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Forest management :forest working plans

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FOREST MANAGEMENT

(Forest Working Plans)

Guide to Lectures

Delivered at the Biltmore Forest School

By C. A. SCHENCK, Ph. D.

Forester to the Biltmore Estate

—
1907
—

HACKNEY & MOALE COMPANY
ASHEVILLE, NORTH CAROLINA

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FOREST MANAGEMENT

(Forest Working Plans.)

PARAGRAPH I.

DEFINITIONS AND INTRODUCTION.

The term "forest management," used in a broad sense, comprises collectively the branches of forestry known as forest survey, forest mensuration, forest finance and forest working plans. Used in a narrow sense, the term "forest management" deals with forest working plans only and is usually defined as that branch of forestry which determines upon and regulates the sustained yield (*la possibilité*) of forests; or, by others, as a systematic arrangement of the rules by which abnormal woodlands are transformed into normal forests.

American forest management will do well to rest on a broader foundation. It should determine, in science, as well as in practice, upon the ways and means by which the desire of the owner, relative to the use of a forest (for revenue, timber supply, shelter, pasture, ornament, water protection, game preserves, etc.) can be best accomplished. In the majority of cases the owner desires to draw from the forest the largest possible revenue. As a consequence American forest management will have to deal usually with the various means by which given forestal investments can be developed in a manner producing the highest dividends in the long run.

In Europe financial considerations are rarely applied to forest management. Since 1871, however, the adherents of John Frederic Judeich insist that forest management (like farm management, railroad management and any other business management) should see its goal in a strife for the highest rate of interest obtainable from all productive capital engaged in the forest.

The owners of forests (like the owners of farms, mines, hotels, railroad stocks) cannot be expected to seek any other managerial end in the administration of their property.

The rapidity of any development depends (in forests, farms, mines, perhaps in all investments), pre-eminently on the owner's financial ability to make desirable moves at the most desirable time.

In many instances development is possibly only with the help of money borrowed by the owner. Borrowed money (mortgages, bonds) usually proves a curse to the owner of forests after the lapse of a few years. His policy of development is handcuffed by the necessity of meeting the indebtedness, year in and year out, irrespective of market conditions and labor conditions. Forestry, in such cases, must be destructive. It must pay the bonds as they mature out of the substance of the forest.

Frequently forest destruction promises better dividends than forest maintenance. In such cases a forest working plan resolves itself into a plan covering the various operations commonly known as destructive lumbering. The soil may be cleared because it is thought to be valuable as farm soil, pasture soil, orchard soil; or the land may be abandoned after lumbering as worthless when the owner believes that the taxes due on the cleared land (taken together with the expenses of protecting a second growth expectable on the cleared land) form a new investment of an unpromising nature.

Forests cannot be well developed where the development of the whole country is in arrears. Here the owner is compelled to adopt a policy of waiting—waiting for that general development of the country which is sure permanently to improve the value of stumpage. In such cases a working plan resolves itself into a plan for forest protection (against squatters, fires, etc.)

In the prairies and also in the East, the land owner is frequently inclined—on a small scale, usually—to improve the condition of his property sylviculturally, making investments for afforestation, cleaning, weeding, etc. In such cases a forest working plan resolves itself, essentially, into a plan covering various sylvicultural operations (constructive forestry).

In Germany and France, at the time being, conservative forestry produces invariably financial results superior to those of de-forestation and of abandonment of cut over woodland. In these countries cut over woodland unfit for the plow (known as absolute forest land), has a value usually exceeding \$10 per acre.

Modern European foresters are in the habit of identifying the term "management" with the term "conservative management" of forests; and all European forest working plans provide for conservative working of the forest.

CHAPTER I—THE IDEAL FOREST

In an ideal forest continuously supplying certain mills or certain markets with an equal annual amount of timber or wood there should be at hand:

- A normal gradation of the age classes (§ II);
- A normal growing stock (§ III);
- A normal increment (§ IV).

No forest ever has been, is, or ever will be "ideal." The ideal forest deserves attention only in theory. Its theory deals with volumes instead of dealing with values.

PARAGRAPH II.

NORMAL GRADATION OF AGE CLASSES.

A normal gradation of age classes is literally at hand in the forest when there are found as many age classes as the rotation comprises

years. Each class has an age differing from that of any other class. The youngest class is one year old; the next class is two years old; the third class is three years old, and so on to the oldest class the age of which equals the rotation.

In the case of natural seed regeneration, the normal number of age classes at hand is expressed by the fraction

$$\frac{r}{s}$$

wherein r stands for rotation, and wherein s stands for the number of years normally elapsing between successive seed years. Since a single seed year is rarely sufficient to secure a complete stand of seedlings, a wood raised by natural seed regeneration is usually composed of two, three or more age classes appearing in mixture and forming distinct aggregates.

Where the rotation comprises 100 years, and where the period of regeneration comprises 20 years, and where seed years occur every 5 years, there a "normal gradation of age classes" contains, in the fall succeeding a seed year, the following aggregate of age classes:

Youngest aggregate.....	1	6	11	and 16 years old
Second ".....	21	26	31	" 36 " "
Third ".....	41	46	51	" 56 " "
Fourth ".....	61	66	71	" 76 " "
Oldest ".....	81	86	91	" 96 " "

OR THE FOLLOWING AGGREGATES:

Youngest aggregate.....	6	11	16	and 21 years old
Second ".....	26	31	36	" 41 " "
Third ".....	46	51	56	" 61 " "
Fourth ".....	66	71	76	" 81 " "
Oldest ".....	86	91	96	" 101 " "

OR THE FOLLOWING AGGREGATES:

Youngest aggregate.....	11	16	21	and 26 years old
Second ".....	31	36	41	" 46 " "
Third ".....	51	56	61	" 66 " "
Fourth ".....	71	76	81	" 86 " "
Oldest ".....	91	96	101	" 106 " "

OR THE FOLLOWING AGGREGATES:

Youngest aggregate.....	16	21	26	and 31 years old
Second ".....	36	41	46	" 51 " "
Third ".....	56	61	66	" 71 " "
Fourth ".....	76	81	86	" 91 " "
Oldest ".....	96	101	106	" lacking

Amongst all age classes under 21 years old, some mother trees are still at hand up to 110 years old; and beneath all age classes over 90 years old, some seedlings are found up to 20 years old.

In the ideal selection forest, all age classes are represented on every acre of ground.

The separation of the age classes (allotting to each age class separate areas) facilitates logging and transportation; it increases, on the other hand, the dangers threatening the forests.

If a proper gradation of age classes exists in a forest it does not necessarily follow that the age classes are properly grouped and ar-

ranged in "cutting series." By "proper cutting series" is understood a number of adjoining age classes, sloping roof-like from the older to the younger, toward the windward side. If the cutting series are improper, then sacrifices must be made, hypermature wood must be left, and immature wood must be cut unless the mistake originally at hand is allowed to be perpetuated. In the latter case, the losses of the future are apt to be greater than the sacrifices voluntarily made with a view to the establishment of proper cutting series. Cutting series must be isolated one from the other, if need be, by "severance cuttings."

