country, ranging from a paraffin base to an asphaltum base, and consequently reduced oil will vary somewhat. The desirable features about oil used in locomotives are comparatively high fire and flash tests.

3. Residuum, which is largely used in California where the crude oil has an asphaltum base and where very little refining into gasoline and kerosene is done. It is there used commonly under boilers in stationary plants, and to some extent, in locomotives in Russia. The residue of Russian oil is utilized extensively, because it contains about 75 per cent. residue and 25 per cent. refined oil. The average American oil on the contrary, contains about 25 per cent. residue and 75 per cent. lighter oil.

It is understood, of course, that the analysis of oil varies considerably in different parts of the country, and the above figures are given as approximate.

Remarks On Use of Oil

When burning oil in locomotives, it is absolutely necessary to line the firebox with refractory material, which ordinarily takes the form of fire brick. This is necessary because of the intense heat generated by the combustion of the oil, and its destructive effects upon the firebox sheets and rear ends of the tubes when not so protected by brickwork.

When burning coal, the firebox temperature rises to about 2300 degrees Fahrenheit and is reduced to about 500 or 750 degrees Fahrenheit at the front end. With oil, the temperature frequently runs up to 2800 or 3,000 degrees with the same drop at the front end. In other words, the firebox and the rear ends of the tubes must stand a much more severe temperature when using oil, necessitating the above mentioned brick lining.

A very important part of the oil burning locomotive equipment are the front and back air dampers on the firebox. These must be very carefully regulated at all times, and positively must be closed when drifting or the cold air will cause leaky staybolts and tubes. Dense yellow smoke from the stack indicates that flame is out, and the oil is simply "roasting" on the hot brickwork.

Burners

There have been about 100 different styles of burners invented for stationary plants and oil burning locomotives, but of these, very few have survived the test of actual use. These burners can be classified into two different styles, the spray and vapor. With the spray style, the oil flows by gravity over the end of the burner through a flat orifice from one inch to six inches long and about one-sixteenth inch wide and is blown into the firebox by a stream of steam (or air) through a similar orifice directly beneath it, which action atomizes or pulverizes the oil. This style is called an outside mixer, and another style is called an inside mixer, and the above action takes place inside the burner, both steam and oil issuing from a single flat orifice, which is about two inches to six inches long and about one-fourth inch to three-eighths inch wide, the sizes depending on the boiler. We have adopted the Sheedy-Carrick oil burner as standard equipment on all our locomotives.

With the vapor burner, the oil is converted into a fine vapor in an external apparatus by means of heat. This latter style possesses a great deal in its favor, yet does not seem to have come into general use for stationary plants, and on locomotives it is not used at all. The steam spray burners are used exclusively on locomotives, because they are simple in operation, require no air compressor or oil vaporizing apparatus, and the steam used in spraying the oil is of such a small quantity that it does not affect the steaming capacity of the locomotive at all. On the contrary, the action of the steam through the burner forms a blower in itself, having the effect of forced draft.

Locomotives equipped for burning oil usually are so made that they can be converted into coal burning by the removal of the brick lining, and substituting grates for the oil burner. Theoretically, this is not the best possible arrangement of burning oil efficiently, but from the standpoint of practical work it is highly desirable. There are a number of slight differences between a burner designed for burning oil exclusively, and one that is designed to burn oil and coal intermittently.

To insure the best results, the oil in the tanks of the locomotive should be heated to from 120 to 150 degrees Fahrenheit. This is necessary at all times, except in extremely hot weather, or hot climates, and is imperative for cold weather, and cold climates. This heating is usually done either by passing the steam direct into the oil at a point about one-half the height of the tank. For small locomotives the latter method is used, and for larger locomotives the former method. There seems to be little difference between the two methods in actual operation, except that perhaps the latter introduces a small quantity of condensed steam in the oil, but this is of small consequence, because oil ordinarily contains considerable water and the introduction of the small quantity mentioned above does not affect it in any way. All oil tanks should be equipped with drain valves in the bottom of the tank for the purpose of draining the water in the oil. If this is not done, spluttering of the flame at the tip of the burner, and, occasionally, blowing out of the flame will occur.

The ideal combustion is attained by adjusting the steam and oil valves to suit the load the engine is pulling, which naturally affects the draft, and consequently, more or less air is drawn through the boiler, necessitating more or less oil as the case may require. The ratio of oil and air for ideal combustion is practically constant for all loads. Complete and efficient combustion is indicated at the stack by a light blue smoke or haze, very similar to that when burning coke in locomotives.

Relative Costs

1. Cost of Burning Wood.—When burning wood, the cost will depend entirely upon what is burned, whether green slabs, or cord wood, and cost of hauling. It is impossible to figure this, as usually "waste" is burned, and each case must be considered separately.

2. Cost of Burning Coal or Oil.—The cost of burning either will depend on grade used, distance from supply, local hauling cost, handling cost, etc., and each case must be considered separately.

Cost of Maintenance

1. Oil vs. Coal.—About equal when firebox is designed for oil.
2. Higher when same locomotive is made oil and coal burning.

Cost of Equipping Locomotives

The cost of equipping logging locomotives for burning oil is not at all excessive, depending upon size of locomotive and oil tank capacity desired, whether it is applied in separate tender or not, etc.

On the small logging locomotives having cylinders 10"x16" the cost of complete oil equipment will be about $150 in addition to usual price of coal burning locomotive.

On medium size locomotives having cylinders 16"x24" the cost will be about $300.

On larger locomotives having cylinders 21"x28" the cost will be about $750.

It should not be assumed from the foregoing, because of the many advantages offered by use of burning oil in locomotives, that they are a universal panacea for all ills. On the contrary, each particular installation of oil burning locomotives must be carefully considered as to relative advantages and disadvantages, also regarding ease of obtaining oil, and, other things being equal, relative cost.

Southern Industrial and Lumber Review, October, 1912.

Electric Drive in Mill Practice.

In Woodcraft, April, 1913, is a six page article with good illustrations, giving specific examples of the use at the present time of electric motors for driving the machines in saw-mills and planing mills. The discussion takes up the application and a comparison of the wound and the so-called squirrel cage types of motors for the different machines. A table giving the power required, the kind of motor, method of connection and speed in revolutions per minute, for each machine in the sawmill, planing-mill, machine shop, etc., is well worth repeating here.

