Come back now to forest as a crop & how it is handle it

Summary of Forestry 1a

(First half)

Graves I
Hawley I + II

Have now gone over the main principles relating to the distribution, development & treatment of forests and forest trees. As the application of these principles ~~of these principles~~ is not always the same but varies in response to local conditions they should perhaps be called tendencies. The discussion and regulation of these forest tendencies is so much a matter of experience and judgement that Silviculture is often called an art rather than a science. Silviculture is, however, quite logically developed from the study of natural factors. Consider of the tree with its physiological requirements for light heat and moisture, as acted upon by the sum of these factors. Physiography, latitude – climate, rainfall, soil – forest regions, silvicultural regions, forest types. Have then the differentiation of specific requirements. One of the habits shown

by the species within the type comes the hint of productive regulation — forest form. Form varied in nature, but tends to varieties either of even aged or selection forest. Hence the systems of

Irish Forest

natural & artificial reproduction: those involving shelterwood, compartment, groups — more and more uneven aged up to the selection system, and those involving no shelterwood, clear cutting; either artificial, or natural repn. as in the strip system. Based on ~~equally~~ non more definite laws of growth are the coppice system of natural reproduction, and the methods of thinning & improving young stands. The first is the use of the plain vegetative power of reproduction; the second involves an earlier knowledge of the life ~~history~~ of a forest crop. Assimilation, food & water supply are to be increased during vigorous age. The means are development of thrifty crown surface with out seri.

fice of food moisture through undue soil exposure or of log development through undue spreading of the crown. Although the chief product of the forest is wood, its indirect benefits are often of equal importance in affecting the policy of management. It regulates stream flow, prevents erosion, and improves the soil. The handling of any forest depends on the requirements of ownership, financial or otherwise, and the condition, composition, growth capacity of the stand. Our topic now is the consideration of forests of typical regions from point of view of practice of silviculture.

Forestry 1a

Record of Written Work and Tests

1909

	I 10/20	II 10/20	Exam.	Exam final
Baker, G. Y.	A	A	A	B+
Chapman, J. L.	B	C	B	
Evans, F. M.	C-	C	C-	
Forbes, G. R.	0	0	0	
Gibbden, A. B.	C	C	D	C-
Hare, S. H.	B	B	B-	
Lothrop, R. D.	C	B	B-	B+
Millington, D. R	C	C-	D	B-
Mills, R	B+	B+	A	A
Parker, G.	A	A	A	A
Pond, B. W.	B	B	B	
Robinson, F. A.	B	B	B	
Phillips, W. L.	B		B+	
Southard, F. D.	C	B	B-	A
Swan, R. D	B+	B	B	B
Tufts, J. A.	D	C	C+	C-
Wiston, J. C.	B	B	C-	

Harvard University

DIVISION OF FORESTRY

Richard T. Fisher
John G. Jack
Austin Cary
Benton MacKaye

Harvard Forest
Petersham, Mass.

C L A S S I F I C A T I O N

of the

FOREST REGIONS OF THE UNITED STATES.

I

THE ATLANTIC FOREST.

(Lying East of the Great Plains.)

1. The Northern Pine Region. Mixed northern conifers and hardwoods. (Covering the Lake States, New England, Eastern Canada, Central Penn.)

Sylvical Regions.

(a) The Spruce Region. Key tree, the Red Spruce, occurring with maples, birches, beech, hemlock, fir, etc.
(Maine, New Hampshire, Vermont, Northern New York, and a spot in West Virginia.)

(b) The Sprout Hardwood Region. Key tree, the Pin Oak, occurring with oaks, chestnut, maples, hickories, etc.
(Southern Massachusetts, Rhode Island, Connecticut, Southern New York, Northern New Jersey, Eastern Pennsylia, Northern Maryland.)

(c) The White Pine Region. Key tree, the White Pine, occurring with Red Pine, hemlock, maples, birches, and some oak.
(Lake States, Western New York, central Pennsylvania, and central New England.)

2. The Coast Pine Region. Mainly the Southern Pines. (Coastal Plain, central New Jersey to Eastern Texas, except Southern Florida.)

Sylvical Regions.

(a) The Pine Barrens. Key tree, Longleaf Pine, occurring with Loblolly, Cuban Pine, subordinate oaks.

(Main portion of the Belt.)

(b) The Swamps. Key tree, the Cypress, occurring with White Cedar, Gums, Swamp Oaks, and Bays.

(Between barrens and Sea, and along Rivers.)

3. The Southern Hardwood Region. Mixed Northern and Southern species, softwoods as well as hardwoods.

(Southern Alleghanies, Ohio and Mississippi Valleys South of Illinois.)

Sylvical Regions.

(a) The Piedmont Plateau Forest. Key tree, the Shortleaf Pine occurring with oaks, hickories, poplars, cucumber, etc.

(Plateau from Western Virginia to ~~Southern~~ central Arkansas.)

(b) The Appalachian Mountain Forest. Key tree, the Tulip Poplar, occurring with oaks, hickories, maples, beech, chestnut magnolia, walnut, hemlock, White Pine, etc., both Northern and Southern species.

(Mountains from West Virginia to Northern Georgia and Alabama.)

(c) The Central Hardwood Forest. Key tree, the Black Walnut, occurring with oaks, gums, Red Maple, elms, ashes, cottonwoods, cypress, locust, etc.

(Flats and bottoms of the Ohio and Mississippi drainage South of the 42d parallel.)

4. The Subtropical Forest. Key tree, the Royal Palm.

(South end of the State of Florida.)

II.

THE PACIFIC FOREST.

(mainly coniferous)

1. The Coast Forest Region. Heaviest growth in the United States. From the crests of the Sierra and Cascade Mountains West to the ocean. South through Oregon, Washington and California.)

Sylvical Regions.

(a) The Douglas Fir Region. Key tree, the Douglas Fir, occurring with Western Hemlock, Giant Cedar, White Fir, Sitka Spruce, etc.

(Coast Forest from Northern California and Southern Oregon North to central B. C. and West of the Cascade divide.)

(b) The Redwood Region. Key tree, the Redwood, occurring with Douglas Fir, White Fir, Western Hemlock, Tanbark Oak, Pepperwood, etc.

(Shore strip from the Oregon line to South of Santa Cruz Bay, - 10 to 30 miles wide.)

(c) The Sierra Region. Key tree, the Sugar Pine, occurring with Yellow Pine, Lodge-pole Pine, Greyleaf Pine, Big Tree, firs, oaks, Incense Cedar, etc.

(Southern Oregon to Southern California in the Sierra and interior Coast Mountains.)

2. The Rocky Mountain Region. Smaller trees and less yield than in the coast regions.

(Rocky Mountains and interior East of the Sierra-Cascade Range.)

Sylvical Regions.

(a) Northern Rocky Mountain Region. Key tree, the Western White Pine, occurring with Giant Cedar, Douglas Fir, Western Hemlock, Western Larch, Yellow Pine, Lodge-pole Pine, Alpine Fir, and Engelman Spruce, Coast species minglong with those of the Rocky Mountains.

(Northwestern Washington, Northern Idaho, Northwestern Montana.)

(b) Central Rocky Mountain Region. Key tree, the Lodge-pole Pine, occurring with Engelman Spruce, Alpine Fir, Douglas Fir, and Yellow Pine.

(Wyoming, Southern Idaho and Montana, Northern Colorado and Utah, East slope of the Cascades in Washington, and the mountains of Northeastern Oregon.)

(c) Southern Rocky Mountain Region. Key tree, the Yellow Pine, occurring with Douglas Fir, Engelman Spruce, Alpine Fir, Limber Pine, Blue Spruce, Junipers, etc.

(Southern Colorado and Utah, Arizona, New Mexico.)

III.

THE NORTH MEXICAN FOREST.

Key tree, the Mesquite, a semi-arid stunted growth.

(Southwestern Texas, Southern Arizona, and Southern California.)

(S. M. D.)

Friday 16

Pacific Forest – mainly coniferous

1. The Coast Forest. From crest of Cascade & Sierra ranges to coast, north to N. B.C., & S. to S. Calif.

General physiography & climate; transitional climates, N.E. Wash. to W. Montana, N.W. to N.E. Calif. Sierra to Cascades in So. Ore.

Tot. stand 1141 Bill; 505 in Wash. & Oregon

Silvical Regions

(a) North Coast or Douglas Fir Region — Oregon 493 Bill, Wash. 334 Bill, 827
9/10 stand of Wash. W. of Cascade crest;

Boundaries: Crest of Cascades to Sea, from S. B.C. to N. Cal. in most parts Coast Range

Physiography; mountains governing temperature & precipitation.

Temperatures

Rainfall

General character of forest: altitude & moisture determining types

Types

1. Douglas Fir Type. Sea level to 4800 — one type.
50% timber in Wash. is fir
Rise, yields

Roughly even aged tree stand form.

Species: Douglas Fir (to 80%) W. Hemlock, Giant Cedar, White Fir, also Sitka Spruce near tidewater, & Amabilis Fir & White Pine toward upper limit of type.

20-100 M
30

2. Fir Type. 3000 to 6000 elevation. Tends to selection form. Species: mainly W. Hemlock & true firs - broad, amabilis, nobilis, P. monticola. Alaska Cedar.

Type thins out into open timberline stand.

10-15 M

3. Alpine Type. Elevation 6000 to timberline - 7000 - 8000.

Scattered, stunted, uneven crest. Species: Black Hemlock, White barked Pine, Alpine Fir, Lyall's larch (N. Cascades) Engelmann spruce. ~~West~~ East of divide sharp change of climate & crest is closed with Rocky Mountain region.

Silvics of Principal Species: Douglas fir, Hemlock, Cedar and Spruce.

General Character of management as determined by ~~each type~~.

Form & life history of types; reprod. of chief species - drying out, brush, fire; called stand liable to loss & undesirable reprod.; clear cut, slash burning & reseeds in dreaded method. Strip system possible. Selection on higher slopes.

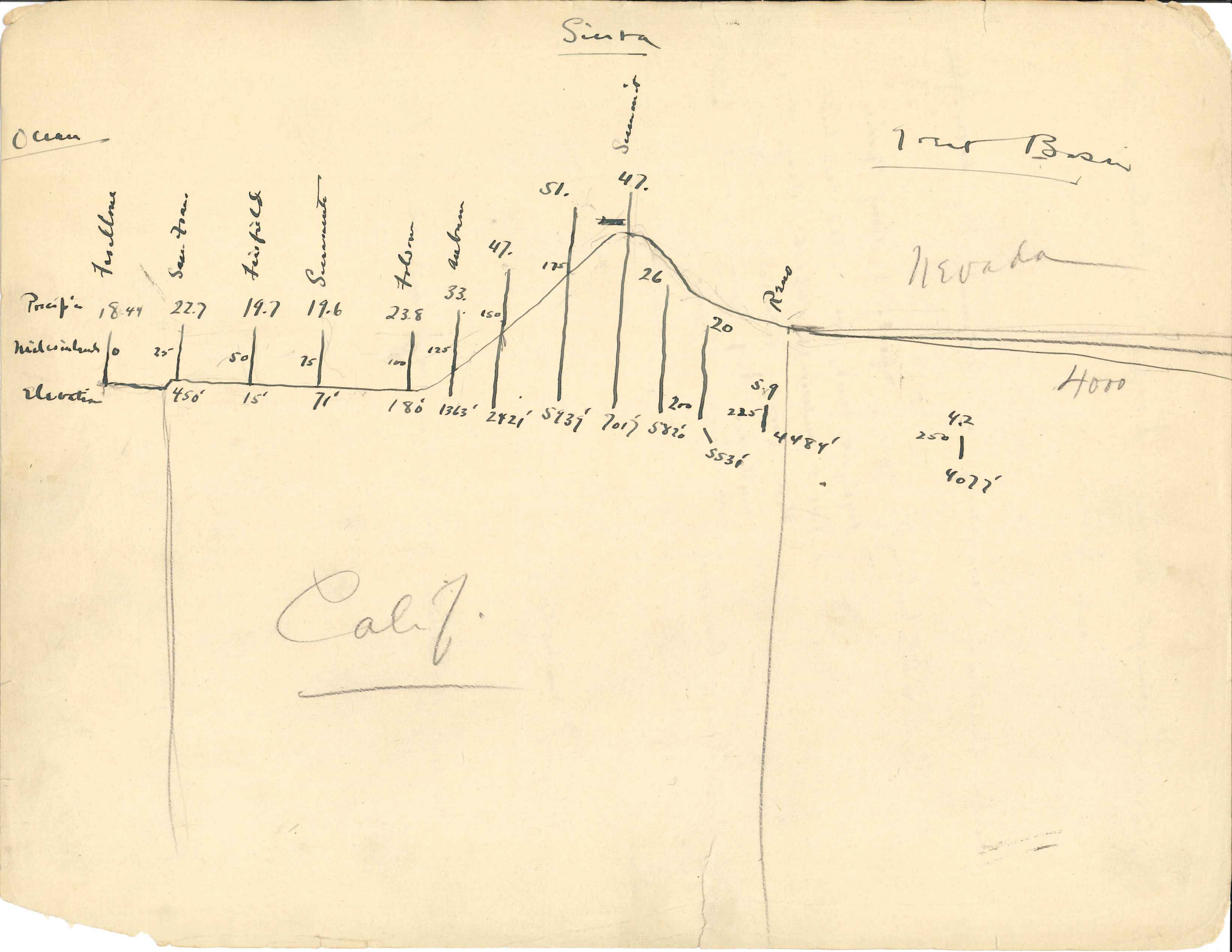
Kind of land & Ownership

2/3 private, large; chiefly acquired, now accessible to lot; speculation holding changing to operating.

Logging methods: large operations, steam, large investment. Must change as power, high country is reached. Costs will rise

Needs of protection - fire, grazing, watershed, insects fungi.

Future of Region


Sierra
Ocean
Summit
Great Basin
Nevada
Calif.
Fairfield
Sacramento
Auburn
Reno
Precipitation
Horizontal
Elevation
18.44
22.7
19.7
19.6
23.8
33.
47.
51.
47.
26
20
5.9
4.2
0
25
50
75
100
125
150
175
200
225
250
450'
15'
71'
186
1363'
2821'
5737'
7017'
5826'
5536'
4484'
4077'
4000

Reading

U. S. G. S. Ann. Rep. 19th & 21st Part V

Forest Service. Circular 150 Douglas Fir

" Bulletin 33 Western Hemlock

" Silvical leaflets 1, 2, 5, 6, 7, 11, 12, 13, 22, 31.

