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CIRCULAR.

Sale of Timber in Forest Reserves.

R

DEPARTMENT OF THE INTERIOR,

GENERAL LAND OFFICE,

WASHINGTON, D. C., *January 22, 1902.*

GENERAL.

1. Timber will be sold, both live and dead, wherever the removal of such material will be beneficial, or at least not detrimental, to the forest reserves.

2. In the disposition of this material the local demand will have preference, and, in localities where this local demand is so great that all available timber is likely to be needed, applications involving the export of the material to distant points will be refused.

HOW THE TIMBER MAY BE PURCHASED.

1. The applicant who wishes to purchase timber will apply, in person or in writing, to the supervisor of the reserve, stating—

(*a*) How much timber he wishes to buy;

(*b*) The kind of material desired;

(*c*) Where the timber is located.

2. As soon as practicable the supervisor or his assistant will go over the ground with the applicant, and determine whether the timber may be sold, under what conditions, and at what price.

3. After an agreement is reached the applicant should sign a definite application, prepared on the regular form, with the assistance of the forest officer.

4. After this, the forest officer marks out the block or area where the timber may be cut, maps it, and estimates the amount of timber on the whole, and also the particular kind applied for. He also makes a general forest description of the tract, block, or quarter section.

5. Then the application, together with the forest officer's description and recommendation, is sent to the Department at Washington.

6. If approved, the timber will be advertised in a local paper for thirty days (sixty days in California). This advertisement will be

waived only in cases where the amount involved in the sale is of $100 stumpage value, or less

7. Bids on this timber will then be in order. These bids, together with a deposit (insuring the good faith of the bidder), should be sent by the bidders to the receiver of the local land office, and the bid will be forwarded from that office to the Department.

8. At the end of thirty days (sixty days in California), the timber will be awarded to the highest bidder; and if the applicant is the successful bidder, the deposit is credited on the sale; if not, the money will be refunded.

9. When the timber is awarded the applicant will sign a contract containing the specifications contained in the original application, as to manner of cutting, scaling and cleaning up, etc., and, if the case seems to justify it, he will be asked to give a bond, usually in an amount double the value of the timber, to secure the proper fulfillment of the contract.

10. Cutting may then begin.

11. The material will be skidded or piled in the customary manner, and the purchaser is required to mark the tops of the logs to facilitate scaling.

12. The scaling will be done in the customary way by the old Scribner rule, by which the contents of a 16-foot log are as follows:

Diameter inside of bark.	Contents in ft. b. m.	Diameter inside of bark.	Contents in ft. b. m.	Diameter inside of bark.	Contents in ft. b. m.
Inches.		*Inches.*		*Inches.*	
6	9	21	304	36	923
7	16	22	334	37	1,029
8	25	23	377	38	1,068
9	36	24	404	39	1,120
10	49	25	459	40	1,204
11	64	26	500	41	1,272
12	79	27	548	42	1,343
13	97	28	582	43	1,396
14	114	29	609	44	1,480
15	142	30	657	45	1,518
16	159	31	710	46	1,587
17	185	32	736	47	1,656
18	213	33	784	48	1,728
19	240	34	800		
20	280	35	876		

This rule applies to saw timber and mining timber. Logs of 24 feet and over in length are scaled at more than one point; so that a log 24 feet long, for instance, is scaled at 16 feet and at the top. In other words, long pieces are treated as 16-foot logs and fractions thereof.

Square-hewed goods are measured like sawed timber, as solid pieces. Thus, an 8 by 12 inch 16-foot timber contains 128 feet board measure.

Railway ties are simply counted, and

30 ties, 8 feet in length, equal 1,000 feet board measure.

40 ties, 6 feet in length, equal 1,000 feet board measure.

Cordwood is measured in the ordinary way. Where green timber 10 inches and over in diameter is cut into cordwood it is charged as timber, and two cords are considered equal to 1,000 feet board measure.

13. The scaling will be done according to the conditions of the case. If the cutting is on a sufficiently large scale, it will be done in such a way as to keep up with the work; otherwise, the scaling will be done at set times.

14. All timber must be marked with the U. S. stamp before it may be removed.

The following blank forms for application and contract filled in as samples will be used in all timber sales:

4—178.

No. *123*.

PUBLIC TIMBER SALE.

Black Hills Forest Reserve.

APPLICATION.

I hereby make application for the sale and purchase of timber located and described as follows: *100* M feet B. M., saw timber, green or dry; *no* M feet B. M., mining timber, green or dry; *no* railroad ties, —— green, —— dry; *250 cords* cordwood, —— green, *and* dry ——; and is located *SW.* ¼, *SW.* ¼, *S. 25, T. 3 N., R. 3 E.* To be used at *mines near Deadwood.*

I promise to deposit with the receiver of public moneys at the United States land office at *Rapid City, S. Dak.*, such sum as may be required at the time of filing my bid for the above-described timber, and I further promise that in case my application is favorably considered I will deposit with the said receiver such sum as may be required to cover the cost of advertising for bids for the purchase of this timber, and in the event that the timber is awarded to me as the successful bidder I promise to pay to the said receiver the amount covered by my bid. [Here insert the condition of payment, whether full cash payment or one-third down and the balance in thirty, sixty, and ninety days, as the case may be.] *Cash in advance, at price of: $2.50 per M ft. B. M. for timber; 30 cents per cord for cordwood of all kinds;* credit being given for the sums heretofore deposited with the said receiver by me in connection with this sale and purchase; which, otherwise, will be refunded to me.

And I further agree and promise to conduct the work of cutting and removing said timber in accordance with the following specifications:

1. I will comply strictly with the laws and the regulations governing forest reserves.

2. Submit all timber and wood to measurement by the forest officer before the same is removed.

3. Pay in advance for all timber before cutting the same.

4. To cut only timber on the area agreed upon and blazed and marked, and not to cut any of the live trees bounding this area.

5. To leave no logs, ties, lagging, or other material in the woods, and to pay double the agreed price for any material thus left in the woods.

6. To pay for all material used in shanties or buildings of any kind; also for material used in the construction of skidways, corduroy, log roads, bridges, and other improvements.

7. To cut only marked timber, and to cut all marked timber.

8. To leave no trees lodged in process of felling.

9. That all material is marked on skidway or in pile, the amount to be placed in plain figures at top or on blaze near by, and that no material will be piled on such skidway or pile after the scaling has been finished.

10. All felling and cutting with saw, *except firewood.*

11. Stumps —— high; none higher than *18 inches.*

12. Shaft of tree to be used to diameter of *6* inches, ——.

13. Cordwood to be cut from all tops down to a diameter of *3* inches.

14. Tops to be dragged bodily into openings ready for burning. *See 15.*

15. Tops to be lopped and brush piled *on entire area.*

16. No hewing, except at skidways in openings ——.

17. No cutting of timber in summer season between month of —— and —— *Waived in this case.*

18. Cut all dead material sound enough for fuel ——.

19. Cut only standing dead material. *See No. 18.*

20. Cut only and all dead material. *Dead and green allowed.*

21. Build camps at place agreed upon, located ——, as per map ——. *No camps allowed in this case.*

22. Construct dam at point agreed upon, located at ——, as per map ——. *No dams allowed in this case.*

23. To pile or skid all material before measuring ——.

24. Scaling to be done [once a week or month, continuously, to keep up with cutting] *once a week*, the maximum to be not over *20* M feet B. M., and *25* cords, —— ties per day or week *per week.*

I further agree that in case my bid for this timber is accepted I will execute a contract embodying the above provisions for the purchase of said timber, and deliver therewith a bond which shall be satisfactory to the forest officers for the faithful performance of the conditions imposed in said contract; and I further agree that in case of failure on my part to fulfill, all and singular, the requirements of said contract I will forfeit the said bond and all moneys paid to the receiver of public moneys herein mentioned.

JNO. DOE.

Dated at *Hill City, S. Dak., Jan. 15,* 190*2.*

4—179.

No. *123.*

PUBLIC TIMBER SALE.

Black Hills Forest Reserve.

CONTRACT.

This contract is hereby entered into by and between *Jno. Doe*, party of the first part, and the Secretary of the Interior for the United States of America, party of the second part, for the purchase of certain public timber in the *Black Hills* Forest

Reserve, based upon the bid of the said *Jno. Doe* for said timber, submitted in pursuance of a duly advertised proposal to sell said timber, which bid has been accepted by the Secretary of the Interior, said bid and advertisement being made a part of this contract.

Approximately 100 M feet B. M., saw timber, green or dry; *no* M feet B. M., mining timber, green or dry; *no* railroad ties, —— green, —— dry; *250 cords* cordwood, —— green, *and* dry. *All timber to be removed within one year from date of this contract*, and is located *SW. ¼ of SW. ¼, S. 25, T. 3 N., R. 2 E.* To be used at *mines near Deadwood.*

In consideration of the sale of this timber to me I, *Jno. Doe*, promise to pay the Receiver of Public Moneys at the United States Land Office at *Rapid City, S. Dak.*, the sum of *three hundred and twenty-five* dollars ($*325*), being at the rate of $*2.50 per thousand for timber and 30 cents per cord for cordwood, entire sum cash in advance*, credit being given for the sums heretofore deposited with the said Receiver by me in connection with this sale and purchase.

And I further agree and promise to conduct the work of cutting and removing said timber in accordance with the following specifications:

1. I will comply strictly with the laws and the regulations governing forest reserves.

2. Submit all timber and wood to measurement by the forest officer before the same is removed.

3. Pay in advance for all timber before cutting the same.

4. To cut only timber on the area agreed upon and blazed and marked, and not to cut any of the live trees bounding this area.

5. To leave no logs, ties, lagging, or other material in the woods, and to pay double the agreed price for any material thus left in the woods.

6. To pay for all materials used in shanties or buildings of any kind; also for material used in the construction of skidways, corduroy, log roads, bridges, and other improvements.

7. To cut only marked timber, and to cut all marked timber.

8. To leave no trees lodged in process of felling.

9. That all material is marked on skidway or in pile, the amount to be placed in plain figures at the top or on the blaze near by, and that no material will be piled on such skidway or pile after the scaling has been finished.

10. All felling and cutting with saw, *except firewood.*

11. Stumps —— high; none higher than *18″*.

12. Shaft of tree to be used to diameter of *6* inches, ——.

13. Cordwood to be cut from all tops down to a diameter of *3* inches.

14. Tops to be dragged bodily into openings ready for burning. *See No. 15.*

15. Tops to be lopped and brush piled *on entire area.*

16. No hewing, except at skidways in openings ——.

17. No cutting of timber in summer season between month of —— and —— *Waived in this case.*

18. Cut all dead material sound enough for fuel ——.

19. Cut only standing dead material. *See No. 18.*

20. Cut only and all dead material. *Dead and green allowed.*

21. Build camps at place agreed upon, located ——, as per map ——. *No camps allowed in this case.*

22. Construct dam at point agreed upon, located at ——, as per map ——. *No dams allowed in this case.*

23. To pile or skid all material before measuring ——.

24. Scaling to be done [once a week or month, continuously, to keep up with

cutting] *once a week*, the maximum to be not over *20* M feet B. M., and *25* cords, —— ties per day or week *per week*.

And as a further guarantee of a faithful performance of the conditions of this contract, I have executed and deliver herewith a bond in twice the amount of the purchase price named in this contract, which bond shall be forfeited, together with all moneys paid or promised under this contract, upon failure upon my part to fulfill, all and singular, the conditions and requirements herein set forth or made a part hereof.

Given under my hand at *Lead, S. Dak.*, this *20* day of *Feb.*, 190*2*.

JNO. DOE.

Given under my hand at Washington, D. C., this *15* day of *March*, 190*2*.

——— ———, Secretary of the Interior.

SPECIAL CONSIDERATIONS.

The following considerations are of special importance:

1. Applications will be considered and attended to in the order in which they are received; but exceptions to this rule will occur, with special local conditions, such as isolation of particular cutting, great distances, insufficient force of workers, etc.

2. All applications in any reserve will be held up and delayed whenever it becomes evident that the reserve force, for any reason whatever, fails to carry out the work according to the prescribed regulations.

3. In every case, the timber purchased is not the *amount* called for in the application, but the amount actually found on the cutting area as located and marked out by the forest officer. If there is less timber on this area than the applicant desires, he must make a new application, but is *never* allowed to cut over the original line as laid down for his case.

4. The following violations of the regulations will be regarded as trespass, and will lead to a suspension of all operations until the case is settled:

(*a*) Cutting across the line surrounding the cutting area;

(*b*) Cutting of unmarked timber;

(*c*) Removal of any material before it is properly scaled and stamped or marked.

5. Since a considerable time is necessarily required in attending to any case of timber sale, and the law positively forbids any short-cut methods, the public is earnestly requested not to delay applications of this kind.

6. When the applicant fails to hear of his application in a reasonable time, say thirty days, he should address letters both to the supervisor and to the honorable Commissioner of the General Land Office, Washington, D. C.

7. Any incivilities, or evident neglect on the part of the forest officers which hinders the purchaser in his work or endangers his case by giving to it the appearance of willful or negligent trespass, should be reported to the supervisor, and, if not promptly corrected, should be reported to the Commissioner of the General Land Office.

8. Trespassers, in the absence of a proper settlement for the trespass, will not be awarded timber.

BINGER HERMANN,
Commissioner.

Approved, January 22, 1902,
E. A. HITCHCOCK,
Secretary of the Interior.

Issued December 5, 1908.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 340.

DECLARATION OF GOVERNORS FOR CONSERVATION OF NATURAL RESOURCES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., October 28, 1908.

SIR: Believing that the Declaration of Governors adopted at the recent conference on conservation of our natural resources is worthy of the widest circulation among the people, and that it will do more than anything else that could be published to arouse a popular interest in this very important subject, I respectfully recommend its issuance as a Farmers' Bulletin.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

DECLARATION OF GOVERNORS FOR CONSERVATION OF NATURAL RESOURCES.

INTRODUCTION.

The Declaration of Governors contained in this bulletin was adopted by the conference of governors of the States and Territories called by the President to consider the conservation of our natural resources, and which met at the White House May 13, 14, and 15, 1908. Besides the governors there were invited to the conference the members of the Cabinet, the justices of the Supreme Court, the members of both Houses of Congress, representatives of the great national organizations, the Inland Waterways Commission, and, as special guests, Hon. William Jennings Bryan, Mr. James J. Hill, Mr. Andrew Carnegie, and Mr. John Mitchell. The late ex-President Grover Cleveland was also invited as a special guest, but illness prevented him from attending. At the request of the President each governor brought with him to the conference three citizens from his State or Territory to act as assistants or advisers.

The object of the conference was stated by the President in his letter of invitation to the governors, in which he said:

> It seems to me time for the country to take account of its natural resources, and to inquire how long they are likely to last. We are prosperous now; we should not forget that it will be just as important to our descendants to be prosperous in their time.

Papers which discussed the present state of our various natural resources were read by experts and specialists in each respective line, and these were followed by an open discussion among the governors of the points brought out.

The conference then appointed a committee to draft a declaration, consisting of the following: Governor NEWTON C. BLANCHARD, of Louisiana; Governor JOHN FRANKLIN FORT, of New Jersey; Governor J. O. DAVIDSON, of Wisconsin; Governor JOHN C. CUTLER, of Utah; and Governor MARTIN F. ANSEL, of South Carolina.

This committee prepared and submitted the declaration which follows, and it was unanimously adopted by the conference of governors as embodying their conclusions on the question of conservation.

DECLARATION.

We, the governors of the States and Territories of the United States of America, in conference assembled, do hereby declare the conviction that the great prosperity of our country rests upon the abundant resources of the land chosen by our forefathers for their homes, and where they laid the foundation of this great nation.

We look upon these resources as a heritage to be made use of in establishing and promoting the comfort, prosperity, and happiness of the American people, but not to be wasted, deteriorated, or needlessly destroyed.

We agree that our country's future is involved in this; that the great natural resources supply the material basis upon which our civilization must continue to depend, and upon which the perpetuity of the nation itself rests.

We agree, in the light of the facts brought to our knowledge and from information received from sources which we can not doubt, that this material basis is threatened with exhaustion. Even as each succeeding generation from the birth of the nation has performed its part in promoting the progress and development of the Republic, so do we in this generation recognize it as a high duty to perform our part; and this duty in large degree lies in the adoption of measures for the conservation of the natural wealth of the country.

We declare our firm conviction that this conservation of our natural resources is a subject of transcendent importance, which should engage unremittingly the attention of the nation, the States, and the people in earnest cooperation. These natural resources include the land on which we live and which yields our food; the living waters which fertilize the soil, supply power, and form great avenues of commerce; the forests which yield the materials for our homes, prevent erosion of the soil, and conserve the navigation and other uses of the streams; and the minerals which form the basis of our industrial life, and supply us with heat, light, and power.

We agree that the land should be so used that erosion and soil wash shall cease; and that there should be reclamation of arid and semiarid regions by means of irrigation, and of swamp and overflowed regions by means of drainage; that the waters should be so conserved and used as to promote navigation, to enable the arid regions to be reclaimed by irrigation, and to develop power in the interests of the people; that the forests which regulate our rivers, support our industries, and promote the fertility and productiveness of the soil should be preserved and perpetuated; that the minerals found so abundantly beneath the surface should be so used as to prolong their utility; that the beauty, healthfulness, and habitability of our country should be preserved and increased; that sources of national wealth exist for the benefit of the people, and that monopoly thereof should not be tolerated.

We commend the wise forethought of the President in sounding the note of warning as to the waste and exhaustion of the natural resources of the country, and signify our high appreciation of his action in calling this conference to consider the same and to seek remedies therefor through cooperation of the Nation and the States.

We agree that this cooperation should find expression in suitable action by the Congress within the limits of and coextensive with the national jurisdiction of the subject, and, complementary thereto, by the legislatures of the several States within the limits of and coextensive with their jurisdiction.

We declare the conviction that in the use of the national resources our independent States are interdependent and bound together by ties of mutual benefits, responsibilities, and duties.

We agree in the wisdom of future conferences between the President, Members of Congress, and the governors of States on the conservation of our natural resources with a view of continued cooperation and action on the lines suggested; and to this end we advise that from time to time, as in his judgment may seem wise, the President call the governors of States and Members of Congress and others into conference.

We agree that further action is advisable to ascertain the present condition of our natural resources and to promote the conservation of the same; and to that end we recommend the appointment by each State of a commission on the conservation of natural resources, to cooperate with each other and with any similar commission of the Federal Government.

We urge the continuation and extension of forest policies adapted to secure the husbanding and renewal of our diminishing timber supply, the prevention of soil erosion, the protection of headwaters, and the maintenance of the purity and navigability of our streams. We recognize that the private ownership of forest lands entails responsibilities in the interests of all the people, and we favor the enactment of laws looking to the protection and replacement of privately owned forests.

We recognize in our waters a most valuable asset of the people of the United States, and we recommend the enactment of laws looking to the conservation of water resources for irrigation, water supply, power, and navigation, to the end that navigable and source streams may be brought under complete control and fully utilized for every purpose. We especially urge on the Federal Congress the immediate adoption of a wise, active, and thorough waterway policy, providing for the prompt improvement of our streams and the conservation of their watersheds required for the uses of commerce and the protection of the interests of our people.

We recommend the enactment of laws looking to the prevention of waste in the mining and extraction of coal, oil, gas, and other minerals with a view to their wise conservation for the use of the people, and to the protection of human life in the mines.

Let us conserve the foundations of our prosperity.

O

PUBLIC LANDS COMMISSION.

[Senate Document No. 188, Fifty-eighth Congress, second session.]

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES, SUBMITTING THE PRELIMINARY REPORT OF THE PUBLIC LANDS COMMISSION APPOINTED OCTOBER 22, 1903, TO REPORT UPON THE CONDITION, OPERATION, AND EFFECT OF THE PRESENT LAND LAWS, AND TO RECOMMEND SUCH CHANGES AS ARE NEEDED.

[Senate Document No. 154, Fifty-eighth Congress, third session.]

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES, SUBMITTING THE SECOND PARTIAL REPORT OF THE PUBLIC LANDS COMMISSION, APPOINTED OCTOBER 22, 1903, TO REPORT UPON THE CONDITION, OPERATION, AND EFFECT OF THE PRESENT LAND LAWS.

58TH CONGRESS, 2d Session. | SENATE. | DOCUMENT No. 188.

PUBLIC LANDS COMMISSION.

MESSAGE

FROM THE

PRESIDENT OF THE UNITED STATES,

SUBMITTING

THE PRELIMINARY REPORT OF THE PUBLIC LANDS COMMISSION APPOINTED OCTOBER 22, 1903, TO REPORT UPON THE CONDITION, OPERATION, AND EFFECT OF THE PRESENT LAND LAWS, AND TO RECOMMEND SUCH CHANGES AS ARE NEEDED.

MARCH 7, 1904.—Read, referred to the Committee on Public Lands, and ordered to be printed.

To the Senate and House of Representatives:

I submit herewith the preliminary report of the Public Lands Commission appointed by me October 22, 1903, to report upon the condition, operation, and effect of the present land laws, and to recommend such changes as are needed to effect the largest practicable disposition of the public lands to actual settlers who will build permanent homes upon them, and to secure in permanence the fullest and most effective use of the resources of the public lands. The subject is one of such great importance and great intricacy that it is impossible for the Commission to report in full thereon at this time. It is now ready, however, to suggest certain changes in the law as set forth in the accompanying report. I commend these suggestions to the favorable consideration of the Congress.

THEODORE ROOSEVELT.

WHITE HOUSE, *March 7, 1904.*

PARTIAL REPORT OF THE PUBLIC LANDS COMMISSION.

WASHINGTON, D. C., *March 7, 1904.*

SIR: This Commission, appointed October 22, 1903, to report to you upon the condition, operation, and effect of the present land laws, and to recommend such changes as are needed to effect the largest practicable disposition of the public lands to actual settlers who will build

permanent homes upon them, and to secure in permanence the fullest and most effective use of the resources of the public lands, respectfully submits the following partial report:

MEETINGS OF COMMISSION.

During the month of December, 1903, the Commission sat in the office of the Commissioner of the General Land Office to receive recommendations and hear the arguments of all who might appear before it. Notice of these sittings was published through the press and special invitations to be present were extended to the public lands committees of the Congress. Senators and Representatives and others appeared before the Commission.

In January, 1904, Messrs. Pinchot and Newell, of the Commission, attended the meetings of the National Livestock Association and of the National Woolgrowers' Associatien in Portland, Oreg., and participated in the sessions of those associations. Returning, they also visited Sacramento, Cal.; Reno, Nev.; Salt Lake City, Utah; Denver, Colo.; Cheyenne, Wyo., and conferred with governors, State land boards, public officials, and citizens generally, and discussed the questions under consideration by the Commission. Upon the return of Messrs. Pinchot and Newell to Washington the meetings of the Commission were resumed.

MAGNITUDE OF PROBLEM.

In approaching the question of attaining the largest practicable disposition of the public lands to actual settlers, and the equally important question of securing the most effective use of these lands, we appreciate that extremely difficult and far-reaching problems are involved. The public lands embrace in area very nearly one-third of the entire extent of the United States and are widely scattered, extending from the Gulf of Mexico to the Pacific and from Canada to Mexico, including every variety of topography and climate. Excluding Alaska there are 23 States and 3 Territories containing public land. This includes approximately from 5 to 95 per cent of the area of these States.

Often in any one State the conditions are so diverse that the man who argues for certain points is usually found to base his argument upon conditions which exist in his locality. If not limited by geographical environment the view point is almost always that of a special industry such as sheep or cattle raising, irrigation, etc., and the arguments are based upon a knowledge of conditions which affect that industry. It is this condition which has led to the presentation before the Commission of irreconcilable statements of exisiting conditions, and the divergence of opinion as to the remedies to be adopted. Certain able men insist that the public land laws are sufficient, and that however the lands are disposed of they will ultimately be put to the best use.

Others go to the other extreme and assert that nearly all of the public land laws should be repealed or modified, that they are incompatible with good administration, and that the lands now being disposed of are held in such a way that they will never furnish homes to people who might otherwise enjoy their use.

Between these two extremes there is a broad middle ground, occupied by the majority of persons who have carefully considered the subject and who agree that changes should be made and that the land laws should be simplified and codified.

ANTIQUATED LAND LAWS.

The information obtained by the Commission through the conferences in the West and the hearings in Washington discloses a prevailing opinion that the present land laws do not fit the conditions of the remaining public lands. Most of these laws and the departmental practices which have grown up under them were framed to suit the lands of the humid region. The public lands which now remain are chiefly arid in character. Hence these laws and practices are no longer well suited for the most economical and effective disposal of lands to actual settlers.

The States and Territories where lies the greater part of the public domain are progressing rapidly in population and wealth, but not in proportion to the disposal of land. In spite of this fact and of the recognition that the land laws might be improved, there is a general fear of change and a wide demand that the present laws be allowed to stand. This is due to dread of the introduction of unfamiliar requirements and to the fear that new enactments may recognize physical conditions even less than the present ones, and may be even less suited to the needs of the country. By the use of practices sanctioned by custom, the people have heretofore been able to get along fairly well; any change in their minds is associated with more difficult requirements, and they dread innovations which may hinder rather than help home making.