Machine	Horsepower	Kind of Mo	Method of Connection	Speed R.P.M.
SAWMILL				
Bandsaws (3)	200 each	Wound	Belted	900
Edger (6 ft.)	50	Squirrel-cage	Direct	1800
Edger (8 ft.)	75	Squirrel-cage	Direct	1800
Slasher	40	Squirrel-cage	Direct	600
Trimmer	30	Squirrel-cage	Direct	720
Hog	40	Squirrel-cage	Direct	720
Bull chain	40	Wound	Belted	900
Chainsaw	10	Squirrel-cage	Belted	1200
Slasher conveyor	15	Wound	Belted	600
Burner conveyor	25	Wound	Belted	1200
Slab conveyor	15	Wound	Belted	600
Cross conveyor	15	Wound	Belted	600
Sawdust conveyor (4)	10 each	Wound	Back geared, chain drive	600
Boiler-room conveyor	15	Wound	Belted	600
Boiler-room conveyor	10	Wound	Belted	600
Slasher chains	15	Wound	Back geared, belted	600
Trimmer chains (2)	15 each	Wound	Back geared, belted	600
Log deck chains (3)	7.5 each	Wound	Back geared, chain drive	900
Bandmill rolls (3)	7.5 and 5	Wound	Back geared, chain drive	900
Timber chains and rolls	25	Squirrel-cage	Back geared, belted	1200
Incline chains	10	Squirrel-cage	Belted	1200
PLANING-MILL				
Band resaw	50	Wound	Direct	600
Planers (10)	75	Squirrel-cage	Belted	1200
Inside molder	30	Squirrel-cage	Belted	1200
Outside molder	10	Squirrel-cage	Belted	1200
Ripsaws (2)	5	Squirrel-cage	Belted	1200
Cutoff-saw	5	Squirrel-cage	Belted	1200
Exhaust fans (2)	50	Squirrel-cage	Direct	514
Charges	50	Squirrel-cage	Belted	900
MACHINE-SHOP				
Line shafts (3)	7.5	Squirrel-cage	Belted	1200
FORGE-ROOM				
Blower	3	Squirrel-cage	Belted	1200
DREDGE				
Pump	35	Squirrel-cage	Belted	1200
Line shaft	30	Squirrel-cage	Belted	1200
ELECTRIC DONKEYS				
Line drums	150	Wound motor	Geared	900
Air compressor	7.5	Squirrel-cage	Geared	1200

The yard locomotives each are equipped with two 10 horse-power motors run by new Edison type storage batteries. The article is concluded with a discussion of the power factor.

Prevention of Water-logging. The vast forests of spruce and fir on the high plains of the United Province and the Punjab of India, are very inaccessible on account of altitude. River driving is the only means of transportation, but since the soft wood soon becomes waterlogged, the forests are practically untouched. Experiments have been made to determine a method of preventing this water-logging, and it was found that by dipping the ends of sleepers that had been seasoned 12 months, into hot coal tar the water-logging was practically prevented. Of 223 broad gauge sleepers treated in this way only 4 were lost, whereas of 331 untreated sleepers 132 were lost. The treatment is very cheap. Further experiments are in progress.

Southern Industrial and Lumber Review.

Reduced Cost of Dressing Lumber.

The July, 1913 number of the Wood Worker gives a short article on remodeling of a planing mill which resulted in reduction of cost of dressing lumber from $2.40 per M. to 93c. A diagram showing the lay-out of the mill is printed with the article. A saving of 1,000,000 feet in 8,000,000 was made by resawing from 2 inch stock and a saving of 1,000,000 feet in 6,000,000 from 3 inch stock.

Fire Rules for Logging Camp.

1. When you see a fire put it out.
2. If you can't put it out tell the hook tender or foreman.
3. Don't lose any time.
4. Five short blasts of the whistle means there is a fire.
5. That means every man in camp is wanted excepting the cook and flunkies.
6. Contract men—fallers and buckers—must fight fire.
7. John Jones is a fire warden and in charge of fire fighting in this camp. Do what he tells you.

The following could be posted on the engine:

1. If a fire gets out from this engine, put it out.
2. If you can not put it out blow five short blasts on your whistle.
3. This engine must be equipped with a spark arrester, 100 feet of hose, 6 shovels and 5-gallon pails.
4. If it is not thus equipped, tell the foreman.
5. After it is equipped, keep it supplied.
6. Don't punch holes in the screen.
7. Wet down around your engine before going off shift and at noon.
8. John Jones is a fire warden and in charge of fire protection in this camp. Do what he tells you.

American Lumberman.

Utilization of Pine Stumps.

Many methods for the utilization of pine stumps have been proposed and tried, and failed; but the success of a newly invented and unpatented process has been announced by the Heald Manufacturing Co., of Laurel, Miss. After six months practical operation it is shown that a fair profit can be made and naval stores of good quality can be produced at lowest prices. The solvent used is gasoline and a cord of 4,000 lbs. of "fat" wood is made to produce.

Resin 500 to 650 lbs.	$10.00
Turpentine 15 gallons,	5.00
Pine oil, 3 gallons,	3.00
Total,	18.00
Cost of production,	10.00
	$8.00

A plant in which $50,000 is invested will have a capacity of 12 cords a day, and employs 16 men. The resin has been of E grade and is now bringing $3.90 per bbl.; the turpentine has been accepted as water white and is bringing 36c per gallon.

Southern Lumberman.

Aerial Tramway.

A very neat method of getting out logs by means of an aerial tramway is described and well illustrated in The Timberman of July, 1913. The tramway was used in logging out five million feet of timber in Idaho where the country was so rough that the cost of railroading made that method prohibitive. It has a capacity of 500,000 feet daily and costs $10,000 per mile for construction. The up-keep is comparatively light.

Tannin Contents Southern Oak Barks.

Tannin content of any of the following species is high enough to warrant use of the bark if enough can be obtained and if it will produce good leather.