Dept. of Agri. Yearbook 1907 Reprint "Cutting Timber on National Forests & Providing for a Future Supply".

(b) The Redwood Region 72 Bill.

climatically a continuation of North Coast, only milder & slightly dryer

Boundaries: Shore strip from S. Ore. to S. of Santa Cruz Bay – 10 – 30 miles wide

Physiography & climate: Shape of Coast Range; outlier of ~~into~~ stopes; transition belt on So. Fork Mt. – ~~to~~ moist climate fading into dry.

General Forest Conditions – influence of sea fogs
Heavy coast forest merging into open pine, e.g. So. Fork Mt.

Types

1. Redwood Flat. Bottoms & benches - good soil & moisture. Species Redwood 70 - 100%; also Sitka Spruce, N. & near coast; P. O. cedar, Giant Cedar, Red Alder, Cascara, Goodin Cypress.

2. Redwood Slope. Ridges & slopes - dryer situations. Species. Redwood 50 - 80%. with Douglas Fir, Hemlock, Red Fir, Tanbark Oak, Madrona. Scattering in both types, Yew, Tsuga, P. Contorta, Pepperwood, ~~Cascara, Red Alder, Goodin Cypress~~

Silvics chief species: Redwood; life history & form - first key to treatment. Associates ~~same~~ as mainly species of North Coast Region.

Management

life history & form

Ownership

Logging

Needs of protection

Future of Region

Reading - Bull. 38 The Redwood -

(c)

The Sierra of Pacific Pine Region. 241 Bil

Boundaries: So. Cascades (Crater Lake), Cross ranges in So. Ore. & No. Cal., & Sierra main range.

Physiography & Climate: Shapes of ranges, relative degrees comp. coast, contrast of moisture condition W. & E. slopes main range, N. & S. on spurs & buttes. Rainy & dry seasons. 20 – 60 inches

General character of Forest: Open, patchy, scanty ground cover, much governed by slope & exposure & altitude. Chaparral.

Types – mainly in zones controlled by altitude, slope & streams.

See diagram profile of Sierra

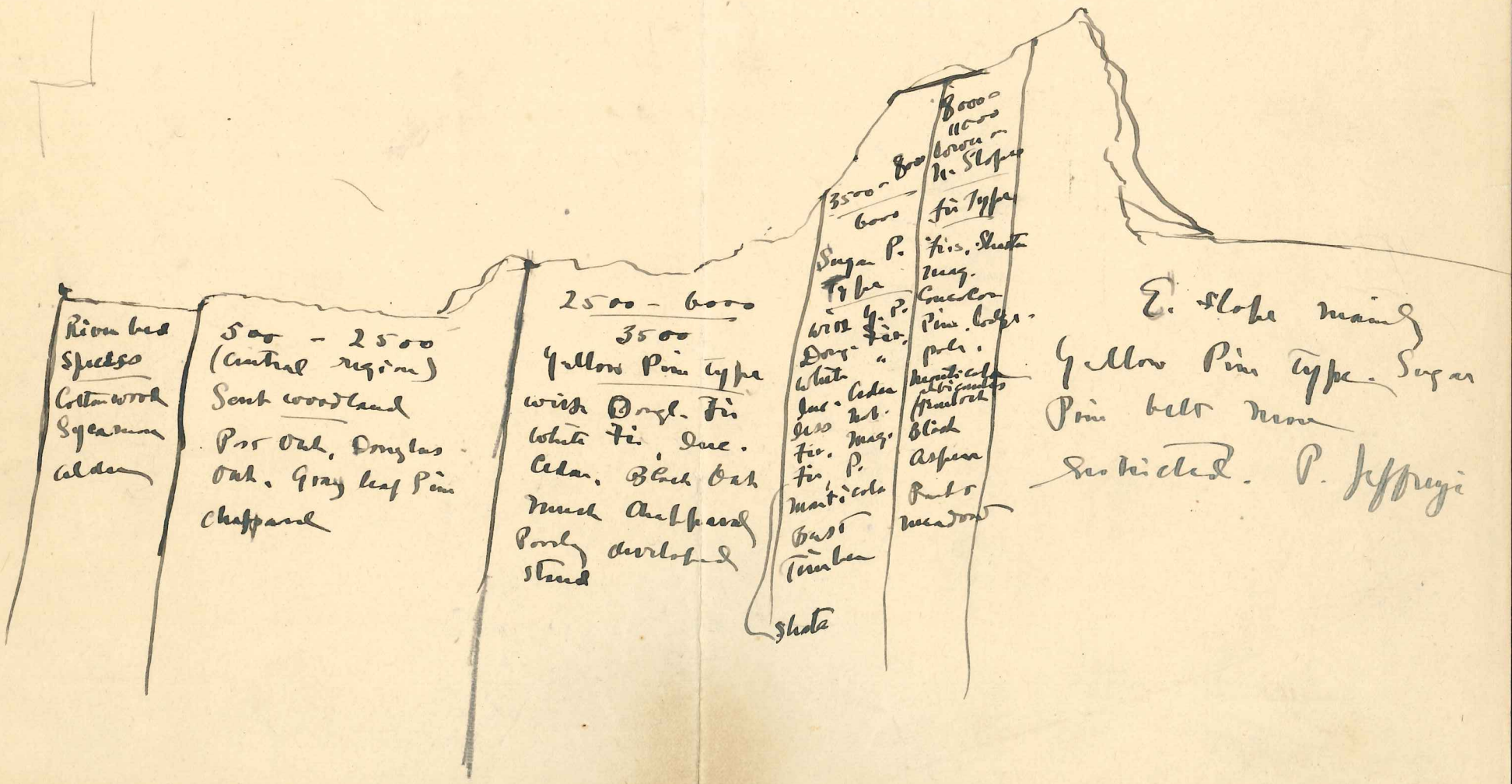
Conservative Lumbering in Sugar Pine

Nature of forest - uneven aged. Refin of valuable species. Selection or group cutting indicated. Fire the chief obstacle. Logging can be modified. Protection already practicable. Achieved by burning slash + patrol.

Lessons of Reports

Sharon

Profile of Sierra wild forest zones



W-Slope

1. Red Fir, Hemlock, Sitka spruce, Red cedar, Lowland Fir, Amabilis Fir, Cottonwood, Noble, Yellow Balm of Gilead, Vine Maple, Red Alder.

To 4000

2. Hemlock, Alaska Cedar, Lowland Fir, Amabilis, Nobilis, Mountain Maple. 4000–5000

3. Black Hemlock, White Bearded Pine, Engelmann Spruce, Lyall's Larch, Lasiocarpa

E. Slope

Service + aspen, lodge pole comes in plenty; Red Fir poor; amabilis + hemlock only in most sports; lodge pole on dryer slopes rapidly giving way to yellow pine.

Exception in upper Skagit Valley behind

Extensions + modifications of Fir Region

(See maps in Part IV (1911) folder)

Rept. due Feb. 17th

Forest Regions
(in detail)

Read Geol. Report
Part V 1921
Rainier + Washington.

Pacific Forest

Rainier, Washington and Olympic Reserves.

General Climatic Condition.

Topography – temperature vs. precipitation.

Distribution of the Forest Zones

Characteristics of each.

Silvicultural Conditions.

Red fir zone 1
Mad. + whit fir zone 2
Alpine zone 3
over

Continuing Pacific Forest

Priest River + Black Hills Reserve

Sierra Reserve.

These in General.

Silvics or Forest Forms

Yellow Pine, Sugar Pine. ~~Many~~ Even aged, or irregular but stand. Life history depending on silvical characters & outside factors; Cool situations & intolerance after seedling stage — Sugar Pine; exacting as to seed bed — light duff & moisture. Effect of progressively dry climate on seed bed, reproduction, & hence need of shelterwood in regeneration.

Management

Logging; method — log chute & flume with donkeys; effects according to character & call; steep slopes erosion follows clear reproduction; also chaparral follows fire & excludes new crop; cases of good reproduction, yellow pine after heavy cut, all species after light.

Ownership

Govt & private; stumpage as affecting conservation method; Govt pine $2.00; private timber just come to have stumpage value as distinguished from lump land price. Going to stand in way of better methods. Taxes have certain effect but not much.

For Screening new Crop
(Sugar & Yellow Pine predominating)

Protection

25¢ per acre est. cupied

Slash burning (25¢ per M. 7 piled); patrol 1-2¢ per acre - 1 man 30-40 thousand acres. Telephone if possible.

Seed Trees & Shelterwood

Diameter limit now 20" but elastic for condition of trees & distribution of trees. Higher would often be better, but costs must decide. Make-up of type should decide marking - yellow pine for lower pine belt, sugar for upper. Determine cut clean as utilization will permit & need for right seed bed. Growing opened & seed trees saved from slash fires.

Silv. tablets.

Reading: Bull. 69 S.P.&L.P. in Cal.; Stanislaus Fr. (21st G.S.G.S.) - Sierra Fr. (20th G.S.G.S.). Suggestions for disposal Slash

2. The Rocky Mt. & Interior Coniferous Region 223 Bull
(Greater extremes of temp & degree climate)
Economic units: W. Mont. & Idaho; Wyo. & Colo.; Utah & Nev.; N. Mex & Ariz.

(a) No. Rocky Mts. Region 130 Bull

(Develop of Coast & Interior species)

Boundaries: Cascade divide E. from N. line of Wash., incl. N-E. Co Wash & all interior ranges N. to No. B.C. & S. to Central Mont. & Idaho.

Physiography: Mt. bridge cascades to Rockies.

Climate: relatively humid with respect to farther South. Rainfall in growing season upto 40 in. Temp range not excessive 90° to -25°F. Growing season in length next to Sierra & North Coast.

General Forest Conditions, Smaller development than on coast. Great Variety of species, variable types.

Types

Altitudes forested areas 2 - 10 thousands

1. Yellow Pine Type - below 2500

Valley or lowland, dry flats. open stand of ponderosa, minor sites cedar swamp with Douglas fir, Giant Cedar, larch, hemlock, white pine or lowland fir.

2. White Pine Type 2500 - 5000 ft. elev.

Grades into preceding. Probably most sites middle elevations. Variable proportions of W.P. larch, arborvitae, Douglas fir, lodgepole pine, hemlock or lowland fir. Type abounds in Priest Lake country. Fire or lake history varies drainage situation, fire, fungus.

3. Lodgepole Pine Type

Usually a temporary type occurring as variation of White Pine. Distributed by

fir & S. lobicas of P. monogama. Exfoliate = intolerance.
sometimes cones, preference for mineral soil.
Tolerant → species eventually kill out this type.

1

4. Alpine Type – above 5000 to timberline
grades into White Pine Type
Species: Alpine fir, white bark pine & Engelmann
spruce, & on lower belts Douglas fir,
lodgepole, white pine, larch & aspen.

Silvics of Chief Species:
White Pine, larch, lodgepole pine, Engelmann
spruce & cross → species

Management

Silvical behavior of types. Serious pests ~~[illegible]~~, W. pine, larch & Engelmann spruce (yellow pine) & fir (long species). Cutting by strip or seed tree, or by selection according to site & species favored. Slash usually piled and burned, or piled & not burned, or scattered acc. to situation & silvical needs. W. Pine & Doug. fir respond to more thinning, surplus & timely seed year. also gradual cutting, reducing undesirable species and trees.

Ownership: mainly Govt, private not being active as yet

W. Pine & D. fir restock burns ∴ heavy thinning & ground fire. Where this impracticable, successive diam. limit cuts favoring good species by high limits

Logging: little; communications scanty in back regions making occasionally possible

Protection –
Fire, fungi:

Reading: Priest River, Flathead & Lewis & Clark Forests
Leaflets – White Pine, larch, Engelmann Spruce

25 Bill in Colo

(b) Central Rocky Mts. Region
(Lodgepole Country)

Boundaries: Rockies in Wyo. So. Idaho + Mont + no. Colo. + Utah. also (historically) East slope Cascades in Wash + Blue Mts. of no. E. Oregon.

Physiography: Trend of Mts, elevations.

Climate
Less favorable than to N. + W. Dry summers + severe winters. Rainfall 15 - 25 much of it snow. Temp. extremes 100 to - 40° F.

General Forest Conditions.

Small timber, many forks, bare valleys, soil + soil moisture almost equally influential with altitude.

Types - trees up to 7000 ft

1. Yellow Pine type

Open, nearly pure, dry flats & ballays.

2. Douglas Fir Type. best 6000-7000 - trees to 1000

Sometimes nearly pure, more often with lodgepole, Engelmann Spruce, Alpine fir (above) & Yellow Pine below.

3. Lodge Pole Pine Type - higher slopes 6000-11000 acc. to moisture.

Prevailing in region, often covering vast areas, e.g. Big Horns. Contains patches of Douglas fir & aspen type. Controlled much by burns.

4. Alpine Type

Alpine Fir, Engelmann Spruce, other alpine trees. At lower edges spruce often predominates.

Subtypes & Chief Species & general life history

Lodgepole, Yellow Pine, Eng. Spruce & Douglas Fir the commercial timbers. Distribution & natural competition. Lodgepole displaces Douglas on drier middle zones; Douglas extends into alpine type following burns & until spruce & fir balsam catch by tolerance in time. Douglas holds own against Yellow Pine (in mixture) on warmer portions of lowlands. Douglas & Lodgepole usually even aged when predominant. Other types tend to many aged form.

Management

Providing Lodgepole type suited to stand system with surface burning. With Douglas fir in mixture, selection method (fir being fairly tolerant in ext. form + able to grow in lodgepole cover) to reduce pine + allow fir repin. Wind fall to be guarded against. Slash burning necessary for protection, but to be confined to smallest areas so as to prevent spread of lodgepole. In Yellow Pine type selection or group cuttings with slash burning. In Alpine type selection with considerable regard to soil conditions. Little changed for Sitka spruce.

Logging methods.

Protection

Fire, windfall, soil aging

Reading: Big Horn Forest, Eng. Spruce circa 170, Douglas fir 150

(C) Southern Rocky Mts. Region 39 Bill
(Yellow Pine Country)

Boundaries: all south of Central Colorado & no. Utah.