The changes suggested at this time have principal bearing upon the control, use, and disposal of the forest lands, as these are among the most valuable of the lands remaining in public ownership. The repeal of the timber and stone act will unquestionably cure the most obvious defect in the administration of the public lands. Next in importance to this is the desert-land law. The Commission is not at present prepared to suggest radical changes in this law, but we believe that the change recommended hereafter in this report, together with a more careful enforcement of the law itself, and especially of those provisions which relate to the adequacy of the permanent water supply, will suffice to insure good results.

TIMBER AND STONE ACT.

Under the act of June 3, 1878, generally known as the timber and stone act, there has lately been an unusual increase in the number of entries, which can not be accounted for by an increase in the demands of commerce or by any unusual settlement of the localities in which the greater part of the entries were made. In 1902 there were 4,022 entries under this act, aggregating 545,253 acres, while in 1903 there were 12,249 such entries, aggregating 1,765,222 acres. A very large proportion of these entries were upon timbered land. The law was enacted to meet the demands of settlers, miners, and others for timber and stone for building, mining, and other purposes. There is much evidence, however, going to show that many entries have been made for purposes not contemplated by the Congress.

Under this law no residence upon nor cultivation of the tract entered is required. An application is made at the local land office in the district in which the land is situated to purchase 160 acres, or less, of land which it is alleged is chiefly valuable for the timber or stone, as the case may be, which it contains. Advertisement is made for sixty days, naming a date upon which evidence will be offered before the local land officers to prove the character of the land. Upon the day named such proof is offered, and, if deemed sufficient and there being no protest nor allegation of fraud or collusion, payment at the rate of $2.50 per acre is made and final receipt is issued. This practically concludes the transaction, the issuing of the patent following in due course of time.

The only grounds upon which the entry by a qualified entryman would be refused are either that the land is not chiefly valuable for timber or stone, or that entry is not being made for the sole use and benefit of the entryman, but for speculative purposes. As the entries under this act are generally made for the timber which the land contains, proof is seldom lacking that the land is chiefly valuable for timber. It is very difficult to prove collusion or that the entry was made for speculative purposes, although it is apparent that many such entries have been made.

In the case of United States *v.* Budd (144 U. S., 154), in a decision made in March, 1892, the United States Supreme Court said (syllabus quoted:

(1) That all the act of June 3, 1878, denounces is a prior agreement by which the patentee acts for another in the purchase.

(2) That M. might rightfully go or send into that vicinity (the vicinity of the land) and make known generally to individuals a willingness to buy timber land at a price in excess of that which it would cost to obtain it from the Government, and that a person knowing of that offer might rightfully go to the land office and purchase a timber lot from the Government and transfer it to M. for the stated excess without violating the act of June 3, 1878.

The Commission believes that Congress did not intend that this law should be used for the acquisition of large tracts of valuable timber land by individuals or corporations, but it has been used for such purposes. Carefulness and vigilance in its administration can not prevent its being so used. A great number of such entries were recently suspended, but the most rigid investigation failed to show that any considerable proportion of them had been made in violation of the law, and the suspensions were removed. The fact remains, however, that many of these entries were made by nonresidents of the State in which the land is situated, who could not use the land nor the timber upon it themselves, and it is apparent that they were made for speculative purposes and will eventually follow the course taken by many previous similar entries and become part of some large timber holding.

While this law is adapted to and chiefly used for the acquisition of timber land, many entries have been made under it where it was alleged that the land is chiefly valuable for stone. There is no doubt that the land in a very large proportion of such entries was not desired on account of the stone which it contained, but for the purpose of obtaining control of water or to add to other holdings. There are, moreover, other laws under which land containing stone may be entered.

Our conclusion is that the law is defective, because even when prop-

erly administered it may be used for purposes for which it was never intended, and we recommend its repeal.

If the timber and stone act is repealed some legislative enactment will be necessary providing for acquiring timber upon the public lands. The manner in which timber upon Indian lands has recently been disposed of suggests a plan for the disposition of this timber upon the public lands. The timber is advertised and sold to the highest bidder, with the result that the market price has been obtained.

In December, 1903, there were two sales of timber upon the ceded portion of the Chippewa Indian Reservation in Minnesota. At the first sale, on December 5, the timber upon 103,027 acres sold for $1,432,771, an average price of $13.90 per acre. At the second sale, on December 28, 95 per cent of the timber upon 72,856 acres sold for $1,218,132, an average price of $16.70 per acre. The amounts to be received from the various purchases are calculated upon the estimated amount of timber upon the land at a stated price per thousand feet, board measure, but the payments will be based upon an actual scale of the logs when cut. Logging operations now in progress indicate that more than the estimated amount of timber will be cut from these lands. It will be observed that but 95 per cent of the timber was sold at the last sale, the remaining 5 per cent being reserved for reforestation.

The average price per acre of both sales is $15.06, and the land is retained for subsequent disposition. Had this land been disposed of under the timber and stone act the price would have been $2.50 per acre for both land and timber. Under these sales the timber on 175,883 acres sold for $2,650,903, and the Government still owns the land. If this land had been disposed of under the timber and stone act the Government would have received for both land and timber the sum of $438,707, a difference of $2,211,196.

Some means should be provided by which the matured timber upon the unreserved public lands may be sold, not only for the use of individuals, but also to supply the demands of commerce. There is now a provision of law for the free use of timber in limited quantities for domestic and mining purposes which meets the requirements of those needing small quantities, but there is no provision for the sale of timber except from forest reserves.

RECOMMENDATION OF SALE OF TIMBER.

We recommend the enactment of a law under which it shall be lawful for the Secretary of the Interior to sell to the highest bidder, at public outcry or otherwise, under such rules and regulations and subject to such conditions and restrictions and in such quantities as he may prescribe, the right to cut and remove, within such period of time as he may fix, any timber from any unappropriated, nonmineral, surveyed public lands, after first having had such timber duly appraised, and after giving public notice of the time, terms, manner, and place of such sale; that he shall have power and authority to reject any and all bids offered at any such sale, and that it shall be unlawful for any purchaser at such sale to sell, transfer, assign, or in any manner alienate the rights secured by him under this act, except as authorized by said Secretary; that the act entitled "An act for the sale of timber lands in the States of California, Oregon, Nevada, and Washington Territory," approved June 3, 1878, and all acts amendatory thereof be repealed, and that no

lands valuable chiefly for timber shall hereafter be patented under the commutation provisions of the homestead laws; that any person who violates any of these provisions, or any regulation or requirement prescribed pursuant thereto, shall forfeit to the United States all benefits conferred, and all moneys paid by him, and that any right to cut and remove timber which he may then hold shall be canceled and revoked.

COMMUTATION CLAUSE OF THE HOMESTEAD ACT.

Much evidence has been submitted tending to show that in the prairie States, where it has been most used, the commutation clause of the homestead act has been of advantage to the settler without causing serious loss to the Government. On the contrary, the Government has been pecuniarily benefited by it, because under this act the land is paid for in cash after fourteen months' residence, while without commutation the entryman would receive a patent after five years' residence without paying for the land. It is no doubt true that the great majority of commutations are made in order to get a title to the land upon which money could be borrowed for its improvement.

There have been abuses of this law as of other land laws, but principally in connection with entries made upon timber lands. It has furnished a convenient means by which an individual could obtain title to 160 acres of valuable timber land which could be readily sold for more than it had cost. In this way large holdings have been acquired.

The timbered areas of the public lands of to-day are generally in mountainous regions, and are not susceptible of a high state of cultivation after being cleared of timber. Entries of such land are seldom made for farming purposes, but if it is desired to do so the settler is permitted, under the law and regulations, to sell any surplus timber upon his claim, the proceeds of which can be used in its improvement. This is a source of revenue available immediately after entry and one which is not enjoyed by the settler upon prairie land.

Our investigations respecting the operations of the commutation clause are still in progress, and we are not prepared at this time to recommend its repeal. We are, however, satisfied that no serious hardship will be imposed upon the actual settler by prohibiting the patenting, under its provisions, of lands chiefly valuable for timber.

DESERT-LAND LAW.

The Commission is of the opinion that the desert-land law should, for the present at least, be allowed to stand, with a few changes in detail. With the experience of the past for guidance it is possible to enforce this law so that its essential provisions shall be complied with. When this is done it is evident that the entryman will have earned a patent at an expense too great for speculative purposes.

The number of entries is not so large as to preclude actual inspection of each by an agent of the Government before final proof is accepted, and the required expenditures for reclamation are of such a character as to be easily ascertained. Especial attention should be directed to the proof that an adequate and permanent water supply has been provided.

There is one defect in this act which should be remedied at once.

The act of March 3, 1891 (26 Stat., 1095), permits the assignment of entries, and to invalidate an entry the illegal intent must assume some tangible form prior to entry. The mere fact that a contract to sell is made after the entry, or any other arrangement whereby the lands are held for some other person, does not warrant cancellation. This feature of the law is the chief objection that might be urged against it.

The right to assign an entry is not in harmony with the fundamental principle underlying the public-land laws that entries should be made for the exclusive benefit of the entryman and not for the benefit of any other person, and its existence practically abrogates the restriction of the act limiting one person to one entry in a compact form, the only actual limitation being to 320 acres, which might embrace a number of noncontiguous tracts taken by assignment.

The interest of the Government and of the actual settler will be protected and promoted by a repeal of so much of the act of March 3, 1891, as permits the assignment of desert-land entries.

AGRICULTURAL LAND IN FOREST RESERVES.

However carefully the boundaries of forest reserves may be selected, it is practically inevitable that more or less agricultural land should be included. Such land usually lies in the narrow valleys of the rivers. Its occupation for agricultural purposes is in the interest of the region in which it lies and of the settlers who would make homes upon it. The presence of the latter in the reserves would, under wise laws, operate distinctly for the protection and general advantage of the reserves. It is essential to the prosperity of the public-land States both that the forest reserves should be maintained and that all of the land within their borders should be put to its best use. To exclude all agricultural lands by Presidential proclamation is not feasible, because of their small area, scattered location, and irregular boundaries. Therefore we recommend that such lands be opened to agricultural entry in the following way:

That the Secretary having supervision of forest reserves may, upon application or otherwise, ascertain, list, and describe, by metes and bounds or otherwise, lands within such reserves which are chiefly valuable for agriculture, and that the lands so listed may, at the expiration of ninety days from the filing of such lists in the land office of the land district in which they are situated, be disposed of to actual settlers under the homestead laws only, in tracts not exceeding 160 acres in area and not exceeding 1½ miles in length; that when such lands are ascertained and listed upon the application of any person qualified to make homestead entry, such applicant may settle upon and enter such lands thirty days after the date of such filing; that no person settling upon, entering, or occupying such lands shall thereby have a right to use any other lands within such reserve for grazing or other purposes; that any entryman desiring to obtain patent to any lands, described by metes and bounds, entered by him under the provisions of this act, may do so by filing, with the required proof of residence and cultivation, a plat and field notes of the lands entered, made by or under the direction of the United States surveyor-general, showing accurately the boundaries of such lands, which shall be distinctly marked by monuments on the ground, and shall post a copy of such plat, together with a notice of the time and place of offering proof, in

a conspicuous place on the land embraced in such plat during the period prescribed for the publication of his notice of intention to offer proof, and that a copy of such plat and field notes shall also be kept posted in the office of the register of the land office for the land district in which such lands are situated for a like period; and further, that any agricultural lands within forest reserves may, at the discretion of the Secretary, be surveyed by metes and bounds, but that no lands entered under these provisions shall be patented under the commutation provisions of the homestead laws or be exchanged for other public lands.

To open the reserves to homestead entry without restriction would be in effect to abolish them. We therefore recommend that the agricultural character of the lands should be officially ascertained, as has been the habit hitherto in the case of agricultural and mineral lands.

The effect of the foregoing provisions is to give an intending settler the right to apply for the particular agricultural land he wants and sixty days' preference in entering it. Through survey by metes and bounds the settler is enabled to take the full amount of 160 acres of actual agricultural land. The principal danger in the administration of this plan is likely to arise from the desire of others than actual settlers to get possession of valuable timber lands on the plea that they are agricultural in character, to cut the timber from the lands, and then abandon them, to the serious injury of the interests which the reserves are created to serve.

Such an abuse would be greatly facilitated by the commutation clause of the homestead act, whereas actual settlers on agricultural lands in forest reserves would seldom or never suffer hardship from the requirement of five years' residence. Agricultural lands in forest reserves are not wholly on the same plane as such lands outside, because their use must be subservient to the purposes for which the reserves were created. Their actual occupation by permanent settlers is of the first importance to this object, and shifting of ownership during the first years of settlement and development would be of serious injury to the reserves. We are of the opinion that to allow the application of the commutation clause of the homestead act to lands in the forest reserves would tend to defeat the object of the opening of these lands to agricultural entry and would embarrass the administration of the reserves.

LANDS RELEASED FROM TEMPORARY WITHDRAWAL.

In making forest reserves it is usually necessary to withdraw temporarily, pending segregation, considerable areas of land which are known to contain forest growth. These temporary withdrawals are made usually of areas larger than will ultimately be proclaimed as forest reserves, in order to enable the officers of the Government to ascertain what are the existing conditions and to draw the boundaries with care and without interference growing out of speculative entries or selections made not for settlement, but to secure certain advantages which may grow out of the creation of the forest reserve. For this reason temporary withdrawals are essential for the careful delimiting of the forest reserve. When the limits of a forest reserve are determined upon, the excluded lands are restored to entry and settlement.

Experience has shown that speculative entries or large filings of so-called scrip are frequently made upon such excluded land, to the

detriment of actual settlers. Therefore provisions should be made to give actual settlers ample time in which to exercise their rights. Accordingly, the Commission recommends that in the event of the modification or revocation of any order temporarily withdrawing lands from settlement and entry resulting in the release of such lands from such withdrawal, or in the event of the exclusion or release of lands from any forest reserve established by the President, under section 24 of the act approved March 3, 1891, entitled "An act to repeal timber-culture laws, and for other purposes," the nonmineral public lands so released from a forest reserve, and not otherwise appropriated or reserved, shall become subject to settlement from the date of the order or proclamation so releasing or excluding them, but shall not become subject to entry, filing, or selection under any law providing for the disposal of nonmineral public lands until after sixty days' notice by such publication as the Secretary of the Interior may prescribe, nor shall they become subject to entry, filing, or selection under any law except the homestead laws until ninety days after said notice.

The Commission will continue its investigations and make further report.

Respectfully submitted.

W. A. RICHARDS.
F. H. NEWELL.
GIFFORD PINCHOT.

The PRESIDENT.

58TH CONGRESS, 3d Session. } SENATE. { DOCUMENT No. 154.

PUBLIC LANDS COMMISSION.

MESSAGE

FROM THE

PRESIDENT OF THE UNITED STATES,

SUBMITTING

THE SECOND PARTIAL REPORT OF THE PUBLIC LANDS COMMISSION, APPOINTED OCTOBER 22, 1903, TO REPORT UPON THE CONDITION, OPERATION, AND EFFECT OF THE PRESENT LAND LAWS.

FEBRUARY 13, 1905.—Read; referred to the Committee on Public Lands and ordered to be printed.

To the Senate and House of Representatives:

I submit herewith the second partial report of the Public Lands Commission, appointed by me October 22, 1903, to report upon the condition, operation, and effect of the present land laws and to recommend such changes as are needed to effect the largest practical disposition of the public lands to actual settlers who will build homes upon them and to secure in permanence the fullest and most effective use of the resources of the public lands. The subject is one of such magnitude and importance that I have concluded to submit this second partial report bearing upon some of the larger features which require immediate attention without waiting for the final statement of the Commission, which, from the very nature of the case, it has not been possible to complete at this time. I am in full sympathy with the general conclusions of the Commission in substance and in essence, and I commend its recommendations to your earnest and favorable consideration. The existing conditions, as set forth in this report, seem to require a radical revision of most of the laws affecting the public domain, if we are to secure the best possible use of the remaining public lands by actual home makers.

THEODORE ROOSEVELT.

THE WHITE HOUSE, *February 13, 1905.*

1. This report is based on a broad general view of the public-land situation, not on specific cases.

2. The present laws are not suited to meet the conditions of the remaining public domain.

3. The agricultural possibilities of the remaining public domain are unknown. Provision should be made to ascertain them, and, pending such ascertainment, to hold under Government control and in trust for such use the lands likely to be developed by actual settlers.

4. The right to exchange lands in forest reserves for lands outside should be withdrawn. Provision should be made for the purchase of needed private lands inside forest reserves, or for the exchange of such lands for specified tracts of like area and value outside the reserves.

5. The former recommendation for the repeal of the timber and stone act is renewed and emphasized.

6. The sale of timber from unreserved public lands should be authorized.

7. The commutation clause of the homestead act is found on examination to work badly. Three years' actual residence should be required before commutation.

8. The desert-land law is found to lead to land monopoly in many cases. The area of a desert entry should be reduced to not exceeding 160 acres. Actual residence for not less than two years should be required, with the actual production of a valuable crop on one-fourth the area and proof of an adequate water supply.

9. After thorough investigation of the grazing problem your Commission is opposed to the immediate application of any rigid system to all grazing lands, but recommends the following flexible plan:

(*a*) Authority should be given to the President to set aside grazing districts by proclamation.

(*b*) Authority should be given the Secretary of Agriculture to classify and appraise the grazing value of lands in these districts; to appoint such officers as the care of each district may require; to charge and collect a moderate fee for grazing permits, and to make and apply appropriate regulations to each district, with the special object of bringing about the largest permanent occupation of the country by actual settlers and home seekers.

10. The fundamental fact that characterizes the situation under the present public-land law is this, that the number of patents issued is increasing out of all proportion to the number of new homes.

SECOND PARTIAL REPORT OF THE PUBLIC LANDS COMMISSION.

SIR: This Commission, appointed October 22, 1903, to report upon the condition, operation, and effect of the present land laws, and to recommend such changes as are needed to effect the largest practicable disposition of the public lands to actual settlers who will build permanent homes upon them, and to secure in permanence the fullest and most effective use of the resources of the public lands, submitted to you a partial report, dated March 7, 1904, which was printed as

Senate Document No. 188, Fifty-eighth Congress, second session. In this report reference was made to the magnitude of the problems and to the fact that it was not then practicable to reach definite conclusions on a number of the more intricate questions.

Since the time of making this first report many meetings of the Commission have been held and special topics have been assigned to experts for their detailed investigation. The members of the Commission have individually and collectively studied many of the subjects assigned to it. During the year 1904 each member spent much time upon the public lands, making personal inquiries into existing conditions and discussing public-land questions with public men and citizens generally.

The Commission now respectfully submits to you a further partial report.

There is in preparation an appendix containing special reports prepared for the Commission, upon which, in part, the conclusions here presented are based. The Commission desires to express to you its high appreciation of the valuable assistance and support it has received from officers of the General Land Office, the United States Geological Survey (especially the reclamation service), and the bureaus of Plant Industry and Forestry of the United States Department of Agriculture.

PROBLEMS PRESENTED.

The total area of the public lands of the United States, exclusive of Alaska, was 1,441,436,160 acres, of which 473,836,402 acres still remained on June 30, 1904. The latter figure, of nearly half a billion acres, while but a third of the original area, is still enormous. Even to see typical examples of these lands in each of the States or larger political divisions would require months of arduous travel. To obtain a full comprehension of all the physical conditions would require years of research. This fact is emphasized because it appears in the general discussion of public-land questions by hundreds or thousands of individuals that as a rule each man sees only certain phases of a group of problems and from his own view point brings argument to bear for or against any one conclusion. Specific cases are cited to show that certain land laws should be repealed or revised, or should be allowed to remain, and instances are given of the beneficial results of such action.

A correct decision must be based not upon individual cases but upon the broadest attainable knowledge of prevailing tendencies and results. In a hundred cases it may be possible to find 10 excellent illustrations of the beneficial workings of a law, and yet the remaining 90 cases show without doubt that the law on the whole is not good. It is only when large groups of facts are comprehended and analyzed that the real conditions appear.

ANTIQUATED LAND LAWS.

In our preceding report reference was made to the fact that the present land laws do not fit the conditions of the remaining public lands. Most of these laws and the departmental practices which have grown up under them were framed to suit the lands of the

humid region. It is evident that the decisions often contemplate conditions such as prevail in the Mississippi Valley and Middle West. Judging cases by arbitrary rules of evidence and considering only such facts as may be presented under these rules, there is much elementary and essential knowledge of which cognizance can not be taken.

The changes we recommend in the land laws are required not only because some of the present laws are wholly unsuited to existing conditions, but also in part because some of these laws as originally drawn contemplated certain conditions or practices which have been gradually modified by various rulings or decisions. In short, the precedents established and which now have practically the force of law have so completely modified the apparent object of the original statute that the statute and the prevailing conditions appear to be wholly unconnected. The effect of laws passed to promote settlement is now not infrequently to prevent or retard it.

LAND CLASSIFICATIONS.

The agricultural possibilities of the remaining public lands are as yet almost unknown. Lands which a generation or even a decade ago were supposed to be valueless are now producing large crops, either with or without irrigation. This has been brought about in part by the introduction of new grains and other plants and new methods of farming and in part by denser population and improved systems of transportation. It is obvious that the first essential for putting the remaining public lands to their best use is to ascertain what that best use is by a preliminary study and classification of them, and to determine their probable future development by agriculture.

Until it can be definitely ascertained that any given area of the public lands is and in all probability forever will remain unsuited to agricultural development, the title to that land should remain in the General Government in trust for the future settler.

For example: The passage of the reclamation act (June 17, 1902) made certain the disposition to actual settlers of large areas of land which up to that time had been considered as valueless. Other areas, which are too high and barren to have notable value even for grazing, are now known to have importance in the future development of the country through their capacity to produce forest growth. The making of wells will give an added value to vast tracts of range lands for which the water supply is now scanty. In short, because of possible development, through irrigation, through the introduction of new plants and new methods of farming, through forest preservation, and grazing control, the remaining public lands have an importance hitherto but dimly foreseen.

In view of these facts it is of the first importance to save the remaining public domain for actual home builders to the utmost limit of future possibilities and not to mortgage the future by any disposition of the public lands under which home making will not keep step with disposal. To that end your Commission recommends (see p. 12) a method of range control under which present resources may be used to the full without endangering future settlement.

After the agricultural possibilities of the public lands have been

ascertained with reasonable certainty, provision should be made for dividing them into areas sufficiently large to support a family, and no larger, and to permit settlement on such areas. It is obvious that any attempt to accomplish this end without a careful classification of the public lands must necessarily fail. Attempts of this kind are being made from time to time, and legislation of this character is now pending, modeled on the Nebraska 640-acre homestead law, which was passed as an experiment to meet a certain restricted local condition. This act (33 Stat., 547) permits the entry of 640-acre homesteads in the sand-hill region of that State. Whether in practice the operation of this law will result in putting any considerable number of settlers on the land is not yet determined.

Your Commission is of opinion, after careful consideration, that general provisions of this kind should not be extended until after thorough study of the public lands has been made in each particular case, because to do so controverts the fundamental principle of saving the public lands for the home maker. Each locality should be dealt with on its own merits. Even if it should ultimately appear that this law has worked beneficially in Nebraska it would by no means follow that such a law might be safely applied to other regions different in topography, soil, and climate. No arbitrary rule should be followed, but in each case the area of the homestead should be determined by the acreage which may be necessary to support a family upon the land, either by agriculture, or by grazing if agriculture is impracticable. Until such acreage is determined for each locality, any new general law providing a method of obtaining title to the public lands would, in the opinion of your Commission, be decidedly unsafe.

LIEU LANDS.

Careful study has been given by your Commission to the subject of forest-reserve lieu-land selections. These selections have given rise to great scandal, and have led to the acquisition by speculators of much valuable timber and agricultural land and its consolidation into large holdings. Furthermore, the money loss to the Government and the people from the selection of valuable lands in lieu of worthless areas has been very great. There has been no commensurate return in the way of increased settlement and business activity. Public opinion concerning lieu-land selections, by railroads in particular, has reached an acute stage. The situation is in urgent need of a remedy, and your Commission recommends the repeal of the laws providing for lieu-land selections.

A partial remedy by Executive action has already been applied by carefully locating the boundaries of new forest reserves, and thus limiting lieu-land selections to comparatively insignificant areas. The last annual message to Congress declares definitely that—

> The making of forest reserves within railroad and wagon-road land-grant limits will hereafter, as for the past three years, be so managed as to prevent the issue, under the act of June 4, 1897, of base for exchange or lieu selection (usually called scrip). In all cases where forest reserves within areas covered by land grants appear to be essential to the prosperity of settlers, miners, or others the Government lands within such proposed forest reserves will, as in the recent past, be withdrawn from sale or entry pending the completion of such negotiations with the owners of the land grants as will prevent the creation of so-called scrip.