	Soluble Solids.	*Insoluble Solids.*	*Non Tannins.*	*Tannin*
Quercus marilandica ...	17.23	.77	6.51	10.73
Q. texana, ...	13.37	1.15	7.44	5.93
Q. velutina, ...	22.81	1.65	9.36	13.45
Q. alba, ...	16.37	1.16	7.09	9.28
Q. digitata, ...	18.68	1.59	7.62	11.06
Q. minor, ...	18.43	.98	8.05	10.38

Blends are often necessary to secure good results as in the case of the bark of the black oak group, which used alone would produce a harsh stiff leather, while when blended with chestnut and oak or hemlock tannin will give good results.

Hardwood Record, July, 1913.

Durability of Cross-ties.

Forest service officers report the following percentages of removals of ties from a test track on the Northern Pacific Railway, after 6½ years service.

At Plains, Montana.

Douglas Fir, green, ...75% removed
Douglas Fir, seasoned, ...77% removed
Tamarack, green, ...97% removed
Tamarack, seasoned, ...93% removed
Both species treated with zinc chloride, 2% removed

At Maywood, Washington.

Douglas Fir, green, ...37 % removed
Douglas Fir, seasoned, ...27.5% removed
Douglas Fir, creosoted, ... 2.5% removed
Hemlock, green, ...92.5% removed

All removals of treated ties were due to mechanical failure and not to decay.

Timberman, July, 1913.

Durability of Wood Paving.

An extract from the Timber Trades Journal bears striking evidence to the long life of creosoted block paving. Even when subjected to London traffic, investigation showed that blocks laid 20 years ago, although worn, were quite sound, the creosote having thoroughly preserved the wood (species not given.)

T. S. W., Jr.

Durability of Wood Paving. Indian Forester, September, 1913, pp. 460.

Pencil Wood.

A large part of all the wood used in the manufacture of lead pencils comes from the Ozarks. The Red Cedar trees rarely reach 12" diameter there and are stunted. Only the red heart-wood is used, the sapwood is thrown away. The timber is usually cut into slats 3/8 inch thick 7 1/4 inches long and 7/8 to 2 or 3 inches wide. One mill in Southern Missouri produces enough of these slats daily to make 1/4 million pencils. There are about 15 other mills in 5 different states in the same business.

Lumber Trade Journal.

Four Sweep Log Unloader.

Illustrations accompany a short article describing a four-sweep arrangement hung from a center pile which is about 14 feet above four other piles that support it. The sweeps are about 30 ft. long and are loosely balanced so that the ends can be raised or lowered about five feet. They swing across the track so that when one end of a sweep is placed against the side of a load of logs, the forward movement of the car forces the load off sidewise. The sweep has reduced the time of unloading a train to 1/2 or 1/3 of that formerly required.

The Timberman. November, 1912.

Stump Burner.

The Southern Lumberman of Oct. 30, 1912, gives two very good illustrations of a simple device for boring stumps and the method of burning them for clearing land. The method has proved satisfactory in pine, fir and tamarack stumps in the Northwest. One man can keep many stumps burning and the rapidity of the burning can be regulated at will.

Container Specifications. In connection with the movement in this country against the use of fragile substitutes for wooden boxes, it is of interest to know that the railroads of Great Britain have adopted regulations in regard to construction of containers for bottles, jars, etc., in which confections or provisions are packed. Wooden boxes for this purpose must have 7/8 inch end boards; sides 3/4 inch; bottoms 3/4 to 1/2 inch, the latter if for canned provisions; lids 5/8 inch. The end joints must be reinforced with strip iron or wire; and partitions not less than 1/4 inch thick must be provided to separate jars and bottles.

American Lumberman.

Woods for Saw Handles. Nearly 2,000,000 feet B. M. of apple lumber is manufactured annually into saw-handles; and this is about the only important use to which apple wood is put altho a small amount is made into tobacco pipes and into miscellaneous turned articles; formerly it was used for shuttles, but persimmon and dogwood have superseded it. The wood is the product of old orchards which have been abandoned on account of insect pests. The lumber is sawed from butts which run two or more feet in length, occasionally reaching 8 ft. Thirteen inches is the minimum diameter. The logs are sawed into lumber 1 1/8 to 1 3/16 inches thick and 6 to 6 1/2 inches wide. The lumber is generally steamed while the sap is still in the wood to produce a deep red color. The steaming requires from 36 to 72 hours depending upon the length of the time the wood has been cut; the greener, the less time required. The trade has become used to apple-wood handles and does not consider any other satisfactory in a high grade saw. The cheaper saws have beech as a common substitute. Other woods used are black cherry, red gum, maple, and where specially ordered black walnut and mahogany.

Hardwood Record.

Piling Used in Various Countries.

The species of timbers and sizes used for piling in various parts are given as follows by the Lumber Trade Journal.

Canada—Vancouver. Douglas Fir. Piles 30 to 40 ft. long are 12 to 14″ diam., 5 feet from butt; other lengths are in proportion; all taper to 8″ small end. Untreated they last in salt water 1 to 3 years; one instance cited in which they fell in 11 months. Creosoted they last from 10 to 18 years. Sometimes they are wrapped with chemically treated paper or with sheet copper. Australian "turpentine" *(Syncarpia laurifolia)* piles have less taper. They last untreated 20 years or more; one case cited in which piles removed after 18 years service still in good condition. Cost is high, 60c lineal foot, which is 20 to 30c more than treated Douglas Fir and 50c more than untreated.

Mexico—Manzanillo. Douglas Fir and Coquito Palm are used in lengths up to 100 ft. with 24″ butts and 12″ points. Creosoted under pressure, if full penetration, they last 3 to 4 years; painted with carbolineum, two years; and if sheathed with felt and sheet copper they last as long as covering is intact.

Mexico—Tampico. Texas Pine 10 to 30 ft. long by 10 to 12″ diameter is used mostly. Formerly were used with bark on, but now creosoted under pressure. Native palms have been in use 10 years and appear to be good for that much longer. Chijol is said to last 40 years and still be in good condition but generally the poles are too short for use. Teredo is said to be the only borer encountered in this section.