PARAGRAPH III.

NORMAL GROWING STOCK.

The normal growing stock is at hand where the age gradation of the various woods composing the forest and their respective volumes are normal. A forest, however, might have the normal volume without having the normal age gradation, when a deficiency of one age class is offset by a surplus in another age class. The normal growing stock, during summer, has the volume

$$\frac{r^2 \times i}{2}$$

wherein r represents the rotation, and i the average annual increment of a mature age class.

Illustration: A spruce forest covers 2,000 acres. The rotation is 100 years. The mature wood, 100 years old, contains normally 120 cords per acre. Under these conditions, the area of an age class is 20 acres; the average annual increment of the mature age class is 24 cords; and the normal growing stock is

$$\frac{100 \times 100 \times 24}{2} = 120,000 \text{ cords.}$$

The volume of poles and trees predestined to be cut and removed prior to maturity (by way of thinnings) is not included in the volume given by the formula.

Whilst one normal growing stock is removed, in the course of a rotation, another normal growing stock—its exact counterpart—is raised on the very same area.

If the original growing stock is abnormally deficient, the foresters, by cutting less than the increment of the forest and thus adding to the original volume, may succeed in gradually establishing the "normal growing stock."

Normality of the growing stock is that condition required in an "ideal forest," which the foresters would find it rather easy to provide. In the virgin woods, frequently the actual growing stock is larger than the normal growing stock, owing to the preponderance of mature and hypermature age classes.

PARAGRAPH IV.

NORMAL INCREMENT.

The normal wood at the age of maturity has imbedded in itself the increments of a wood, one, two, three, etc., years old; consequently, it represents all of the increments taking place annually over the entire area of a normal forest containing the age classes, one, two, three, etc. Since only a few trees, however, reach maturity a rule fails to be entirely correct which reads: "The normal increment of a forest equals the normal volume of its oldest age class."

Generally speaking, since the same causes must have the same effect, the actual increment, in tons of wood fibre, normally formed on an acre of ground, fully stocked, depends solely on climate and soil, wood fibre being "solidified atmosphere." The forester's aim should be to concentrate the increment into the smallest number of trees, without losing any increment, so as to grow the biggest logs in the shortest rotation.

In America, soil is cheap; hence there seems to be no need to force every square inch of soil into the harness of tree production. We should keep in mind, however,—

1. That woods poorly stocked are apt to yield knotty timber;
2. That the outlay for taxes, protection and administration depends more on area than on density of stand;
3. That the logging expenses per 1,000 feet b. m. are small where the stumpage is heavy;
4. That investments for roads and other permanent improvements, per 1,000 feet b. m., are relatively small in well stocked forests;
5. That the fertility of forest soil suffers under a loose canopy overhead.

The main silvicultural measures leading to a normal increment are:

Weeding.

Improvement cutting.

Thinning.

Afforestation.

Reinforcing.

PARAGRAPH V.

FINANCIAL CONSIDERATIONS.

Three kinds of increment compose the latent gross revenue obtainable from any wood which is left to itself or which is placed under forestal care:

1. The quantity increment, depending solely on the amount of wood fibre formed.

2. The quality increment, depending solely on the difference of price shown in the same year by logs of different diameters, per unit of contents.

3. The price increment, depending solely on the difference of value which the same log will exhibit in different years. This latter increment is influenced by increase of population and wealth, cheapened facilities of transportation, exhaustion of the virgin woods, and declining purchasing power of gold.

As an illustration of price increment, the following figures may be of interest:

Wholesale Prices of Yellow Poplar, 4-4 Lumber,
at Biltmore, N. C.

Quality.	In 1896.	In 1907.
fas.	\$21.00	\$43.00 to \$52.00
saps	16.00	33.00
C. 1	12.00	28.00
C. 2	6.50	16.00

The expense of production, with modern mills and improved transportation, is as high in 1907 as it was in 1896, viz.: \$9 per 1,000 feet b. m. Assuming that certain trees have turned out 25 per cent. of fas, 25 per cent. saps, 25 per cent. C. 1 and 25 per cent. C. 2, the stumpage values of such trees was per 1,000 feet b. m.

in 1896	\$ 5.00
in 1907	\$22.00

and has increased, consequently, at the rate of 30 per cent. (simple interest, equalling 14 per cent. of compound interest) per annum.

The increase in the value of many other forest products has been similarly phenomenal; and the question arises: Why is the owner of forests unwise enough to reduce this stumpage as long as the rise continues to be phenomenal,—in excess of any dividend derivable from other investments? The answer frequently lies in three words:

Poverty;
Impatience;
Ignorance.

The enormous increase of gold production during the last 20 years promises to continue and to become more phenomenal. The director of the U. S. Mint reports (in 1904, p. 41) that the rise of wages does not act as an automatic check to gold production, and that the tendency of the expense of gold production continues to be downward. The effect of increasing gold supplies on commodity prices, wages, land values, mortgages, bonds, etc., is easily perceived:

The owner of bonds and mortgages sinks to a lower level of revenue; whilst the owner of forests and farms remains (at least) equally wealthy.

The question will be asked, naturally: Does it pay to strive towards the establishment of an "ideal forest" . . . towards the establishment of an impossibility?

European foresters are apt to answer the question by an emphatic "Yes."

The American forester might consider, before answering, four points:

(1) The great variety of conditions existing in the various sections of the various states from which the financial prospects of conservative forestry depend.

(2) The fact that conservatism in the forest cannot be expected, in the long run, to be as remunerative in this country as it is abroad unless the forest is rendered as safe as the German forests from fire, taxes and whimsical legislation.

(3) The fact that an ideal forest represents a large investment yielding a small rate of surplus revenue.

(4) The possibility that a forest now considered "ideal" as to rotation, composition, species, roads and so on, is apt to be considered deficient when the lapse of years has caused a change of the economical conditions surrounding the forest.

As long as our country develops by leaps and bounds, as long as the immediate future of our forests is dark, as long as other investments seem safer, simpler, better than forestal investments, the time has not arrived to strive toward "ideal forests."

The American forester can consider the forest only as "so much money invested." That forest is ideal which can be expected to yield, for a long time and perhaps forever, a safe, steady and high dividend on every dollar invested. In such a forest, the various items of value (as trees, soil, roads, sawmills) appear as proper shares of the aggregate value.

The following may serve as an illustration:

Value of stumpage, per acre.....	\$7.75, or 77½ per cent.
Value of soil, " "	1.00, or 10 per cent.
Value of roads, " "	.50, or 5 per cent.
Value of sawmills, " "	.75, or 7½ per cent.

Total investment.....\$10.00, or 100 per cent.