There are now lands in private ownership within existing forest reserves, and similar lands must to a limited extent be included in new reserves. Therefore, a method is required by which the Government may obtain control of nonagricultural holdings within the boundaries of these reserves. Your Commission recommends the following flexible plan: Upon the recommendation of the Secretary of Agriculture, when the public interest so demands, the Secretary of the Interior should be authorized, in his discretion, to accept the relinquishment to the United States of any tract of land within a forest reserve covered by an unperfected bona fide claim lawfully initiated or by a patent, and to grant to the owner in lieu thereof a tract of unappropriated, vacant, surveyed, nonmineral public land in the same State or Territory and of approximately equal area and value as determined by an examination, report, and specific description by public surveys of both tracts, to be made on the ground by officials of the Government. When exchange under these conditions can not be effected, lands privately owned within forest reserves should be paid for in cases where the public interest requires that such lands should pass into public ownership. The Secretary of the Interior should be authorized to take the necessary proceedings as rapidly as the necessary funds are provided.

TIMBER AND STONE ACT.

The recommendations made for the repeal of the timber and stone act in the previous report are renewed and emphasized. Additional facts showing the destructive effect of this law have strengthened the belief of your Commission that on the whole its operation is decidedly harmful. This law has been made the vehicle for innumerable frauds, and the Government has lost and is still losing yearly vast sums of money through the sale of valuable timber lands to speculators, and hence indirectly to large corporations, at a price far below their actual value. From the passage of the act, June 3, 1878, to June 30, 1904, 55,372 claims for 7,596,078 acres of timber land were patented under its provisions, and on last date 7,644 claims for 1,108,380 acres were pending. Many transfers of land patented under this law are made immediately upon completion of title, often on the same day, to individuals and companies. In this way a monopoly of the timber supplies of the public-land States is being created by systematic collusion. Under the existing rules and practices of the courts it is difficult to prove this collusion, except in cases of open fraud, and it is therefore practically impossible to secure conviction. Furthermore, under bona fide compliance with the actual provisions of the law the effect is almost equally bad. The law itself is seriously defective.

It has been urged in behalf of this act that it enables poor men to enjoy the bounty of the Government by obtaining tracts of timber which they can afterwards sell with advantage. A careful study seems to show, on the contrary, that the original entrymen rarely realize more than ordinary wages for the time spent in making the entry and completing the transfer. The corporations which ultimately secure title unusually absorb by far the greater part of the profit.

In addition to the direct loss to the Government from the sale of the lands far below their real value, timber lands which should have

been preserved for the use of the people are withdrawn from such use, and the development of the country is retarded until the corporations which own the timber see fit to cut it. The bona fide settler who comes into a country, the timber resources of which have thus been absorbed, may be very seriously hampered by his inability to secure timber except from a foreign corporation. All of the timber land has often passed beyond his reach, and the development of his farm may be retarded and his expenses greatly increased because he can no longer obtain the necessary supplies of fuel, rails, posts, and lumber.

As in the case of other laws, instances of the beneficial operation of this act may be cited, but when it is considered from the point of view of the general interest of the public it becomes obvious that this law should be repealed.

SALE OF TIMBER ON THE PUBLIC LANDS.

Necessity for the enactment of a law authorizing the sale of timber on nonreserve public land is becoming more evident, and the recommendations made in the preceding report of this Commission are reiterated. For the best use of the public lands it is absolutely essential to hold public timber for sale when needed and in quantities necessitated by the continuous growth of prevailing industries. Provision should also be made for a limited free-use right by miners and actual settlers.

COMMUTATION CLAUSE OF THE HOMESTEAD ACT.

In the preceding report a statement was made that our investigations respecting the operations of the commutation clause of the homestead law were still in progress. We were not at that time prepared to recommend its repeal. Investigations carried on during the past year have convinced us that prompt action should be taken in this direction and that, in the interest of settlement, the commutation clause should be greatly modified.

A careful examination of the districts where the commutation clause is put to the most use shows that there has been a rapid increase of the use of this expedient for passing public lands into the hands of corporations or large landowners. The object of the homestead law was primarily to give to each citizen, the head of a family, an amount of land up to 160 acres, agricultural in character, so that homes would be created in the wilderness. The commutation clause, added at a later date, was undoubtedly intended to assist the honest settler, but like many other well-intended acts its original intent has been gradually perverted until now it is apparent that a great part of all commuted homesteads remain uninhabited. In other words, under the commutation clause the number of patents furnishes no index to the number of new homes.

To prove this statement it is only necessary to drive through a country where the commutation clause has been largely applied. Field after field is passed without a sign of permanent habitation or improvement other than fences. The homestead shanties of the commuters may be seen in various degrees of dilapidation, but they show no evidence of genuine occupation. They have never been in any sense homes.

Investigations have been carried on where the commuted homesteads are notable in number. The records of some of the counties examined show that 90 per cent of the commuted homesteads were transferred within three months after acquisition of title, and evidence was obtained to show that two-thirds of the commuters immediately left the State. In many instances foreigners, particularly citizens of Canada, came into this country, declared their intention of becoming citizens, took up homesteads, commuted, sold them, and returned to their native land.

The reasons given for adhering to the commutation clause are diverse and many of them are cogent when applied to individual cases. It is said, for example, that the commuter desires to raise money for use in improving his place. This is often true, but in the majority of cases the records show that the commuter immediately leaves the vicinity. The frequency of loans is traceable in many places directly to the activity of agents of loan companies, who are often United States commissioners also, eager first to induce settlement and then to make these loans on account of the double commission received. Later they secure the business which accrues to them through the foreclosure and transfer of the property. The true working of the commutation clause does not appear until after foreclosure upon the maturity of the loans.

One significant fact brought out by the investigation is that a large portion of the commuters are women, who never establish a permanent residence and who are employed temporarily in the towns as school-teachers or in domestic service, or who are living with their parents. The great majority of these commuters sell immediately upon receiving title, the business being transacted through some agent who represents his client in all dealings and prepares all papers.

The commutation clause, if it is to be retained to cover special cases, should be effective only after not less than three years' actual—not constructive—living at home on the land. Under present practice, the commutation period being fourteen months, six months of this time is generally taken to establish residence, so that only eight months remain. This time is usually arranged to include the summer, so that the shack built need not be habitable in severe winter weather, and the residence on the land may consist merely in a summer outing. Obviously it is essential that residence should be far more strictly defined. It is probable that lax interpretation and enforcement of the provisions of the law regarding residence is responsible for more fraud under the homestead act than all other causes combined.

It may be urged that the frauds which have taken place under the operations of the commutation clause are due largely to lax administration. The fact is that the precedents established by decisions rendered on special cases have so far weakened the powers of administration that additional legislation is necessary.

DESERT-LAND LAW.

In the preceding report the opinion was expressed that the desert-land law should, for the present, at least, be allowed to stand, with a few changes in detail. It was believed that, with the experience of

the past for guidance, it would be possible to enforce this law so that its essential provisions could be complied with. More careful analysis, however, of the operations of this act and of the practices which have grown up has led your Commission strongly to the conclusion that this law should be modified in essential particulars.

Your Commission recommended last year the repeal of the assignment clause. This provision has been made the convenient vehicle for evading the spirit of the law and for facilitating the acquisition of lands in large holdings. The law limits the amount which one person or association of persons may hold, by assignment or otherwise, prior to patent to 320 acres of such arid or desert lands. The most common form of attempted evasion of this requirement is for two or three individuals to form themselves into a corporation, each individual member of the corporation securing, by entry or assignment, 320 acres of such lands and the corporation as such 320 acres. These same individuals then form another corporation under an entirely different name and procure an assignment of another 320 acres, and this process is continued indefinitely.

The General Land Office has within the past year endeavored to put a stop to this practice by holding that a corporation or association of persons is not qualified to receive a desert-land entry by assignment where its individual members, either singly or in the aggregate, are holding 320 acres of such arid or desert lands. This ruling, if enforced, will tend to lessen the evils resulting from large holdings prior to patent, but it is not deemed possible to secure adequate control of this question unless the law prohibits assignments of desert-land entries. By repealing that provision of the law and requiring the claimant to show that he has made the entry for his own use and benefit and not for the benefit of any other person or corporation and that he has made no agreement by which the title shall inure to any other person or corporation the evils incident to large holdings of such lands under the sanction of law will be materially lessened.

It is a striking fact that these large holdings of desert land are not reclaimed and devoted to their best use. Three hundred and twenty acres of irrigable land is entirely too much for economical handling by one person. On the other hand, inspection shows that in the same locality and under the same climatic conditions the homestead entries, where not commuted, are reclaimed and utilized.

The desert-land act as it stands upon the statute books appears to have many features which commend it, but, as before stated, the practices governing it have largely nullified its good features, and the resulting evils can not be fully overcome without legislation.

The area of the desert entry should be cut down from 320 acres to not exceeding 160 acres, and discretion should be given to the Secretary of the Interior to cut it down still further where it is apparent that intensive cultivation is practicable. A farm of 320 acres, if irrigated, is entirely too large for a single family, and its possession simply prevents other settlers from coming into the country. Furthermore, it makes land monopoly easy and induces speculation.

Actual living at home on the land for not less than two years should be required before patent. Your Commission can not understand why any settler should be given both a homestead and a desert entry, either of which without the other should suffice, under the law, to

furnish him a home. The desert-land law should be a means of settlement, and actual bona fide residence should be rigidly required.

The actual production of a valuable crop should be required on not less than one-fourth of the area of the entry. At present, as a rule, the greater part of the desert entries are never actually watered. Hundreds of desert entries were examined by members of the Commission in the last year, and the great majority of them were found to be uninhabited, unirrigated, uncultivated, and with no improvements other than a fence. This applies both to desert entries upon which final proof is now being offered and to other entries to which title has been given.

It is a fact that a very small proportion of the land disposed of under the terms of the law has actually been reclaimed and irrigated, and scrutiny of many hundreds of desert entries now passing to final proof shows that in the majority of cases these lands are not actually utilized, but are being held for speculative purposes. Owing to several causes, among which are the laxity of some of the State laws governing appropriation of water for irrigation purposes, and the insufficiency of the water supply, considerable difficulty has been encountered in administering that provision of the desert-land laws which requires a claimant to have a permanent water right based on prior appropriation. Very often the waters of a stream are exhausted by other appropriators before the time when the claimant goes through the form of posting notices, recording his claim, and complying with other essentials of the State law. Notwithstanding this, he furnishes the testimony of two witnesses that the water thus appropriated has been used in reclaiming his land, and that the supply is adequate for that purpose. While this showing, on its face, indicates a compliance with law, the fact remains that the water supply, if any at all, is not sufficient to permanently reclaim the land.

The ownership of stock in a projected irrigation ditch which does not exist in fact, or the ownership of a pump temporarily installed, has often been accepted, in connection with such testimony, as proof of the possession of water. Many alleged irrigation ditches or reservoirs are familiar to members of the Commission which are utterly inadequate to irrigate a square rod, and upon the strength of such works patent has frequently issued to 320 acres of land.

Frauds committed through conventional forms of perjury and through lack of proper verification of the facts as to the reclamation of the land justify the taking of immediate and radical steps in the revision of the law. The law should absolutely require an actual adequate water supply, and the limits as to quantity should be defined. defined.

In short, the law should render impossible the continuance of the practices by which desert lands without water, without cultivation, and without crops are passed into the possession of claimants.

GRAZING LANDS.

The great bulk of the vacant public lands throughout the West are unsuitable for cultivation under the present known conditions of agriculture, and so located that they can not be reclaimed by irrigation. They are, and probably always must be, of chief value for

grazing. There are, it is estimated, more than 300,000,000 acres of public grazing land, an area approximately equal to one-fifth the extent of the United States proper. The exact limits can not be set, for with seasonal changes large areas of land which afford good grazing one year are almost desert in another. There are also vast tracts of wooded or timbered land in which grazing has much importance, and until a further classification of the public lands is made it will be impossible to give with exactness the total acreage. The extent is so vast and the commercial interests involved so great as to demand in the highest degree the wise and conservative handling of these vast resources.

It is a matter of the first importance to know whether these grazing lands are being used in the best way possible for the continued development of the country or whether they are being abused under a system which is detrimental to such development and by which the only present value of the land is being rapidly destroyed.

At present the vacant public lands are theoretically open commons, free to all citizens; but as a matter of fact a large proportion have been parceled out by more or less definite compacts or agreements among the various interests. These tacit agreements are continually being violated. The sheepmen and cattlemen are in frequent collision because of incursions upon each other's domain. Land which for years has been regarded as exclusively cattle range may be infringed upon by large bands of sheep, forced by drought to migrate. Violence and homicide frequently follow, after which new adjustments are made and matters quiet down for a time. There are localities where the people are utilizing to their own satisfaction the open range, and their demand is to be let alone, so that they may parcel out among themselves the use of the lands; but an agreement made to-day may be broken to-morrow by changing conditions of shifting interests.

The general lack of control in the use of public grazing lands has resulted, naturally and inevitably, in overgrazing and the ruin of millions of acres of otherwise valuable grazing territory. Lands useful for grazing are losing their only capacity for productiveness, as, of course, they must when no legal control is exercised.

It is not yet too late to restore the value of many of the open ranges. Lands apparently denuded of vegetation have improved in condition and productiveness upon coming under any system of control which affords a means of preventing overstocking and of applying intelligent management to the land. On some large tracts the valuable forage plants have been utterly extirpated, and it is impracticable even to reseed them. On other tracts it will be possible by careful management for the remaining native plants to recover their vigor and to distribute seeds, which will eventually restore much of the former herbage. Prompt and effective action must be taken, however, if the value of very much of the remaining public domain is not to be totally lost.

The conclusions as to grazing reached by your Commission were based:

First. Upon the results of long acquaintance with grazing problems in the public-land States on the part of each member of your Commission.

Second. Upon the results of careful examinations made for the Commission of the grazing systems of the State of Texas, the State of Wyoming, the Union and Northern Pacific railroads, and of the Indian Office in the case of permits to stockmen for the use of Indian lands suitable for grazing, and of the grazing conditions throughout the West. A map has been prepared showing the general location and area of the summer, winter, and year-long ranges, and the sections which are largely dependent upon a temporary water supply for their utilization in grazing, and those where there has been extensive development by wells and windmills. We believe that this map will be found exceedingly valuable and interesting in the consideration of all grazing problems, and it is therefore submitted in the appendix.

Third. Upon the results of a meeting called to confer with the Commission by the National Live Stock Association in Denver early in August, 1904, which was attended by the Secretary of Agriculture and by representative stockmen from all the grazing-land States and Territories. The opinion of the stockmen present was almost unanimous in favor of some action on the part of the Government which would give the range user some right of control by which the range can be kept from destruction by overcrowding and the controversies over range rights can be satisfactorily eliminated, the only question being as to the most satisfactory method by which such right may be obtained.

Fourth. Upon 1,400 answers received to a circular letter addressed to stockmen throughout the West. These answers show that under the present system the pasturing value of the ranges has deteriorated and the carrying capacity of the lands has greatly diminished; that the present condition of affairs is unsatisfactory; that the adoption of a new system of management would insure a better and more permanent use of the grazing lands; that a certain improvement in range conditions has already been brought about by range control on the forest reserves, and that the great bulk of the western stockmen are definitely in favor of Government control of the open range.

Fifth. Upon facts presented at many public meetings held throughout the West and upon innumerable suggestions which have been received and considered.

Your Commission concurs in the opinion of the stockmen that some form of Government control is necessary at once, but is opposed to the immediate application of any definite plan to all of the grazing lands alike, regardless of local conditions or actual grazing value. The following plan is intended to bring about the gradual application to each locality of a form of control specifically suited to that locality, whether it may be applicable to any other locality or not. Your Commission recommends that suitable authority be given to the President to set aside, by proclamation, certain grazing districts or reserves. To the Secretary of Agriculture, in whose Department is found the special acquaintance with range conditions and live-stock questions which is absolutely necessary for the wise solution of these problems, authority should be given to classify and appraise the grazing value of these lands, to appoint such officers as the care of each grazing district may require, to charge and collect a moderate fee for grazing permits, and to make and apply definite and appropriate regulations to each grazing district. These regulations should be

framed and applied with special reference to bringing about the largest permanent occupation of the country by actual settlers and home seekers. All land covered by any permit so given should continue to be subject to entry under reasonable regulations notwithstanding such permit.

MINING LAWS.

Your Commission has not yet found it possible to take up the extremely important subject of the revision of the mining laws with the thoroughness which it deserves. From the evidence already submitted it is obvious that important changes are necessary, both in the United States and in Alaska. The Commission hopes to treat this matter more at length in a subsequent report.

RIGHTS OF WAY.

Year after year the question of rights of way across the public lands and reservations has been called to the attention of the Congress in the reports of the Secretary of the Interior and the Commissioner of the General Land Office. The laws on this subject are numerous and apparently often incongruous. Rights of way are granted contingent upon the execution of work within a definite time, but decisions and practices are now in force under which it has become almost impossible to divest the public lands of the incubus of these rights, granted conditionally in the first place, but still in existence, although the conditions were not fulfilled.

Rights such as these are very numerous. They lie dormant until actual development has begun to take place, either under the reclamation act or otherwise; then they appear in enormous numbers to the very serious hindrance of new enterprises. Your Commission is engaged on a study of this subject and will report hereafter upon it.

AGRICULTURAL LANDS IN FOREST RESERVES.

Attention is called again to the recommendation of your Commission in its previous report (hereto attached) that entry of agricultural lands included in forest reserves be permitted under surveys by metes and bounds, and special emphasis is directed to the recommendation, which is here renewed, that in such cases actual residence at home on the land be rigidly required and that no commutation be allowed.

LARGE AND SMALL HOLDINGS.

Detailed study of the practical operation of the present land laws, particularly of the desert-land act and the commutation clause of the homestead act, shows that their tendency far too often is to bring about land monopoly rather than to multiply small holdings by actual settlers. The land laws, decisions, and practices have become so complicated that the settler is at a marked disadvantage in comparison with the shrewd business man who aims to acquire large properties. Not infrequently their effect is to put a premium on perjury and dishonest methods in the acquisition of land. It is apparent, in consequence, that in very many localities, and perhaps in general, a larger proportion of the public land is passing into the hands of speculators and corporations than into those of actual settlers who are making homes.

This is not due to the character of the land. In all parts of the

United States known to your Commission where such large holdings are being acquired the genuine homesteader is prospering alongside of them under precisely the same conditions. Wherever the laws have been so enforced as to give the settler a reasonable chance he has settled, prospered, built up the country, and brought about more complete development and larger prosperity than where land monopoly flourishes. Nearly everywhere the large landowner has succeeded in monopolizing the best tracts, whether of timber or agricultural land. There has been some outcry against this condition. Yet the lack of greater protest is significant. It is to be explained by the energy, shrewdness, and influence of the men to whom the continuation of the present condition is desirable.

Your Commission has had inquiries made as to how a number of estates, selected haphazard, have been acquired. Almost without exception collusion or evasion of the letter and spirit of the land laws was involved. It is not necessarily to be inferred that the present owners of these estates were dishonest, but the fact remains that their holdings were acquired or consolidated by practices which can not be defended.

The disastrous effect of this system upon the well-being of the nation as a whole requires little comment. Under the present conditions, speaking broadly, the large estate usually remains in a low condition of cultivation, whereas under actual settlement by individual home makers the same land would have supported many families in comfort and would have yielded far greater returns. Agriculture is a pursuit of which it may be asserted absolutely that it rarely reaches its best development under any concentrated form of ownership.

There exists and is spreading in the West a tenant or hired-labor system which not only represents a relatively low industrial development, but whose further extension carries with it a most serious threat. Politically, socially, and economically this system is indefensible. Had the land laws been effective and effectually enforced its growth would have been impossible.

It is often asserted in defense of large holdings that, through the operation of enlightened selfishness, the land so held will eventually be put to its best use. Whatever theoretical considerations may support this statement, in practice it is almost universally untrue. Hired labor on the farm can not compete with the man who owns and works his land, and if it could the owners of large tracts rarely have the capital to develop them effectively.

Although there is a tendency to subdivide large holdings in the long run, yet the desire for such holdings is so strong and the belief in their rapid increase in value so controlling and so widespread that the speculative motive governs, and men go to extremes before they will subdivide lands which they themselves are not able to utilize.

The fundamental fact that characterizes the present situation is this: That the number of patents issued is increasing out of all proportion to the number of new homes.

Respectfully submitted.

W. A. RICHARDS.
F. H. NEWELL.
GIFFORD PINCHOT.

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U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE FORESTER

FOR

1902.

BY

GIFFORD PINCHOT.

[From Annual Reports, Department of Agriculture.]

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1902.

CONTENTS.

REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY,
Washington, D. C., September 1, 1902.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Forestry for the fiscal year ended June 30, 1902, together with an outline of the plans for the work of the Bureau for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

INTRODUCTION.

During its first year as a Bureau, the former Division of Forestry has rapidly assumed the character and functions of its new position. With the increased capacity to do its work, the Bureau has gained in stability and effectiveness, and in the character and value of its results. While from the lack of American foresters it yet falls below a high standard of equipment in trained men, a larger proportion of educated foresters than ever before was engaged in its work, both in the office and in the field. The organization of work made possible by the change from a Division to a Bureau has been of capital value throughout the year.

The progress of public interest in forestry during the year far more than kept pace with the growth of the Bureau. The demands for advice and assistance increase from month to month, and continue to outstrip more and more the ability of the Bureau to meet them. The time for the general introduction of practical forestry in the United States is evidently at hand, provided only the necessary information and assistance can be supplied. The inability of the Bureau of Forestry to meet this demand because of inadequate resources is thus the most serious bar to the protection and perpetuation of our forests. With the rapid extension of professional education in forestry, the need of the Bureau for trained foresters can next year be met more nearly than ever before. In view of the increasingly rapid destruction of our forests, it is most fortunate that the imperative demand for assistance in checking the loss is paralleled by the opportunity to supply the demand, if only the necessary resources in money are made available.

SUMMARY.

FOREST MANAGEMENT.

Private lands.—The demands for assistance in introducing practical forestry on private lands increased during the past year almost as much as during the three preceding years. These applications have now reached a total of 4,709,120 acres, under an arrangement by which the owners pay all expenses of the field work except the salaries of members of the Bureau.

The total area of private forests under conservative management, however, reached only the comparatively insignificant total of 372,463 acres, or 7.9 per cent of the total applications. The Bureau has thus been obliged, for lack of men and money, to neglect or defer over 90 per cent of its opportunities to introduce practical forestry on private lands.

It must not be forgotten that the overwhelming bulk of the forests in the United States are in private ownership, and that forest protection by the Government, while absolutely of vast importance, is relatively insignificant when compared with the action of the lumbermen and other private owners. In the light of these facts, the inability of the Bureau to respond to more than 8 per cent of the requests for advice in applying the principles which it continually advocates is seen to be the most dangerous of all checks on the progress of forestry.

Field work on seven large forest tracts was completed during the year, and preliminary examinations were made of 1,620,000 acres. The amount paid by the owners for the expense of working plans was $13,325.

Public lands.—The preparation of working plans for conservative lumbering on the public forest reserves, at the request of the Secretary of the Interior, has continued throughout the year. The total area of these reserves, September 1, 1902, is 58,850,925 acres. Field work was carried on during the past year in five reserves. In addition to field work and the computation of results in the office, the force of the Bureau was drawn upon to supply the entire lack of trained foresters in the management of the National forest reserves.

During the year a request was made by the Secretary of War for working plans for eight military wood and timber reservations, with a total area of 117,468 acres. Among these is the military reservation at West Point, upon which field work will be begun without delay.

Field work was completed on townships 5, 6, and 41 of the Adirondack Forest Reserve by the use of an appropriation of $3,500 made by the New York legislature to cover the field expenses of the Bureau of Forestry.

Forest measurements.—The force employed in computing field results was thoroughly organized. It completed during the year computations of 16,678 acres, and measurements of the rate of growth of 10,786 trees, of 25 species, in 13 States.

FOREST INVESTIGATION.

Commercial trees.—Measurements and sylvicultural facts were gathered for 20 species in various parts of the country. Studies of hardwood sprout lands were carried on in Massachusetts and other parts of New England, and promise valuable results. A special investiga-

tion of the Big Trees of California was begun and is still in progress, and a preliminary study of the swamp forests of eastern Missouri and Arkansas was undertaken.

Studies of North American forests.—The forests of Nebraska were made the subject of an elaborate report, and at the request of the Michigan forest commission an investigation of lands in the southern peninsula of Michigan was made, with special reference to the proper management of the Michigan Forest Reserve. Special studies of forest conditions were pushed forward in Kentucky, Ohio, and Texas, and of the distribution of forests in certain portions of New Mexico, Arizona, South Dakota, Wyoming, Montana, and California. In California the study of the relation of forest cover to the flow of streams was continued, and the results will shortly be ready for publication. In cooperation with the U. S. Geological Survey the study of the Sierra Forest Reserve was completed. In Vermont a cooperative study of the forest resources and conditions of the State was completed, and in Maryland the mapping of the forests by counties, begun in 1899, was continued. Attention was given, both in the office and in the field, to the region of the proposed Appalachian Forest Reserve.