Cuba—Habana. Woods in use for piling are Jucaro, Jiqui, Mahogany, Majagua, Cuban Pine and American spruce and pine. The first two are most popular. Specifications call for 12″ to 14″ diam. by 30 ft. or longer, usually free of bark. Jucaro will last about 15 years untreated, and Jiqui, Mahogany and Majugua about 12 years; American pine not more than 4 or 5 years untreated and Cuban and native pines less than 3 years. Native woods are not treated; American pine when used is generally given 22 lbs. of creosote oil per cu. ft. Native timbers are sometimes given a coating of re-enforced concrete or cement 1/4 to 1/2 inch in thickness. Creosoted piles have not proven satisfactory; in at least one instance gave out in 3 years, but in another were in good condition after 5 years. Cement coating has not yet demonstrated its usefulness. Two borers are destructive in Cuban waters,—limnoria and teredo; the former seems to be the more destructive except waters with a sandy bottom.

Santo Domingo. Yarei (Chamaerops) is in general use, also a little Georgia Pine. There are no special specifications. Stuff about 6″ diam. and 30 to 40 ft. long has been used. Native material lasts 2 or 3, sometimes 6 or 7 years. Creosote injection has been tried.

Haiti. No results given. Cement coating used but work was recently done. It is reported that latania palm lasts 35 years but these palms are scarce and exploitation is very costly.

Martinique. A native wood, Poirier, lasts 10 to 20 years. Sizes are 12 to 20 inches diam., 20 to 30 feet long. No preservative treatment is employed.

Trinidad. Piles formerly used were of Greenheart, Poui, a native wood, is used locally somewhat. Special orders determine sizes, 40 ft. by 15″ is maximum size used. A four inch coating of concrete makes them last 50 years or more, while if unprotected 15 years would be average life. No other preservatives are used.

Venezuela. Vera *(Guaiacum arboreum)* and Curarire *(Tecoma pentaphylla)* are used for piling. Untreated they last about 6 years, sometimes however Curarire lasts indefinitely (this has never been studied). Most common practice of preservation is to coat with tar. Sometimes the piles are charred. Neither method seemed to be effective.

Turpentine Industry in India.

It is interesting to note that the tapping of *Pinus longifolia* in the Himalaya Mountains has developed quite a local market for rosin and turpentine. In 1910-11 the number of trees tapped was 194,000 the yield of rosin 9,500 maunds* and 21,000 gallons of turpentine. In 1912-13, 400,000 trees were tapped with a yield of 20,000 maunds of rosin and 45,000 gallons of turpentine. In 1916-17, the Indian Forest Service estimates that the output will reach 47,000 maunds of rosin and 105,000 gallons of turpentine. The report states: "With the growing Indian de-

*1 maund is equal to from 25 to 82 pounds, varying in different localities.

mand, however, it is doubtful if there will be any available surplus for export. It is at least certain that there will be no export from India for some years to come."

T. S. W., Jr.

Indian Rosin and Turpentine. Indian Forester, September, 1913, pp. 447-454.

STATISTICS AND HISTORY.

German and Prussian Progress.

A most interesting account in detail of the changes in the results of forest management in Prussia during the 25-year period 1889-1913, including, in some directions, data for the whole of Germany, and of other interests than forest economy, is given by Semper.

During these 25 years the *population* of Prussia increased 42 per cent. (in all Germany 40%), but a shifting of population has taken place, by which the proportion of agricultural population has decreased from 42 per cent. to 29 per cent. of the total population, as a result of industrial development. This has led lately to a revival of colonization schemes, the forest administration, especially in the Eastern provinces, being active in that direction.

Emigration, which in the early eighties still ran to over 850,000 per year, in the period 1907-11 had dropped to 125,000. The general prosperity of the country may be gauged by the *savings bank* accounts, which for all Germany doubled from 1900 to 1910 to $4200 million dollars; for Prussia, trebled in 22 years to $2600 million.

Wages have risen (at the Krupp works in Essen) from 88 cents to $1.32, or just 50 per cent.

Agricultural production has increased considerably more than the population and has made Germany independent of importations in meat and bread, so that, while e.g. in 1885 to 1890 imports of rye were 9 per cent. of the consumption, at present exports of 5 to 8 per cent. are reported. The yield per acre has increased for different crops from 30 to 60 per cent. and are at present 1600 lbs. in rye, 1850 in wheat, 1800 in barley, 1600 in oats, and 9320 in potatoes, the latter figure due to the dry years, being a decline of 3200 lbs., over 1905 to 1910. Translated into bushels, these weights represent at least 30, 31, 36, 50, 155 bushels respectively, generally speaking about twice the per acre production of the United States.

In spite of increased coal consumption and substitution of cement, *wood consumption* has increased extraordinarily, for while the population increased 40 per cent., the wood *import* (excess over export, which rose only 48%) in log and lumber increased 150 per cent., namely to between 480 and 510 million cubic feet, and, in value, including woodenware, from $43 million to around $80 million. Meanwhile the export of coal rose from around $20 to $80 million: the coal export paid for the wood import.

In the earlier period, the proportion of unmanufactured round wood to sawed was 3 to 2. In the latter period the round wood import had increased 100 per cent., the sawed lumber by 150 per cent., or if railroad ties are added 170 per cent; but the *pulpwood* import has increased 1500 per cent., namely from 2,000 to over 1 million tons.

While the United States still furnishes only 7 per cent. of the import, during the 25 years the United States export has grown to nearly 8 times what it was in 1888 to 1896. Home *wood production* has increased. A definite census of the total wood production was only made in 1900, namely

MILLION CUBIC FEET

	Workwood	*Fuelwood*	*Brushwood*	*Total*
Germany	706	635	370	1711
Prussia	342	297	231	870
State Forests (31%)	155	106	70	331

The total production is estimated to have since then risen 106 million cubic feet, to 1817 million cubic feet, or 15 per cent. This added to the 510 million imported makes the total consumption 2327 million cubic feet, or 35 cubic feet per capita, of which 42 per cent., or 15 cubic feet, is workwood.

Turning now to conditions of Prussia, the *State forest area* of that State has increased by 12 per cent., or by 125,000 productive acres, for which the State has paid over $18 million, securing a part by exchange; the funds being largely secured from sale of forest on agricultural soil. This increase is largely waste lands or mismanaged forest. Not less than 275,000 acres of waste lands have been reforested during this period in Prussia, which has involved the use of nearly one million pounds of pine seed alone annually.