Physiography

Climate: milder & drier, longer growing season than Central Region. 15-30 in rain according to elevation. Temps -10° to 95°

General Forest Conditions

Types

1. Scrub woodland. Often scattered. Pinon, juniper, scrub oaks, mountain mahogany. Some chaparral. Up to 6000.

2. Yellow Pine type.

Main woodland or forest type, on all but dryest sites. Dist depends on elev. in relation rainfall & temp. subject to local effects of slope exposure. Stands of extent not found above 8500 where moisture & temp favor tolerant species. Open stand, intermixed, parks, little brush, considerable grass.

3. Fir Type

Douglas & Concolor, Lodgepole, Norway, White Pine, with Yellow Pine.
Fir predominates on moister soils.
Mostly above 8500 to 10000

4. Alpine Type.

High elevation, No. aspects, detached bodies. Engelmann Spruce, alpine fir, Cork fir, limber pine. Aspen chief broad species. Engelmann Spruce in pure stands or aspen limits.

Silvics & life history

Yellow Pine & Douglas fir important trees. Douglas in limited areas where suited. Soil moisture, slope exposure, & fires as influencing reprn. S. exposures below 7000 rain is to 20 in. rain does not mean forest of Y. Pine; on N. slopes above 7000 is tree growth with only 17 in. rain. Non continuous with less than 20 in.

Y.P. have not run 100 hr. Black jack & Y.P. - former becomes better at 125 - 150 yrs. Intolerant, but degree the site the more protection from wind & light needed. Cannot stand subjection long. Seeds often. Reprn. checked by spring & fall drought, grazing, grass fires, grazing cattle or poor feed. Not particular as to soil. Long & deep roots make avoid from drought & natural enemy. Also poor for seedlings.

Management – very conservative for local use in future & for protection purposes.

Keeping dead bed right from drying out gives point. Douglas & Eng. experience well in high types under reserve & similar conditions. For yellow Pine, not so much shade as protection from dessication & frost. Hence Stand System. second cut ~~20 – 30~~ 15 – 20 years after first. Bank cut 2/3 & next time take sec. trees. Copped & scathed.

Reading: Circular 174 Reprin of Western Yellow Pine in the Southwest. Bull. 101 W.Y.P. in Ariz. & New Mex.

Review of Pacific Forest

Regions, climates, activity & permanence of vegetation related to factors of locality. Forest influences in several regions. Grazing, where practised, effects in differing localities. Erosion & poor reproduction. Regulations for control.

The Coastal Pine Region

Bounds, Physiography, climate - rainfall 55". temp 61°

Forest Conditions

Types

Maritime Forests - evergreen broad leaf.

Pine Belt Lowlands

Original pine longleaf on sand mainly S. of Raleigh, N. mainly loblolly & shortleaf on ridges & moister sites respectively. Now mixed by man.

Coastal Plain. E. of fleuve running from N.Y. to Macon via Trenton, Phila., Richmond, Raleigh to Macon & Montgomery. Mainly Cretaceous - sandstones, gravels, shales & clays. Alternately under & out of sea. Poor soils & good. Poor in S. Atlantic plain owing to formation & transportation of from silt to sea. Sea level to 500 ft. Low hills, rolling flat, flooded plain with low bluffs, extensive marshes at sea & along larger rivers.

Piedmont Plateau

W. of fall line to foothills Appalachians. Archean rocks - hard crystalline schists & lavas with quartz veins. Degraded to a peneplain. Not always clearly distinct from Appl. Mts. Elevations up to 1500 ft. with higher points scattered. Much cut by streams. Plateaus with hills & cut into meandering valleys with considerable flooded plains. Much good soils.

Appalachian Mts

System runs from S. N.Y. to Georgia bounded W. by Allegheny Plateaus running to Great Lakes & Prairie plains. Trend N.E. to S.W. Alts. 1000 to 6000 in Tennessee. Two drainages: S. of New River to Gulf; N. of New River to Atlantic. Originally nearly as degraded as Piedmont. The uplift in Cretaceous times was higher & resulted in an easterly & a westerly tilt. Soils mainly good in valleys.

Forests of Lowlands of Coastal Plain

Swamps + bottoms, poor drainage

Oak Flats: Scarlet, black, white, black jack + spanish. accompanied gum + cypress swamps

Gum + Cypress Swamps – Swamp chestnut oak, elm, cottonwood, Red maple, blue beech + poor oaks – besides cypress + gums.

Cedar Swamps

Pine Pocosins

Piedmont Plateau Region

E. 500 W. 1000 – 1200

Bounds. climate & physiography. Soils rainfall fairly uniform.

Soils & varying altitude factors affecting distribution. Transition belt – coast species & mountain species overlap in Region

Silvical Regions

Lowlands – streams, large swamps or recurring

Loamy alluvium – birch R. oak, white oak, Magnolia. Poplar – Hornbeam, umbrella tree, dogwood.

Silty soils, gums sweet & black, sycamore, hackberry, over-cup & chestnut oak subordinate above

Uplands. Main area

Primary soils (clayey) in contrast to transported drift of coastal plain

Broadleaf + pine mixed - pure pine only on shallow granitic soils. Body of forest Oaks + hickory, mixed with short leaf pine. Pine increasing in regrowth

Eastern Belt - medium soils

Broad leaves + Pine

Deciduous forests - Better soils

Fast grade dense hardwoods, oaks, hickory, poplar + no pine except on rocky points

Western Pine Belt. Shallow sandy loams.

Pine mixed with broadleaves – chiefly scarlet, black, white, chestnut, post, spanish oaks. Pitch Pine above 1300 mixed with Shortleaf. Scrub pine on poor sites.

I

The Mountain Forest –

Altitude, affecting temperature & humidity governs distribution mainly, soil & site locally. High elevations species grow both on dry ridges & cold swamps: White Pine, Pitch pine, black gum also R-oak Hemlock, beech birches & sugar maple. Phys. orography – cove slope ridge plateau & summit. Soils

Three Belts

Lower Mts. 1500 - 3000

Oaks white, chestnut, black, scarlet, red & shingle, hickory (chiefly white) & chestnut; pines shortleaf, pitch, scrub, & Table Mt. & white. hemlock usually over the broadleaves

(1) Table Mt & pitch (2) Shortleaf pitch & scrub (3) white walnut three divisions of lower mts.

Higher Mts. 3000 - 5000

Much land now in small farms

Distribution according to

Site & aspect

(1) N. Slopes & hollows - covers - deep moist soil

Y. Poplar, Wh. ash. Cucumber, Wh. Oak, Lin.
Black Walnut
Red Oak, Chestnut, beech, maples, birches
hemlock, buckeye, great laurels.

(2) South Slopes & gravelly ridges

Aspen, Shorter stand

Chestnut, White Oak, Red oak, black
Oak & Chestnut Oak.

Stands (esp. in (1)) 90 - 120', often clean
floor & good humus, often great thickets
under wood. Tolerant species usually dep well
beech, birch, hemlock (scattered) sugar maple
+ red oak (medium), Under bottom even

cover tulip Pop., cucumber, ash, chestnut
wh. & red oaks. Index of silvics or
method. Grazing slight & fires few —
except on So exposures.

Mt. Summit Forest — above 5000

Black Spruce, Carolina balsam, Nat. Hol.
Moosewood, Nat. maple, red cherry.

General comment on Nat. Forest Region
Softness, liability to erosion & deterioration,
classes of ownership — small & large. Necessity
of state intervention. Lines of policy:
protection, exclusion of grazing, & cutting

Management

2d Growth, lower slopes, large cut, two stand pine, oaks + stump leaf entwining

1st Growth, upper slopes, virgin, less fire + grazing, often fine condition + perfect selection forest.

Lumbering, farmer cutting long continued, stumpage wasteful acc. by fire + grazing; and recent (20 yrs) large operations destructive.

To be handled

1. Second growth by improvement cutting + pasture.
2. Old " selection cutting for removal of poor stuff + species, mature trees without ~~[illegible]~~ increase of weed trees - dogwood, sourwood, scrub oak.

✓

based on condition by situation or type -
to reduce unmerchantable species or
reproduce good ones. Portable mills or R. R. logging
for big concerns.

Valley or Bottom land Forest

Bounds, physiography, soils (clay & sand - alluvial)
elevation (10 - 20) climate

Silvical Divisions

Glade Bottom - flooded from to time

Red gum, Red maple, cow, red, shingle, overcup &
willow oak, elm, sassafras, hackberry, papaw,
dogwood & blue beech.

Slough Type - always wet

Variable composition
usually cypress & black gum - dense
Sometimes glade species as well

M

Ridges – few feet above – seldom any water

Red Gum predominant with oaks, hickories (mockernut, shag & pecan). Some black Gum. Also Elm, red maple, white ash, hackberry, Sassafras, dogwood & papaw

Most land too good for forest, logged by floating the cut & peel in fall.
Management not yet decided. See Red Gum bulletin 58. Chief point is study of associate species, clean enough cutting for intolerant kinds, & seeing small growth.

Ohio Valley Hds – O., Ind., So. Ill., No. Ky.,
S.E. Ia., N. Missouri, So. Mich + Wis.

Chiefly agri. land. Upland oaks, hickories, wh. ash, yellow poplar, bass, black walnut, cherry, sugar maple, beech; low lying land elm, red maple, black ash, sycamore, willow, red + black gums, bur oak, hackberry, + cottonwood. Now nearly all poor woodlots, cutting good has left poor kinds; grazing brings sod stripping + soil washing with subsoil brought to surface. Woodlot policy, + treatin, if no waste land, to make windbreak – 5 rods wide on windward side. Protection for grazing, surface fires, wind – use of dense borders. Management – old stands giving back, cull successively, 1st dying, due 2d wounds, 3d – crowding specimens of good kinds. 1/5 stand at a cut, not more than 5 years. Open old stands: no grazing, cut dying + diseased, break sod by hogs or harrowing.

Dense young stands: Dispt cutting – cleanings in sapling thickets.

The Upper Hardwood Region

Bounds, ~~clim~~ physiography, climate, soils

General Forest Condition

Southern species giving - Poplar, Pin Oak, chestnut Oak, ~~black Walnut~~ Red Gum, northern absent or few, - Yellow birch, Spruce, White Pine. Condition worst of upper mountain sides due to history - local uses + charcoal + hickory and industries.

Types

On smaller scale somewhat like Appalachian Hard. Types.

Mixed Hardwoods

Better, moister soils, lower gentle slopes to flats.
Usually divisible into three qualities according to soil & moisture. Runs into Cove type

Species (I) Red maple, Chest., R. O., Chest. O., Basswood, Scarlet O., Hard maple, Hickory, Black O., White Ash, White Oak, Black birch, Black locust, Tulip.

II & III differ chiefly in situation above or below, thinner soil, & consequent absence of exacting species. Poplar in II, and also in (III) Bass, White Ash plus cedar, butternut & scattered Pitch Pine. Stands progressively shorter & opener, a poly to pine.

Chestnut Oak

Chest O. Hickory. R. O. Chestnut, Hard maple, Black birch. Also in 2 qualities 50% + Chestnut Oak. Hemlock often understory. Poorest rocky soil

Chestnut — medium soils, moderate slopes

Chestnut, with Oaks Red, Scarlet, Chestnut, White; Red ~~Hard~~ maple, Black birch.

Two qualities ~~[illegible]~~

Red maple Swamp

R maple, Y. Birch, Black ash, with Hard Maple, Red Oak, White ash, Poplar, Elm, Tulip, Basswood, Tupelo, Sycamore

Also Pitch Pine Ridges, Hemlock Slopes, Spruce & Larch Swamps. Scrub pine in S.

Management

Character of ownership, woodlots, estates, ~~[illegible]~~ institutions, water companies

needs of the forest — factors improved, growing stock renewed.

Treatment — protection fire + grazing

Coppice System — good + bad

Successive thinnings

Selection

J.16

Supplementary points on Cal. Forests: interior North, Big Tree country, S. Coast Conditions.

Work for Sat + Fri. Careful analysis of s.lo. condition of block to be marked + cut. Repetitate on method as distinguished from pretty writing. Present case requires - put diagram on board. Virtually a Compt. description. Name lot a plot, give age, species, percentages, form, rep'n, health, - leading to decision as to best treatment.

To to Sharon

Distinguish among

Silvics of a Species

Forest Description
Locality + name of Tract
area (with map)
Topography (classify in sites)
Soil
The Forest - General
Land classes, history treatment,
Enumeration of Types
The Stand in detail
Type A
Site
Table { Species, % cut, dbh, Ht.
age
Rep'n
S.lo. Condition

Com'l Forest'n

Management
growth
Proportion, loss
Lumbering
Costs, Prices

9) Choice between seeding & planting largely a question of expense and cultural conditions. Cheap seed & good chance for growth might justify seeding. Planting is surer & not necessarily more expensive.

Forest Planting

Planting to be considered wholly from commercial point of view, relation of cost of formation and tending to stumpage price of final crop. Thus have to know (1) method (2) the cost of raising seedlings and planting them out in final position. The question of the practicability of planting depends on cost of land, expenses of planting + subsequent care, and the ultimate value of the crop. Relation of these terms in U. S. various - planting locally advisable but generally not yet profitable.

Security?

Silvics of Species related to planting

Synopsis of Forest Valuation

the Data for a Working Plan

1. Area Survey
2. Stand Survey (Estimate, Measurement)
   - A. Inventory Stand Survey
     - I. Special Stand Description
       1. Situation
       2. Wood Crop
   - B. Inventory Stand Survey
     - I. Stock Determination
       - a) Single stems - logs, cliff, a standing tree
       - b) Whole stands
     - II. Reckoning Growth
       - a) Volume growth of Single stems
       - b) " " " stands
       - c) growth in value
       - d) Growth and Rotation - determination of rotation acc. to course of growth.
     - III. Valuation by Yield Table

J. 7

Following discussion of the principles underlying the Forest Working Plan – an outline of a typical full plan

Part I The Forest

General Description

Location
Area
Topography
Types
} supplemented by forest map

The Stand
1 Vol. tables
2 Yields "
4 Tot. Stock
3 Rate of Growth

Rights & legal Restrictions

Lumbering
Products & prices
Market and transportation
Fire and other dangers

Part II The Management

Objects of Management (Forestship)
Division into Compartments & Working Circles
" " ~~Allotment of areas~~

Silvicultural Method - includes formation
Rotation - financial calculations
Determination of Yield
Plan of utilization
- Final Cuttings
- Intermediate Cuttings
- Logging rules

Estimate of Returns
Records of Operations - Tables.
Protection
Administration

Bull. 30
p. 40

Forestry 7

Prel. due Friday Nov. 12th

Conference Nov. 1st 11-12

Hour Exam. on work from Wednesday 14th

Confs. 11-12

The Normal Age Classes

The normal distribution for equal returns in volume. Then, for different methods of treatment – area cut annually ?