The form of the ideal revenue depends on the owner's wish. The owner may or may not prefer an annual revenue of 40 cents per acre, obtained without decreasing the value of the stumpage, to a revenue of \$2.00, exhausting the forest in a dozen years. The owner alone can decide whether a dividend is safe enough, steady enough and high enough; his decision is based, naturally, on a comparison between forest revenue and revenues obtainable from other investments.

The investor stakes his money on that enterprise in which he has the greatest confidence; and it is usual that the farmer puts his money in farms; the miner in mines; the railroad man in railroad stock; and the lumberman in forests,

The American lumberman is apt to consider investments in forestry (be it destructive or conservative) as ideal investments; outsiders are not prone to share his view.

As long as this country abounds in merchantable woods, the lumberman has an easy chance, after exhausting the stumpage on a given tract completely, to shift his capital to another tract, purchasing the stumpage thereon out of the moneys obtained by his operations conducted on the preceding tract. Usually, he prefers, for obvious reasons, the purchase of timber to the purchase of the forest in fee simple. Under such conditions, the lumberman *cannot* be interested in the production of second growth, nor in operations merely withdrawing trees working at a small rate of revenue.

The owners of the fee simple—farmers, townsfolks, aliens—do not command any knowledge of forest investments; having paid the taxes on the land for a number of years without any returns, they embrace readily the first chance at obtaining “big returns.” These big returns usually exceed the price by far at which the land was bought. Nevertheless, and just as usually, such “big returns” are a mere pittance.

The Forest Service of the United States has before it an enormous task: the task of proving to the owners of woodlands, who are ignorant of present and of prospective values of timber, the advisability of conservative lumbering.

Unfortunately, there do not exist anywhere associations of forest owners through which the members might be enlightened.

PARAGRAPH VI.

SUSTAINED YIELD (“POSSIBILITY”).

Normally, the “sustained yield” of the forest is that number of cubic feet of wood which nature produces in the forest annually; the annual removal of this number of cubic feet does not decrease the original amount of stumpage. The normal sustained yield equals the annual surplusage of production.

The cutting of a sustained yield—no more, no less—is indicated wherever the capacity of the market is limited, a condition which we meet almost invariably on the fuel market. In Germany, two-thirds of the annual increment of all forests consists of fuel wood. In America, the requirements of expensive, non-movable plants (tanneries, pulp mills, mines) are in the direction of a sustained yield.

When all merchantable trees have been removed from a forest, a sustained yield can not be obtained any more. Before touching the primeval forest, the owner must decide whether or not conservative forestry, whether or not a sustained yield is indicated.

Primeval woods containing a large number of idling and decaying trees should not be worked for a sustained yield.

It should never be forgotten that there is a vast difference between

the term "merchantable trees," and the term "mature trees." Merchantable trees are very often far from being mature; and mature trees have often ceased to be—or are not—merchantable.

An equal annual yield offers to the lumberjack the advantage of equal and steady employment in one and the same forest or at one and the same mill.

An equal annual yield offers to the owner approximately equal annual dividends.

Where no yield is obtainable for a long series of years, there the outlay for taxes, protection and administration will accumulate at a rate deterring the owner from any attempt at conservatism.

The disadvantages of a sustained yield where it binds the forester in iron chains, are:

1. It is impossible to take advantage of boom prices.
2. It is necessary to cut in years of panic.
3. Trees without increment are left uncut; trees of good increment are cut where the yield is strictly sustained. Similarly, needful thinnings are often postponed; or in other cases conducted with excessive severity.
4. Valuable young growth is often left under severe pressure overhead; or in other cases prematurely exposed.
5. Seed years are not used to full advantage.

The normal possibility, from the economic standpoint, cannot be expressed by volume; it must be expressed in dollars and cents. It is that sum of money which yields annually the expected or desired interest on all capitals engaged in the forestal production. In other words, it is the yield of a forest when in financial equilibrium. In that case, no wood works at a lesser rate than at the proper indicating percentage adequate to its age.

PARAGRAPH VII.

UTILIZATION PERCENTAGE.

The ratio between annual cut and stumpage at hand reads, in the normal forest:—

$$\frac{\text{sustained yield}}{\text{normal growing stock}} = \frac{r \cdot i}{r^2 \cdot i} = \frac{2}{r} \quad \text{The factor } \frac{2}{r}$$

is called the utilization percentage. It expresses the fact that a short rotation allows, when the growing stock is given, of a larger possibility than a long rotation. Short rotations are handicapped by silvicultural drawbacks and the production of small trees only, the demand for which is restricted (firewood, spokes, axe-handles and railroad ties). The utilization percentage, since it is the ratio of volumes only, has little economic importance.

CHAPTER II—SUBDIVISIONS OF A FOREST

The subdivision of a forest into minor units of management is based on local conditions and on local needs.

A large forest is usually subdivided into

Working circles (§ VIII).

Working sections (§ IX).

Compartments and blocks (§ X).

PARAGRAPH VIII.

WORKING CIRCLES.

Under "working circles" we understand, after Schlich, that forest area owned by one person or company which is much under the provision of one and the same principal working plan.

PARAGRAPH IX.

WORKING SECTIONS.

In large working circles, the economic conditions are frequently such as not to allow of uniting all woods under one cutting plan. Woods growing under more or less equal conditions and exhibiting equal silvics are allotted to distinct working sections, to be dealt with independently from all others. A working section should comprise woods of all ages and classes, and should consist of several cutting series. There is no need for the working section to cover a coherent area. For each working section in Europe, the financial possibility is ascertained separately. The following moments may necessitate the formation of a working section:—

1. Different species.
2. Different silvicultural requirements.
3. Different rotation.
4. Different laws.
5. Different means of transportation.
6. Different locality.

A large number of working sections complicates forest administration.

PARAGRAPH X.

COMPARTMENTS AND BLOCKS.

The leading foresters do not agree with regard to a proper definition of the term "compartment." For the majority of foresters, a compartment is a "unit of silvicultural treatment." The compartment may contain sub-compartments consisting of smaller or larger groups which, to speak with the advocates of that definition, should be elim-

inated by purification of the compartments. Others maintain that the compartment should designate merely a geographical unit of the forest used to describe, in instructions, reports and records, the exact locality at which a certain act is to be or has been performed.

The boundary lines of geographic compartments should be natural lines (ridges, creeks and slopes) as much as possible, and not artificial lines (survey lanes and roads). The size of the compartment depends entirely on local economic conditions. High timber prices and intensive management invite the formation of small compartments.

Several adjoining compartments are allotted to a "block;" for instance, the compartments on a certain mountain or beyond a certain creek. In some cases, each block has a separate series of compartment numbers, each series beginning with "one." A block may be composed of compartments belonging to different working sections.

Under extensive management, a block might be formed by the area drained by an entire river system; and the compartments composing it might be designated by the names of the creeks traversing them.