Private forest on the other hand has been decreased, not only by the sales to the government, but by exploitation, induced by the great industrial development, especially in the eastern provinces, although the State has in the meantime assisted reforestation in the western provinces by money conribution to the extent of over $500,000, besides some $100,000 in other ways, furnishing expert advice, and otherwise assisting private forest owners through the provincial forestry bureaus.

The State forests of Prussia, representing only 30.9 per cent. of the total forest area, produced in 1900 as much as all the private forests, comprising 50.8 per cent., or 1½ more, and in the last 13 years a further considerable improvement has taken place.

The *per acre production* which in 1887 was 52.6 cubic feet, in 1910 to 1911 had increased to 70 cubic feet, and the workwood per cent., from 39 to 65; in conifers alone, to 76 per cent. This increase in workwood production was made possible by the removal of rights of user; increase of coal production, calling for mine timber; road and railroad construction, making smaller sizes profitable; and industrial development, in which the paper pulp development played no mean role. More intensive management became possible, increasing the amount of thinnings from 39.2 per cent. of the main yield to 65.6 per cent. in 1910 and 1911, which figures an increase of these intermediate fellings of 137 per cent.

The *paper pulp industry* shows the following development:

	1888	*1900*	*1910*
		Thousand Tons	
Transported on railroads—			
Paper and board	424	1,071	2,097
Paper pulp	363	778	1,292
		Million Dollars	
Export paper material values	2	7.4	8.6
" paper, etc.	18.5	24.	36.

In the statements regarding *railroad* development, it is of interest to note that 32.24 per cent. is laid on metal ties, and the metal tie is growing in favor. It is also notable that of the 3.3 million wooden ties used in 1910 almost 2 million were imported.

The railroad mileage of Prussia more than doubled from 1885 to 1911, and that of German State roads increased 84 per cent., to over 70,000 miles. The transport of wood more than trebled to nearly 20 million tons, 40 per cent. of which was lumber.

The expenditure on *forest roads* during the period was $5 million, of which in 1911 to 1912 alone $1.5 million, the expenditure per acre of forest in this direction growing from 11 cents to 19 cents. *Prices* rose 80 per cent., from 4.2 cents per cubic feet to 6.8 cents; pine logs in particular by 74 per cent.; spruce by 33 per cent; oak logs in the last 6 years alone by 25 per cent.

Owing to all these various influences, the gross *income* of Prussian State forests more than doubled (162%), and the net yield trebled, the former being now $5.00, the latter $2.87 per acre, so that with a total income of $21 million the forests next to the railroads are the best revenue producers.

And the *age class distribution* allows the expectation of still further increases. Considering the increase of over 11 per cent. of forest area (to 6,289,000 acres), the increase being largely of poor lands planted up, and the increased cut in older age classes, the percentic change of age class conditions is remarkably conservative.

	I	*II*	*III*	*IV*	*V*	*VI*	
Year	*Over 100*	*81-100*	*61-80*	*41-60*	*21-40*	*1-20*	*Blanks*
1881	11.3	13	14.5	18	19.8	19.7	3.2
1911	15.7	11.8	14.9	19	18.4	17.9	3.3

Regarding the possibility of increasing the returns, the author says: "Even the opening of the Panama Canal and the cheapening of freights from the enormous forest resources of the Pacific Coast States can reduce these expectations only for a short time, since in the United States economic sustained yield, self denial for the sake of the future, is not known, and their own consumption will soon exhaust their stores."

Of minor interest are the fire and game statistics. During the first half of the period an average of 28 fires per year was experienced with 1375 acres, during the last half, 23 fires with 2,000 acres each year.

High game (some 300,000 pieces) is reported as having increased 50 per cent. since 1900, in spite of increased killings.

The net revenue from the chase has increased from $60,000 to nearly $150,000.

25 Jahre staatlicher und privater Forstwirtschaft in Preussen. Zeitschrift für Forst-u. Jagdwesen, June, July, 1913, pp. 341-369, 430-446.

Forestry in England. A decided step in advance towards encouraging forestry in Great Britain was made in 1910 with the appointment of a Development Commission, which is to advise the government as to the propriety of giving grants from a specially organized Development Fund to government departments or other public bodies for development and road improvement purposes.

This Board, which, it will be noted, has only advisory powers, in 1911 authorized and establishment of a demonstration area of 5 to 10,000 acres in Scotland, with a forest school attached, and for Ireland, approved a grant of $125,000, to start a scheme of the Department of Agriculture for counties to "acquire and reforest waste lands."

Various reports or memoranda regarding the conduct of the demonstration forest, forest garden, and all other requirements mittee, but a note by Ferguson complains of the situation as far as Scotland is concerned. "A forestry department for Scotland remains non-existent. ——— no representative of the government helps—though several hinder—in making provision for demonstration forest, forest garden, and all other requirements for State training for forestry and for State afforestration."

Development of Forestry in England. Transactions Royal Scottish Arboricultural Society, July, 1913, pp. 147-160.

Protection Forests in Savoy. Those interested in the early history of the coniferous protection forests in the Northern Alps will find a valuable contribution in Mr. P. Mougin's article which traces the regulations in force from the 17th century. As early as 1729, a fine of 50 livres was levied for those who cut "wood and trees of any kind whatsoever which are suitable for maintaining the snow and preventing avalanches and erosion." After the reunion of Savoy to France in 1792, various decrees were published but the administrators of the Departments of Mont-blanc and Léman did not allow the real maintenance of protection zones. During the transitory period, 1815-1822, it was decided at the start to suppress all forestry work, and unlimited free use of the forests was allowed. Naturally, great damage resulted. On October 15, 1822, commencing the period 1823-1833, the Forest Service was reorganized and it was ordered that trees necessary to hold snow and prevent avalanches should not be cut under penalty of 50 to 300 livres. In addition, it was provided that civil damages could be collected. In general, the regulation of cutting was well observed. On the first of December, 1833, legislation was enacted with the object of economy to "render patrol of the wood less costly." At the same time a veritable forest protection code was passed containing interesting details which are well worth study.

T. S. W., Jr.

Forêts de Protection de Savoy. Revue des Eaux et Forêts, September, 15, 1913, pp. 545-557.

POLITICS, EDUCATION AND LEGISLATION.

Organization in France.