Size of classes

How distributed?

1. The Annual Coupe.

(a) Coppice & C. with Standards

$$c = \frac{A}{r}$$ also with Standards

(b) Clear cutting ~~out~~ High Forest

$$c = \frac{A}{r}$$ If c is not at once destroyed – say for s years, then

$$c = \frac{A}{r+s}$$

(c) Shelterwood Compartment System

Regeneration during m years, number of annual coupes being thrown together into a periodic

$$\therefore \text{periodic } c = \frac{A}{r} \times m$$

This raises the Rotation either to $r + \frac{m}{2}$ (when cuttings begin at year r), or (cutting beginning at year $r - \frac{m}{2}$ & ending at

$r + \frac{m}{2}$) leaves it at r years. Better method assumed here.

(d) Selection System

Cope in theory whole area of forest. Really restricted in area for convenience & effect on reproduction. If it takes l years to go round then $C = \frac{A}{l}$

2 Size of Age Classes

In practice no single year age gradations are joined in age class. Area depends on size of C and number gradations per coppice. Area $= n \times c$. Number of classes $= \frac{r}{n}$ is variable. n usually a round number 10, 20 30 etc. Coppice commonly 5 classes designated by I, II, III, youngest first, thus indicating general age.

(a) Clear Cutting

C (area of age class) $= n \times c = n \times \frac{A}{r}$ or $= n \times \frac{A}{r+s}$

(b) Shelterwood Comp. System

Approximate arrangement of age classes

See Schlich III p. 217

(c) Coppice System

Standards arrangement only theoretically useful

(d) Selection System

Arrangement calculated = age classes $\frac{r}{l}$,

$C = \frac{A}{l}$, never reached in practice.

3. Distribution of the Age Classes

assume now that stand has been assessed, & mean annual incr. figured, or the time & amount of a future yield ascertained, as in the case of a plantation. In fixing on the management, then expected yields must be expressed in terms of money. In other words, any plan for the exploitation of a forest based upon growth involves the time element, so that the money tied up in the forest, and its accumulating interest, must be balanced against the returns from cutting with their accumulating interest. This is where the real working plan differs from the ordinary lumbering plan, which figures all its profits on the basis of growing stock at present in sight. Plainly the working plan precludes larger immediate profits; and the greater security & continuity & improvement of forest property under the working plan claimed for Europe cannot yet be counted on for U.S. Hence, though capital is ~~willing~~ satisfied with a low rate of interest from forestry in Europe, it is not yet satisfied a low rate

here. Nevertheless, factors which make timber investors demand high & quick returns, the speculative spirit, fire risk, & recent abundance of timber are all losing force, and more and more will people be ~~willing~~ content with lower ~~rates~~ & more sustained returns, and hence the need for gauging the value of future returns will become continuously greater.

Consider now the typical cases in which figuring on future values with compound interest is necessary. In all cases have on one hand costs & expenses, on other net returns, both bearing interest because you W.P. investors continued growth & not flat exploitation. Question now is what rate of interest to allow. Schlich's arguments for low rate do not altogether hold for us, because forestry has not all advantages he claims & has some he does not claim. Cf. quick growing plantation. We have to use a rate of interest such as cap. can fairly get in investment of like degree of certainty. Usually have to use as high as 4%

Ex. Pine Plantation
Estimated 20 cut in selection forest

Cost Value
Sale Value
Exp.
Rental & Subsistence value

N. Increment = that possible under given locality, species, rotation. Abn. by bad treatment, injurious factors, predominance of certain age classes.

N. age classes. So woods of normal age are available to be cut at right times

N. Pr. St. = when (1) + (2) are present

From the constitution of N. For. certain laws follow: chief of which are that final yield = Vol. oldest age class = mean an. final increment of all gradations = tot. current an. increment of all gradations.

Now, nat forest is always abnormal, but increment is the factor which chiefly affects the productiveness of Pr. St. Hence Increment the most important thing to determine, + if possible to make approach the normal. As a matter of fact, the best practical regulation of a forest is cons. during the special treatment required for each distinct wood, type or block, +

Then adds up the entings by which the heat mmr is to be carried out.

So as the Study revealed they for us to know we come to

Increment or Growth.

Forestry 7

Growth

Diameter (cont.)

Diam. on age

Ordinary diam. growth stated by plotting diams. on age & averaging the points in a curve. This usually reduced to D.b.h. outside bark from St. Louis by aver. factor of decrease for each class. If analyses are made at breast ht. bark weight has to be got & averaged from trees of varying age & diam. Thus the simple expression of diam. growth unless to fix general diam on age, or commonly age, the study always applies to particular conditions.

For even aged stands

In addition to type, site class, & density, even & uneven aged stands are measured separately. Even aged forest common forest. Any study assumes a particular treatment or lack of it.

Three ways of getting figures for diam. growth.

(1) By analysis of all trees on selected plots. This good method if no suppressed trees are used, the stand is already merchantable, and the plots carefully located. Few will do.

(2) Can analyze average trees

Figure by calculating the average tree on sample plots & then average the measurements in a curve. Method depends on having a merchantable stand & remembering that average tree is not always such. Results do not include trees growth that die, but represent valuable stand at present on ground.

(3) Can average ~~chosen~~ trees chosen from all sizes. Good way in restricted area when necessary to follow chopper. 100 trees.

(4) Direct Dbh. of Standing Trees

This is to find the Dbh. of the mean tree at any age. Last way gave not the mean tree at any age, but the mean tree of ~~the stand~~ ~~trees~~ reached maturity. So this method must take stands of required range in age, & get diam. & age of aver. tree in each, & plot in curve. Useful result because gives actual Dbh. outside bark.

Might also get max d., min. d., & heightening d. maximum grows trees for index of result in thinning.

Light accretion figures from accidentally thinned groups by decade intervals, & used as correcting factor for accretion in unopened stands.

Diam in unknown aged stands

Conditions vary so that it is usually unusable to average growth at different ages.

Special portions of forest or groups of trees could be taken together if their condition was or was to be plainly uniform. E.g. lower story, adverse growth &c. In usual uneven forest, we can

(1) Figure the average age of certain diameters, giving for example, rotation in a selection forest. This gives probably (but not always) a low result.

(2) Get diam. growth for diam. classes without regard to age. Done by growth in St. for last 10 yrs. grouped & averaged by Dbh. classes. Better if figures are grouped by tree class, crown shape – dom., int., & shade. Decrease by partial cutting hard to reckon in. Plainly all trees later do not increase. U.S. Forest Service meets this by getting two sets of figures, one for origin, one for cut over woods, & averaging by ratio of trees showing increase to trees showing none. Uncertain at best. Diam. gr. can also be got by incr. borer. Bringing measured & used like data in diam class accretion.

Harvard University

DIVISION OF FORESTRY

CAMBRIDGE, MASS.

J.
M.
F.

Tot. Time 40 Days

1st Year			2d Year		
Instr.	Course	Dates	Instr.	Course	Dates
Jack	7.3a	Oct 1-9	7 + M.	~~7.7b~~ Thesis	Oct. 1 - 9
Mackaye	7.2	" 11 - 16	Fisher	7.7b	" 11 - 16
Fisher	7.1a	" 18 - 23	Mackaye	Thesis	" 18 - 23
Mackaye	7.2	" 25, 27, 29	Fisher	"	" 25, 27, 29
Fisher	7.1a	" 26, 28, 30	Mackaye	"	" 26, 28, 30
Jack	7.4a	Nov. 3 - 6	Fisher	Mills, Marking	Nov. 3 - 6
Mackaye	7.2	8 - 13	Fisher	7.7b	8 - 13
Fisher	7.1a	15 - 19	Mackaye	"	15 - 19
Mackaye	7.2	22 - 30	Fisher	"	22 - 30

2d lecture

Balance has been mentioned between the economic value of forest and silvicultural possibility. between what forest is capable of & what owner can afford to do. Consider yourself a consulting forester. Owner usually ignorant & helpless, except for mere knowledge of what can be done with merchantable wood in sight. Has certainly no notion of what is best for the land. First point is Prel. Exam. has always possible a necessary in acct. of cost & simplicity of problem. Cost of advice for small tract comes high per acre. Must always (in nearly ex) for the woods & bess with owner. Here is the chief point in U.S. forestry success: Know what ought to be done, but tell owner only what is practicable and wise for him. Do not try to push elaborate forestry on a backwoods farmer. In beginning make lists of what you know & ~~be confi~~ don't try to solve the problem before you know all the evi-

Oct. 3 '04

Forestry 7

This course embodies the final application of previous studies - mensuration, silviculture, botany, and a further consideration in Production, Valuation, Statics + Regulation. Expression of all or most of this in the Working Plan. Course will have for its main aim the training of the student in the theory + preparation of Working Plans. It will thus confine lectures + problems in the theory with practice in the field.

D'Arcy Chap. II Prel. Work

Fernow Ec. Ch. I-IV

Books needed are, chiefly, Schlich. Others, esp. Indian Reports + Bureau publications will be referred to from time to time. German + French books ought to be accessible. Field work will consist 1st in a series of small reports + problems on local tracts, and 2d in

a spring trip (April - June) probably to Squam Lake, where a complete working plan will be made. First field work now will be a Preliminary Examination. Purpose of Prel. Exam is to ascertain whether forest management is ~~possi~~ practicable - to get the elements of the problem which is ultimately settled by the working plan. Certain considerations underlie the solution of such a problem. They are on the one hand the economic value & situation of the woodland - stand, market, costs, value, owner's attitude - on the other the silvicultural condition of the forest. its productive possibility. These two main lines of study we shall take up in more detail.

General Conception of Forest Capital

F.7

in hand. Precipitation is to jump at conclusions, especially when questioned. Often bet. circle forestry is possible but that important.

Such are general hints bearing on ~~practical~~ practical side of forest work, especially Prel. Exams. Now for consideration of the details of the problem itself. To begin with, for the first stage, take a forest description. These simple for woodlot. E.g. - read on woodlot Report for Pratt Merriman, + Piney Woods. Headings necessary:

General

Area; topography; soil + situation;

The Forest

Types; species in mixture; average dimensions; age; soundness; other injuries; reproduction; silvicultural condition; class of product; estimate of stand.

Area accretion not so useful to know in U.S. Can be related by converting diam-table into circles.

Height Growth. Useful for silv. reasons — planting, quality, improvement cuttings. Height must be taken for type, & especially for density. Mainly needed for volume growth. For ordinary tables, H.G. got from complete stem analysis & plotted. For use in getting vol. of even aged stands, we get the average height of the stand & of the test trees. Many use H.G. on Diam. classes, & on H.G. class.

End

Prof. Evans. (cont.)

After first description, comes prior & present treatment, effects, possibility of perfection. & finally brief statement of what should be done, when, frequency as applied to tract in hand should be. also ways analyze the ownership. Should be able to estimate the growth & stand roughly. E.g. Harriman hardwoods:

Years	Mean Ann. Growth I	II	III	Chestnut
10-20	.58	.28	?	.71
20-30	.86	.46	.28	1.00
30-40	.74	.51	.37	1.05
40-50	.65	.38	.26	.9[illegible]
50-60	.56	.31	.20	.74
60-70	.47	.36	.16	.59

Give accr. here of Harriman figures — first, yield, market, cost of cutting

Harriman Farms

Expenses		Selling Price
Marking	.05 - .10 per cd.	3.50
Chopping	.85	
Hauling	1.00 - 1.25	
Loading	.25	
Shipping	1.75	
	2.90 - 3.20	
	75	
	3.95	

and hauling, marking, taking of wood, loading shipping, final profit. Then topography & distance affected the wood job. All these points - at least roughly - must be taken stock of in the field. Exam. Read Olmsted on the Cooper River Timberlands.

I. Management a term from French damen. agement. Differs here from European sense wh. is organized. Then must be profitable. Economic considerations the basis for forest policy. E.g. grit reserve & reclamation work. Management depends on practicability - on forest production - forest growth - increment per unit of area. European work now mostly revision & checking of plans already made. Here we have methods mostly to make. Hence our field Exams. must be different - it outlines & limits the management

Mayr
Boitlard
Pater
Loeber
Gutenberg

Forestry 7 Oct. 12th

Prel. Exam. must first settle the practicability of forestry, which is usually unnecessary in Europe. Prel. thus highly important.

The Working Plan embodies the management in detail - gives the plan of work. Lumberman have W.Ps but without the provision for continuity of yield. The W.P. is of varying degrees of elaborateness according to the size & ownership of tract. Complete report. Whether Prel. or plan must avoid technicality & information already known to owner, such as area, bounds etc. All details only to man ignorant of tract. Tracts of any size need maps - stock maps showing, usually, types, age, & yield, and natural or artificial boundaries. In regular W.P. maps first is divided into compartments for convenience of reference & treatment. May or may not correspond with type lines. Bounds for ease in

working. With W.P. 9ers in such cases finest description by compartments for locating work. Often done a regular form sheet with columns for work done as well as descriptive data. Next task for J.J will be a type map with provisional compartment lines put. To this end rough topography must be put in to show justification for choice of bounds. On top of this map - not large - we shall likely make a small W.P. this autumn. Scheme somewhat as follows:

I Introductory

1. General accounts of work & policy.
2. Results to be accomplished.
3. List of prescriptions.
4. Cost
5. Profit

II

Description of property. Land classification &c.

II

1. The Forest – General

a. Origin b. Age c Composition d. Size e Condition f. Yield g. Growth

III

1. Treatment Recommended, Special work for first period.

2. Plan of Protection

3. Superintendence, men to be employed, Statement of their duties.

Such is a Silvicultural W. P. wh. is not strictly speaking a real W. P.