Fires and grazing.—Investigations of the effect of grazing on the forest were conducted in Washington, Oregon, Wyoming, New Mexico, Utah, and California. The study of forest fires was conducted in 12 States, and work was pushed on the preparation of a report.

Dendro-chemical investigations.—Special attention has been given during the year to the chemical investigation of tan extracts from native woods and barks, and of gums from the Philippine Islands. The study of pulp woods, with special reference to the qualifications of untried species, has been carried forward.

Turpentine orcharding.—The investigation conducted by the Bureau into the methods of producing naval stores in the Southeastern United States has resulted in the development of a method which it is believed will radically affect the whole industry. A report is in preparation describing its actual operation.

Forest entomology.—In cooperation with the Division of Entomology, a beginning was made in the investigation of insect damage to the forest, with the direct purpose of devising remedies. The vast importance of the subject makes the continuance of this work imperative.

Various studies.—Investigations of the lumber industry of the State of New York and the maple sugar industry of the United States were completed, and a study of the osier willow industry was begun.

A careful investigation of the Eucalypts and Acacias cultivated in the United States was completed, and bulletins were prepared for each.

Timber construction and supplies.—In cooperation with the Bureau of Plant Industry, great progress was made during the year in arousing the interest of mining and railroad companies in the preservation of timbers and in the sources of timber supply. The practical assistance of many railroads toward the establishment of conservative forestry was begun, and the work shows conspicuous promise.

Forest exhibit.—A forest exhibit was prepared and installed at the Pan-American Exposition at Buffalo, and later transferred to Charleston, S. C.

TREE PLANTING.

Planting plans.—The cooperation of the Bureau of Forestry with the owners of timber land is paralleled by its cooperation with the owners of treeless areas who wish to plant. Up to June 30, 1902, there were received 262 applications for assistance, in response to 224 of which planting plans were prepared. In the course of the work 197,439 acres of land were examined. The area to be planted under plans already prepared is 6,474 acres. These plans cover 29 States and Territories and 172 different localities.

Planted woodlands.—In order to use the information already at hand from previous planting, careful studies of 20 large plantations, 8 in the Middle West and 12 in the East, were carried on during the year. A similar study is now under way to find trees adapted for the Southwestern plains.

Forest extension.—Studies of the natural extension of forests were continued during the year. A careful forest survey of a large part of Nebraska was completed, and resulted not only in arousing great interest throughout that State, but in the creation of two forest reserves for tree planting, a most valuable contribution to the forest policy of the United States.

Reserve planting.—Preparations for planting considerable areas in the two reserves in Nebraska were made during the latter part of the fiscal year.

Sand dunes.—Investigations with a view to preventing damage from drifting sand dunes were begun during the year, both on the Atlantic and Pacific coasts, and promise results of great value, especially along the Columbia River.

RECORDS.

Office work.—The office work of the Bureau has continued to increase steadily in efficiency throughout the year.

The collection of forest literature from the Department Library was transferred to the library of the Bureau, which now contains 1,120 bound volumes, 1,900 pamphlets, and numerous periodical publications.

The photographic collection was largely increased, and is now serving as the source from which nearly all forest illustrations are derived.

The correspondence of the Bureau increased until the number of mail pieces forwarded during the year was 24,538.

Eight new publications and 10 reprints were printed during the year, with a total number of 77,200 and 127,500 copies, respectively.

A photographic laboratory was prepared at the quarters of the Bureau, and was nearly ready for occupancy at the end of the fiscal year.

FOREST MANAGEMENT.

PRIVATE LANDS.

During the past year the Bureau of Forestry has continued to give advice and practical assistance to private forest owners. The demands upon this branch of its work have increased steadily, and they are now even further beyond its capacity than at the end of the previous fiscal year. In the Southern States in particular there has been a

rapid awakening to the advantages of practical forestry, and a growing appreciation of the opportunity open to private forest owners through the offer of cooperation made by the Bureau in Circular No. 21, which gives the terms on which farmers, lumbermen, and others may cooperate with the Bureau in handling their forest lands. Wood lots, not exceeding 200 acres, are studied without cost to the owner, but in the preparation of detailed working plans for larger tracts the Bureau and the owner share the expenses of the work, the former paying the salaries of its men and the latter their traveling and field expenses. From July 1, 1901, to July 1 of the present year, 37 applications have been received from private owners for advice and assistance in the management of their forest lands. Twenty-five were for timber tracts and 12 for wood lots. They reach a total of 1,904,476 acres. The total area of private lands, in handling which assistance has been requested since the publication of Circular No. 21, in October, 1898, to July 1, 1902, is 4,709,124 acres.

WORKING PLANS MADE.

The field work necessary for detailed working plans was completed during the year for seven tracts with a total area of 421,000 acres in Maine, New York, Michigan, South Carolina, and Tennessee. The total amount estimated as the cost of these working plans to the owners was $9,725 and the total amount actually expended was $9,040.86.

One of these working plans was for a tract of 110,000 acres in Polk and Monroe counties, Tenn., on the western slope of the SmokyMountains. The field work occupied a party of 12 men for six months. It included a thorough study of the forest, the habits and rates of growth of the timber trees, and their behavior after lumbering. A careful investigation was made in order to determine what modifications of present methods of lumbering will leave the forest in good condition without seriously impairing present profits. The stand was actually measured upon 1,500 acres, and 1,200 measurements of volume and rate of growth were made upon felled trees. The tract was divided into blocks, according to watersheds, and the stand of each of the merchantable kinds was computed separately for each block. The silvicultural problem was very complicated because of the large number of species in the forest mixture. Only a few of these have as yet any market value, and it was difficult to determine how the tract may be lumbered so that the reproduction of the few valuable kinds may hold its own against that of the less valuable trees upon the lumbered areas. Careful studies were made of the habits of the more important trees and of the other local conditions which determine the form of management. Methods for the effective protection of the forest from fire were thoroughly investigated. The principal recommendations of the working plan may be summarized as follows:

(1) A diameter limit is set for each of the commercial trees, below which none may be cut.

(2) A certain number of trees above the diameter limit recommended should be marked and left standing to serve as seed trees.

(3) Contracts for the sale of stumpage should provide that a certain quantity of the less valuable kinds be cut and removed with the valuable trees. This should be done in order to leave the forest after lumbering in a condition favorable to the reproduction of the valuable kinds, the chief object of the working plan being to produce a future

stand of timber in which Yellow Poplar, Ash, Hickory, Walnut, and White Oak will be much better represented than in the present forest.

(4) A plan is outlined for the protection of the cut-over lands against fire.

The application of practical forestry to this tract is exceedingly important as a long step toward the adoption of conservative forest methods in the Southern Appalachians.

Another tract for which a detailed working plan was prepared lies in Scott, Campbell, and Anderson counties, Tenn., and has an area of 50,000 acres. The field work occupied a party of 10 men for four months. The tract is situated in the bituminous coal district of the Cumberland Mountains, and in addition to a valuable stand of hardwoods the property contains numerous accessible veins of soft coal, for which a good market exists. The object of the owners is to lumber conservatively in conjunction with mining operations. The main object to be worked for is to combine present profits with a valuable second crop. To this end the more valuable species will be favored in the lumbering and so given every chance to reproduce themselves well. The present forest is a mixture of hardwoods with a sprinkling of White, Shortleaf, and Scrub Pine, and Hemlock. It is remarkable for the number of species. Among the more important are Yellow Poplar, Ash, Hickory, White Oak, Chestnut Oak, Black Oak, Post Oak, Black Walnut, and Black Cherry. Most of the merchantable timber stands in the coves or hollows, while the slopes are covered by an open and less valuable growth. As a basis for an estimate of the stand of merchantable timber, all the trees were actually measured on 2.5 per cent of the total area. To ascertain the merchantable contents and the rate of growth of the commercial kinds, measurements called stem analyses were made of 2,474 felled trees. For greater accuracy, the tract was divided into 18 blocks, the boundaries of which correspond to the boundaries of the smaller watersheds, and the stand was calculated separately for each block. The working plan contains detailed silvicultural descriptions of the three principal types of forest growth—coveland, Chestnut Oak slope, and Black Oak slope. It also discusses the silvicultural characteristics of the most important species, and gives diagrams showing their rate of growth in diameter, height, and merchantable contents. The regulations for lumbering give the diameters for each species, under which no tree should be cut, and direct that certain trees of the more valuable species above this diameter limit be marked and left standing to furnish seed for a second crop after lumbering. A plan is outlined for the protection of cut-over lands from fire, and recommendations are made concerning transportation and contracts for the sale of stumpage. The working plan is accompanied by a forest map, showing the distribution of the important timber trees. The conditions on this tract are peculiarly favorable to the successful application of practical forestry.

A tract of 60,000 acres for which the field work was completed is that of the Okeetee Club, in Beaufort and Hampton counties, S. C. The important tree here is the Longleaf Pine. As a result of the past management, the forest varies irregularly from mature stands to young woods, and is broken by occasional patches of open ground, where heavy cutting followed by fire has destroyed the forest altogether. The hearty cooperation of the Okeetee Club in the scientific investigations of the Bureau of Forestry and the exceptional oppor-

tunity for experimentation which is offered combine to give this piece of work peculiar usefulness.

The working plan deals mainly with the following points:

(1) An accurate estimate of the stand of merchantable timber.

(2) A study of the rate of growth of the Longleaf Pine.

(3) A system of fire protection and the organization and instruction of a fire service.

(4) A plan to foster and increase the reproduction of the Longleaf Pine.

(5) Where lumbering operations should begin, how they should be carried on, to what extent the timber should be cut, what yield should be expected, what would be the expense of cutting and marketing under proper rules, and what financial results might be expected.

The preparation of the working plan for a tract of 10,000 acres on Grand Island, Michigan, gave useful results. The field work necessary for a working plan occupied a party of 6 men for two months. The stand was actually measured upon 301 acres, and 299 measurements of contents and rate of growth were made upon felled trees in addition to careful silvicultural studies of the more important species. The forest is composed of hardwoods of large size, which, from the nearness of a strong market, are of high value. There is here an unusually good opportunity for conservative forest management, upon a paying basis from the start.

The tract of the Moose River Lumber Company, of 15,000 acres in Herkimer County, N. Y., was studied by a party of 4 men for four months, and the data necessary for a working plan were collected. The area is equally divided between virgin and cut-over land. On the latter there is a fair amount of small spruce among the first growth of hardwoods, while the former contains in addition a fine stand of mature spruce. The Moose River Lumber Company operates its own mill at McKeever, and can therefore manufacture its own product without the expense of long transportation for its logs. The unusually good opportunity for conservative forest management rendered the preparation of a working plan for this tract of decided importance.

The sixth tract upon which the Bureau completed field work during the past fiscal year includes 150,000 acres of the 275,000 acres in northwestern Maine which belong to the Great Northern Paper Company. The field work occupied a party of 20 men for four months. It included complete measurements of the stand upon 3,303 acres, and of the volume and rate of growth upon 900 felled trees. Careful study was made of the Red Spruce and Balsam, which are here, both commercially and in number of individuals, the most important trees. The chief problem in the management is so to modify the present methods of lumbering that the Spruce may hold its own in the reproduction on cut-over areas. A part of the field work was the preparation of a map of the tract to show the topography and the burnt-over lands, the lumbered areas, the virgin forest, and the forest types.

The field work necessary to a working plan for the 15,000-acre tract of Mr. E. H. Harriman, near Arden, N. Y., was begun April 1 and completed June 15. It was carried out entirely by 9 students, constituting the senior class of the Yale Forest School, under the immediate direction of Prof. Henry S. Graves, formerly assistant chief of the Division of Forestry, and still a collaborator of the Bureau. A forest map of the entire tract was made, as well as a careful study of the forest, by which its character, condition, present stand, and future yield were ascertained.

The working plan will deal with the following topics:

Part I:
- The purpose and scope of the examination.
- Character of the forest, including a general description of the distribution of trees, distribution of age classes, merchantable yield, present condition of the timber, future production, etc.
- Recommended treatment of the forest, including a description of the thinnings actually made.
- Financial possibilities of the forest.

Part II:
- Detailed description of the forest by compartments.
- Forest map.
- Silvicultural study of the forest.

During the spring about 100 acres were thinned under supervision, and about 1,000 cords of wood were cut.

WORKING PLANS IN PREPARATION.

Personal examinations were made during the year of 10 timber tracts in the States of Georgia, Tennessee, North Carolina, South Carolina, Texas, Pennsylvania, and New York, covering a total area of 1,620,600 acres. The preparation of detailed working plans was recommended for six of the timber tracts examined and the recommendation in each case was approved by the owners, at a total estimated cost to them of $10,100.

The largest and most important of these tracts is that of the Kirby Lumber Company and the Houston Oil Company, in southeastern Texas. It comprises an area of 1,250,000 acres, and includes practically all of the virgin Longleaf Pine land in the 7 counties in which it is situated. The forest is divided into three principal types: Longleaf Pine land, Shortleaf Pine land, and hardwood bottom land. The first covers about 80 per cent of the total area and is commercially the most important.

The opportunity for practical forestry on these lands is unusually good. The tract consists largely of pure woods of Longleaf Pine, only about 15 per cent of which have been cut over. With reasonable protection the reproduction is assured, while the presence of a heavy stand of mature timber, the absence of underbrush, and the flatness of the country are conditions exceedingly favorable to clean, conservative lumbering.

The points which will be chiefly studied in the preparation of the working plan are the following:

(1) The present method of lumbering and its effect upon the forest, in order to ascertain what practicable modifications will hasten the production and improve the quality of a second crop.

(2) The reproduction of the Longleaf Pine and the rate at which it produces timber.

(3) The effect of fire on the Longleaf Pine, and the fire problem in general, in order to devise a simple and effective system of protection. Whether this system should include the whole area of the forest or should, as seems probable, deal only with the protection of lumbered areas until the reproduction is old enough to be comparatively safe, can be decided only by a thorough study on the ground.

(4) The railroad tie industry, its effect upon the forest, and its commercial wisdom under the methods and to the diameter to which trees are now cut for ties.

Another valuable opportunity for practical forestry is offered by a

tract of 72,000 acres, the property of E. P. Burton & Co., situated in Berkeley County, S. C. The principal species are Loblolly and Longleaf Pine. Ease of lumbering and transportation and excellent reproduction render this tract one of the most promising with which the Bureau has yet had to deal.

A third tract for which an examination was made, a working plan advised, and its preparation approved by the owners, is that of the Linville Improvement Company, in Mitchell, Caldwell, and Watauga counties, N. C. It has an area of 16,000 acres. The forest is composed chiefly of broadleaf species, among which Yellow Poplar, Yellow Birch, and the oaks are the most important. It presents an interesting silvicultural problem in addition to conditions exceedingly favorable to conservative management upon a sound financial basis.

A smaller but not less promising tract which has been examined, and for which a working plan is now being made, lies on the west side of the Susquehanna River, 13 miles above Harrisburg, Pa., and has an area of 2,300 acres. The owner wishes to hold it as a permanent investment and to manage it with this end in view. With the exception of about 200 acres the forest is composed entirely of sprout growth of Chestnut, Rock Oak, White Oak, and Hickory, together with excellent Scrub, White, Shortleaf, and Jack Pine. A strong market exists for all kinds of forest produce, and transportation facilities are good.

PUBLIC LANDS.

The preparation of working plans for the National forest reserves is one of the urgent pieces of work before the Bureau. It has arisen from the request upon the Secretary of Agriculture from the Secretary of the Interior for advice as to the best management of the reserves, which now comprise a total area of 58,850,925 acres. The study on the ground necessary to a working plan was carried on during the past year in the Prescott Forest Reserve, Arizona, which contains 423,680 acres, the Priest River Forest Reserve, in Idaho, with an area of 645,120 acres, and the Big Horn Forest Reserve, in Montana, which includes 1,216,960 acres. The field work in the Prescott Reserve occupied a party of 11 men for three months. Measurements of the stand were taken upon 1,648 acres, and 1,840 measurements were made of volume and rate of growth; the Bull Pine was carefully studied, particularly with reference to the effect of the present methods of lumbering upon the reproduction of the tree, and the data were obtained for a comprehensive plan for the best management of the reserve with due regard to its value in the production of timber and in maintaining the water supply. The field work carried on in the Big Horn Reserve occupied a party of 7 men a period of four months. The stand was measured on 820 acres, and 1,299 measurements made upon felled trees. In the Priest River Reserve a party of 6 men were at work for three months. The stand was measured upon 879 acres, and 720 measurements of volume and rate of growth were made.

A thorough preliminary examination preparatory to a working plan is now being made of the San Francisco Mountains Forest Reserve, in Arizona.

The field work necessary to a working plan for townships 5, 6, and 41, Hamilton County, N. Y., in the Adirondack Forest Reserve, was begun and completed during the past fiscal year. It became possible through an appropriation of $3,500 by the New York legislature to

cover the field expenses of the agents of the Bureau engaged in the work. The area of these three townships is 69,916 acres, and the necessary studies on the ground occupied a party of 16 men for four months. The work was carried on upon lines similar to those followed in the preparation of a working plan for township 40, Hamilton County, which has already appeared as Bulletin No. 30, Division of Forestry. Measurements of the total stand were made upon 3,471 acres and of volume and rate of growth upon 2,081 felled trees. A careful study was made of the forest, not only from the point of view of the forester, but also from that of the lumberman, and a map was prepared for the three townships showing the combined work of both. This map, in addition to the forest types, gives information necessary to the best lumbering of the tract, showing desirable sites for splash dams, and indicating necessary improvements of streams for driving and other points of practical value to the lumberman.

MILITARY RESERVATIONS.

An important piece of work which will be taken up as rapidly as the force and appropriation of the Bureau will permit has arisen through the request by the Secretary of War upon the Secretary of Agriculture for technical advice governing the handling of military wood and timber reservations. These are eight in number and comprise a total area of 117,468 acres.

A preliminary examination has already been made of the West Point Military Academy Reservation of 2,000 acres stocked with second-growth hardwoods, and a detailed working plan has been recommended and field work will soon begin. An excellent opportunity is offered for thinnings which will materially improve the character of the forest and at the same time yield a supply of firewood for the use of the Academy.

FORESTS UNDER MANAGEMENT.

The working plan prepared in 1901 for the tract of the Sawyer & Austin Lumber Company, of Pine Bluff, Ark., and which has been published as Bulletin No. 32 of the Bureau of Forestry, was put into effect in March, 1902. The forest is a mixture of Shortleaf and Loblolly Pine, with scattered hardwoods, the pine only being cut to a diameter of 14 inches on the stump. The tract was visited by agents of the Bureau and the area to be cut over within the next year, approximately 6,400 acres, was carefully examined. On this area a certain number of Loblolly and Shortleaf pines to be left as seed trees were marked and stamped. They average one tree to 6 acres. It is estimated that there will be left after lumbering at least six seed trees below a diameter of 14 inches, and it is believed that with the larger trees referred to above they will amply suffice to seed up the cut-over lands. The Loblolly grows more rapidly than the Shortleaf and is of practically the same value in the market; hence, wherever possible, it was favored in the markings in order to increase the stand of Loblolly in the second crop. A good beginning in fire protection has been made. One thousand acres have been set aside and an attempt will be made to protect this area thoroughly against fire. It is favorably situated, being completely surrounded by abandoned railroad spurs. These spurs have been cleared of rubbish and will act as excellent fire lines. A man who lives on this area has been detailed

to act as fire warden, under a contract which provides that he shall be paid only in case there is no fire, or, if a fire occurs, then if he can clear himself of contributory neglect; that he may hire assistants when necessary, that he must burn a fire line round the area once or, if necessary, twice a year, and that he shall keep the land thoroughly posted.

An experiment was made on this tract in burning the tops of felled trees, which are sources of great danger if fire once starts on cut-over land. It was found that to be burned successfully the tops must first be lopped and piled. If this method does not prove too expensive upon further trial, the tops on all cut-over lands will be dealt with in this way. An examination was made of the height at which stumps are now cut, and a report was submitted to the company showing the loss which follows from cutting high stumps.

In 1898 a working plan was made for the several wood lots included in the estate of Maj. W. A. Wadsworth, near Geneseo, N. Y. The owner desiring to put the plan in operation, the lands were visited by an agent of the Bureau of Forestry in the fall of 1901. The forest is composed of a mixture of hardwoods, and the main object is so to lumber it that its future productiveness will be assured. All trees to be cut were marked and stamped. The markings favored the more valuable Hickory, Ash, Black Walnut, and White Oak against the less valuable Beech, Maple, and Black Oak. The intention was both to aid the former in the present stand and to increase their relative proportion in the second growth which will follow the lumbering. All dead or dying trees were at the same time marked for removal. An excellent local market exists for lumber, cord wood, and ties. There is assurance that the cutting will prove a financial success and will tend to improve the forest.

The work in practical forestry on the 6,000-acre domain of the University of the South, at Sewanee, Tenn., goes steadily on. Trees containing approximately a total of 500,000 feet board measure have been marked for felling by the Bureau of Forestry, and the lumbering proceeds under its general supervision.

In the Adirondacks the tract of the Moose River Lumber Company has been added to those to which practical forestry is applied under the direction of the Bureau. In accordance with the recommendations of the working plan Spruce is being lumbered to a diameter of 12 inches. The marking of the trees to be cut, as well as the lumbering itself, is being carried on under the general supervision of the Bureau. An experiment is also being made in the conservative lumbering of the hardwoods.

The working plan for the tract of 110,000 acres upon the west slope of the Smoky Mountains in eastern Tennessee has been applied and lumbering has begun under the supervision of the Bureau. Contracts made for the sale of stumpage include provisions recommended by the Bureau. These specify the kinds which shall be lumbered and fix the diameter limits to which they shall be cut. They provide against waste in lumbering and against unnecessary damage to young growth. It is further provided that trees cut in violation of the rules for conservative lumbering drawn up by the Bureau of Forestry shall be paid for at double the contract price.

Including lands not mentioned above, the total area of private forests actually under the supervision of the Bureau of Forestry is 372,463 acres.

FOREST MEASUREMENTS.

The force employed in computing field data was thoroughly organized as a section of the division of forest management during the past fiscal year and the effectiveness of its work notably increased thereby. This section now is equipped to handle all the figures of any kind gathered by the Bureau in its many lines of activity.

During the year the section of forest measurements worked up the figures and prepared the tables for the working plans made by the division of forest management and for the studies of commercial trees by the division of forest investigation. The data consisted of measurements obtained in 13 States and upon 25 species. It included surveys of the stand of timber upon 16,678 acres and analyses of 10,786 trees. These were cast into final tables of present and future stands and yields, of volume, and of rates of growth in diameter and height for the localities and species covered. With the exception of data obtained in the Black Hills Forest Reserve, which await further figures before they can be completed, the force engaged upon forest measurements has entirely finished the work for the field season of 1901, and has scaled also 10,000 acres of surveys left over from 1900.

EXPENDITURES.

The total expenditures during the year by the division of forest management were $53,947.89, or 29.1 per cent of the total appropriation of the Bureau.

Of the $13,325 contributed by owners as their share of the expenses in the preparation of working plans, begun or continued during the year 1901–2, $9,160 had been expended at the end of the fiscal year.

WORK FOR THE ENSUING YEAR.

WORKING PLANS.

Public lands.—The field work necessary to a working plan for the San Francisco Mountains Forest Reserve will be undertaken, since the preliminary examination has established its advisability. Working plans will probably be begun for three other forest reserves, the preliminary examinations of which will be made during the current year.

Private lands.—The study of private forest lands, in the handling of which assistance has been requested under the terms of Circular No. 21, will be carried on as rapidly as the appropriation and the field force of the Bureau will allow. Particular attention will be given to the rendering of assistance in the handling of wood lots. The field work necessary to a working plan for the 1,250,000-acre tract of the Kirby Lumber Company in southeastern Texas will be undertaken, and also for the two tracts of the E. P. Burton Lumber Company, the one of 45,000 acres, the other of 6,000 acres, in South Carolina.

INSPECTION.

Forests under management.—Markings and inspection of lumbering will continue upon those forest lands already under the general management of the Bureau, and upon other lands for which their recommendation is approved in working plans already prepared or in process of preparation.

FOREST MEASUREMENTS.

The section of forest measurements will continue to work up all field results obtained by the Bureau. It will at the same time carry on field work within its own province.

COMMERCIAL TREES.

The purpose of the Bureau in this branch of its work is to complete during the ensuing year the studies of commercial trees already begun. The more important of these are the southern hardwoods, the southern pines, the Adirondack hardwoods, the Balsam in Maine and New York, the White Pine in Michigan, the Lodgepole Pine in the Middle West, and the Sugar Pine in California.

FOREST INVESTIGATION.

STUDIES OF COMMERCIAL TREES.

During the past year, both by this division and by the division of forest management, much valuable information was gathered for the discussion of the growth and yield of White Pine, Red Pine, White Oak, Scarlet Oak, Red Oak, and Aspen in Michigan; Sugar Pine in California; Balsam in Maine; and White Oak and Chestnut Oak in Tennessee, Kentucky, and Missouri. Similar data was collected for Lodgepole Pine in Wyoming and Montana, and for Western Yellow Pine in Arizona.