CHAPTER III—WORKING PLAN REPORTS

The term "working plan" is a misnomer. The "working plan" is a report more on facts than on proposed schemes.

The meaning of the term is somewhat indistinct. It might represent one or the other of the three following statements:

1. The chief (principal) working plan, extending over a large number of years (a whole rotation, or the time of installation).
2. The periodic working plan, extending over 10, 20 or 24 years usually.
3. The annual working plan, forming a mere annual budget.

In many cases, the principal working plan is simultaneously used as a periodic working plan.

PARAGRAPH XI.

THE CHIEF WORKING PLAN.

The chief working plan is called by Schlich, more properly, "chief working plan report," and contains the following three parts:

1. A statement of facts based on stock taking.
2. The desire of the owner regarding the purpose of forest management.
3. The plan proper, containing the forester's advice as submitted to the owner, discussed with the owner and approved by the owner.

The plan proper is, usually, a compromise between owner and forester.

The chief working plan requires revision and is invariably re-drawn *before* the lapse of many years whenever the facts are altered on which the plan was based.

The subheads of a chief working plan [under the chapters "facts," "desire of the owner," "plan"] are:

Forest survey (§ XII).

Description of locality (§ XIII).

Yield tables and volume tables (§ XIV).

Problems of silviculture and of protection (§ XV).

Forest utilization (§ XVI).

Forestral investments (§ XVII).

All data ascertained and all changes planned should be shown, if possible, on maps allowing of rapid reference.

The scale and the detail of the maps depend on the value of the investment per acre.

PARAGRAPH XII.

FOREST SURVEY.

The objects of a forest survey are:—

1. Outside boundaries and those of interior holdings.
2. Railroads, rivers, creeks, bluffs and other obstacles, and means of transportation.
3. Lines between localities having different laws, inasmuch as they influence forest management.
4. Differences in ownership.
5. Boundaries of the various forest ranges.
6. Configuration.
7. Differences of soil; mineral possibilities.
8. Dividing lines between forest soil, farm soil, pasture soil, and mineral soil.
9. Lines of working circles, if there are any.
10. Roads, trails, and fire-lanes.
11. Age, species, and quality of growing stock, according to compartments.

It is not necessary, of course, that all of these points should be exhibited in all working plants.

PARAGRAPH XIII.

DESCRIPTION OF LOCALITY.

The "locality" is usually described by compartments. The "quality of the locality," which means to say its productiveness, is a function of soil and climate.

The height growth of the trees yields the best indication of the

quality of the locality. The number of qualities of locality distinguished in a chief working plan depends on local conditions,—notably on the intensity of management.

PARAGRAPH XIV.

YIELD TABLES AND VOLUME TABLES.

Yield tables are required for a forecast of future timber crops. In America, tree growth tables (volume tables) must frequently take the place of yield tables.

Yield tables and volume tables show the interdependence between soil, age, diameter and volume. It is wise to show the development of the value of a tree as well, with a view of determining the age of maturity. A tree is mature when the annual quantity, quality, and price increment ceases to yield a sufficient rate of interest on the stumpage value of the tree.

PARAGRAPH XV.

PROBLEMS OF SILVICULTURE AND OF PROTECTION.

Wherever local conditions allow of it, the chief working plan dwells at length upon the silvicultural system to be adopted for the various working sections. The method of regeneration, the species to be favored, the extent of improvement cuttings, the method of weeding and the financial effect of these measures must be shown. The extent and advisability of forest pasture, turpentine or sugar industry, game preservation, landscape considerations, etc., must be touched.

Silvicultural investments are unwise where the forest can not be protected from fires. The financial outlook of investments in first growth is better than the financial outlook of investments in second growth wheresoever the restriction and the control of fires is difficult.

The chief working plan describes the existing and the proposed means of protection from forest fires, detailing the outlay to be incurred on that score.

Continuous employment of workmen in all parts of the forest, year in and year out, together with ready access to all parts of the forest, are the surest means of fire protection.

PARAGRAPH XVI.

FOREST UTILIZATION.

For many a year to come, the major part of the work to be planned and to be done by the American forester must consist in the utilization of the forest (lumbering). The forester is essentially a lumberman.

The working plan considers the most advisable way of transforming into money the various raw products of the forest. It discusses the

financial effect of the various methods of logging (animal power versus steam power), of the various mills (portable, circular, band, etc.)

The degree in which the owner (through the forester) attends to the removal and to the refinement of his timber products is controlled by local as well as by personal conditions. The owner might offer for sale stumpage, or logs yarded, or rough lumber, or refined lumber.

As long as there are more owners of timber land than manufacturers of lumber, the stumpage market is a buyer's market; and the owner of forests does well to engage in manufacturing enterprises.

Of the utmost importance is a careful study of the means of transportation (water, rail, flumes, etc.) The forester should never forget that lumbering—and consequently forestry—is essentially a problem of transportation.

The expense to be incurred for permanent and for temporary means of transportation requires careful discussion. In conservative forestry, the main arteries of transportation, necessarily, have a permanent character. The combination of the means of transportation to be adopted (railroads, narrow or standard; cables; water-courses; flumes; wagon roads) depends on local circumstances. Public roads and railroads, advisable alterations, charters to be secured from the legislature are topics requiring attention. The plan of transportation is explained by a map showing the existing and the proposed lines of transportation.

PARAGRAPH XVII.

FORESTAL INVESTMENTS.

In the United States, no private activity having the forest for its object (*id est*, any forestry in a broad sense), is conceivable which does not mean to result in good financial returns. Forestry is business, and in business there is no room for sentiment. That forestry must be considered best, which pays best.

Compared with other investments in realties (e. g., farms, mines, houses), forest investments show several undesirable features. They are difficult of control; they fail continuously to yield annual cash dividends; they are endangered by fires and cannot be insured against destruction; their products are not as absolutely indispensable to mankind as farm products, mine products or the shelter of a house; subdivision, joint ownership, sale in fee are difficult to arrange; mortgages or bonds on forests are hard to secure, and theft of timber is hard to prevent.

There are, on the other hand, many factors speaking in favor of forest investments: Notably the phenomenal increase in the value of timber brought about by an increase in population and continuous prosperity; the certainty of wood production, year in and year out, with which fires only can interfere; the strong possibility of more extended use of wood products in the manufacture of paper, packages,

yarns, alcohol, sugar and food stuffs; the fact that the forest stores its own products away, free of charge, until it may please the owner to place them on the market; the rapid advance in the value of soil, etc.

According to the location of the forest and in a higher degree, according to species of trees and age of trees, the disadvantages connected with forest investments vary from case to case. They seem to weigh heavily on a second growth which yields no dividend whatever, is seriously endangered by fire, contains assets of prospective value only and offers no chance at extraordinary results. There exist in the United States enormous areas covered with second growth forests: What sense can there be, consequently, in investments tending to produce still more second growth?