Regulation – the purely financial adjustment of the Policy – is not the main thing. Other points are stronger. Form for Comp's Disc. may be needed; for record of returns, costs & profits.

	Cd	Ties	Poles	Timber	Costs	Rts	Profit
C. I							
C. II							
C III							

For future of planting may be wanted. Follow figures v Chestnut from Maltby.

Dom. Trees in Forest

age	St. Dib.	Dob bh.	10 ft	20 ft	30 ft	35 ft
10	2.1	2.1	1.35	0.3		
20	5.4	5.1	4.3	3.4	0.9	
30	8.7	7.8	6.9	6.1	3.7	
40	11.5	9.7	8.9	8.	5.8	5
50	13.7	11.3	10.6	9.5	7.3	6.5
60		12.5	11.9	10.7	8.6	7.8

From 39 trees. Gives hint of benefit from thinnings.

Trees in Open

age	St. Dib	Dob. bh.	10 ft	20 ft	30 ft.	35
20	7.8	7.4	5.9	4.5	2.5	
30	13.2	11.5	9.8	8.	6.0	
40	18.5	15.3	13.2	11.0	7.9	
50	23.4	18.5	15.9	13.4	11.2	

From 29 trees So. Ct.

May such figures be approached by early & frequent thinning?

F.7

Vol. Table - Red Oak

Dbl. Made at N.H. on 135 sprout tree

	Height of tree in feet											
	20	25	30	35	40	45	50	55	60	65	70	75
5	1.23	1.61	1.91	2.24	2.55	2.91	3.12	3.40	3.66			
6	1.78	2.31	2.83	3.31	3.77	4.22	4.61	5.04	5.45	5.81	6.16	
7			3.79	4.40	5.08	5.68	6.25	6.79	7.32	7.81	8.31	8.78
8			4.88	5.75	6.56	7.31	7.99	8.75	9.43	10.07	10.70	11.31
9					8.31	9.27	10.13	10.97	11.76	12.62	13.31	14.04
10							12.62	13.64	14.63	15.62	16.52	17.42
11							15.70	16.87	18.04	19.16	20.18	21.17
12									22.33	23.62	24.90	26.04
13									27.33	28.85	30.34	31.62

Dbl	80 foot
7	9.27
8	11.93
9	14.75
10	18.30
11	22.15
12	27.15
13	32.98

7.7

Vol. Table, Chestnut

Based on 118 Sprouts, N. H.

Heights in feet

DBH	35	40	45	50	55	60	65
5	1.9	2.3	2.7	3.2			
6	2.57	3.2	3.8	4.2	4.72		
7	3.42	4.2	4.9	5.6	6.25	6.8	7.5
8	4.7	5.6	6.5	7.3	8.1	8.9	9.7
9	6.1	7.2	8.2	9.2	10.3	11.2	12.3
10	7.7	9.0	10.3	11.7	12.9	14.0	15.1
11		11.7	13.2	14.7	16.1	18.1	18.7

Vol. Table White Oak - 105 trees, N. H.

DBH	20	30	40	50	60		
5	1.2	1.9	2.5	3.0	3.6		
6		2.8	3.6	4.5	5.3		
7		3.8	5.1	6.2	7.1		
8		5.3	6.9	8.2	9.5		
9			8.8	10.4	11.8		
10				12.9	14.7		
11					17.4		

Estimates based on vol. tables must be corrected for lopwood, since these tables consider only boles. Foresters allow 25% for limbwood. 15 to 20% is nearer. Figures taken at Kew Haven behind choppers, for red oak, gave following percentages

11%	for	5 in.	Converting factor - cords
10	"	6	
8.8	"	7	For defl wood .. 0.7
7.4	"	8	" small rounded wood 6
6.3	"	9	
5.4	"	10	
4.4	"	11	

Products locally dealt in are: cordwood ties, poles, & piles & posts.

Poles 10 to 15 to m. about $1.00 on stump; so better than as logs.

S. N. E. Co's specification for delivered poles are:

30 ft. (13 in Dol 5 ft. up) $ 2.75
35 14 " 3.50

40 ft (16 in 5 ft up) $4.50
50 17 " 7.50

Chestnut desirable wood

Piling commonly 35 ft, 7 in. Dob at top any species. 75¢ on stump. Posts, cedar & chestnut, 7½ ft, 6 in. Dib. from 10¢ to 25¢ delivered. Ties 25¢ for no. 2, 40¢ for No. 1.
No. 1; 8 ft. 6 in face, 6 in thick; which a rock oak & chestnut. No. 2 have 5 in. face. 100% of 2s are allowed

---

Forest Capital

Forest a producing fund, yielding interest. Hence any hurt to it diminishes producing power. Our courts do not recognize future yield. E.g. young growth burns. For sound forestry must have safety from fire & reckless cutting. Ordinary lumbering reduces capital. Large Companies get land enough to allow for constant growing stock. Sustained yield: equilibrium bet. amounts cut & amounts growing

Too much left in stand may block growth & reproduction: Removals have to maintain production by just right amt. of cutting. Sustained annual yield; sustained periodic yield. Points governing the sustained yield: permanent & government ownership; need of paying for steady administration & of helping out revenue. Conditions making for S. y. are long & safe organization such as Europe's. Why sustained yields is not for our Govt yet. More general welfare has brought about our reservations. Attitude of U. S. toward reserves. A few to pay for all, most being merely protection forests. Question of reservation by purchase. No precedent here. Appalachian Park first effort.

Policy

Extensive & intensive forestry: one, as coppice with low capital tied up, other as high forest, with much & for long.

Austria has financial rotation of 80 years; Bavaria has 144 years. With sacrifice of highest rate of interest. On good forests not yet touched by question of interest. Public good in general terms has been only argument.

Other owners

Rich men with comfy estates. Many such. Have differences and do not know what they want. Usually not anxious about comp. interest. Self supporting work will satisfy him. Like relations but does not need them. Management not always limited by impossibility of profit. Best thing is to achieve owner's wishes & improve stand as well. Sometimes cash is needed. In such cases (& others) best silviculture is not possible & compromise is always legitimate.

Towns & Institutions. Commonly have forests, held as parks. Question here mainly silvicultural. Management has thus to be highly conservative. Defends

a individual case.

Railroads require (commonly) to see profit in enterprise - this a profit at a cheap rate. You must be sure of data. You not yet data enough to satisfy such owners who ask about compound interest. Same with Canadian Companies, who wants something new. Wilcox said to them: "You must be able to tell them whether the thing will pay."

Water Companies. Special case, must have priority of a sort.

Sporting Clubs. Risky ownership in view of changes in officers & expenses. Often are heavily & turn to priority for an income which is naturally, then, impossible.

Bx Companies we sometimes have land for them on subdivision, will adopt priority if returns are immediate & if there is prospect of a rise in price with growth as well.

Un Residential Houses. Must take Com.

pay or for speculation. Can expect chiefly return from a rise in price. Often has to cut at once.

Farmers. Thus can often practice best silviculture owing to small holding costs cutting & supervision. Not concerned with interest. Has his own labor & must supply it. Also good wood lot is best asset. Improvement enhances the value of his farm. Many farmers treat their woods extremely well. Trusty for such easy to start.

Financial questions ~~requiring~~ involved in determination of management can be solved only through a study of growth. & the first Germans are already informed. Our conclusions so far scanty. Hence need for study of growth. With us the pure science of it is always complicated with the economic side. Must solve the individual problem. Had better read up & refresh on growth & in German of

Connect qr. with Mr. Forest

possible. at least in White Pine & measuring the forest crop.

Growth - ascertained from first measurement which is really a part of Management. Separated for convenience. Growth must be studied for Diam. Ht. Vol. & sometimes Wt. - single trees & whole stand. Usually consider diam. & basal area. Latter represent actual growth, while d. indicates only a dimension. Starting theory of growth. Depends on food supply; greatest near crown; stem swell due to sap congestion at coolest point. Modern theory of mechanical strain causing irritation & stimulation. Scanty embrion may cause food to rush a past usual place of deposit. Prof. Graves has proved the strain theory for pine. Insufficient nourishment sometimes confuses this law. Owing to eccentricities of growth take all data - a Dbh. a reduce to dbh. value.

D: (Basal Ar.) & Ht: to get Vol.

Kinds of Growth Increment & accretion

F.7

Virgin Woods
Broken woods
Woods where mixture must be changed
Second Growth

Conditions with us are make growth hard to study. Few plantations. Adaptation forest. Poor species, injuries, feeble health. In such abnormal stands d. unusually risky as an index of vol., especially where stimulated increment is to be measured. For increase may be low on bole & vol. hence not in proportion. Growth is determined in Europe for different types & qualities, but also stands are types. Else will get false results. If took 25% slope thus & 75% flat disproportionate conclusion is plain. With even aged stands, if all under management, method would be simple – thinnings and all. Difference bet. average diam. at given age & various diam. really occurring at the given age. The latter for vol., the former for economic age. Tables showing avg. age for different diameters. Useful in description & to reckon economic age, but

See Bull. 26

not safe as an index of future growth. Diam. growth of diam. classes. Used in selection forests, but requires careful ~~sele~~ choice of trees. Basal area more accurate than diam. as a basis.

Points on Growth. Measuring measurements for diam growth. Preparation of sections. aver. radius. swollen areas. Should correct be made at breast or ground? Need of accuracy on stumps. Ways of reducing stump readings to breast height value. False rings. Selection of trees for diam. records. Number of trees at least 100. Trees well chosen better than many at random. Different expressions of diam growth. 1. Growth of different diam. without regard to age. Not very accurate. Used for predicting future cuts. 2. Aver. age of different diams. 3. Aver. diam. at various ages. Used as general statement. Economic age shows when tree is capable of reaching, leaving out abnormalities. Diameter growth on cut over a

7.7

called lands. Growth greater at stump than elsewhere on acct. of increased assimilation & skin restricting it. Systems of partial clearances gaining in Europe. Cushion to gale rotation avoids windfall & lets drying out of soil. Girdling & increment at once on acct. of trees being still vigorous. With such treatment: 1. Young trees will show increase. 2. Butt growth does not represent actual volume growth. Ht. growth is also necessary to make volume tables. Rate shown for different periods. Times for ht. tables should ordinarily be dominant, which have, of course, always been so. Exception is very tolerant species. Applies to even aged stands. Always after 30th year to species other than tolerant. In aver. ht. growth a table of the relation of maximum to aver. ht. at any age is made. Few trees suffice for ht. data, as ht. growth is more

7.7

regular than diam. Sometimes ht. growth for different hts. regardless of age may be made, might be used in predicting immediate increment. Also have tables of ht. based on diameter. Note here relation of ht. to diameter in even aged stand. Vol. growth is figured by the combination of proper ht. & diam. data. Same principles of selection apply as for diam. growth. Vol. increment is expressed in % of vol. of tree, simple interest. Called growth per cent. Growth for next few years is obtained by prolonging the curve of past growth. German method of setting growth percent for standing trees by using the growth percent of basal area. Only good for trees, like old opening stands, in which ht. may be disregarded.

Schwappach: Holzmesskunde 139 & 140

Schneider's method

$$p = \frac{400}{nD}$$

also

$$\frac{b-u}{b+u} \times \frac{200}{n} = p.$$

7.7

n. = no. years in last inch.

Val. growth of whole stands. Such are basis of working plans. Increment for a given tract for a given period. Get by compartments. Sample plots give stand without tree to be removed in thinnings, - enumeration by classes & species. Rate of growth (a any val. calculation) is then determined for each species and group by sample trees. Uneven aged stands after cutting. Such are constantly studied by Bureau, as see Bull. 26 - already taken up under head of diam. increment. In general, for q. tables of uneven aged stands, get large no. plots different ages fully stocked. Figure contents of each. Get dist. of loc., group thoroughly, and work out. Difficulty to get fully stocked area. European rule is that stands of same age & loc. should not vary more than 15 % in basal area.

Bull. 26 on growth

Have always to throw out plots too fully stocked & plots too poorly. This method works fairly well, tho arbitrary. To ascertain Qual of Loc.

an 2 methods. 1. Find some old stands normally stocked & get ht. curve of dom. trees. Get such curves for each qual. — assign younger stands to qualities they approach nearest. Too yr old stands are divided into arbitrary qualities. Germans in 1888 agreed on lines of vol. as dividing qualities classes. 2. Method is Baur's — curves of vol for different situations, — cut the area included by limit curves into zones. Sometimes average hts. of plots instead of volume. Difficulty in getting mixed even aged stands grouped in U.S. is that surface of different species produce different diams., so this broad area

Schlich Pt II Chap I - VI

J.7

Have now (supposed) covered chief computations of growth. Primary use is to fix rotation or cutting maturity. Usual need is, when does money increment culminate? But rotation is not merely a matter of money yield. Other requirements of the utilities of forest have a bearing. Life history of tree shows diff. time - physical rotation. Following dimensions with reference to age shows rotation at which is most valuable for a certain purpose - technical rotation. Volume curve for a wood gives R. of max. Vol Production. None of these may agree with the best return on the investment. Nor does Rotation of Highest Income - not with out interest & inspection of time when items of return occur. Diff betw sum yields - costs ÷ by T. Financial R. represents most significant measure of value of forest. Is rot of highest net return, with given percent & comp. interest.

All these types of R. must be taken in light of public policy as well as private work & enterprise. Cf. great varieties of purposes forests serve. Money yield the main thing, but must not lose sight of other considerations, protection, beautification etc.

Cannot be taken as unit for stocking. Solution has yet got.

Schwarzly on diam-growth of Scots pine Dorchwachstum

Further on Growth of Stands

First, what is to be included in contents? Consider under this head uses of the product. Cf. diam limit & round-edge lumber for box boards. We need such data. In making tables, many steps requiring system & order, getting files notes, arrangement thereof, location of sample plots, work thereon; choice of normal stand; what plots to throw out; grouping of data & construction of tables.