NEW ENGLAND HARDWOODS.

The study of New England second-growth hardwoods was continued by two field parties, and valuable facts were collected for the future discussion of their value and the best method of maintaining it.

The first draft of a study of the silvicultural characteristics of the Longleaf Pine was revised and enlarged. The study of the growth and characteristics of Loblolly Pine was not completed last year, partly on account of the illness of the expert in charge of the work and partly because his services were diverted to other urgent work. The report on this pine is now practically completed and the manuscript will soon be ready for the press. The study of the Sierra Big Tree in California and its exact distribution required additional attention, but is now practically finished. The maps and manuscripts will be ready for printing early during the present fiscal year. A study of the Bristle-cone Fir in southern California was completed and will shortly be ready for publication. The report on the Pacific Coast Redwood was prepared this year and awaits editorial revision. The report on Western Hemlock was completed and is in press.

SWAMP FORESTS.

A preliminary study of the factors which determine the distribution and best growth of swamp forests in eastern Missouri and Arkansas was begun last season. The timber trees concerned in this investigation are principally Cypress, Red Gum, and Black Gum. Little is known of the conditions most favorable to the reproduction and to the best growth of the Cypress, which is a timber of the first commercial value, or of the gums to be included in this study, the results of which are likely to be of practical value.

STUDIES OF NORTH AMERICAN FORESTS.

Michigan.—At the request of the Michigan forest commission a study was made of typical areas of forest and other lands in the

northern part of the southern peninsula of Michigan. The land examined is included in the State forest reserve, which contains some 60,000 acres of White, Red, and Jack Pine stump land.

A study of the reserve was made for the purpose of suggesting a plan for its proper management and for that of other similar lands in the same region, and recommendations were made to the commission.

Kentucky.—Investigations were begun last season on the forest conditions and resources of Kentucky, with special regard to the effects of destructive lumbering and of fire on the forest and its reproduction. A preliminary report of progress has been made, but another season's field work is required before a full report can follow.

Ohio.—A general examination of the forest resources of Ohio was begun last year to determine the location and extent of available supplies of commercial hardwood timber. In connection with this examination a study was begun of the relation of the wood-consuming industries of the State to existing supplies of timber. Search was made also for historical and other evidence to show the effect of denuding forest lands on the flow of streams. A report on the available tree species of the State has been submitted, together with a preliminary account of the consumption and principal sources of timber supply. The information in question is greatly needed to answer constant inquiries concerning supplies of Oak, Hickory, and other hardwoods.

A special study was begun of the moisture content of green wood. Tables have been constructed showing the percentage of water contained in samples of the green wood of seven commercial timbers of Ohio. This study will be extended and will form a basis for the determination of the best conditions for air-drying timber.

Texas.—The forest resources and general forest conditions of Texas were studied and a report which gives an accurate survey of the general and typical forest conditions of the State is nearly ready for publication.

New Mexico.—An examination was made of the forests on and in the region of the Sacramento Mountains. Particular attention was given to the relation of grazing to the perpetuation of the forest cover, and of the latter to the flow of water, which is of vital importance in contiguous agricultural regions.

Arizona.—Studies were made of the forests of Mount Graham, the Santa Catalina Mountains, the Huachucas, and the Chiricahuas. A portion of the forest lands of the Verde River basin was also examined, likewise with special regard to their relation to local water supplies. Aside from this question, the facts gathered will be of great service in answering frequent inquiries concerning the commercial timber supplies of these regions.

South Dakota —The forest lands on and in the vicinity of Turtle Mountain, Short Pine Hills, and Slim Buttes were studied and reported upon for the same important purposes.

Wyoming.—An examination of the forest lands contiguous to the Yellowstone National Park was made with special reference to the grazing problem. The urgent need for protection of the local water and timber supply gave this work peculiar significance.

Montana.—A special study was begun in the Flathead Lake region of the terrestrial and climatic factors which influence the distribution

of certain types of coniferous forests. The practical object of this study is an accurate knowledge of the soil, climate, and other conditions most favorable to the development of the species considered. A preliminary report of the progress of this work has been submitted. Further field investigations are needed, however, before a full report can be made.

California.—The study of the relation of forest cover to the flow of streams, begun two years ago in southern California, was continued. The facts collected during two field seasons, have been partly elaborated, but require further study, which is being given. It is believed that a complete report of this investigation will be ready for publication early in the present fiscal year.

A general study was made of forest land in northern California with a view to its protection against fire, overcutting, and overgrazing. The examination covered altogether more than 2,000,000 acres.

Iowa.—Studies of the distribution, character, and value of forests in Iowa have been in progress for some time. It is expected that complete reports will be ready for publication at the close of the calendar year. The information will be of particular value to land owners of the Middle West.

COOPERATIVE INVESTIGATIONS.

California.—The study of forests in the Sierra Forest Reserve was again taken up in cooperation with the U. S. Geological Survey, and the unfinished south half of the reserve was completed. The purpose of this work was to make a description and classification of the forest and other lands within the reserve, to map the distribution of tree species and forest types, and to ascertain the condition, quality, and stand of commercial timber. The relation of these forests to various industries was considered, and the effects of forest fires on the growth and reproduction of the trees. An area of about 3,000,000 acres was examined. A report of the work of two field seasons, covering the entire Sierra Forest Reserve, is in preparation and will be completed early in the present fiscal year.

Vermont.—In cooperation with ex-Governor Smith, the Bureau began a general study of the forest resources and conditions of Vermont with a view to recommending a forest policy. A preliminary report was submitted and the complete report is in preparation.

Maryland.—The study of the forests of the best timbered counties of Maryland, begun in 1899 in cooperation with the State geological survey, was continued during last season under the same auspices. Reports on the timber resources and forest conditions of Cecil, Garrett, and Calvert counties have been prepared. Those on Cecil and Garrett counties are being published as a part of the report of the State geologist, while the Calvert County report will be published later.

Appalachian forests.—Descriptions of additional forest lands under consideration for inclusion in the proposed Appalachian Forest Reserve were completed during the past year. The results of this and the previous season's work, conducted in cooperation with the U. S. Geological Survey, were embodied in an elaborate report submitted to Congress and ordered published as Senate Document No. 84. The report is copiously illustrated by maps and photographs.

Its immediate purpose is to give reliable information upon the desirability and feasibility of establishing the Appalachian Forest Reserve. Aside from this purpose, the report embodies exhaustive data on the composition, condition, character, extent, and distribution of the forests of a little-known region.

EFFECTS OF GRAZING ON THE FOREST.

Investigations of the effects of grazing on the forest were conducted in the region included by the Yellowstone and present Teton forest reserves in Wyoming, in the Sacramento Mountains of New Mexico, in the Uintah Mountains of Utah, in the southern Sierras, and in the State of Washington. The purpose of these studies was to secure information which would permit a satisfactory regulation of grazing in regions where agricultural and other interests dependent upon water supply and upon timber have suffered as a result of excessive grazing.

STUDY OF FOREST FIRES.

A study of the effect of fires on the forest was conducted in Maine, Vermont, Michigan, Maryland, the Appalachian Mountains, Wyoming, Utah, Idaho, California, New Mexico, and Arizona. The examination of published forest-fire records was extended to a large number of Western papers. A discussion of the destruction caused by forest fires and the significance of the fire records now accumulated was embodied in a report which will be ready for publication during the present fiscal year.

DENDRO-CHEMICAL INVESTIGATIONS.

Under cooperative plans arranged last year between the Bureau of Forestry and the Bureau of Chemistry, the following dendro-chemical studies were carried on:

Commercial derivatives from native and exotic barks, woods, and gums.—Particular attention was directed to the quality and quantity of tan extracts produced by native woods and barks. The species studied include White Oaks, Black Oaks, Chestnuts, and Hemlocks. A number of gums produced in quantities by trees native of the Philippine Islands were studied with reference to the production of dammar and gutta-percha, and a large amount of work is yet to be done on similar material from the same source.

Standard pulp woods and untried species probably suitable for paper pulp.—The rapid exhaustion of the supply of standard pulp woods renders it imperative to discover, if possible, other equally useful species. To demonstrate the usefulness for pulp of certain plentiful timbers not yet used for that purpose will be exceedingly valuable if it can be done. Wherever supplies of such timber are present the life of the wood-pulp paper industry may be greatly extended.

The species being studied are White Spruce, Black Spruce, Red Spruce, Balsam Fir, Red Pine, White Pine, Loblolly Pine, Hemlock, Arborvitæ, Southern White Cedar, Aspen, Large-tooth Aspen, Cottonwood, White Birch, Basswood, Red Maple, Silver Maple, Tulip-tree, and Black Gum.

The study of these woods embraces the preparation of pulp from their woods and the manufacture of commercial paper in accordance

with standard methods of manufacture. A detailed microscopic study is also being made of the wood fibers as an additional means of ascertaining the structural basis of the excellence or unfitness of certain fibers for the manufacture of paper. The paper produced will be subject to thorough tests, including the wear and strains to which they are subjected in actual use.

Removal of resin from fir pulp woods.—In connection with the general investigation of pulp woods a special attempt is being made to devise a cheap treatment which shall remove all the resin in fir woods, or at least a sufficient part of it, to permit its reduction to pulp by grinding without clogging the reducing stones.

TURPENTINE ORCHARDING.

The method of producing naval stores in the South is rapidly destroying the forests of the Longleaf Pine, a timber whose preservation is absolutely essential to the prosperity of that region. These facts led to an investigation of the production of crude resin by the Longleaf Pine, and an attempt to devise a more economical system. The survival of the naval stores industry depends absolutely on the abandonment of the old system of boxing and the introduction of a new method which will protect the life of the tree. The old system invites the destruction of the forest by fire and wind, as well as by the boxing itself. The Herty method of tapping, devised by Dr. C. H. Herty, a member of this Bureau, leaves the tree practically intact. By this method the resin, from two or more shallow streaks chipped on the trunk, flows into galvanized iron gutters which conduct it to an earthen pot hanging by a nail to the trunk of the tree. To test the new method in comparison with the old, 20,000 trees in strips intimately mingled were tapped. Great care was taken to make the comparison perfectly fair. The run of gum from sets of trees tapped for the first, second, third, and fourth times was collected and measured for each method. A bulletin giving in detail the results of the test is now in preparation. It is sufficient to say here that in quantity, quality, and economy of production the new method is decidedly superior to the old.

The acknowledgments of the Bureau are due to Mr. John H. Powell, of Ocilla, Ga., without whose assistance this experiment could not have been carried out.

COOPERATION WITH THE DIVISION OF ENTOMOLOGY.

In cooperation with the Division of Entomology, much attention has been given during the past year to the ravages of insects injurious to forests. Problems of the first importance to conservative forestry are presented by insect damage in the East and West alike. It may be cited as an example that the timber killed by insects in recent years in the Black Hills of South Dakota amounts to not less than 600,000,000 feet B.M.

VARIOUS STUDIES.

A history of the lumber industry in the State of New York.—This study, prepared by the superintendent of forests of the State of New York, was completed during the year, and has recently appeared as Bulletin No. 34 of this Bureau.

Osier willow industry in the United States.—An exhaustive study was made of the status of the osier willow industry in this country. Important statistical data, hitherto unpublished, were compiled and supplemented by original inquiries. A representative of the Bureau studied on the ground the growth and management of American osier plantations, and added a thorough survey of the osier willow culture in foreign countries. A bulletin embodying the results of these investigations is nearly ready for publication. There is a widespread call for the information it will contain.

Tree growth on burned lands.—The study of burned mountain slopes in southern California was continued during the year. Special attention was given to the study of natural reseeding from surviving trees, and to experiments in direct seed planting of Western Yellow Pine, Torrey Pine, and Monterey Pine, in denuded sections. Since the spring rains very encouraging results have followed this seeding. With the exception of the Yellow Pine, the species named are of little direct value, but a protective cover of these trees will make possible the later introduction of more useful timbers. Strong local sentiment was aroused by this work, and the agent in charge has been given cordial support and assistance from settlers in collecting seed and in planting it.

Eucalypts cultivated in the United States.—A careful study was made of the distinguishing characteristics, culture, uses, and distribution in the United States of about 40 species of Australian Eucalypts, and the results of these studies were embodied in a bulletin which is now in press. Collectively, the information made available in this bulletin is nowhere else accessible. It will give information much needed and often requested by correspondents of this Bureau.

Acacias cultivated and naturalized in the United States.—A similar study was made of the Acacias cultivated and naturalized in the United States, but the report is not yet ready for publication. Information concerning these trees is in constant demand by correspondents of the Bureau in the Southwest.

TIMBER CONSTRUCTION AND SUPPLIES.

Durability of treated and untreated railway timber.—In cooperation with the Bureau of Plant Industry, the durability of timber used for construction, and particularly of railroad timber, was given thorough attention. Large quantities of railroad ties, contributed and transported without cost to the Department by various companies, were laid in the roadbed under test conditions.

The value of insect-killed timber, both treated and untreated, for various purposes was carefully investigated, and great interest in various questions was aroused among the mining and railroad companies. Widespread support and encouragement was given by the latter in various ways. This work, continued from previous years, is among the most promising in which the Bureau of Forestry has been engaged.

EXPOSITIONS.

The forest exhibit installed at the Pan-American Exposition on June 20, 1901, remained on exhibition until November 1, 1901, when, with the exception of the two largest transparencies, it was moved to Charleston, S. C., and installed there on December 30, in the South

Carolina Interstate and West Indian Exposition. The only new feature of the exhibit at Charleston was the addition of 70 samples of commercial woods from the Philippine Islands. At the close of the Charleston Exposition one-half of the exhibit was installed at the New England Association of Arts and Crafts, at Providence, R. I., where it now is; the remainder of the exhibit was boxed and shipped to Washington, D. C.

IDENTIFICATION OF FOREST SPECIMENS.

Much time was consumed in the division of forest investigation in identifying specimens of native and exotic trees and samples of commercial woods. An important service was rendered to the Tennessee and Virginia Boundary Commission by the identification of the species of witness trees and the determination of the ages of blaze marks upon them.

EXPENDITURES.

The total expenditures of the division of forest investigation during the fiscal year were $55,468.84, or 29.9 per cent of the total appropriation of the Bureau.

WORK FOR THE ENSUING YEAR.

DENDROLOGY.

Monographic studies of the White and Black Oaks and the osier willows will be continued, and studies will be begun of the Sugar Maple and the Western Cottonwood. Investigations of the forest floras of important regions will continue.

FOREST DISTRIBUTION.

A study of the character, extent, and value of forests in the best-timbered counties of Maryland will be continued in cooperation with the Maryland State geological survey. Studies of forest conditions and forest resources will be carried on in Vermont, Michigan, Ohio, Kentucky, Iowa, Montana, and California. Special forest problems concerning types of forests in Texas, Arkansas, and Missouri will also be taken up.

STUDY OF FOREST PRODUCTS.

Dendro-chemical investigations.—Chemical investigations of woods, barks, and gums to determine their production of tan extracts and of the adaptation of untried pulp woods for the manufacture of paper pulp will be continued in cooperation with the Bureau of Chemistry. The lines of this work will be considerably broadened to include examinations of new material and the manufacture and testing of papers made from untried woods.

Removal of resin from pulp woods.—In connection with the investigation of pulp woods, experiments will be continued to devise a method of cheaply removing resin from fir woods in order to facilitate their reduction by grinding to pulp. Similar experiments will be made also with inferior pine woods, which, if freed from resin, can be used for certain grades of paper.

MECHANICAL AND OTHER PROPERTIES OF LEATHER PREPARED BY TAN EXTRACTS FROM DIFFERENT NATIVE TANBARKS.

An investigation to determine the mechanical properties of leather from different tannages will be begun at the request of a leading manufacturer of American leathers, upon samples to be furnished by him and other manufacturers. This study follows naturally upon the investigation of tan barks already mentioned. It is expected to yield important results upon the comparative wearing qualities of leathers prepared by various tannages.

CONIFEROUS PRODUCTS.

Turpentine orcharding.—This investigation will be continued for this season along the lines already described. A comparative study of European and American methods on the ground will be undertaken and should be of very great advantage to the development of the new method now under experiment.

Distillation of pine woods.—The preliminary study already made of the distillation of waste Longleaf Pine butts for the production of turpentine and other by-products will be continued, with a view to its application to waste pine tops.

FOREST STATISTICS.

An effort will be made to begin the collection of data showing past and present consumption of raw and manufactured wood of various kinds for all purposes. The investigation is planned to include a considerable number of American and foreign woods in home and foreign markets and the production and value of forest by-products.

PRESERVATION OF WOOD.

The mechanical treatment of railway and other construction timbers with preservatives to increase their durability and comparative studies of the behavior and durability of treated and untreated timber in actual service will be continued. Further study of the causes of decay in timber and methods of prevention will be made. These investigations will be conducted in cooperation with the Bureau of Plant Industry.

TIMBER TESTS.

In cooperation with the Bureau of Chemistry, a series of tests to determine the strength of the principal merchantable timbers of the United States has been commenced. There is an urgent and widespread demand for reliable information of this kind, and it is intended to take up the work in a very thorough way. The Division of Forestry began in 1891 tests which related principally to the southern pines and which in 1896 were discontinued. Beyond this no systematic tests of American timbers have ever been made.

The work in timber testing now undertaken by the Bureau of Forestry will be of direct practical value to engineers and to others interested in the utilization of timber. Testing stations have already been established at Washington, D. C., and at New Haven, Conn., the latter in connection with the Yale Forest School, and their number will be increased as rapidly as possible. Experienced engineers will be employed in the laboratories, and the material will be collected by trained men.

FOREST ENTOMOLOGY.

In cooperation with the Division of Entomology, the study of the relation of injurious insects to practical forestry will be continued, and will include an investigation of the relation of insect pests to American osier willow plantations.

MISCELLANEOUS INVESTIGATIONS.

Pacific Coast Tan-bark Oak.—A thorough investigation will be made of the distribution and available commercial supplies of the Tan-bark Oak of the Pacific slope. Special attention will be given to the growth of the tree and its methods of reproduction. The importance of this investigation is very great, since the supply of this bark, which is the most valuable in the West, is rapidly decreasing, and its place can not be taken by material from any other western Tan-bark Oak.

Pacific cedar-shingle industry.—A study will be made of the cedar-shingle industry of the Pacific coast region. The industry will be investigated at the principal manufacturing centers, while a careful study will be made in the forest of the distribution, character, and extent of cedar timber available for shingles. So far as it is possible during the present season, a study will be made of the reproduction and silvicultural characteristics of this cedar.

RECORDS.

QUARTERS.

At the beginning of March, 1902, an entire floor of the Atlantic Building was added to the quarters of the Bureau. This addition was required by the congested condition of the rooms on the seventh floor. It permitted a rearrangement of the offices, the installation of the library, and the assignment of quarters to the photographic laboratory, hitherto in the building of the Bureau of Chemistry by the courtesy of the chief of that Bureau.

LIBRARY.

The transfer of the main collection of forest literature from the Department Library to the quarters of the Bureau was prevented by lack of space until March, 1902, when a large room was equipped for library purposes. The library now contains 1,120 bound volumes, 1,900 pamphlets, and files of 28 current forest and lumber-trade journals, including French, English, and German periodicals. There were added during the year 3,821 clippings from newspapers relating to forest work. The library staff was increased by the appointment of two librarians, making it possible to classify properly much valuable material collected in former years and to keep abreast of the current work.

The photographic collection was largely increased. Prints to the number of 3,643 were added during the year. Of this number, 3,235 photographs were taken in 42 States and Territories, and 408 forest photographs were received from foreign countries, including excellent collections from India, Switzerland, and Germany. These were classified, catalogued, and filed.

The collection now numbers 6,059 prints. Every State and Terri-

tory, including Alaska, Porto Rico, and the Philippine Islands, is represented. The collection of lantern slides now numbers about 1,000, of which over 400 were added during the year. Loans of 476 slides were made to 13 persons during the year.

CORRESPONDENCE.

As in preceding years, close attention was given to the expeditious handling of correspondence. Notwithstanding the large increase of mail matter, all letters received were promptly referred for attention, and, with few exceptions, were acted upon and acknowledged within thirty-six hours. The number of pieces of mail matter forwarded from the Bureau during the year was 24,538.

MAILING LISTS.

The mailing lists of the Bureau are the following:

(1) A special list of libraries.

(2) A list of representative newspapers.

(3) A small foreign list of journals, libraries, and individuals engaged in forest work.

(4) A special list of persons engaged in forest work in the United States.

(5) A general list of persons interested in forestry.

The first four lists, which number together 2,817 addresses, receive all publications of the Bureau as soon as they are available. To the general list are sent the reports of the Forester, reprints of the contributions from the Bureau of Forestry to the Yearbook of the Department, and circulars of information. Cards are also sent, giving notice of the appearance of bulletins, with brief descriptions of their contents. Applications for these bulletins, made in response to the card notices, are honored in the order of their receipt. The number of addresses on the general list is 5,056.

PUBLICATIONS.

New publications.—During the year eight new publications appeared, as follows:

	Copies.
Bulletin No. 31	7,200
Bulletin No. 32	10,000
Circular No. 23	10,000
Extract No. 212	15,000
Extract No. 214	10,000
Extract No. 236	5,000
Report of the Forester for 1901	10,000
Farmers' Bulletin No. 134	10,000
	77,200
Press Bulletins (Nos. 14, 15, and 16)	12,000
Total	89,200

A word of explanation is required concerning the number of new publications issued, without which it would seem that the publication of results had not by any means kept pace with the Bureau's activity in other directions. While but 2 new bulletins have appeared, as against 3 in 1901, there are now in course of publication 4 new bulletins, the manuscript of a fifth is completed and awaiting the beginning

of the new fiscal year before being submitted, and 2 additional extracts from the Yearbook will appear shortly. It is thus true that the work of publishing results has been carried on much more rapidly than ever before.

Reprints—Ten reprints of former publications were printed, as follows:

	Copies.
Bulletin No. 7	1,000
Bulletin No. 10, first edition	2,000
Bulletin No. 10, second edition	1,000
Bulletin No. 12	2,500
Bulletin No. 17	1,000
Bulletin No. 26	3,000
Bulletin No. 29	10,000
Bulletin No. 30	10,000
Circular No. 23	2,000
Extract No. 212	10,000
Farmers' Bulletin No. 134 (various reprints)	85,000
Total	127,500

In addition to the reprints listed above, the following are now in course of publication:

	Copies.
Bulletin No. 6	2,500
Bulletin No. 8	2,000
Bulletin No. 13	2,500
Bulletin No. 22	1,000
Bulletin No. 28	10,000
Total	18,000

PHOTOGRAPHIC LABORATORY.

Owing to lack of space at the quarters of the Bureau of Forestry, the photographic laboratory remained, as already mentioned, until recently, in the building of the Bureau of Chemistry, through the courtesy of the chief of that Bureau. With the acquisition of the eighth floor of the Atlantic Building it was possible to assign sufficient quarters for the equipment of a photographic laboratory. The work of installing the equipment is now completed. An enlarging and reducing camera of large size was purchased, and the laboratory is now thoroughly equipped in all branches of photographic work, including map photography, enlarging, reducing, and wet-plate work.

The work of the laboratory during the year was very satisfactory. Five thousand three hundred and thirty-two films and plates were developed, 9,695 prints were made, and altogether 20,884 items of work were performed.

INSTRUMENTS AND SUPPLIES.

Instruments.—The rapid extension of the work of the Bureau in the field made heavy demands for additional instruments, while experience in the woods suggested improvements in the construction of several types. A very small percentage of field equipment was lost or damaged beyond repair, for the members of the field parties were generally careful in the handling and use of the instruments. The total expenditure for instruments during the fiscal year was $7,245.61, or 3.9 per cent of the total appropriation.

Supplies.—With the exception of $400 from the contingent fund of the Department, all furniture, typewriting machines, stationery, and supplies of all kinds have been purchased from the funds appropriated for the Bureau of Forestry. This expenditure was $10,200.74, or 5.5 per cent of the total appropriation.

Accounts.—At the beginning of the fiscal year 1902 a system of accounts was introduced, the principal object of which, in connection with the proper preparation and handling of vouchers for the payment of salaries and expenses, was to furnish at all times an accurate, comprehensive, and permanent record of the condition of the appropriation for the expenses of the Bureau, and of the several allotments made by letters of authorization for the traveling expenses of members of the Bureau engaged in field work. A system setting forth in detail the allotments and liabilities of every class has been submitted at the end of each month to the chief of the Bureau.

TREE PLANTING.

The work of this section has broadened steadily during the past year. Cooperation with forest planters under the provisions of Circular No. 22 was widely extended, met with a high degree of public appreciation, and remains the most important work with which the section is charged. Other lines of work of equal promise originated during the year. The first National reserves for the distinct purpose of forest planting were established. It was fairly proved that some lands, hitherto considered incapable of doing so, will stock themselves without planting, if well directed assistance is given to the natural reproductive power. The reclamation of the coast sand dunes by forest planting was for the first time undertaken by the Bureau.