It is obvious that the chances of first growth to be remunerative are, generally speaking, very good. This first growth does not increase in volume, the death rate of timber offsetting the birth rate; its increase in value, however, is certain; heavy logs are getting scarce,—and they alone furnish lumber commanding the highest price; the degree to which the trees are utilized without waste increases from year to year; the difficulties of transportation are declining continuously. Is it to be wondered at, then, that many investors—and notably all lumbermen—are eager to invest in first growth whilst utterly unwilling to stake their money on second growth?

The question might be asked: Why are the owners reluctant to practice "conservative lumbering," a modus of logging which tends to secure the maximum sum total formed of net present returns and prospective values left? To take an illustration from the South: Why does the owner insist on cutting every pine making a log of over 6 inches at the small end? Why does he refuse to leave all trees having a diameter under 20 inches and yielding over 7 per cent. of latent annual interest?

The explanation lies in the following points:

1. No seer can actually foretell the latent annual interest which trees of various diameters will yield in the immediate and in the more distant future. The forest dividend consists largely of price increment; the price increment of big trees is (veneer business!) particularly good. There is little financial advantage in the utilization of big trees (if they are sound), as long as an annual price increment of 10 per cent. and more can be counted upon. A big tree having a stumpage value of \$12.00 per 1,000 feet b. m. is not mature *per se*. The fine poplars, oaks and chestnuts of the Southland must be considered immature, since their value is absolutely sure to increase at an annual rate of over 10 per cent.

The assumption of the principle is wrong, it seems, that conservative lumbering should leave the smaller trees and remove the big trees; or that maturity can be determined by diameter limits.

The owner of woodlands (and the forester) can only venture a forecast, guessing at the future condition of the lumber market; big trees have—to say the least—the same chance with small trees to be money makers. And it is natural that the owner is inclined to either remove or to leave *all* of his trees.

2. Let us suppose that the owner leaves in the course of lumbering all trees having under 18 inches diameter representing a stumpage of 1,500 feet per acre. The reduction of the cut by 1,500 feet per acre has increased the logging expense per 1,000 feet of stumpage removed,—an increase which can be considered only as a new investment added to the value of 1,500 feet per acre left.

For a number of years to come, the small trees are non-removable, since it cannot pay in the near future to remove a handful of inferior lumber from an acre of ground. In the meantime, the property must be watched and taxes must be paid.

The owner leaving small trees embarks in a new venture which cannot be countermanded nor altered, for years to come, without serious loss; and which is subject to more serious dangers than the old venture.

Small trees form, prior to the removal of the big trees mixed with them, a tangible, merchantable asset. After the removal of the big trees, however, they can be considered only as an intangible asset, an asset of merely prospective value, an asset impossible to realize on.

3. After lumbering, small trees left are much more endangered by fire, windfall, insects, fungi than before lumbering. Where fires cannot be controlled at a reasonable expense, conservative lumbering is, under almost any circumstances, absolutely absurd.

4. The soil on which small trees are left,—in order to grow into better dimensions and in order to act as seed trees for a third growth,—cannot be used for pasture without interference with the object at stake.

5. Conditions may arise, before a second growth of small trees becomes merchantable, rendering the soil occupied by them valuable for farming purposes. In that case the small trees must be removed without any benefits accruing to the owner from such removal.

6. The taxes on land completely stripped are lower than the taxes on land conservatively lumbered. When a long number of years is required to convert a second growth left into a merchantable stand, the taxes annually paid "*ad valorem*" and increasing at a compound ratio, form a countercharge against the slowly increasing value of the second growth difficult to countenance.

Considering these various points, the financier cannot be called unwise when he prefers investments in first growth forest to those possible in second growth.

Many a man in the United States and in Canada has made a fortune by clever investments in first growth, whilst no one, practically, has

had a chance to show dividends obtained from second growth forest (exceptions: farm wood lots; second growth pine in Virginia).

Under what conditions, it may be asked, can or does conservative lumbering pay in primeval woods?

The conditions are those under which any business proves to be remunerative, . . . be it a livery business or a hotel, a railroad or a music store: that business alone can be remunerative in which the parts composing the business investments are at hand in proper proportions; that business alone can be remunerative which is established in an economically proper site; that business alone can be remunerative, which is safe from over-taxation and—by insurance or otherwise—safe from accidental destruction of its assets.

Let us take the livery business for an illustration: The investment consists of several components, viz.: horses, carriages, harness, saddles, buildings, feed. These components must be at hand in proper proportion. It would be preposterous, for a livery, to have invested, e. g.,

in horses	\$ 1,000
in carriages	25,000
in harness	100
in saddles	50
in buildings	350
in feed	15,000

Again, the proper economic site for a livery business is in the city, the village—not in the back woods of Maine; not in the wild swamps of Minnesota; not indeed in Chicago one hundred years ago; which shows the dependence of economic sites on economic development. Finally, a livery business is never overtaxed, and all of its investments allow of being insured. There is, probably, many a livery in the United States whose owner is “falling behind,”—usually because his investments are wrongly balanced or because the site of his business is wrongly selected. Still, it would be wrong to conclude that a livery business is generally a poor business.

Properly arranged within, properly arranged without; properly insured against accidents a business *must* be remunerative.

Applying this logic to conservative lumbering as a business it is safe to state that it must be remunerative

A. Where its components are properly balanced.

B. Where an economic site is obtainable for its conduct.

ad. A: The components of a business investment in conservative forestry are partly derived from nature (natural gifts, natural powers) and partly made by man. The natural components are usually at hand in primeval forests,—which does not mean to say that they are at hand in proper amounts. The components made by man are added to those made by nature and consist, above all, in investments permanently employed for forest utilization.

Thus the aggregate investments in conservative forestry may con-

sist of all of the following components—whilst only No. 1, No. 2, No. 8, No. 11 and No. 12 are considered essential:

- (a) Natural components:
 - 1. Soil.
 - 2. Trees.
 - 3. Fish and game.
 - 4. Minerals.
 - 5. Water power.
- (b) Semi-natural components:
 - 6. Pastures.
 - 7. Farms and orchards.
- (c) Artificial components:
 - 8. Permanent means of transportation.
 - 9. Logging appliances.
 - 10. Industrial establishments.
 - 11. Means to prevent and to subdue forest fires.
 - 12. Surveys, maps, working plans.
 - 13. Ranger houses, workmen's houses, lumber camps.
 - 14. Nurseries.
 - 15. Silvicultural improvements.
 - 16. Capital set aside to defray taxes, protection, administration and other current expenses.

In the case of well-stocked virgin woods, the aggregate final investment is likely to be lower than the original purchase price of the forest, when the virgin forest contains a surplus of mature timber exceeding in value the expense required for the establishment of the essential artificial components.