Forestry as an Investment

Gov't, in irrigation & reserve project does not figure in comp. interest for public good is too obvious on other grounds. These will pay ultimately tho' this not does count. Same with N.Y. Preserve. Private forestry however, is a direct investment - or may be, & it is as such

this we must bear it in advising owners. People want a steady & sure income. A large forest theoretically gives this. Forests differ from bonds in growth & improvement & continuity. Money constantly employed. Have not the instability of stocks, nor are they subject to a fictitious valuation. Differ from house real estate in freedom from depreciation: forests under management improve. Also prices rise. All true for forest long under management. In America case is different. Long investments, shy in act. of shifting tenure of land. Desire for immediate returns. In Europe just finishing up organization of perpetual investments which have come to be believed in. Large lumbermen have consider compound interest if at all, on basis of cost value. The speculative spirit will last long yet. It will help foresters, for ability

to buy low and sell high well often depends upon knowledge of intrinsic (true) value which ordinary man does not know. Much low priced land is low only from ignorance of its productive capacity. Returns are expected only on cost value.

Value of forest lands falls under heads:

1. Cost value
2. Sale "
3. Intrinsic "

Figures based usually on cost value. Value useful in many cases, as condemnation proceedings, when works re. land has a value based on possible earning power. So far not so valued in U.S. But always so in Europe. So far has been no one here who could assess land on this basis. Besides, eminent domain, damage is a case when intrinsic value will in time come in – i.e. value on basis of earnings

In such valuation we assume a rate of interest – not more than 5%

F.7

forest cannot produce a high rate of compound interest. High rates of ordinary investments conditioned by their short duration. Hence in forestry we cannot reckon with a high rate. Profitability of forestry worked out with more care than anything but insurance. Low rate is recommended on acct. of security & length of the investment. These do not appeal in U.S. partly on acct. of impatience of investors, partly on acct. of real greater uncertainty of the returns. Fire the last danger in Europe, is the first here. Many forests in Europe will not burn. Nevertheless we must use interest here in dealing with valuation and profits of forest crops.

Income from forestry is usually periodic. in theory regularly so. These returns are considered like any other purely financial income. Have therefore to figure (at need):

1. Future Value - Comp. interest on rentals

J. 7

2. Present Value of future Value

3. Future Value of Periodic returns

4. " " " annual "

5. Present " " future periodic returns

6. " " " annual "

7. Present " " infinite " "

(Read. Fisher's "Economics of Investing" Chaps. II, V, VIII.

Formulae for these little used and not necessary to remember. Know only the cases which they fit & where to find them when needed. Capital value of soil, of growing stock leading to determination of value of forest. Read and discuss in class.

Schlich III, pt II, II, III IV & V.

$$C_0 (1.0p)^m + C_0 (1.0p)^{2m}$$

$$C_0 (1.0p)^M + C_0 (1.0p)^{2M} + C_0 (1.0p)^{3M}$$

$$\cdots \quad C_0 (1.0p)^{NM}$$

$$C_0 \{ 1.0$$

Future value $= \left[R + R(1.0p)^m + R(1.0p)^{2m} \cdots R(1.0p)^{(n-1)m} \right]$

$$a + ar + ar^2 + ar^3 \cdots$$

$$R \frac{(1.0p)^{nm} - 1}{(1.0p)^m - 1} \qquad nm - m \qquad (n-1)m$$

$$S = a + ar + ar^2$$

$$rS = ar + ar^2 + ar^3$$

$$S = a + ar + ar^2 \cdots ar^{n-1}$$

$$rS = ar + ar^2 \cdots + ar^n$$

$$rS - S = -a + ar^n$$

$$S(\cancel{r-1}) = \frac{a(r^n - 1)}{r - 1}$$

$S = 63$

$$S = 1 + 2 + 4 + 8 + 16 + 32$$

$$2S = 2 + 4 + 8 + \cancel{16} + 32 + 64$$

$p = 3$ $m = 5$ $n m = 80$

$$500 \frac{(1.03)^{80} - 1}{(1.03)^{5} - 1} = \frac{9.57}{.1545} = 65 \times 500$$

$\log 1.03 = 0.0128$

$$\begin{array}{r} 0.0128 \\ 80 \\ \hline 1.0240 \end{array}$$

$$\begin{array}{r} 0.0128 \\ 5 \\ \hline .0640 \end{array}$$

10.57

1.1545

$32\,500$

7.2

following. Typical W.P.s (T.40, Pine Bluff, West Point) take policy in other regions - management in larger sense, where conservative lumbering is less possible. Policy the attitude of community toward forest property & production. Thus in effect it is made up of the attitudes of various classes in control of forest.

Take Red Fir Region: Observation; fire laws; taxation stumpage, value, & destruction logging. Fundamental conditions of security & fair taxation in cutting. Have forestry as a commercial scheme is a poor prospect. Limitations to conservative lumbering are all they could be - unbalanced fire, high taxes, expensive logging, overgrown forests. Govt. relieved of some of these obstacles - fire & taxes. & being permanent one, can go in for conservation. Also the small men in settled regions. The favorable element is the productiveness & prolificness of forests. With safe & fair state policy possible management will have a chance to utilize this fast growing forest. The probable method: slash burning & system of reserves & strips. Situation shows how forestry must always wait for stable & safe economic conditions - an organized & intensive forest state.

Forestry 2 - 1906-7

Reading

Oct. 1 Fernow ch. I - IV D'Arcy ch. I

" 8 Bul. Exam. Langille on N. Cascade Res., Olmsted on Cooper River, self on Stephens on lines & outline for wood lot report.

" 29 D'Arcy ch. I Schlich Vol. III, ch. III & IV Fernow ch. V.

Nov. 19 on growth in White Pine & in Bull. 26; also D'Arcy on growth Pine Bluff Working Plan (32); also Bull 60

Working Plans: (also Stolz & Indian)

Forestry 7

Synopsis of Lectures During the First Half Year

Introductory Outline

Forest Management deals with the organization of wood production and the regulation of yield. The crop, or producing stock, ~~which~~ bearing interest in the shape of wood, is technically called Forest Capital and as such distinguished from the Capital Value of Forest Land. Since the interest can be harvested only in the form of merchantable trees (those of the Exploitable age), the yield can be sustained only by a series of progressively ripening stands or age classes, known as a Normal Forest. A crop so constituted is rarely achieved in practice, but it can be approached, and it offers the only model or ideal scheme according to which the Increment or Volume Production of a forest can be interpreted and measured. The ~~the~~ Real Increment of ~~the~~ Real Forest may be compared with the Normal Increment of the Normal Forest for the same area, and the relation between them used

to determine the Possibility, or Sanctioned Yield, that is, the Annual or Periodic Cut. Increment so considered, and ~~[illegible]~~ restricted so as more or less constantly to approach the normal, forms the technical basis for the calculation of the earning power of forest land, both present and future. The ascertainment of this proper increment, and the means whereby it is maintained are (in the strict sense) the chief purposes of the Forest Working Plan.

I The Preliminary Examination: in general

1. Purpose: the practicability of forestry.

a) The Economic Factor: the varying utilities of forests related to varieties in the character and duration of ownership; value and saleability of product.

b) The Silvicultural Factor: detailed forest investigation leading to possibilities and requirements of treatment.

II The Preliminary Examination: in detail

1. Arrangement of Data

a) The Forest: location, area, types, age, reproduction, silvicultural condition, etc.

b) The Stand: estimate of wood, timber etc.

c) Saleability: value, market, cost of marketing, probable profit etc.

d) attitude of Ownership

e) Conclusion as to management, degree of forestry, need of Working Plan etc.

III Forest Organization: the underlying principles of the Working Plan

A. The Normal Forest.

1. The Normal Age Classes

a) area cut under various silvicultural methods.

b) Extent of age classes.

c) Distribution.

2 The Normal Growing Stock.

a) Definition.

b) Relation to age classes and increment

c) Determination as to Volume.

3. The Normal Yield
   a) Definition
   b) Determination by area or volume.
4. Relations among Increment, Growing Stock, and Yield
   a) Allotment of Increment
   b) What Normal Yield is Equal to,
   c) Utilization per cent
5. The Real Compared with the Normal Forest.
   a) Kind of abnormality
   b) Usefulness of the "Normal" idea.

B. Growth or Increment.
1. Function in Forest Regulation.
2. Classes of Growth and Uses of Data.
   a) Height Growth.
   b) Diameter accretion.
   c) Area accretion.
   d) Volume increment.
3. Irregular character of Woods in which Growth must be Studied.
5. Studies classified by
   a) Form of Forest - even or uneven aged

b) The Forest type.
c) Quality of Locality.
d Class of Product.

6. Diameter accretion on a Basis of Age.
   a) For Even aged Stands by
      1. Analysis of all trees on selected plots.
      2. Analysis of average trees.
      3. averaging analyses of trees of all Sizes
      4. Direct measurement of standing trees.

   b) For uneven aged Stands by
      1. Computing average age for required diameters
      2. Computing rate of accretion for each diameter class.

7. Area Accretion: use and calculation
8. Height growth: use and calculation.

for p. 2 notes

1

Management

Introductory. Basis of management is organization, determination or regulation of yield. This presupposes taking the crop as capital or producing stock yielding interest in the shape of increment. Only the growing stock is here meant; when it comes to translating the wood yield into money, the value of land &c. has to be received in. Since timber is only saleable at a mean maturity the increment of a crop has to be taken off in merchantable trees, ~~that~~ so that to secure the possible increment it is necessary to have a series of crops or age classes which will maintain a regular supply of grown trees. The means of achieving this purpose, depending on a much investigation of the forest + its economic situation, when determined, are embodied in a report called the working plan. Note here the contribution of all other branches of forestry to this conclusion.

The purpose

The Capital or Producing Stock

Constitution of the crop in an organized forest. Simple series of even aged stands on equal areas. This is capital in a true sense, but only part of the capital value of the forest. Normal and abnormal capital. Age classes may be irregularly distributed and still be normal. Possible to have all degrees of distribution from equal areas of each age class to complete intermingling of selection forest. Though age classes must be equal in amount with reference to total area, the number of trees in each is not - being greatest in the youngest. E.g. It follows then as to the producing capital in an organized forest that, (a) for a definite yield a complete series of age classes is necessary, however distributed; (b) in such a normal capital the exploitable yearly [material = mean average an. production. This amount is yearly collected in the annual cope; let the the amount of an. ~~a fe~~ yield bear

always a fixed relation to the total cap. which is greater as the rotation is increased. Increasing the rotation however, does not increase the yield in the same proportion. The name given to ~~regularly~~ an organized forest producing a sustained yield at the best rate of which the soil is capable is the normal forest. It has a silvicultural as well as an economic significance. The normality depends upon the rotation or method of treatment. E.g. normal selection forest would not be normal if considered under another system. Perfectly normal forest purely ideal. Abnormality in fact consists either in too much or too little growing stock, deficient age classes, or poor growth. The necessity in real forestry of a working plan thus follows from the essence of forest capital. If the income (increment) is to be constant, the growing stock must be measured and organized so as to offer a more and more nearly normal

output at regular intervals. In a physical sense the capital, the producing machinery, is itself the product. Hence it must be built up & accumulated to a certain point before production is normal. If normal regulation be the aim, it is then very easy to sacrifice indispensable growing stock while apparently deriving benefit in immediate profit.

Exploitable Age. The age of the tree when fit for the purpose intended. Distinguish from rotation or revolution; latter (strictly) interval between successive cuttings on same area & equal to exploitable age, but true except for coppice. Trees not cut always at Expl. age on acct. of irregularity in growing stock. Determination of Expl. age. age of sized trees that will bring the best return - price & interest. Indirect Expl. age. This age varies with ownership as well as market.

Oct. 9

Increment - increase in vol. mean + current annual. Define. Tot. production (with thinnings) goes to make up mean an. increment. Course of increment with (thn); (crop).

Possibility - in theory the full wood producing power of a given area. Really, what may be cut without harm to the growing stock. abnormal q. st. requires compensative cutting. Aim to allow stock approach to normal.

Prescription of Possibility. By (area), (No. of trees), (volume). Number used in standards + selection forest. Usually area limits the cut wh. is measured also by vol. or number. Vol. alone used in methods regenerating by successive thinnings. Sustained yield impossible until time elapsed sufficient for establishment nor. q. st.

Income + Interest revenue = net income. Usually stated with reference to area. If yield is periodic, revenue taken by average + comp. interest used.

Interest = rel. between money value of forest (land + forest capital &c) + net annual income. Measurement of interest derivable under differing treatment of forest finances

Reading in Forestry

To Mid years 1907

Schlich, Manual of Forestry (2d. Ed.) Vol. III Pt. III Ch. III-VII.

Fernow, Economics of Forestry, chaps. I - V incl.

D'Arcy, Forest Working Plans, chaps. I & II

Pinchot & Graves, The White Pine } portions on growth
Bulletin 26

Typical Preliminary Examinations as required for reference at desk in Gov't Hall; Bulletin 60; Examples of Reports on forest reserves in parts V Annual Reports of the U.S. Geological Survey.

OUTLINE OF BIBLIOGRAPHY ON THE LUMBER BUSINESS

References to be classified in two groups (1) General and (2) Regional. Titles in each group to follow the divisions given below:

Name of Region or General

1. Timber and Forests
   - (Geographic limits
   - (Physiography and climate
   - (Principal species and types
   - (Stands per acre and existing stumpage
   - (Land and stumpage values
   - (Accessibility and lines of shipment
   - (Maps

2. Operation
   - (Character of ownership
   - (Methods of acquisition
   - (Financing - bonds
   - (Type of logging - equipment, organization, costs
   - (Utilization and uses
   - (Land control - maps, classified estimates, survey
   - (Taxation
   - (State and Federal restrictions
   - (Fire protection

3. Sawmills and Manufacture
   - (Types of mill and machinery
   - (Utilization of waste
   - (Grades and grading
   - (Kiln drying and seasoning
   - (Yards and yard plans
   - (Other forest products

4. Distribution
   - (Markets and uses
   - (Method shipment and rates
   - (Selling agencies
   - (Direct buyers
   - (Selling methods
   - (Production and distribution
   - (Wood substitutes

5. Labor Relations

6. Association activities

7. Forest management

Please Return
to R. T. Fisher
Petersham Mass

Field Notes on Woods Operations
for Filing in
Compartment & Experiment Records

Princ. of Forestry

L. 1 Measurements

Intro. Course to cover the forest as a material (units of measurement, use + relations) including growth; as a crop, life history, fers, + reproduction; operates as a renewable resource. Example of value of measuration + check on growth + growth: Hellen Dorkey estimate; Ala. Co. with cutting shifted to older age classes raising net return + lengthening the life of the enterprise. Cubic vol. the basis for reckoning total stem material + for scientific work. Lumber manufacture gets from 30 to 40% only, except in pulp. πr $\frac{axl}{2}$ $v = \frac{A+a}{2} \times l$ $\frac{axl}{3}$. Computation of Cu. Vol. + working up illustrated by diagram. Sawing + resulting waste: slab, robbing of taper, saw kerf, variable with gauge. Round edge + square edge sawing. The board foot + its applied — round + square edge. Log rules, construction + use. (1) formula e.g. Doyle $\left(\frac{D-4}{4}\right)^2 \times l$; (2) diagrams; (3) mill tally. Comp. accuracy + application.