COOPERATIVE PLANTING.

On June 30, 1901, there had been received in response to the offer of cooperation with forest planters, announced in Circular No. 22, a total of 192 applications for assistance. For 173 applicants planting plans had been prepared, in the course of which 113,842.3 acres were examined. Probably 10 per cent of this area will be planted within twelve or fifteen years, but the detailed plans, made in consequence of the examinations, covered but 3,057 acres, which is the area to be planted within three or four years from the date of the plans. Where the planting was not extensive, in many cases it is now complete and in others it is near completion, for many landowners began planting at once on receipt of their plans.

This planting has generally given satisfactory results. For example, at Fowler, Kans., the main part of a wood lot of 12 acres has been established without losing a single tree. At Enid, Okla., satisfactory results were obtained in establishing a wood lot of 5 acres. In a few instances the planting has been temporarily deferred, and in two cases the agreements have been canceled because they could not be carried out by the owners.

During the past fiscal year 70 applications for assistance were received and 51 planting plans were made. There was examined an area of 83,596.9 acres, a large percentage of which is subject to planting. The area actually covered by the plans made during the year, and to be planted within the next two or three years, is 3,417.57 acres.

The total number of applications to June 30, 1902, is 262, the number of plans prepared 224, the area examined, 197,439.2 acres, and the area to be planted, 6,474.32 acres. Thirty-eight applications await attention.

The plans represent 29 States and Territories and 172 localities. In addition, personal advice and instruction have been given in these localities to many other planters. It has been the practice of the representatives of the Bureau in this work to attend and address local meetings when such are called in the interest of forestry by the citizens of a community where work is being done. At Anthony, Kans., where such a meeting was held last summer, over 500,000 trees were set out this spring in consequence, in addition to the planting under plans regularly prepared in that locality.

Planting under this year's plans has several purposes. Protective shelter belts and farm wood lots have generally been the object in the Middle West. Several commercial plantations are being developed in Oklahoma, Kansas, and Nebraska for fence posts and telegraph poles, though none is of great extent. An average example is a plantation at Stafford, Kans., which covers 30 acres and has for its object the production of fence posts. The Middle West has comparatively little nonagricultural land, and except for the production of fence posts, telegraph poles, and railroad ties, forest planting will not as a rule be practiced by individual planters on a larger scale than farm wood lots and shelter belts. The Eastern States have a high percentage of land adapted only to forest purposes, a good part of which has been stripped of timber beyond the hope of natural reproduction. Such land often lies within reach of good lumber markets. In many places in New England land worth from $2 to $5 per acre can be stocked with White Pine at fair annual profit on the investment, reckoning lumber at present prices and a period of growth of from forty to sixty years, and this has encouraged many land owners to begin planting on their idle lands.

An increasing amount of forest planting is being done for the purpose of protection, and this Bureau is giving practical aid in several cases of this nature. For example, the most extensive planting in New England is being done by the Metropolitan Water and Sewerage Board of the Commonwealth of Massachusetts, for the purpose of protecting from silt the immense reservoir under construction at Clinton, Mass., to supply Boston and surrounding cities with water. Seed beds, in preparation for this planting, were established two years ago. Planting was begun this year under plans prepared by the Bureau and carried forward with a force of 48 men under the immediate direction of a forester privately employed. One hundred and seventy-five acres were planted. It will require three years more to complete the planting at present planned, which will cover 1,500 acres. Seedlings are already on hand for the planting of this area, which is, however, but half of that which the plantation will eventually occupy.

In no case has the Bureau furnished seeds or trees or participated in any degree in the expense of planting. Its outlay is limited to the expenses of its agents in making the preliminary examinations and planting plans.

STUDIES OF PLANTED WOODLANDS.

Reliable advice and instruction in forest planting must be based upon a thorough knowledge of the purposes for which planting is

practicable, and of the methods to be economically employed in various regions. This knowledge can be obtained only by an exhaustive study of plantations already established. Such a study was vigorously pursued, during the past year, along the lines already established, in 20 large plantations, 8 of which are located in the Middle West and 12 in the East. The study of the Hardy Catalpa for economic planting was completed, and a bulletin based upon it is in press. A study of the White Pine for economic planting in New England is in progress, and a report is in course of preparation.

Closely connected with these investigations is a study now under way with the object of finding trees better adapted to the Southwestern plains than those hitherto in use. Types of trees inured to hard conditions of climate and soil in other regions are being introduced, in the hope that trees thoroughly fitted for the situation may be discovered.

STUDIES OF FOREST EXTENSION.

The study of the practicability of forest extension by assisting natural reproduction was begun two years ago in the timber belts which project into the prairies along the streams of the Middle West. During the past year this study was much advanced by a forest survey which included a large portion of Nebraska. It was found that the forests of that State, which consist mostly of narrow belts along the streams, have extended over large areas of prairie land within the last twenty-five years, where they were protected from fire and stock. It is estimated that in eastern Nebraska, where the timber is confined to hardwoods, the growth of the forest through its encroachment on prairie land amounts to not less than 400 square miles. The extension of the forest is noticeable on almost every stream and ravine. The forest is known to have traveled up certain streams as much as 2 miles and to have taken complete possession of tracts of 80 to 100 acres of prairie lands within the last twenty-five years.

A knowledge of how to assist natural reproduction effectually will be useful throughout the Middle West, where there are hundreds of scantily wooded stream valleys which should support a heavy stand of timber. Such knowledge will also be of much use in dealing with the denuded lands in the Eastern States, especially where reproduction has been prevented by repeated fires. It is likely to be of greatest value, however, on the National forest reserves, where the stand of timber is often deficient and in the management of which time is often a less important factor than on private lands.

RESERVE PLANTING.

The first step in this important work was taken this year. In the forest survey made in Nebraska, convincing evidence was found of the adaptability of the sand-hill district of that State to the growth of forest trees. Bull Pine and Red Cedar are spreading over the hills naturally near the Niobrara River, a decided tendency toward shrub growth exists throughout the district, and the Government's experiment in planting conifers, made nearly fifteen years ago, has been attended with marked success. At the recommendation of Senator Dietrich, of Nebraska, supported by the Bureau of Forestry, the President, on the 16th of last April, established in the sand-hill region two forest reserves of a joint area of 208,902 acres. With the

consent of the Secretary of the Interior, the Department of Agriculture will establish nurseries and undertake forest planting on these reserves. Preparation for the work was begun this spring, and similar work on other reserves is about to begin.

SAND DUNES.

Work on the control of sand dunes by forest planting was begun for the first time during the past year. Dune control has become important in several parts of the country where serious damage is threatened to valuable property by the encroachment of sand. In southern Virginia and northern North Carolina a chain of immense sand dunes stretches north and south along the coast. These dunes are moving slowly landward, and within the last few years have become dangerous to the United States life-saving stations and to private property of large value. Last fall, at the request of a number of private owners, the Bureau made an examination of a district in Currituck County, N. C., and began work at one point to fix the drifting sand sufficiently to permit forest planting. In cooperation with the owners of the land, board fences and other structures were erected to alter the course of the most threatening dunes and to clear the superfluous sand from a plain about certain valuable buildings. The work was so successful that this spring the ground was in condition for the planting of beach grass, which is being used temporarily as a cover. With a fair growth of grass this season, forest planting on from 30 to 50 acres may be begun next spring. The forest, besides protecting the buildings, will yield a much-needed supply of fuel. At other points in the same district, which extends 30 miles along the coast, the Bureau is now giving similar aid. In addition to its direct use this work will have great value as an object lesson in dealing with the sand.

An investigation is also being made of the dunes formed by the drift sand along the Columbia River in Washington and Oregon. The dunes are destroying valuable orchards and rich agricultural lands. They form serious hindrances to transportation along the lines of the Northern Pacific Railway and the Oregon Railroad and Navigation Company. After a careful examination the Bureau will attempt to devise methods for controlling the movement of the sand. The Oregon Railroad and Navigation Company is assisting in the investigation.

EXPENDITURES.

The expenditures of the section of tree planting for the year were $16,616.86, or 8.9 per cent of the total appropriation. Of this amount 53 per cent was for salaries and 47 per cent for field expenses.

WORK FOR THE ENSUING YEAR.

The work in cooperative planting is giving highly satisfactory results and will continue unchanged. Increased attention will also be paid to protective planting, especially in the Eastern States.

Preparations for extensive planting on the Dismal River and Niobrara forest reserves in Nebraska will be pushed forward as rapidly as possible. Seed beds and nurseries are being put in readiness. A large collection of seed will be made this fall and nursery work will begin. Examinations will be made of other forest reserves, notably

those in Oklahoma, Colorado, Arizona, and southern California, to determine the advisability of systematic planting.

Careful studies will be made in Oklahoma and Arizona during the year to find methods of extending the present forest stand by improving the conditions for natural reproduction. In both regions field parties are already at work.

The reclamation of sand dunes, both along the coast and in the interior, is one of the large problems before this Bureau. Two field parties, one on the Atlantic coast and one on the Columbia River, will continue to investigate this problem during the present season.

U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE FORESTER

FOR

1903.

BY

GIFFORD PINCHOT.

[FROM ANNUAL REPORTS, DEPARTMENT OF AGRICULTURE.]

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REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY,
Washington, D. C., October 28, 1903.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Forestry for the fiscal year ended June 30, 1903, together with an outline of the plans for the work of the Bureau for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

INTRODUCTION.

No previous year has seen such progress in forestry as the last. During this time public sentiment in favor of forestry became more marked, and practical forest work in the woods was better in quality and greater in amount than ever before. But great though the progress was in comparison with other years, actually it was small. The saving of the forests by wise use is but little nearer than it was a year ago, except for the wider spread of a knowledge of the nature and objects of forestry. The means available are yet too feeble to make much impression on the gigantic task of preventing the destruction of the lumber industry, the fourth among the great industries of the United States, and of using conservatively the forests which supply wood and conserve water for the use of the nation. The interests which these supplies serve and maintain are so vital to all our people that it can not be in question whether they shall be preserved, but only how best it can be done. The present provisions are wholly insufficient.

The very rapid progress of the sentiment for forest preservation during the last year has been nowhere more conspicuous than in the Western States. The greater part of it may be traced directly to the growing desire for development in irrigation which followed the passage of the National reclamation law. Except where special interests complicate and obscure the issue, the public opinion of the West has become unanimous in favor of forest preservation for the protection of the water supply, and practically so for the perpetuation of the supply of timber.

The necessity for the creation of forest reserves for their influence on the stream flow and timber supply is being better understood and is steadily receiving greater support where once there was opposition to the policy. The people of the West have not only come to understand that existing forests must be preserved if irrigation is to maintain its

continued development, but they are realizing also the importance of reserving lands once covered with forest, but now denuded, and the essential necessity that the Government should reclothe them with trees.

Decidedly the most important development of the year in forestry has been the awakening of the great lumber interests to the necessity for practical forestry and the hearty cooperation they have begun to give to the efforts of the Government for forest perpetuation. At the convention of the National Lumber Manufacturers' Association, held in Washington, more attention was given to forestry than to any other subject. The convention expressed itself in favor of the perpetuation of forests by wise use, and gave evidence of its good will by visiting the Bureau of Forestry in a body. Members of the association have since that time begun active cooperation with the Bureau with the object of forest preservation, and it may fairly be said that forestry has become a live issue in the minds of the great timber-land holders of the United States.

Only less important is the recent tendency of the railroads of the United States to consider the future of their timber supply and to take measures for its perpetuation. Railroads are among the greatest consumers of timber in the United States, and the preservation or destruction of vast areas of forest will depend on the attitude they assume toward this question, which is not less vital to them than to other users of wood.

A marked feature of the year is the increase in State cooperation with the Bureau of Forestry. The reference of State forest problems to the Bureau of Forestry for solution has reached the point where it involves a large and constantly increasing share of the attention of the Bureau, which could be given to few more profitable lines of work. The legislature of California has passed a law under which the State contributes $7,500 a year for two successive years for a cooperative study of its forest problems by the Bureau of Forestry, which contributes an equal sum.

The legislature of New Hampshire appropriated $5,000 for a systematic study of the forests of the State by the Bureau, including an examination of the proposed White Mountain National Forest Reserve. The State of Wisconsin and the Territory of Hawaii have each asked the Bureau to nominate a principal forest officer for them, while Maine, Michigan, and other States are in close and continual consultation with the Government forest officers.

The growing tendency of the Bureau of Forestry to devote its energies rather to Government work than to the assistance of private owners was marked during the past year. In spite of the rapidly increasing demand for assistance under the terms of Circular No. 21 on the part of private owners, a very large proportion of the work of the Bureau was given directly to Government forest problems on public land. But the greater part of the forests of the United States are and doubtless will remain in private hands, and their preservation is essential to the National safety and prosperity. While, therefore, it is right that the Bureau of Forestry should meet first of all the demands for strictly Government work, it can not neglect the requests for assistance from private owners without most seriously endangering the central object of its existence, which is the perpetuation of the forests of this country by wise use.

The widening of the field for practical usefulness of the Bureau in cooperation with private owners was shown by the growing number

and the eagerness of such demands. In meeting them it is the public rather than any private interest which is at stake. It is plain that a great opportunity has presented itself at a critical time. If this Bureau can be equipped to meet the demand before destruction has gone too far, the extensive protection of woodlands by the practice of forestry will certainly be attained. The only obstacle is present inability to handle the work. The Bureau is face to face with a situation with which it is unable to cope. Not only are the demands already made upon it far beyond its present capacity to meet, but there is grave danger that vast areas of the forests will have disappeared before the Bureau of Forestry can be made ready to use the opportunity to save them.

The making of working plans for the handling of small tracts of forest, such as woodlots, is a part of the most important educational work of this Bureau. The results of such work are by no means confined to the area or even to the neighborhood immediately concerned. Every such plan is a plain and practical demonstration of what is needed on similar holdings in the same region, and as such is of use to all those who wish or who may be brought to wish to manage and improve their own woodlands.

Large operations must always be conducted by trained foresters. Not so the small cuttings of the average farmer. The work of the Bureau in this direction must be along the line of teaching every woodlot owner to become his own forester. During the year the studies of woodlot problems already made have taken shape in publications of the greatest practical value to woodlot owners in nearly every region where such holdings occur.

Not less useful to the farmers of the treeless West are the planting plans prepared by this Bureau to assist them in selecting wisely and planting successfully the trees whose shelter gives so large an added value to their farms.

At the end of the fiscal year for which this report is made the following organization was, by your approval, established for the Bureau of Forestry:

Forester, Gifford Pinchot.
Forest Measurements, Overton W. Price, assistant forester, in charge.
Forest Management, Thomas H. Sherrard, assistant forester, in charge.
Dendrology, George B. Sudworth, assistant forester, in charge.
Forest Extension, William L. Hall, assistant forester, in charge.
Forest Products, Hermann von Schrenk, in charge.
Records, Otto Luebkert, in charge.

FOREST MANAGEMENT.

PUBLIC LANDS.

NORTHERN MINNESOTA.

Under the provisions of the act of June 27, 1902 (32 Stat., 400), amending the act of January 14, 1899 (25 Stat., 642), known as the Morris bill, the Forester of the Department of Agriculture is charged with the selection, subject to the approval of the Secretary of the Interior, of 231,400 acres of land from certain of the Chippewa Indian reservations in northern Minnesota. This area includes 200,000 acres of pine land, 25,000 acres of agricultural land, and an amount equivalent to 10 sections to be reserved from sale or settlement. The act provides that the 225,000 acres of pine and agricultural lands, after

the pine has been lumbered under rules prescribed by the Forester and approved by the Secretary of the Interior, shall constitute a National forest reserve.

Field work under the act was begun early in August, 1902, and occupied an average of four men throughout the remainder of the year. The task before the Bureau was to ascertain what lands within the Chippewa reservations were best suited to the purposes of a National forest reserve, to select and draw up rules for conservative lumbering upon them, and to mark for reservation from cutting the 5 per cent of merchantable timber which the act provides shall be left standing as seed trees. The Bureau is charged also with the inspection necessary to enforce its rules for conservative lumbering. This work, which has been prosecuted with difficulty because of the remoteness of parts of the Indian reservations, their large size, and the faultiness of existing surveys and land classifications, has been carried on successfully throughout the year. A first selection of lands to constitute the Minnesota National Forest Reserve, embracing 104,459 acres, has been made by the Forester and approved by the Secretary of the Interior. The study necessary to a second selection comprising the remaining area has been made, and the official announcement awaits only the completion of Indian allotments within it by the Department of the Interior and the delineation of the flowage line for the Leech Lake and Lake Winnibigoshish reservoirs by the War Department. The 10 sections to be reserved from sale and settlement under the provisions of the act have also been selected and the selections have been approved by the Secretary of the Interior.

The necessary study was made to determine the best methods of reserving the 5 per cent of merchantable timber. The forest was actually measured upon a sufficient area to furnish a close estimate of the stand, and measurements upon felled trees were made to secure reliable volume tables upon which the selection of the 5 per cent for seed trees and a diameter limit for lumbering were based. Rules were drawn up to govern the lumbering and have been approved by the Secretary of the Interior, and the trees to be left standing have been marked upon over 6,000 acres.

In the Black Hills Forest Reserve, in South Dakota, material was gathered for a forest map supplementary to the working plan for the reserve, which was completed in 1901. The field work occupied one man for five months and consisted of a careful classification of the forest into its important types.

West Point Military Reservation.

As the result of the request of the Secretary of War upon the Secretary of Agriculture for technical advice governing the handling of military wood and timber reservations, a working plan for the reservation of the United States Military Academy at West Point was prepared during the past year. The forest comprises about 2,300 acres, and consists of a sprout growth of broad-leaved trees. Little cutting has been done for fifty years, but ground fires have annually burned off the vegetable mold and so injured the trees that the forest generally is in poor condition.

The purpose of the working plan is to prevent further damage by fire and gradually to improve the quality of the forest by judicious cuttings. The importance and value of the tract as a part of the equipment of the United States Military Academy and the urgent demands

for forest produce in the Quartermaster's Department demanded the preparation of a more detailed plan for protection and management than is generally necessary under forest conditions in the United States.

Field work in the collection of data for the working plan occupied two months. It was done by 16 students of the senior class of the Yale Forest School, under the direction of a field assistant of the Bureau of Forestry. A topographical map showing 20-foot contours was made as a basis for the forest map and for the assistance of the forester who will carry out the working plan. The field work showed that wood roads and trails enough already exist to serve as a basis for a thorough system of fire protection. Fire lines to supplement them were indicated on the forest map, and regular beats were established for the daily patrol of the tract. With the system of fire lines and the constant patrol which the working plan recommends, it is believed that fires entering from the outside or starting within the reservation will be easily controllable.

For the restoration of the stand to vigorous condition the working plan recommends careful improvement and reproduction cuttings. In situations where there are now fair stands of healthy trees the form of cutting recommended aims at the removal of the dead and dying and the inferior trees which retard promising growth. In poorer situations the purpose of the cutting will be to secure a new stand by making openings for seedling and sprout reproduction. Where it is improbable that the new growth will establish itself, seeding and planting of desirable species is recommended. Trees were marked for removal on sample acres to guide in future work. The forest was divided for administrative purposes into three ranges, and each range into compartments varying from 40 to 200 acres, according to the character of the stand and the natural boundaries. Each compartment was carefully cruised, described, and subdivided into forest types. In each type representative sample plots of from one-fourth of an acre to 1 acre were carefully selected. On each sample plot every tree was calipered and recorded by kind and diameter. Average sample trees—that is, representative trees whose diameters correspond as nearly as possible to the average diameter of all trees of the same kind upon the sample plot—were felled, and their volume and rate of growth were measured. The results for each sample plot were computed and tabulated. The total volume and the merchantable volume were obtained by multiplying the total and merchantable volumes of the sample trees by the number of trees which they represented. In this way units were obtained from which were calculated the stand and rate of growth of the more important species in all types and for the whole forest. Tables and curves showing the growth of the different species in diameter, height, and volume, tabulated summaries of sample plots, tables of stand of the various forest types, and estimates of the probable cost of the improvements recommended and of the probable income from the cuttings advised are included in the working plan.

Indian Reservations.

In compliance with the request of the Secretary of the Interior to the Secretary of Agriculture, field study of the Lac Courte Oreille, the Menominee, and the La Pointe Indian reservations, all in Wisconsin, was undertaken during the past year.

It was asked that an examination of each reservation and a report containing a description of the forest and recommendations for lum-

bering, in the form of rules, should be made, in order that they might form part of every contract for lumbering on these reservations. The request specified that the application of these rules should be supervised by an agent of the Bureau of Forestry. The field work occupied two men for two months. Its results were embodied in reports upon each of the three reservations, which include a full description of the forest and of the effect of past methods of management upon it, and recommendations of practical means for improving its condition. Each report contains a definite plan for the protection of the reservation from fire and rules for lumbering, which specify the lowest diameter to which trees should be cut and which provide for the avoidance of waste and of damage to standing trees.

Private Lands.

During the past year the requests for assistance under the offer made in Circular No. 21 have increased in number and insistence. A marked growth of interest in forestry in the Southern States has taken place, and here, as in other regions, the Bureau is confronted by enormous opportunity for effective work. Although the preparation of working plans for woodlots and timber tracts goes steadily on as fast as the resources of the Bureau and the other claims upon them will permit, its inability to meet the demands for this branch of its work was never more evident than it is at present.

During the year 94 applications were received for advice and assistance in the management of private forest lands. Thirty-seven of these were for timber tracts, with a total area of 941,179 acres; 57 were for woodlots, with a total area of 5,868 acres. The total area of private lands in the handling of which assistance has been requested since the publication of Circular No. 21 is 5,656,171 acres, of which 5,640,579 acres are in timber tracts and 15,592 acres in woodlots.

Five great railroad companies have during the past year requested the cooperation of the Bureau to determine the advisability of the purchase and conservative management of forest lands by the companies for the production of railroad ties—the New York Central and Hudson River Railroad, the Pennsylvania lines west of Pittsburg, the Missouri, Kansas and Texas Railway system, the Erie Railroad, and the St. Louis and San Francisco Railroad Company. In view of the enormous quantity of timber used annually by these and other railroads and of the rapid decrease in available supplies, their attitude toward practical forestry offers in some ways an unparalleled opportunity for useful work.

Working Plans Made.

WOODLOTS.

Working plans based on thorough study on the ground were made for 48 woodlots, with a total area of 5,650 acres, in the States of Maine, New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania, Delaware, New Jersey, Virginia, and West Virginia. Where cuttings were advisable a number of trees were marked for removal to guide in future work. The results of the examination of each woodlot, with detailed recommendations for its management, were embodied in a report to the owner. The general willingness shown to follow the advice of the Bureau in the handling of woodlots is very marked.

In cooperation with Mrs. Henry C. Potter, who contributed $1,000 toward the cost of the work, of which $579.39 was actually expended during the year, the Bureau completed during the past year a thorough study of woodlot conditions in Otsego County, N. Y. The purpose was to draw up simple rules for woodlot management for the use of farmers and other private forest owners in Otsego County. The field work, which occupied a party of four men for three months, included a careful study of the more important trees and of the effect of present methods of cutting upon the production of a second crop. At present the woodlots of Otsego County are in generally poor condition. The cutting practiced in the past has removed the best trees without regard to the forest of the future. The chief need of the woodlots was found to be a system of thinnings which will yield merchantable material and, by the removal of unsound and undesirable trees, will steadily improve the condition of the forest. The results of the field work have been embodied in a report which describes typical woodlot conditions in Otsego County and gives detailed instructions for bettering them. Upon several woodlots markings for thinnings are now being made in order to demonstrate exactly how the work should be done.

TIMBER TRACTS.

The field studies necessary for detailed working plans were made during the year upon five tracts, with a total area of 482,321 acres, in Maine, Pennsylvania, North Carolina, South Carolina, and Texas. The total amount estimated as the cost of these working plans to the owners was $12,100, and the total amount actually expended was $11,398.29.

SOUTHERN PINE.

One of the tracts for which a detailed working plan was prepared lies in Berkeley County, S. C., and covers an area of about 39,000 acres. The field work occupied a party of six men for three and a half months. The forest, which is typical of much of the eastern portion of the Southern pine belt, consists chiefly of Longleaf and Loblolly pines, about two-thirds of the area being pine land and the remainder Cypress and hardwood swamp. The forest is of good quality, and the flatness of the country and the situation of the tract along the Cooper River render logging unusually cheap. The field work included the actual measurement of 5 per cent of the forest, which afforded an exceedingly close estimate of the stand. The rate of growth of Longleaf and Loblolly pines and of Cypress was obtained, and also their volumes for given diameters.

The protection of the forest from fire, which is here, as elsewhere in the Southern pine belt, the most urgent problem in conservative forest management, was thoroughly studied on the ground. Present methods of lumbering and their effect upon the forest were carefully investigated, in order to formulate plans for work in the future which will insure the production of a second crop without seriously impairing present profits. Material was collected for the preparation of a detailed forest map showing the area and distribution of the forest types and the approximate stand per acre. The working plan contains a description of the methods employed in field work and a full record of its results. It includes recommendations for the protection of the forest from fire and for profitable modifications of present methods of lumbering. Among the important conclusions drawn

from the field study is the superiority for this region, under conservative management, of the Loblolly Pine over the Longleaf Pine, because of its much more rapid rate of growth and its equally plentiful reproduction.