In the American forests, after the usual lumbering operations, very little is left of the natural components; as a consequence, relatively heavy additional investments are required (as a rule without a chance of deriving immediate revenue) in order to make the aggregate, in time to come, a permanent source of revenue.

The conclusion is simple: Unless the owner, *before* he begins to operate primeval woods, decides to embark in conservative forestry, the chances are slim that he will ever embark in it.

In German working plans the necessity of ascertaining the most opportune amount of capital to be invested in forestry is invariably overlooked. The explanation lies in the following:

- 1. The value of the growing timber and of the soil comprises, say, 95 per cent. of the investment.
- 2. The means of transportation are already at hand, developed at a time at which financial considerations were not made in forestry.

The "period of installation" should cover as many years as are required to obtain the proper total and the proper composition of the forestal investment.

It is unfortunate that the period of installation in conservative forestry must comprise a number of years; whilst other investments (e. g., a livery) can be fully installed in the course of a few weeks or a few months.

ad B: Whosoever has traveled in recent years through Germany with an eye to the forest can not be in doubt that every state and every county offers innumerable sites at which conservative forestry can be conducted as a remunerative business. Indeed, economic sites are at hand in Germany wheresoever the trees do not happen to occupy farming soil.

Such was not the case in Germany two hundred years ago; and such is not the case in Russia, Canada and the United States today.

Economic sites are those where stumpage values range high; where natural reproduction is easy; where the danger of fires is small; where the land is unfit for agriculture; where forest taxes are low.

These conditions prevail, particularly, in the pineries of the Coastal Plains and in the hardwood forests of the higher Appalachian region.

It must be clearly understood that these conditions did not—or did not all—prevail some 20 years ago; further, that the absence of such conditions in the West *anno* 1907, does not render conservative forestry in the West for all times impossible.

It is unfortunate, indeed, that the majority of these conditions arises only at a very late hour, to-wit, invariably *after* the general disappearance of the primeval woods.

No man in the United States has had, so far, sufficient confidence in conservative lumbering to postpone the tapping of his primeval woods until the "economic site" for conservative lumbering had locally arisen.

The man who does will never live to regret his confidence.

CHAPTER IV—METHODS REGULATING THE YIELD IN WOOD AND TIMBER

The question as to the amount of timber which might be removed annually without reducing the growing stock (the main investment) has occupied the minds of foresters since many centuries. European governments prescribe definite methods by which the yield of a forest is to be regulated. The family laws governing entailed property do likewise. For America, at the present moment, these methods will find application in rare cases only. A sustained yield in virgin forests containing large numbers of idling trees is an economic absurdity. Pulp

mills, tanneries, and other industrial establishments requiring large investments to be made close to a forest may, however, seek for sustained yields on cut over lands, from which the idling trees have been removed.

PARAGRAPH XVIII.

GENERAL REMARKS.

The methods commonly used for regulating the "possibility" of the forest are:

- A. Brick masonry methods.
 - 1. Area method (Par. XIX.)
 - 2. Volume method (Par. XX.)
- B. Formula methods.
 - 3. Charles Heyer method (Par. XXI.)
 - 4. Hundeshagen method (Par. XXII.)
- C. Increment methods.
 - 5. Common increment method (Par. XXIII.)
 - 6. Brandis method (Par. XXIV.)
 - 7. Pinchot method (Par. XXV.)

These seven methods consider the forest as a whole, ascertain the productive capacity of the whole, and locate the annual cuttings thereafter.

The methods to be considered in the next chapter (V.), treat every part of the forest according to its individual financial merits, thus locating the cuttings to begin with. Thereafter, they merely see to it, if necessary, that the total cuttings of a year agree with the consuming capacity of the market.

PARAGRAPH XIX.

AREA METHOD.

The simplest way to regulate the yield by area is a division of the entire forest area into as many lots as the rotation numbers years. This scheme has been followed often in the case of coppice forests having rotations less than forty years. In the case of high forests, the rotation is divided into a number of periods of equal length (ten to twenty-four years). On the "Statement of Ages" the acreage of each compartment is allotted to that periodical column to which it belongs according to its present age. The oldest compartments are allotted to period number one; the next oldest period number two, etc. The total acreage allotted to each periodical column is found by addition and compared with the average contents of a column. If a column contains too much acreage, the surplus is shifted backward or forward into adjoining columns. Compartments growing vigorously are shifted

backward into later periods and vice versa. After shifting, each column contains *in toto*, approximately, an equal number of acres.

By valuation surveys or yield tables, the volume contents of the compartments allotted to the first period are ascertained; and the contents are increased by the probable volume increment of these compartments expected during half a period. The total contents are then divided by the number of years comprised by the period. The result is the annual "sustained yield." Obviously, the sustained yield is apt to change at the end of each period.

The installation period comprises a whole rotation. At the end of a rotation the forest is sure to exhibit a more normal age gradation.

This method is in use in Prussia, Bavaria, etc., and has been working in almost all European forests since 1780. The method is not applicable to selection forests. It might be improved by replacing the "Statement of Ages" by a "Statement of Indicating Percentages."

PARAGRAPH XX.

VOLUME METHOD.

A statement of ages is prepared, each compartment being allotted to a periodical column according to the number of years which separates it from maturity. The compartmental entries made in the statement of ages are, in this case, however, the final volumes expected at maturity, and not the compartmental acreages.

The totals for each period are drawn and compared with the average volume expected from each periodical column. Again, by shifting compartments onward and backward, surpluses are shifted into columns showing a deficit, under adequate allowance for changed yields. The possibility is obtained by dividing the total of the first column, as it stands after shifting, by the length of a period.

The method does not work towards normal age gradation. The shifting of volumes is times taking, and the method is not in use nowadays.

PARAGRAPH XXI.

CHARLES HEYER METHOD.

By cutting the actual annual increment, the growing stock is left undisturbed. In order to convert the actual growing stock into a normal growing stock, it is necessary to decrease the annual cut if the normal growing stock is larger than the actual growing stock; and to increase the cut if the normal growing stock is smaller than the actual growing stock. Heyer expresses this idea by the formula: The annual possibility (P) is equal to the sum (S) of the expected average increments diminished by the n 'th part of the difference existing be-

tween the normal growing stock (Ng) and the actual growing stock (Ag).

$$P = S - \frac{Ng - Ag}{n}$$

"n" is the number of years forming the installation period.

The field work in this method is timestaking; especially so under the selection system or group system when the actual growing stock can be ascertained only by complete valuation surveys. On the other hand, the method prevents any over-cutting or any under-cutting of the forest, and shows clearly how much of the revenue obtained is, in fact, net revenue and not capital withdrawn, or else, how much of the revenue is left latent being used to increase the original growing stock. This method is well adapted for irregular forests. The method requires:—

1. A detailed description of compartments giving the normal and actual volume, and the normal and actual increment for each compartment.

2. A statement showing the normal growing stock, the actual growing stock, and the total increment for the period of installation.