Reading Gross Mens. Ch. II. Get comm. + comm. of Doyle, Scribner, Spaulding, Interna'l Int. rules

based over by circle table

L. 2

Cubic volume is the real criterion of usable material

Inches on board measure of round edge: middle dib., allowing for wane, crook, rot etc. Defect easier to determine because deducted automatically from each board.

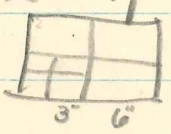
Gross measure 5 + 8 chops.

Scaling: the stick; diam in even inches, lengths by standards in market, or in long logs by wheel; logs tallied by l. + dib + worked up in office; checked when measured. allowance for defect. classes of, methods, generally done by judgment.

Comparison bet bd. ft + cu. contents. Cu. ft yields more bd ft. as diam increases. Range from 4 to 8. Ave. 6

U.S. only board foot correlating (except Canada)

Cord measure: dimensions of cord; a cord foot; different lengths in use. Amt. cu. ft in cord; factors governing, size of stick, species, length, split or round. Show uniformity of vol regardless of diam if all sticks perfect, smooth + straight



550 bd ft per cord in average size logs. Local equivalents vary from 300 to 1000

Discuss field trips; days, transport,

Feb. 7/22 L. 4

Winding log scales with A. D. L. charts. How sound analysis of softly & utility of material must proceed from cubic measure acct. variability of cord & bd. ft. Expand of Doyle, Scribner, Maine, Mill Tally.

Ultimate marketability & hence value of wood depends on possible utility, what it is good for. This kind of quality cannot be measured for trade purposes by a unit of vol. or wt. Broadly speaking the main obvious differences in usefulness of woods are differences in kind (species), as hickory for strength & flexibility, cedar for durability without strength, yellow pine for stiffness (structural). Beyond this, and within each kind of timber, are wide variations in quality arising from structural features of the tree itself – size, life history, open grown or not, injuries suffered, and finally seasoning. These factors underly the standards & specifications under which lumber has come to be bought & sold – grading rules. Lumbermen must take up chief points in physiology & growth. Illuminating cutting etc.

L. 3

Written test on Reading & Pictures

Take 2

Mont & Brown Ch. I, II
Nisbet Chap. IV

1. What are log scales and how are they constructed?

5 2. In a region of close utilization & small timber which of the following rules would you recommend for adoption and why: Doyle, Maine (Holland), International?

Get Woodsman's handbook

3. Discuss the relation between cords & cubic measure.

Tree - anatomy & functions of growth

Root - nutrition

Stem - distribution & support

leaves (~~crown~~) - assimilation

Formation of the annual ring; growth throughout the tree. Parts of tree as classified for measurement & study. Crown, d.l., merch. l, dbh, sects. (if any) by ln & dib

L.3

Volume Tables: definition, construction, different types of, general + local

Get Graves's handbook

Timber estimating: strip surveys + how to make it.

Field Trip: strip surveys + ht. measurements

Read Graves Ch. ~~IX~~, ~~XI~~, XII

L.4

Life history of a forest

Prof's Oct. '16 Utility + R.R. Cuttings

Seedling 0 - 3': high mortality, soil relations

Small sapling 3' - 10": closing up, crown, natural pruning

Large sapling ~~Small pole~~ 10" - 4": ht. gr. accelerates, tree class, pruning

Small ~~Large~~ pole 4" - 8": ht. culminates, mortality slows.

Large pole 8" - 12": Vol. culminates.

Standard 12" - 24": crowns spread as ht. declines with not tipping to crowns

Vet. a metus 24"+: little ht. gr. flat crowns seed production

Overmature - decline.

First Year Class (22)

	Brown M.C.	uncertain as to job
	Cabe, John	✓
✓	Gaynor	?
	Gillis J.C.	uncertain
	Gulledge E.L.	✓
✓	Harrier, L.G.	?
	Kerhn, G	✓
✓	McAlister J.B.	✓
	Pierson C.W	uncertain
✓	Rogers, D.R	?
✓	Fay	(auditor)

2 Cuts - New Hampshire trip & sickness

L. 5 Discussion of strip surveys. How to combine type map with estimate: gridironing from a base line. Show diagram. Area fundamental in estimate based on plots or yield per acre. Different forms of plots: 1/4 A circle r = 59' square plots. The sample tree: in uniform stands I may do, or several by major diameter classes. Range of method from guess to tree to tree. Choice of method based on form of stand, area, size and value of trees, limits of cost etc.

Valuation. Enumeration of costs leading to stumpage price. Cost items in portable operation. Discuss stumpage: factors governing.

Type map & photos

L. 6 Cont. of above. detail of small mill costs & organization.

Field trip Wayland Rd. 6A pine Est. Est. by 2 crews: (1) Sample tree & tree count. (2) Strip method.

Feb. 21

Cont. Analysis Stumpage:

Net or operating value = Gross price − (Cost + profit)
Stumpage price = going rate of sales
Cost value = Exp. of growing or carrying charges

marginal producer

In all types of value the main factors are
(1) Quality & Price of product
(2) Investment required, incl. group of method, layout etc
(3) Operating costs

Stumpage's raw material - from cheap, high grade old growth, through higher prices, scarcity to poorer grades, + finally to second. Hence enters element of growth, + possible renewal.

Outline Operating Costs

Types? Depr. wear & tear? Interest?

L.7

Discussion of finished estimates.
Costs as related to conditions on lot = chopping 4 men @ 4.00 = $2.50; logging 2 teams & stumpers @ 8.00 = 2.50; sawing small job $5.00; sticking 2 teams $24.00 = $1.50. Total $12.00. Hauling $2.00. Profit stumpage — price. Rel. to owner.

How forest as raw material differs from that of other industries. e.g. coal, cotton etc.

Growth as related to management.
Changes in economic status of forest raw material from days of big supply & cheap land to those of scarcity & high stumpage. Three possible business relations:

1 Just — incent raw material

2. Just + growth of present stands

3. Just + present stands + renewable crop

Each dependent on certain economic + political conditions. Indirect relation of forests to industry + public: influences.

Jump now Ch. V + VI now VII Ch. VIII

Interest Problems due Mar. 17

Mar. 14 Described construction of the gold letters

L. 8 ~~Reading test~~ Cont. L. 7

Reading test Jan. 14 Wed.
Constr. + Use of Yield Tables. Field Problem Jan 12

L. 9 Growth of an existing stand. Use in finding yield in money or rate of interest represented by growth. Defs. Diam. Secti area, Ht. Vol. Increment = growth in usual practice, i.e. Volume. Quality incr., price incr. Current Ann. growth, periodic, and mean annual. Growth per cent. Obtained by $p = \frac{v-v}{v+v} \times \frac{200}{n}$

or $p = \frac{400}{ND}$

Problem in use of Yield tables. Construction: selection of plots, limits of basal area 150%, ht. of dom. trees determines quality. Vols. plotted + curved accts age + quality.

To use Y. Yield table on stand as follows: Mixed hd. stand 50 acres. Price with land $75 per acre. Assumed stumpage price (future) $15 per M.

Find vol. at 70 years & value at stumpage of #15. Use ht. dom. trees to fix quality considering also age. Figure basal area take ratio bet. actual & yield table b.a. for reducing vol. as given in yield table.

Dbh.					age Ave. ht. dom. trees Tot. basal area

L. 10 Sick-Cut.

Mon
Ch. XIII +
XIV

L. 11 Discuss yield problem.
Discussion report on drill operation: amp of bit & lay out of job. Opinion of drill location as relates to drawing in, sticking, stripping, water etc. Organization of crews & probable cost.

L. 12. Discuss mill problem.

Report on mill job

Map on separate sheet, showing shape of lot & principal natural & art. features, roads, bounds streams, location of principal timber stands & layout of job, mill site, stick yard

Text. Location, area, topography, bottom, stand, age density, dbh & ht., distribution.

Organization & conduct of job by persons chopping, logging &c: size of each crew & economy & efficiency of work

Summary with portable cost as basis on output.

L. 13

1

Summary of Lectures to Midyears

The Forest Resource from Point of view of the Lumber industry

Engineering or Business

Measurement

1. Board measure & the board foot, rules & squaring logs.
2. Cubic & Cord measure; allowances for cutting trees
3. Log Scales, construction & use
4. Volume tables, ditto
5. Timber Estimate
   Cruiser, tree count (sample trees) plot or strip involving total area. Mapping incl. or not
6. Utilization
   Gross price – cost of marketing + profit
6. Growth
   Yield tables, construction & use
   Definitions of Growth

Biological

~~Physiology of Tree~~

1. Functions of Crown stem & root; formation of the annual ring
2. Life History of Timber Crop
   Natural help & competition
   Progress of soil improvement, nat. planting, his growth &c to maturity & decline.
3. Indirect Relations of forests to life & industry.
   Influence upon soil, water distribution, local climate, health & recreation.

Summary (Cont.)

7 Formulas for profit sharing

$$p = \frac{v-d}{v+r} \times \frac{2ro}{N} \text{ (mid. hr.)}$$

$$p = \frac{2ou}{N.D}$$

8. Valuation

Stumpage price = Gross price − Cost of operation + profit

~~Analysis of~~ Organization & costs for small mill

References given to date

Graves Ch. II, V, VIII, IX, XI, XII
Fernow " V, VI
Moore & Brown " I, II, VIII, XIII, XIV,

L. 14 Read Graves Ch. XIV
Discuss quiz table & stumpage Fernow Ch. V & VIII
write. Exam Questions

Valuation of future yields carrying charges as distinguished from operating costs: int., taxes, protection, administration (overhead)

Triplett & Outline. Wood identification

L. 15 Valuation (Cont.)

Present Value of standing so far

E. g.

Logging { Cutting Logs
Drawing in

Milling { Sawing
Stickering

Transp. { Handling & Trucking
Freight

Int.
Ins.
Taxes

Difference bet Operating cost + profit selling and Gross Cost.

L. 16

Future Value. how different, what items added:

Land + Cost of formation - plant or standing left
from imp'ts

Silvicult work } Protection
Administration
Taxes
Interest

Taking case of investing in new crop on bare land

These items single (or initial) and recurrent. all must be reckoned at compound interest for the period of the expected rotation as determined by growth study & yield tables. Future value of crop

Synopsis of ~~Forestry Course~~
First Year Course
1 ~~Mensuration~~ Forestry and Lumbering

Lumber: ~~The~~ board ~~foot~~ measure; square & round edge lumber.
~~Cutwork &c.; Cord measure~~

Logs: Log scales; bd. ft. contents for length and diam.; cubic measure; cord measure.

Single trees: Volume tables, contents on ht and dbh

Whole stands: Estimates of stumpage. (1) with wind control by strip or sample plot and by sample trees, (2) by the counts ~~partial or entire~~. Types ~~etc~~ & mapping.
Growth: Yield tables, growth percent
~~Vol. growth.~~
2 - Silvics & Silviculture

Natural history of the forest

Physiology of a tree, growth and the annual ring; progress of a stand, crown cover & soil, natural pruning, increment & thickness

The seven stages, maturity & reproduction.
S. Cortes of species and the fundamental forms of stand-type & growth agent.
Principal methods of obtaining natural reproduction

Operation of a timber tract:
organization, equipment & costs

Valuation of Stumpage
(Op. costs + profit) – gross price.
Price as related to grade. Physical characters grading is based on.
Grading rules, number, use, & variability.

Analysis of investment in timberland
distinguish: merchantable stumpage, immature stands, organized forest – a system & yield.

Constitution of the Organized forest.
Normal gr. st, inc. & age classes

Carrying charges or the costs of Forestry

(1) Taxes, interest, prot., administ.

(2) Direct cost logging, planting or the stumpage, marking trees

Taxation, prevailing methods, scientific principles, examples of reform

Protection, nature and extent of fire damage, factors to control, protective organization or by State or Forest Service.

Management & Financing of the State Forest

Discussion of Cost accounting

Practise of Forestry by Reynes

(see L. 23).

is diff. bt. summation of costs and stumpage value of final stand. Use of compound interest formulae

Present value of future crop

E.g. Sapling or poleswood. Discounting a future return - see above.

Amount of capital required to yield interest equivalent to the future yield.

L. 17. Some problems in Valuation - due Feb. 16

1. Costs of forest nop - initial

Land #5*

Planting 7.

Taxes 2% est. Comp 50 years = #15

Protection (omit)

Cut at 50 years, actual net return is #4939.04 for 20 acres. Figuring 4% on investment what is the profit per acre?

2. 30 acres bought in 1918 for #1200. Taxes paid to date #21. each year. Offered for stumpage on 3 acres in 1921 (Feb.) #800. Acc. to yield table will be 30 M per acre balance of area

Taxes 2%
Val. 1000 - 1 yr.
" 2000 - 2 "
3500 10 "

Selection System – Rough heterogeneous

Clear Cutting System
- Whole area
- Strip methods
- Cleared Groups
- Seed Tree

Shelterwood System
- Standard Comp't Method
- Group "
- Shelterwood Strip "

Methods vary in
(1) Cost of operation
(2) Investment in seed trees or remaining stand
(3) Effect on fire risk – slash disposal
(4) Success of reproduction – weeds w. desired species
(5)

in 40 years, worth at least $15. an stump. What will be the final return on the investment, figuring interest at 4 %?

Wood structure on Friday?