PENNSYLVANIA HARDWOODS.

Another tract for which a detailed working plan was prepared is situated west of the Susquehanna River, about 15 miles above Harrisburg, Pa., and has an area of 2,321 acres. The forest has been clean cut, all of it once and some of it twice, for charcoal wood. The present stand consists of second-growth hardwoods, among which Chestnut, Chestnut Oak, White Oak, Black Oak, and Scarlet Oak are the predominating trees. The present owner intends to hold the property as a permanent investment. As the land is unfit for agriculture and contains no deposits of coal, iron, or other minerals, its capacity to yield returns lies only in the production of wood.

Three men spent six weeks in the field work necessary for the working plan. A thorough study was made of the forest and of the silvicultural characteristics of the more important trees. The local market for wood and timber of the sorts obtainable from the tract was investigated with a view to the disposal of the material from thinnings and improvement cuttings. Data were collected for a detailed map showing the distribution and character of the forest and the location of the more important streams and roads. It was found that on 1,659 acres the growth is still too small to be merchantable, but that on 662 acres the forest will now furnish telephone poles, railroad ties, and firewood. The market permits this material to be cut at a profit. The purpose of the working plan, therefore, was to determine how cuttings yielding salable material could be made with the best results in improving the quality of the stand. Since the land is capable of producing White Oak and Yellow Poplar, cuttings are recommended with the object of gradually replacing inferior coppice growth with a seedling forest of the more valuable kinds and at the same time maintaining the present proportion of Chestnut in the mixture, which is desirable on account of its good market value, its rapid growth, and its capacity to reproduce from the stump.

SOUTHERN APPALACHIAN HARDWOODS.

The tract of the Linville Improvement Company, comprising 16,000 acres in Mitchell, Caldwell, and Watauga counties, N. C., offered a somewhat unusual problem in the preparation of a working plan. The tract includes Grandfather Mountain, one of the highest peaks of the Southern Appalachians. Except for the cutting of Black Cherry fifteen years ago, little lumbering has been done. The present owners desire to cut the mature trees in such a way that the beauty of the forest will not be impaired, while its condition will be improved. The field work occupied a party of four men for three months. The stand was actually measured on 600 acres, the rate of growth of the more important species was determined, and a study was made of their silvicultural requirements and of their present market value. From the data obtained a map was made showing the distribution of the forest types and giving an approximate estimate of the stand of Ash, Cucumber, Basswood, and Hemlock, here the more important commercial trees. The problem of lumbering at a profit in such a way as to improve the condition of the forest without impairing its

beauty was carefully studied. The working plan contains detailed instructions for the location and execution of cuttings, so planned as not to injure standing trees and young growth, and to provide for reproduction.

LONGLEAF PINE IN TEXAS.

During the past year the study for a working plan for the forest lands of the Houston Oil Company in southeastern Texas was begun, and field work upon the holdings of the company in Jasper and Newton counties, comprising an area of about 300,000 acres, was brought near to completion. Longleaf Pine is here the tree of chief commercial importance. Lumbering has been in progress uninterruptedly for twenty years, and about 25 per cent of the entire tract has been cut over. During recent years the use of railroads instead of streams in transporting logs to the mills has had a marked effect upon the character of the logging. The problem of conservative management upon the forest lands of the Houston Oil Company falls, therefore, under three heads:

(1) Management of virgin forest.

(2) Management of forest lands lumbered before the construction of the railroads, which have merely been culled of the largest trees and which now contain a fair stand of merchantable timber.

(3) Management of forest lands lumbered since the railroads were completed, in which the cutting has been comparatively close. Here Loblolly and Shortleaf pines were lumbered as well as the Longleaf, and in addition to the logging for lumber, piles and railroad ties were cut to a considerable extent from small trees.

The field work for this working plan has already required the services of 35 men for four months. Much information of general application was collected upon which to base the working plan for the entire tract. Careful measurements were made of 8,000 felled trees in order to determine the volume and rate of growth of Longleaf Pine, and a detailed study was made of present methods of logging. The timber was measured upon 8,432 acres.

The chief object of the working plan is to devise practical modifications of present methods of lumbering which will hasten the production and heighten the quality of the second crop. Study of the forest shows that it contains a large number of small trees which, under present market conditions, can be lumbered more profitably when they reach larger size. Since the proportion of small trees varies greatly in different localities, a map of the forest has been made, based upon its composition and dividing it into types and blocks for lumbering. The working plan fixes the diameter to which trees should be cut in each of these types and blocks, recommends practical measures to limit the waste in lumbering and to provide for satisfactory second growth upon cut-over lands, and outlines a simple and effective means of protecting the forest from fire.

SPRUCE IN MAINE.

The fifth tract upon which the Bureau completed field work during the past year includes 125,000 acres of the 275,000-acre tract of the Great Northern Paper Company in northwestern Maine. The field work upon 150,000 acres was completed last year, and the study for a working plan for the whole tract is therefore completed. The field work, which occupied a party of 32 men for three and a half months, was continued along the lines of the preceding year. The men were

divided into two parties, each fully organized, and with the knowledge of local conditions given by previous experience it was possible to push the work rapidly to completion. The stand was actually measured upon 5,481 acres, and the volume and rate of growth of 2,058 trees were determined. The most difficult problem with which the working plan had to deal was to increase upon cut-over lands the reproduction of the Spruce, which under present methods of lumbering does not compete successfully with the Balsam. The working plan will include a discussion of the silvicultural characteristics of the commercial trees and diagrams giving their rate of growth in diameter, height, and merchantable contents. Detailed regulations for lumbering will be given, which indicate a diameter limit for the Spruce below which no tree should be cut, and provide in other ways for the production of an abundant second crop. A detailed forest map will accompany the working plan showing the several forest types, the localities in which lumbering has been carried on, and the areas which have been burned over.

Working Plans in Preparation.

Under the terms of Circular No. 21 preliminary examinations were made during the year of ten timber tracts in the States of Alabama, Louisiana, Mississippi, South Carolina, New Hampshire, New York, and Pennsylvania, comprising a total area of 415,522 acres. Upon seven of the tracts examined it was found that the application of practical forestry would be sound business policy, and the preparation of detailed working plans was therefore recommended. For six of the seven tracts this recommendation was approved by the owners. The total estimated cost to them for the plans will be $3,150.

One of the tracts examined during the year, for which the study required for the preparation of a working plan has been begun, is that of the Blue Mountain Forest Association, in Sullivan County, N. H. The forest, which comprises an area of 25,000 acres, consists mainly of Spruce in mixture with commercial hardwoods. The generally good quality of the stand and its nearness to market make the tract particularly favorable for conservative lumbering. The working plan will include a detailed forest map, an estimate of the stand of commercial timber and its rate of growth, and a thorough study of the present condition of the forest as a basis for plans for its best development. The present method of lumbering will be given careful study with a view to advisable modifications.

Alleghany Spruce and Hardwoods.

Another tract for which the field work incident to a working plan was commenced during the past year comprises 50,000 acres of the holdings of the Baltimore and Ohio Railroad in Webster, Nicholas, and Pocahontas counties, W. Va. This mountain forest contains, in addition to valuable hardwoods—among which are Yellow Poplar, Basswood, Cucumber, Black Cherry, and Ash—a heavy stand of Spruce on the higher slopes. The composition and quality of the forest may be improved without appreciable reduction in returns from lumbering. The ownership of the tract is such that a steady income is preferable to a speedy return. In addition to estimates of stand and rate of growth, and to the results of silvicultural study, the working plan will consider the logging problem under existing conditions. The latter is here the most difficult factor in conservative

forest management, since the successful reproduction of the more valuable trees is complicated by the varying requirements of the many kinds in mixture.

MIXED FOREST IN NEW ENGLAND.

Another promising opportunity for practical forestry is offered by the tract of the Pike Manufacturing Company, comprising 3,000 acres in Grafton County, N. H. The collection of data necessary to the working plan was begun toward the close of the past year. The forest is a mixture of broadleaf and coniferous trees of the general type common to northern New England. The desire of the owners is to hold the tract permanently and so to manage it that it may continue to yield valuable crops of timber. Although it has been cut over, the forest contains enough merchantable timber to make lumbering very profitable if conducted in a careful and systematic way. The merchantable product of the forest may be disposed of at fair profit, while the danger from fire is slight if suitable precautions are taken during the lumbering.

PRIVATE FORESTS PUT UNDER MANAGEMENT DURING THE YEAR.

The working plan prepared during the past year for the tract of Mr. R. C. Neal, comprising 2,321 acres of second-growth hardwood land near Harrisburg, Pa., has been put into effect under the supervision of the Bureau. Markings for cuttings have been made upon 30 acres. This experiment in practical forestry is an exceedingly promising one, and since the forest is typical of large areas in southeastern Pennsylvania its conservative lumbering will have wide value as an object lesson.

At the request of the Houston Oil Company two field assistants of the Bureau of Forestry were temporarily detailed, beginning with June 1, to put conservative lumbering into effect upon the holdings of the company in Newton and Jasper counties, Tex., under the supervision of this Bureau and in accordance with its recommendations.

In connection with the preparation of the working plan for the forest of the United States Military Academy at West Point sample markings for cuttings were made and an arrangement has been reached by which the application of the working plan is under the immediate supervision of this Bureau.

The application of conservative management to twenty-seven woodlots in the States of Maine, New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania, and Virginia, comprising a total area of 4,410 acres, is now under the supervision of this Bureau. The lack of available men renders it impossible for the Bureau of Forestry to supervise the application of all woodlot working plans which it prepares. Work is supervised only in those woodlots which present peculiarly difficult problems in their management and the conservative handling of which is of particular value as object lessons for the regions in which they lie.

The 104,459 acres which constitute the first selection for the Minnesota National Forest Reserve are now under the supervision of the Bureau, and the marking of trees to be left standing after lumbering is in progress.

The total area of private lands under the supervision of the Bureau in practical forestry, including those not mentioned above, is 679,194 acres; that of public lands, exclusive of forest reserves, is 106,759 acres.

Cooperative State Forest Studies.

MAINE.

During the past year a study of forest conditions in Maine was begun in cooperation with the Maine forest commission, which contributed $1,000 toward the expense of the work. Of this sum, $679.12 was actually expended. This study was undertaken as the first step in a thorough investigation of the Maine forests. The field work occupied 10 men for about two and a half months. It included a careful study of the Spruce and, so far as possible, of the trees with which it occurs in mixture. Particular attention was given to determining the rate of growth of Spruce in diameter and height in different localities, its distribution, and the conditions necessary for its successful reproduction. In this first attack upon a very large problem it became evident that the best results could be gained from a thorough study of a typical forest area. With this in mind, Squaw Mountain Township, which lies in Piscataquis County, immediately south of Moosehead Lake, was selected for the work. This township, as a result of its varied topography, contains a number of the forest types which are characteristic of the forest growth upon large areas in central Maine, and includes also virgin forest, lands cut over for spruce and pine lumber, lands cut first for logs and then for pulp wood, and lands lumbered for hardwoods. Since logging has been going on continuously for six years just past there was good opportunity for measurements of rate of growth on stumps and felled trees as well as for a study of the effect of present methods of logging upon the forest.

The results of the work were published as a part of the fourth report of the forest commissioner of the State of Maine. A careful description of the forest is given, with tables showing the stand and the rate of growth of the commercial trees, and a summary of conclusions concerning the conservative management of forest lands similar to those of Squaw Mountain Township.

NEW HAMPSHIRE.

Toward the close of the past year the Bureau began the field work of a study of the forests of New Hampshire. This was made possible by an appropriation of $5,000 by the State legislature to cover the expenses of the work, whose specific purpose is to ascertain present forest conditions and their causes. It will include the determination of methods by which the forests of the White Mountains and ultimately of the whole State may best be preserved. The field work is directed along the following main lines:

(1) A study of the composition and quality of the forest and an estimate of the present stand. The results obtained will be used partly in the completion of the forest map of New Hampshire published in 1894.

(2) A study of the characteristics of the more important trees and of the conditions necessary for their successful reproduction.

(3) A study of the methods and extent of lumbering, of its effect upon the forest, and of practicable modifications to improve the condition of cut-over lands.

(4) An investigation, with the assistance of the United States Geological Survey, of the value of the forest as a conserver of the water supply. This includes the determination, first, of the size and condition of the watersheds tributary to large streams rising within the White Mountain region; second, of the effect of forest destruction upon the flow of these streams; and, third, of the amount and value of water power which is available at different seasons of the year or which is already in use.

(5) A study of the size, the value, and the character of the lumber industry of the State of New Hampshire.

CALIFORNIA.

During the past year a comprehensive study of the forests of California was begun. This work is the result of an act of the California legislature approved March 16, 1903, which provides that—

> The State board of examiners is hereby empowered to enter into a contract with the chief of the Bureau of Forestry of the Department of Agriculture for the purpose of studying the forest resources of the State and their proper conservation, and especially with a view of formulating a proper State forestry policy, to the extent of $15,000: *Provided, however*, That these expenditures for such purposes shall not be in excess of the amounts to be expended by the various departments of the Federal Government in collaboration.

The field work is carried on in cooperation between the offices of forest management and forest extension, since the study involves these two branches of the work of the Bureau. Seven men are now engaged upon the investigations incident to forest management. These include the collection of data for a forest map of California showing the distribution of the important trees and of the great forest types and indicating cut-over forest and chaparral. A careful study will be made of present methods of lumbering to find practicable modifications which will hasten the production of a second crop upon the cut-over lands. A similar study will be made of grazing and its effect upon the forest, to determine how it may best be regulated. The results of the work will be embodied in a report which will include, in addition to a detailed description of the work done and its results, recommendations for a forest policy for the State of California.

Studies of Commercial Trees.

It has been possible during the past year to organize definitely the work of this Bureau in its studies of commercial trees and to extend their scope. With the increased number of trained men available it is now possible to conduct these studies in the best way—by studying each tree with small parties in various parts of its range. Carried out along these lines, the commercial tree studies now being made by the Bureau of Forestry are valuable contributions to our knowledge of North American forests.

In the studies of commercial trees conducted during the year particular attention was given to finding the average merchantable stand per acre and its rate of increase. The silvicultural characteristics of each tree were carefully studied, as well as those of the trees with which it occurs in mixture. The distribution of the tree, its behavior in mixture, the forest types in which it occurs, and the effect of elevation and other factors upon it were thoroughly investigated. The influence of present methods of lumbering upon its reproduction was

in every case given systematic study on the ground in order to ascertain the modifications necessary to insure reproduction upon cut-over lands.

During the year the study of Sugar Pine in California, begun in 1901, was completed. The field work occupied a party of seven men for three and a half months. Lodgepole Pine was studied in Park and Gallatin counties, Mont., by a party of four men for three months. Commercial hardwoods were studied in West Virginia, North Carolina, Tennessee, and Kentucky, occupying 31 men, organized into four parties, for four months. A study made of Balsam in the Adirondacks, because of its rapidly growing importance in supplementing the dwindling supplies of wood for paper pulp, is particularly opportune at the present time. A comprehensive study was made of Chestnut in southern Maryland with the specific purpose of determining the best management of woodlots for the production of that timber. The results of the work cover determinations of the stand per acre, the rate of growth of Chestnut seedlings and stump shoots, their silvicultural characteristics, and the method of management under which they may most profitably be grown. A study of Red Pine was begun in northern Minnesota. The field work, which occupied five men for three and a half months, was directed chiefly at the study of second growth in order to determine accurately what happens on cut-over lands under present methods of lumbering.

Forest Measurements.

The section of Forest Measurements computed and put into final form 25,113 valuation surveys, 23,455 stem analyses, 7,947 measurements of height, and 12,217 taper measurements during the past year. These data furnished information upon the present and future stand and the rate of growth in diameter, height, and volume of 42 species of trees in 14 States. In addition to the computation of data and the preparation of tables for working plans and commercial tree studies, a large number of miscellaneous results obtained in other lines of the Bureau's work were put into final form. It is noteworthy that during the past year the section of Forest Measurements has, without increase in force, completed nearly twice as many results as in the fiscal year 1902.

Expenditures.

The total expenditures during the year by the office of Forest Management were $71,192.48, or 24.4 per cent of the total appropriation of the Bureau.

Of the $15,114.25 contributed toward working-plan studies begun or continued during the year 1902–3, $12,864.82 had been expended at the end of the fiscal year.

Work for the Ensuing Year.

PUBLIC LANDS.

Under the request by the Secretary of the Interior upon the Secretary of Agriculture, the study of technical problems involved in the management of the National forest reserves and Indian reservations will be taken up as rapidly as the resources of the Bureau and other claims upon it will permit.

PRIVATE LANDS.

The field work necessary to a working plan for the tract of the Houston Oil Company in southeastern Texas will be continued. Under the conditions of Circular No. 21, a working-plan study will be made of the 27,000-acre tract of E. P. Burton & Co. in South Carolina and of the 100,000-acre tract of the Kaul Lumber Company in southern Alabama. Particular emphasis will be laid upon the preparation of plans for the conservative handling of woodlots, which is rapidly becoming one of the most important lines of work in the Bureau.

INSPECTION.

The marking of the timber to be left standing upon the lands which will constitute the Minnesota National Forest Reserve will be continued, and the rules for lumbering, which have been prepared by the Forester, will be put into effect under the direction of the Bureau of Forestry. The supervision of the markings of trees to cut and of conservative lumbering will continue upon those lands already under the general supervision of the Bureau, or which, as the result of the approval of working plans already completed or still to be prepared, are placed under supervision during the coming year.

STATE COOPERATIVE FOREST STUDIES.

The forest study in California will be continued to completion, and the results of the first season's work will be embodied in a progress report. The study of the forests of New Hampshire will be completed along the lines already established. A study will be made of important forest problems in Vermont, especially of those which confront the private owner.

COMMERCIAL TREES.

Balsam will be studied in Maine and work upon this species brought to a completion. The study of Southern hardwoods will also be completed and the results prepared for publication. The study of Red Pine in Minnesota will be continued, and during the winter a comprehensive study of White Pine in Minnesota and of the Southern pines will be begun.

FOREST MEASUREMENTS.

The computation of field results obtained by the Bureau will continue.

FOREST INVESTIGATION.

The division of Forest Investigation has covered a very wide field during the past year. Its work in turpentine orcharding has furnished its most notable contribution to the progress of forestry.

TURPENTINE ORCHARDING.

One full season's test has been made of the cup system of turpentining, introduced by the Bureau, in comparison with the "box" method. The following very important facts have been established:

(1) That the box is a destructive and unnecessary wound.

(2) That the cup system yields over 23 per cent more turpentine than the box.

(3) That the cup system gives uniformly high-grade rosins not possible from the box.

(4) That the cup system occasions the least possible injury to trees and will greatly lengthen their life and prolong the duration of the naval-stores industry, the extinction of which by the use of the box was imminent.

Through the circulation of Bulletin No. 40 and Circular No. 24, and through the personal instructions of Dr. Charles H. Herty, in charge of this investigation, the advantages of the cup system have been demonstrated to a large number of turpentine operators, of whom 20 are now using 345,000 cups. Many more operators would have installed the new system had it been possible to get cups at the proper time. The only present manufacturer of the cup could fill but a small number of the orders received. Widespread indorsement of the cup system by operators gives positive indication that it will be very generally adopted another season.

Experiments were continued at Ocilla, Ga., on some 20,000 trees to obtain still more accurate data on the comparative yield by the cup and the box systems. The present season's experiments have made it possible to install the cup system at about half the cost estimated for the season of 1902.

Forest Distribution.

MARYLAND.

In cooperation with the Maryland geological survey examinations were made of St. Mary, Prince George, and Kent counties. Reports of these studies are practically finished, and are to be published in the annual report of the State geologist for 1903. The reports embody (1) classification of wooded and other lands, the extent and location of which are shown on maps; (2) description of the forests and their composition by types and species; (3) stand of available merchantable and domestic timber by classes and species; (4) uses and consumption of wood by species; (5) effect of forest fires and other sources of injury, and recommendations for prevention and control; (6) recommendations for the increase and conservative management of the country's forest resources.

TEXAS.

Following a study of the general forest resources of Texas, completed last year, a detailed study of the forests of Edwards Plateau (southeastern Texas) has been made. The forest growth of this region is important both for its influence on stream flow needed for irrigating adjacent agricultural lands and for supplies of commercial and domestic timber. Supplies of Post Oak and a brown-wooded cedar (*Juniperus sabinoides*) are abundant. The latter is important as a substitute for the scarce red-wooded pencil cedars. The results of this study are embodied in a valuable report, which will soon be ready for publication.

MISSOURI.

Progress was made with the study of swamp forests in this State. The plan includes analyses of the factors which determine the distri-

bution and growth of Bald Cypress, and the Red, Black, and Cotton gums. There is a growing demand for information concerning these swamp timbers, which are rapidly coming into wide use.

CALIFORNIA.

The Pacific coast tanbark industry was investigated, with important results. This investigation is mainly a study of the Tanbark Oak (*Quercus densiflora*) in California, the region of principal supply. The work includes the collection of data on the commercial range of the species, a study of the effect of cutting and bark peeling on the reproduction of the tree, and on the extension of its range, the relation of present consumption of bark and methods of cutting and peeling to future supplies, the quality and value of the bark, and the tannin content of various types of bark. Qualitative and quantitative analyses made of a large number of bark specimens by the Bureau of Forestry in its work of collaboration with the Bureau of Chemistry showed that the tannin content of the bark varies very greatly (12 to 18 per cent) with the region, soil, and density of stand, and that, through scarcity of supply, the genuine bark is extensively mixed with useless and inferior oak and alder barks. This practice is harmful to the tannage, and in several localities has done much to injure the reputation of genuine bark. The investigations have already made it possible to instruct buyers how to detect spurious and mixed barks.

OHIO.

Investigation of the distribution of commercial hardwood timbers in Ohio has continued with special attention to available supplies and their relation to wood-consuming industries, and a large number of laboratory experiments were made to show the water content of green and of air-dried woods. The latter studies are directed toward determining the best method of air drying small-dimension sawn lumber.

A thorough investigation of the Basket Willow industry in Ohio was made as a part of a full study of Basket Willow culture in the United States.

MICHIGAN.

A study of the causes which affect the distribution and growth of forests in the sandy Jack Pine plains of northern Michigan was completed. Detailed investigation of the influence which soils and soil modification in consequence of fires exert on the succession of forest types will assist in formulating recommendations for the recuperation, extension, and preservation of forest growth in the region. Much information that will be useful in dealing with these and similar forest regions was secured.

IOWA.

Notes and photographs bearing on the distribution, growth, and commercial importance of the Sugar Maple and Cottonwood in Iowa were collected for use in future dendrological work.

MONTANA.

Studies begun in 1902 of the factors which determine the distribution of coniferous forest types in Montana were completed this year

and embodied in a complete report, with maps and photographic illustrations.

Cedar Shingle Industry.

The cedar shingle industry of the Pacific Northwest was investigated during the fiscal year. The work included a study of the distribution of available supplies of shingle cedar, the scope and status of the shingle industry, its consumption of timber, the relation of present methods of cutting to future supply, and a study of cut-over cedar forests in relation to reproduction. In addition to field investigations, circulars were sent out to secure data not otherwise attainable from cedar shingle manufacturers. Nearly all the manufacturers addressed showed marked interest in the investigation.

Dendro-Chemical Investigations.

The work of the dendro-chemical laboratory was conducted in cooperation with the Bureau of Chemistry, the Bureau of Forestry paying the salaries of experts and giving direction to the work, while the laboratory and appliances and immediate technical and administrative oversight were furnished by the Bureau of Chemistry. Investigations were made during the past year along the following lines:

(1) Study of the commercial value of gums and resins from forest trees of the Philippine Islands.

(2) Study of the production of tannins by native barks and woods. Analyses were made of the standard Chestnut Oak barks of the East and West and of the black oaks of the East. A series of analyses was also made of the woods of these trees to show their tannin content.

(3) Study of untried pulp woods to determine their usefulness as substitutes for standard woods now becoming scarce.

Considerable time was spent as a preparation for this work in a study of the structural and other characteristics of standard pulps, the felting qualities of which are known to meet the requirements of various papers. Of untried or little used woods, studies were made of the pulps produced by Black Gum, Cotton Gum, Colorado Spruce, Black Cottonwood, Narrowleaf Cottonwood, Aspen from the Rocky Mountains, and Engelmann Spruce.

(4) Experiments to determine the effects of certain poisonous chemicals on the life of trees. The purpose was to discover cheap and effective agents with which to destroy noxious woody growth.

Studies were also made of the damaging effects which illuminating and other gases and fumes have on the roots and leaves of trees. This Bureau is often asked to supply exact information on this subject. Several important problems have been presented for solution relative to the effects of fumes from smelters on the foliage and the life of nearby forest trees.