By decree, dated September 19, 1913, the French Forest Service was organized as follows: 32 District Foresters, 193 Supervisors, 191 Deputy Supervisors and 198 Forest Assistants (with field and office assignments). The salaries for the year 1913 were established as follows:

General Inspectors (assigned to central office at Paris)	
Class 1	$2,509.00
Class 2	2,123.00
District Foresters	
Class 1	$2,316.00
Class 2	1,930.00
Class 3	1,737.00
Class 4	1,544.00
Supervisors	
Class 1	$1,225.55
Class 2	1,032.55
Class 3	926.05
Class 4	858.85

Deputy Supervisors	
Class 1	$839.55
Class 2	743.05
Class 3	646.55
Forest Assistants	
Class 1	$569.25
Class 2	512.05

These salaries were converted from francs to dollars by counting 1 franc equal to 19.3 cents.

T. S. W., JR.

Revue des Eaux et Forêts, October 1, 1913, pp. 601-602.

OTHER PERIODICAL LITERATURE.

Forest Leaves, XIV, 1913,—

National Forestry. Pp. 50-52.

Recent Legislation. Pp. 58-62.

The Botanical Gazette, LV, 1913,—

Reproduction by Layering in the Black Spruce. Pp. 452-457.

[LVI, 1913]

The Origin of the Erect Cells in the Phloem of the Abietineae. Pp. 36-50.

Summer Evaporation Intensity as a Determining Factor in the Distribution of Vegetation in Connecticut. Pp. 143-152.

Quarterly Journal of Forestry, VII, 1913,—

Forest Soils and Surface Conditions. Pp. 247-268.

Forests and Forestry of Southern Nigeria. Pp. 280-287.

Influence of the Parent Tree on the Progeny. Pp. 335-337.

Transactions of the Royal Scottish Arboricultural Society, XXVII, 1913,—

The State Forests of Saxony. Pp. 174-187.

Continental Notes—Germany. Pp. 212-222.

The Gardeners' Chronicle, LIV, 1913,—

The Spruce Aphis. Pp. 4-5.

The Large Larch Sawfly. Pp. 184-185.

The Indian Forester, XXXIX, 1913,—

The Supply of Railway Sleepers in India. Pp. 169-173. Discusses the question of the use of various species.

Forestry in Trinidad. Pp. 183-193.

Gives the history, statement of reserves, description of chief trees, and account of the plantation work.

The Treatment of Sleepers at Pyinmana. Pp. 217-225. Experimental facts.

Prosopis juliflora. Pp. 320-324.

Treatment of Terminalia tomentosa Sleepers. Pp. 378-379.

Review of Report on the Forest Administration of the Central Provinces for 1911-1912. Pp. 386-390.

The Cork Oak and its Products. Pp. 390-393.

Bulletin de la Societe Dendrologique de France, 1913,—

Graines et Plantules des Angiospermes. Pp. 75-119; 129-178. Continuation of the series.

Monthly Bulletin of Agricultural Intelligence and Plant Diseases, IV, 1913,—

The Forests of Bulgaria. Pp. 772-774.

Forestry in China. Pp. 915-917.

A New Method for the Afforestation of the Sandy Portions of the Great Hungarian Plain. P. 917.

Present State of Forestry in Portugal. Pp. 989-997.

Management of the State Forest in Bavaria. Pp. 1247-1249.

Encouragement of Afforestation in Hungary. P. 1250.

NEWS AND NOTES.

Among the fourteen hundred delegates present in Washington at the Fifth National Conservation Congress, from November 17-20, were more foresters than had ever heretofore attended any similar meeting in this country. The forestry work accomplished, as evidenced by the twelve printed reports in pamphlet form prepared under the direction of the Forestry Committee, is a noteworthy contribution to American forestry literature.

The adoption by the Conservation Congress of the recommendations unanimously presented by its Committee on Water Power was a long step forward in the development of a definite governmental policy, recognizing clearly the principle of public control; and also recognizing clearly the necessity of offering to the investor opportunity to invest his time and money in the development of water power under conditions which safeguard both the public interest and his investment.

"The fact that a committee comprised, not only of professional experts of the highest distinction, some of whom are actively associated with the water power interests, but also such men as Ex-Secretary Henry L. Stimson, Mr. Gifford Pinchot and Mr. Lewis B. Stillwell were able to agree upon a definite and constructive program, and that this program received the emphatic endorsement of the Conservation Congress, is a demonstration of the public spirit of the Committee and the ability of the Congress to accomplish effective and constructive work. All true Conservationists will hope that our National Government will promptly enact the legislation that is so greatly needed."

This year for the first time the annual meeting of the Western Forestry and Conservation Association will be held in Canada. This Association is made up of the various forest fire organizations on the Pacific Coast of the United States and represents the combined efforts of private owners of timber lands, various Western States, and the Federal Government, in the prevention and control of forest fires.

Vancouver, B. C., will be the place of meeting this year and the meeting will be held December 15 and 16th. This is the most important yearly gathering of timber owners in the United States or Canada. At the meeting in Seattle last year one-third of the standing timber of the United States was represented and here were present over thirty men prominent in western Canadian forest affairs. It is not a public meeting to discuss forestry generalities nor is the time taken up by set papers.

With the help of loggers, railroad officials and others involved. the practical men who are actually doing the private, state and government protective work describe and debate their field methods and adjust their differences.

One of the most interesting features at Vancouver will be a frank debate between British Columbia lumbermen and government over the merits and demerits of the province's forest policy and methods. Other topics will be experiments in state co-operation and compulsory patrol; logging camp rules and precautions; slash and right of way burning; forecasting hot dry winds; supply, report and payroll systems; lookout, map and signal systems; forest telephone building; wireless auxiliaries, and railroad regulation and co-operation. An unusual attraction will be an exhibit of all devices and instruments used in American forest protection.

Provision has been made by the Province of Nova Scotia for the appointment of a Provincial Forester, and it is expected that a man with technical training will be selected in the near future to fill this position. This action is the result of recommendations made by Dr. B .E. Fernow in his report on the forest conditions of Nova Scotia, published about a year ago. The appointment of such a man was also urged by the Commission of Conservation at its annual meeting in January, 1913. The Provincial Forester will have general supervision over the work of the fire rangers employed by the provincial government, as well as conduct an educational campaign among private owners of woodlands. He will also be able to render valuable service to the Crown Lands Department in connection with the administration of the 1,417,000 acres of crown lands. The forests of Nova Scotia are principally in private ownership, and to a very large extent, in the form of small holdings and farmers' woodlots. Only a small remnant of the forests of the province remain unalienated, a very large percentage of the Crown Lands consisting of either natural or man-made barrens. This is evidenced by the fact that out of over one million, four hundred thousand acres of Crown Lands, only 5,297 acres are under license to cut timber, the revenue from which during the past year was slightly over $17,000.