3. A statement enumerating the compartments in which the possibility is to be cut.

No particular stress is put on reaching a normal gradation of age classes.

PARAGRAPH XXII.

HUNDESHAGEN METHOD.

Hundeshagen assumes that the ratio existing between the increment and growing stock is constant. With the help of yield tables, he ascertains the ratio existing between normal increment and normal growing stock and, further, the actual growing stock found in the forest. Multiplying the actual growing stock by the above ratio, Hundeshagen obtains his actual annual possibility of the forest.

In normal forests (yield table forests), the ratio is necessarily at an optimum. If that optimum is applied to abnormal forests, over-cutting seems the necessary consequence. Absurd results are apt to crop out if the growing stock is under normal and the increment poor.

Inasmuch as the method requires periodic stock taking, over-cutting or under-cutting the forest for any length of time is, however, excluded. Indeed, any method is good which controls its own results by periodic stock-taking. Hundeshagen's method is applicable to all sorts of silvicultural conditions, and might well be applied in a tentative first working plan. In that case, it will be sufficient to express the ratio, "normal increment over normal growing stock" by the frac-

tion $\frac{2}{n}$.

PARAGRAPH XXIII.

COMMON INCREMENT METHODS.

The increment methods are the oldest and roughest methods of yield regulation. The underlying idea is the following: As long as only the increment is cut—no more, no less—an overcutting of the forest is impossible. The average production per acre can be ascertained from yield tables, by systematic experiments, or, as is the usual practice, by estimating.

The methods do not pay any attention to normal growing stock, normal age gradation and normal increment. The methods are not applied anywhere, nowadays, in scientifically conducted forestry.

PARAGRAPH XXIV.

BRANDIS METHOD.

The Brandis method was first applied by Sir Dietrich Brandis in the Teak forest of Burma. The method ascertains the number of mature trees in a forest as well as the time which an equal number of trees styled "immature," next in diameter to the mature class, require to grow as large as the mature trees are, so as to be fit to replace them.

Dividing the number of mature trees by the period of replacement, the annual possibility of the forest is ascertained. The method perpetuates the original composition of the forest, calling it normal because natural.

An illustration might be obtained from the data contained in bulletin No. 32, Bureau of Forestry, prepared by F. E. Olmsted:

Diameter of mature trees, 20 inches and over.

Number of mature trees, per acre, 4.94.

Number of immature trees, having 15 inches to 19 inches diameter, per acre, 4.99.

Number of years required by a 15 inch tree to grow mature, 34.

The annual possibility, after Brandis, in this case amounts to

$$\frac{4.94}{34} = 0.145$$

mature trees per acre, or 145 mature trees for every 1,000 acres.

After bulletin No. 32, the volume of the trees having 20 inches and over at breast height is 4561 feet b. m.

The possibility in lumber is, consequently,

$$\frac{4561}{34} = 134$$

feet b. m. per acre per annum.

PARAGRAPH XXV.

PINCHOT METHOD.

The published working plans for which Mr. Gifford Pinchot is responsible as author or as forester of the U. S. Forest Service, are, notably, the following:

The Adirondack spruce, published by the Critic Co., New York;

A Forest Working Plan for Township 40, Bulletin 30; Bureau of Forestry;

A Working Plan for....., Arkansas, Bulletin 32; Bureau of Forestry;

A Working Plan for....., South Carolina, Bulletin 56; Bureau of Forestry;

A Working Plan for....., Alabama, Bulletin 68; Forest Service.

These publications fail to be working plans in the proper sense of the word. This failure might be due to the educational character of the publications. Whilst they define the term "working plan" as "simply a scheme of management for a forest tract," the reader looks in vain for an actual "scheme of management." Forest utilization, which commands the lion's share of forestal activity, is not considered by the scheme of forestal management.

The Pinchot method is classed as an increment method because it lays all stress on yield forecasts. Future yields are forecasted on the basis of a first cut, reaching down to a stated diameter limit, for periods covering from ten to fifty years.

Continuity of action is not advised in any case. Forestry as an investment is considered in bulletin No. 32 and No. 68. Table No. 15 in bulletin No. 32, however, showing the interest on the assets left by lumbering in virgin woods and depending as to their size on the severity of such lumbering, is incorrect.

After the Bureau, a working plan should contain:

1. A statement of facts.
2. A statement of yield capacity.
3. A statement of market and transport conditions.
4. A systematic plan for lumbering.

Only one-half page of bulletin No. 32, comprising 48 pages, is devoted to point 3, and only two pages to point 4.

The chief rules of management are in all working plans:

1. A fixed stump diameter limit.
2. A fixed height permissible for stumps.
3. Recommendations to prevent fire.
4. Recommendations to prevent damage to young growth.

Bulletin No. 68, published in 1905, excels in clear financial considerations of the merits of a second growth, judged according to diameter limits observed in cutting.

CHAPTER V—METHODS REGULATING THE INVESTMENTS AND THE RETURNS

The methods to be described in the three paragraphs following are:

Judeich Method (Par. XXVI.)

Raess Method (Par. XXVII.)

Schenck Method (Par. XXVIII.)

Judeich, Raess and Schenck advocate conservatism only when conservative forestry pays better than destructive forestry.

A "sustained yield" is considered only where it guarantees better financial results than an irregular yield.

No two forests are alike. The financial development of any forest offers a problem of its own; on the basis of a difference existing in the resources of the forest; the accessibility of the forest; the availability of manual labor; the climate; the dangers threatening the forest, etc.

Aside of these tangible differences there is invariably met another intangible difference in two forest problems otherwise comparable,—due to a difference in ownership. Among the problems confronting the managing forester, the most difficult is, perhaps, the task of ascertaining the definite desire of the owner. This task is more trying in the case of individual ownership than in the case of stock companies.

Working plans cannot be made for a forest when an owner, lacking continuity of purpose, is subject to whimsical fluctuations of mind; or when the owner's financial status happens to be of a shaky nature.

It must be clearly understood, on the other hand, that a "working plan" is a plan merely outlining a definite policy; a policy to be followed as long as (and no longer than) the economic conditions surrounding the financial problem remain unaltered.

The market of forest products in America is—unlike the German market—an interstate market, not a home market.

In Germany the sustained yield of the forests is framed, essentially, with a view to the consuming capacity of a home market.

In this country, so far, no attempt is being made towards the adjustment of a supply of lumber and demand for lumber—with the exception only of the cypress industry which, controlled by firms of remarkable strength, seems effectually to establish an equilibrium between lumber demand and lumber supply.

In the production of the hardwoods and of pine, concerted action of the producers toward a similar end is, for the time being, a pious wish.

"Concerted action" of the producers is usually decried as a "trust." From the patriotic standpoint, no more beneficial trust can be imagined than a lumber trust.

The German sustained yield, adopted by practically all owners of stumpage, amounts to a "trust-yield."