Read from ch. III + IV

L. 18 Discussion distribution, regions, definition of forest types.

L. 19 Brief definition of "silvics of species" with examples of conspicuously contrasting habits, such as Douglas fir + Hemlock. Many ages + even aged forms — indicating reproductive habits of species + hence probable methods of handling. Three kinds of reproduction: seed, sprout, + suckers. Discussion. First, high forest. With latter four methods or silviculture systems are recognized: selection, clear cutting, shelterwood or seed, coppice. Take up in order. Preliminary definitions: Rotation, reproduction period

Bogaloo

Performation in between
with Cooler business

L. 19 & 20. "Systems" cont

Topics for interpolated lectures bearing on Practice of Forestry

1. Fire - effects on forest & soil use in S. Industries, control by protection & prevention measures.
2. Taxation - actual & ideal

L. 21 Analysis of Principal items making up the cost of forestry.

I Maintenance of Reserve

1. Increased cost of Logging
2. Cost of planting or stumpage tied up
3. " " Marking Trees

Moon Ch. VII

N. Y. Cons. Com. Bulletin

Ontario Circular

II Fire Protection

III Taxation

IV Administration

Lake Fire - 8 mil. horse & team

Kinds of fire @ 20-30 mil.

Surface, Ground, Crown

$$\frac{V-v}{V+v} \times \frac{200}{N}$$

$$\frac{7000}{67000} \times \frac{200}{5} = \frac{1,400,000}{335000} =$$

335 | 1400 (4.5
1340
600

7000
200
1400000

5 | 4000 (1.4
8000
5000
2500000

55,000 | 2500000

Describe the construction and indicate by a skeleton form the make-up of a yield table. How is it applied to an actual forest?

In ~~For~~ a tract ~~100 acres~~ of pine land ~~the~~ following are ~~actual~~ volumes per A at the ages indicated:

40 years	30 000 ~~33,500~~ ft
45 "	37,000 40,700 "
60 "	~~57,000~~ " 53,000
65	61,700 " 57000

Find the growth per cent at 45 + 65 years.

Define or explain the following terms: roundwood, stumpage price, quality increment, diagram scale, annual ring, dominant tree, natural pruning, merchantable length.

Spring 1912

Problem 7 in 25

Investment as related to profitable cutting age

A. Jones owns 30 acres second growth Pine in Mass. assessed @ 75. per A; tax 2½%
Ans. 0 ;

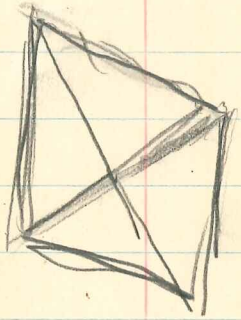
Now selling a stump for 9. with measure.

Effects on Timber, soil, reproduction & future composition of forest
Causes, human, engines, lightning

Status of Protection

Public by state laws

Prevention - Education
- Penalty for setting
- liability for damage
- Spark arresters
- Slash disposal



Control - Warden & lookout system with skeleton organization & equipment, & power to gather volunteers.

Private: e.g. N.W. Forest Conservation

Protection to be achieved by study of conditions to be met - the classes of hazard i.e. combustibility, risk (by starting), character & distribution of neighboring population. Organization built in relation thereto - public, private or corporative. Attitude of general

public final factor of rot. Must be changed. Improvement shows in legal status of valuation for business ~~[illegible]~~ in mature growth. Expectation value recognized in S. Dak. cases ~~[illegible]~~. Replacement cost frequently standard

Field trip Patton's lecture

L. 22 Discussion grading pine grading rules in relation to Falls timber & visit to Blocker & Shepard. Ref. F.S. Bulletin on grading. In selling intimate knowledge of lumber qualities and trade needs do not to be replaced by printed rules

L. 23 Outline for discussion of Practise of Forestry by Regions

The Forest: topography, distribution composition, yield, stories & princip species.

Lumbering: history, ownership methods as related to lumber & physical factors, utilization, effects upon forest, present condition of logged lands, slash, fire, grazing, weeds

~~to other disease~~

Production of Future Crops:

Silviculture re (a) cutting method (b) planting & seeding (c) improving young growth, local factors of taxation, protection, utilization and market as controlling practicability. Yield of second growth & probable return on investment.

L. 24 [Pattern lecture]

Problem: Marketing a pine woodlot. 30 A. Mills pine bought @ $10. per M. mill measure. Contract can be let to put on sticks @ $13 per M. Ins. @ 2%; Int. @ 4½%. H. B. & W. Co offers $40 per M f.o.b factory, mill run sawed 1" round edge; costs 2.50 to deliver by truck. With a delivery cost of $4.00 is it better or worse to saw it to possible grades & sell in Boston?

Procedure: Caliper every tree on one acre (to be treated) & work out grade percents by averaging estimates of all. Note at yard specifications & sizes especially bark & extremely knots & stubs for each standard grade, & if possible wholesale price.

Report Synopsis
Instruments
date due

Graded

Apr. 1922 Blechner & Shepard

\# 1 Barn Interior 130.
\# 2 " " 110.
\# 3 " " 90.

\# 1 Cats (2) $150-175.

Patton to lecture Mar. 9

L. x 25. Problem due Mar. 14

Discuss Yardstick + grading. Agree on B.&S. grades. Show difference in regrade of two assignments at same price. Value to operator should depend on proportionate quality & grade in sale. Show synopsis of disposal of Tessenden Bros stumpage.

How is final problem affected by B.&S. data?

Timberland (Stumpage) (Value + marketing chiefly dependent on quality)

Sold as Box Shook stock 70-90%; price $30-32

Sold as Butts + second cuts (Sash + blind or better than box). Price $50-60.

How far can sellers cut into retailers profit? Could he sell direct at retail prices.

How define quality in face of varying grading standards.

Mention growing effect + contrast between "cork" pine + second growth.

Regrades as:

No. 1 Cut + better	$125
" 2 "	to
" 1 + 2 Box	
3 "	$40
Box	

To comment
1/3 of course

Fills Lot
Operating & Selling Plan

Timber Est. & Logging Condition

Location
Area
Topog. & Co. Slope, Bottoms
Timber Est. by Spec. & grade

(Bought March A23 for $3000)

Operating Plan Logging Prog. &c.

Mill site, yard, roads, outlets
Size of crews
~~Cost~~ Program of work by dates

Map

Machinery plan, saw bill

Discussion available logging with effect of cost of sawing & delivery
Saw bill decided upon

Costs & Patterns

Instruments at 36 Quincy St
Signs & Patterns. Woods work in crews if desired.

"Economic & other limitations on forest production."

Value of forest products
Completeness of utilization
Rate of growth
Cost of maintaining reproduction
Taxation - amount, method
Protection - degree, cost.

L. 26 Management Standard Forest
Location & area
Forest Conditions - & previous history
&c

S. to. policy
L. 27 Growing Stock & yield
Logging & milling
Protection
Costs & Returns

Point is to get a basis of actual exp. in forestry for judging possibilities in financial return

Forest paid all expenses to date & still let operating costs & gross has averaged 2000 to 3000. expense of incidental work & exp. improvements, and instructional equipment, ~~[illegible]~~ information ~~[illegible]~~ has been required all this

Practicability of operating on a sustained yield basis must be judged with reference to the

~~While~~ On the other hand, while all the
consignment purposes of units
~~Dormagemant~~ ~~can be carried~~ can be
carried out on a commercial
scale and thus provide substantial
~~interest of units~~ figures of cost,
the area is not large enough
~~either~~ to keep the organization
and equipment ~~occupied with~~
continuously occupied in the marketing
of fruit products

most efficient size of unit of
arrangement - land & organization -
this is possible under existing
conditions. If the present maximum
allowable yield, when corn forms the 4 ½,
(app 400 M) the return would be ~~=~~ not less
than $3600. per annum. This is figuring
the operating exp. ~~at~~ $16 slack
disposal 50 ¢, + supervision $2.
~~and~~ Interest + insurance $1.00, and
an average tax (tot. land ÷ by
output in bd. ft.) of 50 ¢, and
Stumpage at 6. If 10000 acres
instead of 2000 were under the same
management ~~same~~ the expenses + supervision
together could be cut down at least
$1 per M. which would mean
a corresponding increase in return
per M. Thus the total ~~other~~ ~~tot~~
for a larger unit would be not
$18000 but $20000.

So far this accounting is based solely on
the financing and annual operation of
the existing stumpage. ~~Such~~ is a strong
point. Next step is to reckon the
~~taxes~~ expenses involved in maintaining and
perpetuating the production i.e. replacing the stand

Off $26

flat price of $35

Orig. price $55,000
Int at 6% $3300
Saving net $17,000

without which no enterprise in portion can be permanent as soon as the stand

are: (1) slash disposal (2) increased cost of logging ~~due to~~ (3) direct outlay on clearing a wooded natural reproduction crop. On the Experimental Farm this was already included in the calculation as charged to operating expenses. The third represents money spent in order to tide up in future yields. ~~and~~ It should be included as a carrying charge ~~against~~ at compound interest against the ultimate stumpage on land acre cut over. ~~and reproduced to a new crop~~

Second item: Land value may be high because of small stumpage value

?

In practice this item has averaged less than $10. per acre. The annual cut from the 1000 acre unit, allowing for the influence of poor stocking on drained lands, would not average to cover more than 100 acres. If these deductions for reproduction paid out of receipts, it would reduce the total amount returned by $1000. On the other hand this sum would go into the capital account together with land value, where it would represent the accumulating cost of the stumpage it was spent to produce.

cor. cot planting (labor + stock) #10. per A.
Disengagement 5. "

Just how long
after cot
planting &c

L. 28

Prot. could be left out as covered by general tax through public organization. 3 & would would be fair for ~~prior~~ annual cut. fact: (1) on periodic sitting valuation as now customary assumption being the investment in new crop is independent + not part of going fact on a sustained yield; (2) eliminated as covered or sustained yield by annual returns; (3) on new State forest tax basis.

L. 29

1909

Price $35,000 (incl. land $10,000)

Stand 10½ million

Inc. 250 M

Int. @ 4½%

planting work & vacation

Costs 1928 $

Off. st. to car 40%	16.
Slash	.50
Super. + overhead	2.00
Tax	.50
Int. + ins.	1.00
Stumpage or int. on cost	6.00
	26.
Base price	35
Net	9.

?

1919

Stand 12½ million

Incr. 380 M

allow. cut 400 "

Contract stand 14,000 cds.

" Incr. 500 "

Value stumpage + land going prices $150,000

Cost of new crop above logging $10. per A.

Subject of Lumber Thesis

Fire Protection Cost & Results.

Losses of - with insurance secured, post-o & comfort of lands &c.

Proportion of incr. yield due to management?

70 acres planted
30 " improved

Date of Petersham Trip
Return. - apr. 1 ~ end of term; scope
Marie - lies + fire figures.

5. Changes in prices + selling dress through future of large lumber + struggle to avoid sales.

Character production
Ownership
Logging
Distribution - increasing freights as centers of supply are worked out & left.

Tendencies

1. Transportation bears an increasing % of cost ($10 South to N.Y.; $22 Pac. to N.Y.) but prices of offence rises out of proportion.

2. Constant improvements in utilization through by products of salable spec. & uses for inferior spec.

75% private; 250 owners hold 50%

3. Large holdings characteristic of N.E., South & West followed in worked out regions by small units, small mills, and more complete manufacture on a mill i.e. near timber.

4. General pressure of decreasing timber supply rising value, increasing costs, forcing policies of continuous management & land. Agitation for better tax, better fire protection and public control are specific directions wh. this tendency takes. Prom. ownership & stable communities.

← over

Forest Regions

I Atlantic

1. Northern Forest
   (a) Lake States
   (b) Northeast or Spruce Region
   (c) Appalachian Region
2. Southern Pine Region
3. Central Hardwoods

II Pacific

1. Rocky Mt. Forest
   (a) No. Rockies (Inland Empire)
   (b) Central Rockies
   (c) So. "
2. Pacific Coast Forest
   (a) NW Coast (Douglas Fir)
   (b) Sierra Region
   (c) Redwood Region

~~For~~ each: prime species, market distribution, logging + milling methods, ownership.

Suggested Program in Forestry 1905-06
(Forest in Petersham acquired 1907-08)

Freshman year

First half	Second half
Introd. Botany	Introd. Botany
1a. Silviculture	1b Practical silviculture

Sophomore year

2 Forest measurements	4 Forest protection
3 Forest botany	3 For. Bot. (cont'd)

Junior year

5 For. history	
6 Lumbering	6 Lumbering (cont'd)

Senior year

7 Forest management	7 For. Mgt (cont'd)
9 Anat., development, phylogeny of the higher pines + deciduous trees	6 Bacteria, mycetozoa, fungi

Four courses at a time was the standard work load, so full instruction in Forestry would have taken half a man's time. He would not have qualified for A.B. degree; nothing said here about B.S. degree.

FORESTRY.

None of the courses in Forestry can be counted towards the degree of A.B.

For Undergraduates and Graduates.

*1a ¹hf. Elements of Silviculture. *Half-course (first half-year). Tu., Th., at 10, with additional hours for field work.* Mr. FISHER. (XI)

*1b ²hf. Practical Silviculture. *Half-course (second half-year). Tu., Th., at 10, with additional hours for field work.* Mr. ——. (XI)

*2 ¹hf. Forest Measurements. *Half-course (first half-year). Mon., Wed., at 11, with additional hours for field and laboratory work.* Mr. ——. (IV)

*3. Forest Botany. *Mon., Wed., at 9, with additional hours for field work.* Mr. JACK. (II)

*4 ²hf. Forest Protection. *Half-course (second half-year). Tu., Th., at 10.* Mr. FISHER. (XI)

*5 ¹hf. Forest History. *Half-course (first half-year). Tu., Th., at 10.* Mr. ——. (XI)

*6. Lumbering. *Tu., Th., at 11.* Messrs. FISHER and ——. (XII)

*7. Forest Management. *Mon., Wed., at 10, with additional hours for field work.* Messrs. FISHER and ——. (III)

Attention is called to the following courses offered by the Department of Botany, which, in addition to certain introductory courses in Botany, form part of the instruction in Forestry: —

[*6 ²hf. The Bacteria, Mycetozoa, and Higher Fungi. — Lectures and laboratory work. *Half-course (second half-year). Tu., Th., Sat., at 11.* Professor THAXTER and an assistant.] (XII)
Omitted in 1905–06.

[*9 ¹hf. The Anatomy, Development, and Phylogeny of the Siphonogama (Higher Gymnosperms and the Angiosperms). — Lectures and laboratory work. *Half-course (first half-year). Tu., Th., at 9.* Asst. Professor JEFFREY and an assistant.] (X)
Omitted in 1905–06.