The provincial parliament of New Brunswick, at its session last winter, provided for a survey, examination and classification of the crown land areas of the Province. The report, as provided in the Act, is to cover the following points: the character and quality of the lumber; the quantity of timber and the reproductive capabilities of the various areas, estimating as accurately as may be the annual growth of the timber upon each area or tract; the accessibility of the timber in each section; the cost of logging the different areas; the cost of stream-driving to the point of manufacture; and the location of the lands deemed suitable for agricultural purposes. Owing to financial considerations, it was not deemed practicable to create a separate organization and provide for the collection of this very important information on an intensive scale at first hand. The existing staff of cruisers and scalers has therefore been charged with the duty of collecting and compiling all available information along the above lines, under the supervision of Mr. W. H. Berry, Superintendent of Scalers. The Provincial Government feels that at least the great bulk of the above information can be collected in this way, to an extent sufficient for present needs, and consistent with financial considerations. It is, however, obvious, that the required study of reproduction and rate of growth must be handled in an entirely different way, since information of this kind can be secured only as result of close and detailed study by men who have been especially trained for this class of work. It is expected that the necessity for securing this class of information, as well as for supplementing the estimates made by the staff of cruisers and scalers, will result in the establishment of a forestry branch in the Crown Lands Department, with a technically trained forester in charge. This action will prove not only logical but necessary, since the crown lands of the province return an annual revenue of over half a million dollars to the provincial treasury, and the absolute necessity of providing adequately for the perpetuation of this resource can not long be avoided. The crown lands comprise an area of over ten thousand square miles, or approximately one-third the total area of the province.

The Canadian Commission of Conservation and the Department of Lands of British Columbia have entered into a co-operative arrangement for a study of the forest conditions and forest resources of British Columbia. Dr. H. N. Whitford has been employed by the Commission of Conservation to begin the work of collecting information along the above lines from all available sources. The large amount of material which has been collected by the British Columbia Forest Branch will be supplemented by information to be secured from all other possible sources, including the Forestry Branch of the Canadian Pacific Railway, and statements by timber cruisers, limit holders, surveyors and others. The Canadian Pacific Railway Forestry Branch has collected much valuable information with regard to the forest resources of the southern portion of British Columbia, and much of this information is to be made available through a co-operative arrangement between the Commission of Conservation and the authorities of the Canadian Pacific Railway.

In the Prince Albert District of Northern Saskatchewan, a similar study of forest conditions and forest resources is being carried on for the Commission of Conservation by Mr. J. C. Blumer. This part of the work is being conducted in co-operation with the Dominion Forestry Branch.

This work is part of a general study, which has been undertaken by the Commission of Conservation, having for its object the approximate determination of the amount of timber in each of the various provinces of Canada.

The 1913 International Forest Congress was held at Paris, June 16 to 20, under the auspices of the Touring Club de France. The honorary Presidents of the Congress were the following: Clementel, Ministre de l'Agriculture; Klotz, Ministre de l'Interieur et des Cultes; Leon Berard, Sous-secretaire d'Etat des Beaux-Arts. M. L. Dabat, Director General of the French Waters and Forest Service, was honorary president of the Committee of Organization and M. H. Defert, Vice-President of the Touring Club, was president of the Congress. The members attending were largely from France, many of them notable administrative officers in retirement, and in addition there were representatives from the Republic of Argentine, Austria, Belgium, Bulgaria, Chili, Denmark, United States, Great Britain, Greece, Haiti, Hungary, Japan, Norway, Holland, Portugal, Roumania, Russia, Salvador, Columbia and Sweden. Arrangements were made for the presentation of addresses at Paris during the week ending June 20 followed by excursions in the forests. The first excursion left Paris the morning of June 21 and occupied the entire day; it was to Lyons-la-Forêt. The second excursion left Paris the morning of June 22 and included visits to Grenoble and the French Alps.

The bureau sessions at Paris were admirably arranged. In the first place there was an open meeting addressed by such notable personages as the Secretary of Agriculture. Then there were simultaneous meetings to discuss the details of technical forestry. There were five sections; 1, silviculture; 2, forest economy and legislation; 3, forest technology and products; 4, engineering; 5, forest esthetics and education. An address was presented by Mr. Henry S. Graves, Forester of the Forest Service, on the technical development of forestry in the United States, with special reference to experiment stations. As soon as the official detailed report of the proceedings of this Congress is published, a review at some length will be given of the more notable discussions.

The Paris session was made agreeable by a reception at Hotel de Ville by the municipality and by a banquet held at the Quay Dorsay Hotel, which was attended by more than 300 delegates. The excursion to Lyons-la-Forêt included a tour of this interesting beech-oak high forest, in automobiles, luncheon in the forest, a reception by the mayor of the village of Lyons-la-Forêt and return to Paris via Rouen where a banquet was held at the principal hotel. The whole atmosphere of hospitality and good will which pervaded the Congress was due to the charming knack of welcoming foreigners which the French nation possesses to such a degree.

T. S. W., Jr.

Changes in Dr. Schenck's school make the course two full years, one year in the East, one year in the West, Germany being excluded, the time during the winter being spent in logging camps.

Prof. James B. Berry is spending a year in Germany studying at Munich. His address is Barerstrasse 90/3.

A highly interesting report is put out by the municipality of Seattle, H. C. Johnson forest engineer, on the cost of stocking the watershed from which the city draws its supplies. The watershed comprises 59.35 square miles and is valued at present at $700,000, the lower portions of which it is proposed to restock with Douglas Fir.