There is no possibility—neither abroad nor here—to establish an absolute equilibrium between production of trees and consumption of lumber, the latter being subject to continuous fluctuations, whilst the former allows only of slow alterations.

The American producers, with rare exceptions, have never attempted to curtail the output of the lumber industry. On the contrary, when the price of lumber was low, when the margin of profit was small, the producers have usually increased the production so as to obtain the surplus receipts required to meet pressing financial obligations (mortgages, bonds, notes due, etc.)

The output of the lumber industry has risen by leaps and bounds; and it is astounding that the prices of lumber have advanced, nevertheless, by bounds and leaps.

The advance of lumber prices is certain to continue, the available supply of merchantable timber declining from month to month.

An increased production of stumpage we may expect, indeed, to take a start when the price of stumpage has increased at a ratio proportioned to the increased price of lumber.

Still, many a year must elapse before an increased production of trees can result in increased offerings of lumber. In the meanwhile, the famous "law of demand and supply" is set at rest; and prices will continue to climb upward.

PARAGRAPH XXVI.

JUDEICH METHOD.

Judeich's method treats every part of the forest according to its own financial merits. The management of the forest as a whole is merely a consequence of the requirements of the individual woods composing it. Sustained yield of volume or money does not underlie Judeich's method. Where the capacity of the market requires it, however, sustained yield is advised.

The treatment for each piece of wood is prescribed in detail for the next working period. From these prescriptions the total volume yield of the period as well as the total area to be cut during the period is finally ascertained.

The normal growing stock is entirely disregarded. Working plan periods shall not exceed ten years; and every five years a thorough revision of the entire working plan shall take place.

Judeich puts great stress on the development of proper cutting series (small). The lumberman's axe is meant to enjoy freedom of action and a multitude of points of attack.

For each working section the financial rotation is determined. Judeich realizes, however, that the financial rotation is subject to change and is satisfied with fixing it approximately. The plan of cutting embodies the following points:

There must be cut:

1. All economic necessities, especially severance cuttings.
2. All decidedly mature woods the indicating percentage of which is too low.
3. All woods which must be sacrificed to the proper progress of the axe within the cutting series; for instance, a group of polewoods lying between two mature pieces. Whether such a sacrifice should be made or not is answered according to the rules of forest finance.
4. All such woods as are about to mature, as far as such woods can be reached by the axe in the proper progress of cuttings. These are the pieces for which an exact examination of the indicating percentage is particularly desirable; which, however, are so near financial maturity that mistakes made will entail small losses only.

By summing up the areas and yields of the above headings, the periodical yield is ascertained. Control is required whether or not the market is able to consume that yield without changing the prices of forest produce on which financial calculations are based. The contents of the working plan are as follows:

1. Actual conditions of the forest.
2. Compartments, cutting series, plan of road building.
3. Yield.
4. Future treatment, silviculturally, and forest utilization.
5. Detailed descriptions of compartments and sub-compartments.

PARAGRAPH XXVII.

RAESS METHOD.

The method recommended by Dr. Raess might be termed the method of sustained money yield. The method pays full attention to the silvicultural as well as the financial requirements of the forest, and gives the forester great freedom of action. Raess realizes the financial mistakes due to a strictly sustained timber yield, and finds, on the other hand, that a sustained money yield is a necessity for the proper balance of annual budgets in case of wood-owning families, communities, or states.

Like Judeich, he treats every piece of the forest according to its financial merits. If the revenue thus obtained exceeds the normal revenue, when the excess is placed in a bank and left over for lean years, etc. The normal revenue is that which brings the normal indicating percentage on the capital value of the forest. Normal growing stock and age gradation are discarded. Periodic stock-taking, not of timber

but of values, forms part of the working plan. Over-cutting as well as under-cutting is thus prevented. The enormous amount of book-keeping required has prevented the introduction of this method in the German practice.

PARAGRAPH XXVIII.

SCHENCK METHOD.

Schenck foots on the belief that forestry is business; and, enlarging upon this truism, that forestry is at its best when it pays best.

Schenck's working plans do not advocate conservative forestry; they advocate destructive forestry whenever the destruction of the trees promises the best financial results; they advocate conservatism—to a lesser or higher degree—where conservative management seems to be the most productive of dividends; they advocate a policy of patient waiting whenever it recommends itself financially.

Schenck's working plans are, consequently, according to the exigencies of the situation and of the owner:

- either merely plans of silvicultural development;
- or merely plans of forest protection;
- or merely plans of utilization;
- or plans combining silvicultural advice with a distinct plan of lumbering and forest protection.

Schenck's working plans are characterized by the following:

1. After revising in detail the investments existing in the forest, Schenck shows the most opportune level to which the various components of the investment shall be either raised or lowered. Bad investments must be eliminated. Good investments must be added.
2. Schenck considers, as sources of forestal revenue, not merely the trees but as well the farms, the meadows, the pastures, the minerals and the water powers available on the forest property.
3. Schenck forecasts the cash revenue obtainable from the adjusted investments,—not merely the yield in lumber and wood; he confronts the forecasted revenue with the revenue obtainable from unadjusted investments.
4. In plans of conservative forestry Schenck insists on the necessity of permanent protection from fires and of permanent investments to provide facilities of transportation.
5. Schenck insists that in forestry as in railroading, banking, insurance, etc., calculation at compound interest must be applied to the comparison of receipts and expenses.
6. Periodic stock taking is demanded, so as to control, from time to time, the actual status of the entire investment.
7. Trees are either good or bad investments, and should be treated

—as individuals or as aggregates—according to their financial merits. The trees are divided into four classes:

- (a) Money makers, promising to increase in stumpage value at a rate of interest higher than normal; *trees to be preserved.*
- (b) Indifferent trees, yielding a normal rate of interest, merely, through growth in volume, value and price; *trees to be preserved or cut.*
- (c) Idlers, merchantable trees yielding an inadequate rate of interest; *trees to be cut.*
- (d) Weeds, trees of negative value (not merchantable), never promising any revenue; *trees usually left to rot.*

Practical experience in the woods, in the mill and in the office is required to allot a given tree correctly to one of the four classes given. Volume tables are of little use in the determination of the maturity of a tree.

8. A sustained yield is recommended only when it promises greater safety or higher remunerativeness of the investments.

Schenck's working plan reports consist of the three parts given in Chapter III, viz.:

- first part, detailed statement of facts;
- second part, statement of the owner's desire;
- third part, detailed plan of action.

The plan of action weighs the financial merits of all methods of development or treatment possible under the prevailing conditions and shows the financial superiority of its own recommendations over any other proposed plan of management.

The heads under which the first part and the third part are treated should be those given in paragraph XVI.

The "installation period" is the time required for the proper adjustment of all investments.

The annual working plan is an annual budget. It dwells in detail on that part of all provisions of the chief working plan which should be carried out in a given year of the period of installation.