With seedspots, 6 by 6 feet, using 25 seeds to the spot, .7 of a pound would be required, or $1.40 per acre, the labor varying from $2.35 to $3.30, with 50 cents added for administration, bringing the acre to $4.25 to $5.20 for different sites, as against $9 for broad-casting. It is figured that a crew of three men can sow 2.5 to 3.5 acres per day. Planting nursery stock, on the other hand, is figured at $14.87 with 1200 plants, the plants costing $4.84, the hauling $1.20, the setting $8.32, and administration 50 cents.

Various tables of cost under varying conditions, yield tables, and financial tables add to the interest of the report.

All told, about $8,000,000 has so far been spent in purchasing forest areas in the Appalachian and White Mountains under the Weeks Law.

In the last fiscal year 711,415 acres had been examined and appraised by the Forest Service and approved for purchase by the Commission; of the acreage 100,000 acres were in the White Mountains. The average price was $5.07. The annual appropriation is $2,000,000, and it is expected that next year about 1,200,000 acres will be added.

Over 15,000 lbs. of tree seed and nearly 4 million trees were imported from Europe into the United States last fiscal year; including material for ornamental and forest use. France furnishes nearly twice as much as Germany of plants, but the greater part of the seed came from Germany, Holland being third in the plant export.

The enthusiastic friends of Luther Burbank of international fame as plant breeder have associated themselves with a Society, which has undertaken to publish a record of his life work in a most gorgeous set of volumes, 12 in number, illustrated with over 1200 remarkable color photographs. The proof of parts of the first volume has just come from the press and is submitted to the honorary members of the Society, professional men, for criticism. It contains three chapters, namely, How the Cactus got its Spines —Twenty-three Potato Seeds—No Two Things Exactly Alike. It is an interesting popular discussion of what every plant physiologist knows, illustrated by accomplishments of Mr. Burbank's assiduous work.

Dr. C. A. Schenck, of Biltmore, N. C., announces a tour through German woods, the participants, not to be members of the Biltmore school, limited to 50. The tour, open to graduates, lumbermen and timberland owners, is scheduled to start from New York in January, 1914, returning in eight weeks, total expense $350, everything included.

The Canadian Forestry Branch, through the initiative of its Chief Fire Ranger, has been successful in bringing the Indians into line as firewardens. A pow-wow held this summer in Northern Manitoba developed unusual interest among the Indian chiefs and councillors. Some 18 Indian fire rangers, proud of the metal badge which makes them officials, average about 18 miles of patrol per day.

An interesting method of applying the principle of reduction in taxes on reforested lands has been inaugurated by the Louisiana Conservation Commission. It consists of a contract with a lumber company, under which the assessment of the land is kept at $1 per acre, as long as the company is reforesting and not cutting timber except for good forestry practice. In case the company fails to carry on the contract, the land is not only reassessed at its full value, but the accumulated tax to the owner during the period when the contract was alive is also assessed. The first contract refers to 250,000 acres cutover lands, and it is expected that some 200,000 acres may come under such contract.

A correction of statement in the last issue, p. 447, regarding price of Carbolineum by the Carbolineum Wood Preserving Company makes the price for the United States considerably lower, namely, from 65 cents per American gallon (231 cubic inches) in car loads to 80 cents in single barrels. The prices formerly stated are for Imperial gallons (277 cubic feet), as sold in Canada. Such reduction in price should, indeed, stimulate a wider application of preservative methods—a great increase in conservation is possible in this direction.

COMMENT.

We revert once more to the educational situation in the State of New York, in order to correct impressions which may have been produced by an incomplete statement of facts under *Comment* in the last two issues of the QUARTERLY.

A friend calls our attention to the manner in which Cornell University revived instruction in forestry. In 1903, Cornell abandoned the New York State College of Forestry, as a matter of political expediency. Not until Syracuse University had secured the passage through the Legislature, in the session 1909-10, of a bill to re-establish the College at Syracuse, did Cornell consider the propriety of again taking up education in forestry. The bill for establishing a College in Syracuse was vetoed by Governor Hughes, but re-enacted by the next Legislature and signed by Governor Dix. Meanwhile, Cornell had instituted a course in farm forestry (see circular, August, 1911) in the College of Agriculture, as a part of a farmer's, not a professional forester's education, and supported from the general funds appropriated by the State for Agriculture. It would also appear from our correspondent's account that the $100,000 for Cornell was not appropriated specifically for a "Forestry building," but as one of the "second section of Plant Industries Group buildings," which formed part of the extension plans for the College of Agriculture. To name it Forestry building, according to our correspondent, appears to have been an afterthought, after the College at Syracuse was inaugurated. The addition of a professional course at Cornell seems also to have been an afterthought.

On the other hand, we find from various reports issued from Cornell University, that the plan to revive forestry education at Cornell was discussed by the Director of the College of Agriculture in 1906 and in 1907; in the latter year the establishment of a forestry department, which should include the training of professional foresters, was also foreshadowed. In 1908 and 1909, these recommendations were reiterated. From this it would appear that the establishment of a professional course was not an afterthought. The professorship at Cornell was, to be sure, not established by the Board of Trustees until the summer of

1910, and in the fall of that year the effort was made to secure Professor Roth to organize the professional course, that is before the Syracuse bill was enacted, although actual instruction did not materialize until 1912.

We give these statements for facts as they were given to us or are found in reports, and abstain from further comment except to reiterate our original reflection as to the propriety of spending State money at two institutions for forestry education, both institutions trying more or less to cover the whole field. Even in Germany, the only State having two professional forest schools is Prussia, which is three times as large as New York, with a highly developed forestry system, the reason for the duplication being the great difference in forest conditions of the different sections of the Kingdom.

Not in America alone has the cry for more logging instruction at forest schools been heard. As an echo to the discussion at the Yale Forest School Alumni Reunion, December, 1911, (Report, pp. 56-78), comes the proposal from Germany in the April number of the "Zeitschrift für Forst-und Jagdwesen" to include six months experience at a sawmill in the practical training of the candidate of Forst Assessor. (See "Forestry Quarterly," Vol. XI, pp. 46-47.) "Agrarier" commenting on this thinks that, with all this specialization in the business end of forestry, silviculture is apt to suffer.

This stricture reminds us of Captain J. B. White's excellent dictum that the growing of timber and the logging, manufacturing and marketing of timber are entirely separate professions. The former is forestry; the latter lumbering, and it is scarcely just to expect either the forester to be proficient in lumbering or the lumberman in the growing of timber.

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