(5) Detection of adulterated spirits of turpentine. A thorough study was made of several hundred samples of commercial turpentine from all possible sources for the purpose of discovering a reliable test by which adulterated spirits could be detected. The most extensively used adulterant was found to be petroleum. The amount of spurious turpentine thus placed on the market is very considerable, and is increasing so rapidly that the Savannah Board of Trade applied to the Bureau for instructions as to how to detect the adulterated article. A simple and reliable test has been found for detecting the smallest per cent of petroleum in turpentine, and a description and illustration of the method has been prepared for publication.

Forest Entomology.

Investigations in forest entomology were conducted by the Division of Entomology in cooperation with this Bureau. The life histories and depredations of forest insects were studied in the principal timber forests of the East, South, and West for the purpose of devising methods

of controlling their ravages. One station was established in the Southern Longleaf Pine belt (Tryon, N. C.) and one in the Red Fir and Yellow Pine forest of Washington (Hoquiam), at which detailed studies and experiments which have already been of use were carried on. Much helpful advice was given to individual owners of timber tracts. Studies of and recommendations for the disposal of beetle-killed timber of the Black Hills Forest Reserve are notably important. Special chapters on the insects affecting the Red Fir, Western Hemlock, and Coast Redwood, and a Yearbook article (1902) entitled "Some of the principal insect enemies of coniferous forests in the United States," were prepared. Studies were likewise made of insects affecting commercial Pines and Cypress of North Carolina, South Carolina, Georgia, Florida, and Texas, Pine and Fir in the Black Hills, Priest River, and Olympic Forest reserves, Hickory in Michigan, Pine forests in New Mexico, tree Yuccas in southern California, Redwoods in California, Tanbark Oak in California, and Sitka Spruce and Giant Cedar in Washington.

Girdling experiments were applied to several hundred Pine trees in the Black Hills, South Dakota; to Yellow Pine and Cypress at Tryon and Boardman, N. C.; also, to Red Fir, Sitka Spruce, Giant Cedar, and Hemlock in Washington (Hoquiam), resulting in the accumulation of data which will be of special value in recommending methods for preventing losses. Excellent results are predicted.

At current stumpage values and wholesale prices of commercial products the annual loss from forest insect depredations is estimated to be about $100,000,000.

Miscellaneous Investigations.

BASKET WILLOW INDUSTRY.

During the past year a comprehensive study was made of the Basket Willow industry in the United States. The investigation included, for the sake of comparison, a careful review of the osier industry of European countries. This Bureau is constantly asked for information on the culture of willows.

An analysis of the present status of the Basket Willow industry in the United States shows that there has been a marked decline in the number of growers and in the quality and quantity of rods produced. This is due partly to the widespread destruction by insects of osier holts in the South and partly to a lack of proper methods of culture. The finest osier rods are now imported from French and German growers, whose methods of culture are practically unknown to American growers. With standard stock, the method of culture determines the commercial qualities of the rods, and it is evident that if the best methods are applied to American holts, high-grade rods can be grown here.

MAPLE-SUGAR INDUSTRY.

Further study of the maple-sugar industry was made during 1902. Special study was made of the care, improvement, and management of working groves and the creation of new groves by planting and by natural reproduction, and of the present and future commercial possibilities of the maple-sugar industry, which has declined.

One of the principal aims in this investigation is to point out meas-

ures through which adulteration may be checked and an honest product may be put on the market with greater profit to the producer than his present small returns.

COMMERCIAL OAKS.

The commercial distribution and growth of White Oak and Chestnut Oak in the Southern Appalachians was studied.

EXPOSITIONS.

Plans for the Bureau's forest exhibit at the World's Fair, St. Louis, Mo., 1904, have been completed. The fund allotted for the exhibition is $7,500. Five thousand square feet of floor space in the Forest, Fish, and Game Building are to be devoted to the exhibit.

CORRESPONDENCE.

The giving of original and compiled information by letter on various technical subjects constitutes an important part of the work of the Dendrologist. One thousand eight hundred and forty communications were prepared during the year—a great increase over the previous year. The subjects of correspondence vary greatly. A large percentage of these letters asked for information either not yet published or widely scattered through various documents.

EXPENDITURES.

During the fiscal year ending June 30, 1903, the total expenditure for forest investigations was $27,714, which is 9.5 per cent of the total appropriation.

WORK FOR THE ENSUING YEAR.

DENDROLOGICAL STUDIES.

DESCRIPTIONS OF TREE SPECIES.

Bulletins descriptive of North American tree species, including their geographical and commercial range, will be in preparation. Five separate regions will be considered—the Northeastern, Southeastern, Rocky Mountain, Southwestern, and the Pacific slope (including adjacent islands and Alaska). These bulletins will supply simple, concise descriptions of our forest trees, and should be particularly useful to lumbermen, architects, engineers, and operators of wood-consuming industries, who are constantly applying to the Bureau for information which is nowhere available at present.

COMMON NAMES OF TREES.

Serious difficulties are constantly arising among architects, builders, engineers, nurserymen, and other wood consumers because of the present confusion in the common names of trees. Careful study will be given to the subject during the coming year.

SPECIAL STUDIES.

Studies of swamp forests in Missouri and Arkansas will be continued during this field season, and a special study will be made of the distribution, growth, and commercial value of swamp hardwood forests in Texas.

Monographic studies of the Black and Red oaks will be carried forward to completion. This work will be concerned mainly with the silvicultural requirements and growth of these oaks for the purpose of completing unfinished reports by the late Doctor Mohr.

The study of the distribution, reproduction, and ownership of the Big Trees of California will be continued, and should be followed by important recommendations for the preservation of the most unique of our forests.

A systematic study of the timber and other Acacia tree species indigenous and naturalized in California, Arizona, New Mexico, and Texas will be continued.

Experiments will be continued on the Potomac Flats to determine the best methods for the production of commercial Basket Willow rods, the best supplies of which are at present imported largely from foreign countries.

TURPENTINE ORCHARDING.

Field experiments will be continued at Ocilla, Ga., and elsewhere to compare still more widely and accurately the cup system and the box system, to improve the cup system further, and to increase the yield. A study of the French system of turpentining is being made on the ground.

FOREST EXHIBIT.

The Bureau's exhibit at the World's Fair, St. Louis, Mo., 1904, will be installed during the present fiscal year. The detailed preparation is going forward as rapidly as possible.

FOREST LIBRARY.

The usefulness of the library will be increased during the coming year by making available for reference, by title, author, and subject index, all essential published matter bearing on forestry and closely related subjects. Summaries of published information on special subjects will be made by the library force. Material is being collected for a general history of State forest legislation.

FOREST PHOTOGRAPHS.

The photographic laboratory will be continued as heretofore.

FOREST EXTENSION.

The forest-extension work of the Bureau of Forestry has to do with the creation of forests where at present there are none. It continues the cooperative planting carried on by the Bureau with private landowners since 1899, and includes forest planting on the public reserves, the investigation of forest fires, studies in forest replacement, and the reclamation of shifting sand dunes.

COOPERATIVE PLANTING.

In cooperating with private landowners in forest planting, the Bureau continues to examine land and prepare planting plans, and to superintend planting under these plans when the cost of such superintendence, not including salaries, is defrayed by the owner.

PLANTING PLANS MADE.

At the beginning of the fiscal year there were awaiting attention 38 applications for planting plans; 70 applications were received during the year. Sixty-eight planting plans were prepared in 29 States. These plans cover an area of 4,283 acres. The total number of planting plans prepared to date is 292, covering an area of 10,807 acres. The following tables give further details on the planting plans which have been made:

Cooperative planting.

JULY 1, 1902, TO JUNE 30, 1903.

No.	State.	Applications.	Plans made.	Area for which plans were made.
		Number.	*Number.*	*Acres.*
1	Alabama	3	2	740
2	California	3	1	108.7
3	Colorado	2		
4	Connecticut	2	4	145
5	Florida	1	1	650
6	Illinois	1	2	57
7	Indian Territory		2	29.5
8	Indiana		4	107.5
9	Kansas	2		
10	Kentucky	3		
11	Maryland	1		
12	Massachusetts	7	8	402.5
13	Michigan	3	4	254
14	New Hampshire	1	1	6
15	New Mexico	2	1	430
16	New York	4	5	120.8
17	North Carolina	1	1	250
18	North Dakota		6	35.44
19	Ohio	3	1	7.4
20	Oklahoma	3	6	87.43
21	Pennsylvania	3	3	54
22	Rhode Island		1	112.95
23	South Dakota	1		
24	Texas	14	11	80.98
25	Vermont	3	3	554
26	Virginia	3		
27	Washington	1		
28	West Virginia	1		
29	Wisconsin	2	1	50
	Total	70	68	4,283.2
	Number of previous applications	38		
	Aggregate	108		

PLANS MADE PRIOR TO JULY 1, 1903.

		Number.	*Number.*	*Acres.*
1	Alabama	3	2	740
2	California	7	4	210.95
3	Colorado	14	12	51.75
4	Connecticut	8	8	260.13
5	District of Columbia	1	1	45
6	Florida	2	1	650
7	Illinois	5	4	80

Cooperative planting—Continued.

PLANS MADE PRIOR TO JULY 1, 1903—Continued.

No.	State.	Applications.	Plans made.	Area for which plans were made.
		Number.	*Number.*	*Acres.*
8	Indian Territory	2	2	29.5
9	Indiana	12	12	1,038
10	Iowa	8	8	42.9
11	Kansas	46	44	747
12	Kentucky	3		
13	Maine	1	1	700
14	Maryland	1		
15	Massachusetts	13	12	1,939.5
16	Michigan	6	6	319
17	Minnesota	9	9	48
18	Missouri	2	1	5
19	Nebraska	23	23	190.86
20	New Hampshire	5	5	84
21	New Mexico	4	2	440
22	New York	7	6	130.8
23	North Carolina	2	2	280
24	North Dakota	27	27	187.62
25	Ohio	7	4	17.4
26	Oklahoma	27	25	276.68
27	Pennsylvania	8	7	705.72
28	Rhode Island	4	4	289.20
29	South Carolina	2	2	100
30	South Dakota	32	31	252.23
31	Texas	22	19	156.23
32	Virginia	6	2	96
33	Vermont	3	3	554
34	Washington	1		
35	West Virginia	2	1	10
36	Wisconsin	3	2	130
	Total	328	292	10,807.47

The planting plans of the past year, like those prepared before, are mostly for farm woodlots of not more than 10 to 20 acres. There have, however, been numerous exceptions. One of the plans was for the Presidio Military Reservation, in the city of San Francisco, Cal. This reservation consists of 1,800 acres, 400 acres of which were planted in timber between the years of 1888 and 1895. The growth of the planted trees has been vigorous, and the stand has become very dense. Recommendations were made for thinning the present stand of timber and for planting an additional area of 108.7 acres. An appropriation of money by the War Department has already been made for this work, which is now in progress. Both thinning and planting should be completed within the next two years.

In May, 1902, Governor White, of North Dakota, made application for the assistance of this Bureau in the preparation of planting plans for the grounds of several of the State institutions. The plans have been made during the past year. The plantations provided for in the plans made will furnish examples of protective shelter belts such as are necessary in the Northwestern plains. The plans have been accepted by Governor White and transmitted by him to the various institutions concerned. The planting under them should begin next spring.

In the spring of 1902 the Fort Worth and Denver City Railroad made application to the Bureau of Forestry for its assistance in the encouragement of forest planting by farmers in the prairie region of Texas through which the road extends. An examination of the land lying contiguous to the railroad between Fort Worth and Texline, Tex., was made by the Bureau of Forestry, and conferences on forest

planting were held with landowners at numerous points. Ten plans were made as a result of this work, and upward of 600,000 trees were planted last fall and this spring in accordance with them. The Fort Worth and Denver City Railroad cordially supported the work by giving transportation to the agents of the Bureau of Forestry and hauling free of charge the trees which were ordered for planting under its plans.

During the year a plan was prepared for the planting of 640 acres in Cullman County, Ala. This land was originally covered with Longleaf and Shortleaf pine, but after being cut over was burned by successive fires until reproduction failed. The plan included recommendations for protection of the land from fire and its planting to Loblolly Pine, White Oak, Post Oak, and Chestnut. The request for this plan is significant of the growing interest of the Southern States in the restocking of cut-over lands.

PROGRESS OF PLANTING.

In practically all cases in which plans were prepared during the past year the owner was ready to proceed with the planting at once. In most cases the planting will be completed within two or three years. Planting also continues under plans previously made.

The Metropolitan Water and Sewerage Board of Massachusetts during the year has planted 225 acres under the plan prepared by the Bureau in 1900. About 400 acres, therefore, have been planted around the edges of the immense Wachusett reservoir of the Boston water supply.

The Currituck Shooting Club, whose grounds lie between Currituck Sound and the Atlantic coast, in Currituck County, N. C., began during the year the planting of trees and shrubs for the reclamation of shifting sand dunes on the club grounds. The preparation of the ground for this planting was done by the club under the Bureau's direction during 1902.

The city of Woonsocket, R. I., has begun extensive planting under plans prepared by the Bureau last year. Like the Metropolitan Water Board, the city of Woonsocket has a large area of bare land surrounding its storage reservoir. This land must be planted to protect the water. Planting began in the fall of 1902 by the setting out of 10,000 White Pine, and was continued during the spring of 1903.

RESERVE PLANTING.

A good beginning in planting on the public forest reserves was made during the year. Work has been in active progress on the Dismal River Reserve in Nebraska and the San Gabriel Reserve in California, on both of which there is urgent necessity for establishing forests without delay.

DISMAL RIVER RESERVE.

On the Dismal River Forest Reserve, one of the two reserves established in the sand hills of Nebraska for forest planting, the boundary lines have been surveyed and marked. Nine sections, including the district which is to be planted first, have been surveyed and mapped. Since the reserve does not afford a satisfactory nursery site, a tract of 240 acres adjacent to the north side and lying in the valley of the Middle Loup River, about 2 miles west of Halsey, was set aside by

Presidential proclamation for a forest nursery. Eighty acres of this bottom land have been fenced, and a seed bed of 1 acre has been prepared and covered by suitable framework for the protection of seedlings. This bed has now been entirely seeded to pine and spruce. Materials have been obtained for the construction of an additional seed bed of the same size as that already made, so that space has been provided for the growing of 2,000,000 plants.

During the fall of 1902, 30,000 seedlings of the Western Yellow Pine were collected in the Black Hills Forest Reserve and 10,000 Jack Pine seedlings in the woods of Minnesota for the Dismal River Reserve. During the past spring 60,000 additional seedlings were obtained in the woods in the vicinity of Brainerd, Minn. These 100,000 trees were planted in the north part of the reserve. The planting of these forest-pulled seedlings is for the purpose of determining how far that method is practicable. The present indications for the survival of a large percentage of the trees are excellent.

The cost per 1,000 of collecting, shipping, and planting these seedlings was as follows:

Species.	Cost of collecting.	Freight.	Cost of planting.	Total.
Jack Pine	$3.85	$1.20	$1.46	$6.51
Western Yellow Pine	4.58	.56	1.72	6.86

Seven thousand Cottonwood and 3,000 willow cuttings were planted along the Middle Loup River and on the adjacent hills.

In addition to the sowing of the seed bed and the planting of trees and cuttings, 10 acres in the sand hills adjacent to the nursery site were sown with Red Cedar, and 24 acres with Jack Pine, Western Yellow Pine, and Blue Spruce.

A temporary building was erected near the nursery site to provide protection for tools, implements, and supplies. A well was sunk and a windmill erected to supply water for the irrigation of the beds. A reservoir of $1\frac{1}{4}$ acre-inch capacity was constructed some 60 feet above the seed beds. The level of this reservoir gives ample head for using the water either in the seed beds or in the protection of the buildings in case of fire. A complete irrigating system has been established.

It is significant of the local interest taken in the Bureau's work that the commissioners of Thomas County have recently laid out a road direct from the station at Halsey to the Bureau's headquarters, and have bridged the river, at a cost of $800.

SAN GABRIEL FOREST RESERVE.

SEED PLANTING.

The work of planting on the San Gabriel Forest Reserve was greatly extended by this office during the past year. Planting was begun on Brown Mountain, at the western extremity of the San Gabriel Reserve, in November, 1902. This mountain, which has been heavily burned for many years, is now bare of timber and but scantily covered with brush. The planting was done at an elevation ranging from 2,000 to 4,500 feet. For the larger part of the work seeds were planted. Seed spots were dug from 6 to 12 inches deep and 2 feet across, the surface was smoothed, and from 8 to 15 seeds

were planted in each spot. The spots were from 6 to 15 feet apart, or an average of about 375 per acre, and, when possible, were placed in shelter. The total cost of planting was $7.41 per acre, not including cost of superintendence. The force engaged in the work consisted of two members of the Bureau of Forestry, with from 12 to 15 laborers. The amount of seed planted in this way was as follows:

	Pounds.
Knobcone Pine	85
Coulter Pine	1
Torrey Pine	2
Gray Pine	33
Western Yellow Pine	26
Sugar Pine	45
Incense Cedar	9

The seed of the Knobcone Pine planted in November began germinating in January, and the Incense Cedar a little later. From this time until April the seedlings appeared in abundance. Owing to the great numbers of birds (linnets), precautions had to be taken for the protection of the seedlings. Later in the season, with the growth of more vegetable food, the birds' attack largely ceased. In addition to the birds the rabbits did great damage by biting off the young and tender seedling trees.

SEED BEDS.

During the past year a seed bed 15 by 50 feet has been constructed in Pasadena, where there are ample facilities for water. On account of the presence of birds it was necessary to cover this entire inclosure with wire netting. This bed has now been wholly planted to Pine and Incense Cedar seed.

The thanks of the Bureau are due to Mr. J. R. Bell, forest ranger, Idyllwild, Cal., for assistance in securing seed for planting; to Mr. William G. Kirchkoff, president of the Los Angeles County Water and Forest Association, who gave $262 to the work, and to the Pasadena Board of Trade for a contribution of $600 for the same purpose.

SEED COLLECTING.

For the planting both in Nebraska and in California this Bureau has itself collected the seed. This was usually necessary because the seed was not to be found in the market, and in all cases it has insured seed of fresh quality and from suitable places. In addition the Bureau has acquired valuable information in regard to the collection and treatment of tree seeds. In all, 856 pounds of seed have been collected.

FOREST REPLACEMENT.

Investigations to determine methods of improving thin forest stands without resorting to expensive planting were begun during the past year. Three distinct studies have been carried on, one of the reproduction of hardwoods in Oklahoma, another of Western Yellow Pine on the Prescott Reserve in Arizona, and a third of White Pine on abandoned fields and pastures in New England.

REPRODUCTION OF HARDWOODS IN OKLAHOMA.

The natural line between timber and prairie which extends southward through Missouri and eastern Kansas bends distinctly westward

in Oklahoma to include the Wichita Mountains, which consist of several low ranges separated by high prairies or parks. For the most part the valleys at the foot of the mountains and the higher slopes are covered by a scattering growth of hardwoods, consisting principally of Post and Black Jack oaks. The land until 1901 was controlled entirely by Indians, who used it for grazing, and was regularly burned off each year for the improvement of the range. In the longer settled portions of Oklahoma, where originally there were similar thin stands of oak, a dense growth of young oaks sprang up at once after the settlement of the country and the end of the fires. The chief purpose of this investigation was to find whether such reproduction is to be expected in the Wichita Mountains.

A large number of silvicultural and reproduction surveys were made on the Wichita Forest Reserve, which includes the principal mountains, and evidence was gathered which shows that if fires are kept out of the reserve and grazing somewhat limited a strong though not perfectly distributed reproduction of species such as Post and Black Jack oaks and Red Cedar may be expected. A map of the reserve was made showing the various types of reproduction and areas where timber is wanting and can not be expected except by planting. This is an important feature of the investigation, since there are large tracts of this kind of land in the reserve. Full information in regard to planting and concerning suitable locations for nursery sites has been obtained.

A general reconnaissance was made of the timber belts of Oklahoma and surrounding regions for the purpose of finding whether they are extending since the settlement of the country. The opportunity which this investigation afforded to study the planted timber of the region was used. As a result of this investigation a report was submitted on forest extension and planting in Oklahoma.

REPRODUCTION OF THE WESTERN YELLOW PINE ON THE PRESCOTT FOREST RESERVE.

Because of the small amount of useful timber in central Arizona and the great need of lumber for the rapidly growing mining and agricultural interests a study of the reproduction of the Western Yellow Pine was made on the Prescott Forest Reserve. The purposes of this study, as of that made in Oklahoma, were to find (1) how far sufficient reproduction exists, (2) whether by artificial means this reproduction can be increased, and (3) whether planting is practicable on any portion of the reserve.

Reproduction surveys showed what portions of the reserve have now a sufficient stand of young timber, and some of the causes of the failure of reproduction were ascertained. Abundant evidence is present to show that the vital seed which reach the soil at a seasonable time have a high percentage of germination. Tests in seeding are advisable.

WHITE PINE REPRODUCTION IN NEW ENGLAND.

White Pine reproduces itself abundantly on abandoned fields and pastures in certain localities in southern New England, but the distribution of the young trees is not good. A study to discover methods of improving reproduction began in the summer of 1902 and continued far enough to indicate its practicability. The study was carried on locally in Worcester County, Mass., and Cheshire County, N. H. It showed that seed years for the White Pine in that region

take place with considerable regularity and that the seeding of a tract depends upon the proximity of seed-bearing trees, the condition of the surface soil, and the character of the ground cover. The latter two conditions being subject to easy control, there seems good ground for believing that methods may be found under which, if seed trees are present, the landowner may, without great difficulty, secure a fairly even stand of White Pine. The investigation, which is to be continued during the coming season, will make it possible to give definite recommendations to landowners who wish to improve the conditions for White Pine reproduction.

Forest Fires.

The object of the study of forest fires is to get the best information possible both on the immediate money loss by forest fires and on the indirect damage to the forest and to local interests of various kinds. The ultimate purpose is to find effectual methods of prevention and control.

OREGON AND WASHINGTON.

After the fires which occurred in Oregon and Washington in September, 1902, the Bureau at once made an investigation of the losses which had been sustained. The report of this investigation covered the loss of life and property, the causes of the fires, the methods used in fighting them, the damage to the soil, and the outlook for reproduction. The burned districts were mapped.

The area burned over in Oregon was approximately 170,000 acres, of which 120,000 acres carried a heavy stand of Red Fir, estimated at 17,700 board feet per acre, or 2,124,000,000 board feet. The value of this timber at a stumpage rate of $1 per thousand, board measure, was $2,124,000. Though much of this is a total loss, a great deal can still be utilized if lumbering is undertaken immediately. Logging roads have already been built into the burned districts.

The principal fires in Washington were in Skamania, Cowlitz, and Clarke counties, where the area burned is estimated at 434,000 acres. With the exception of 150,000 acres all of the land was fully as heavily timbered as in Oregon and of better quality. The amount destroyed is estimated at 5,026,800,000 feet board measure. At a stumpage value of $1 per thousand the total stand of Red Fir amounted to $5,026,800.

In addition to the green timber, both States sustained heavy losses in sawmills, sawed lumber, logs, railroad ties, telephone and telegraph poles, and cordwood, besides farm buildings, stock, hay and grain, fences, farming machinery, vehicles, and orchards. The total losses in Washington and Oregon are estimated to be as follows: Oregon, $3,910,000; Washington, $8,857,100—total both States, $12,767,100.

Many of these fires could have been extinguished before they became serious. An efficient system of forest patrol in these localities would probably have prevented them altogether. Watchfulness on the part of the Government rangers prevented severe fires on the forest reserves.

GEORGIA AND FLORIDA.

An investigation was begun last March to determine the damage done by fires to forest reproduction in the Longleaf Pine forests of

northern Florida and southern Georgia. In this region, where the forest stand is never heavy and where grass always grows beneath the trees, it has been a long-standing practice to burn over the ground each year to improve the grazing. The investigation was attended by many difficulties, chief among which are that burning has been so general that areas not affected by fire could seldom be found, and without which there was no opportunity for comparison; that the individual fires are so light that the damage is not easily determined, nor is its influence long to be seen, and that the indifference of many of the people made it impossible to obtain specific information.

A few tracts of land were found, however, where, with the original condition the same throughout, some parts had been repeatedly burned, while others had been protected through a number of years. These conditions gave opportunity for a comparative study, the results of which are applicable over an extended region. This study, though at present incomplete, indicates that definite information may be secured on the damage which fire does to the Longleaf Pine forests.

THE LAKE STATES.

In May, 1903, investigations were begun in Michigan and Wisconsin to find methods of preventing forest fires in the White Pine region of the Lake States. In addition to a detailed study such as was conducted in the Southern States, the Bureau has made careful inquiry into the methods of fire protection proposed by railroads and landowners. Fires do not occur so frequently in these regions as in the pine belts of the South, but more often reach the dimensions of a conflagration.

The Bureau of Forestry plans, by means of full field studies, to replace with carefully gathered facts the vague general notions that now exist about forest fires. After detailed study of particular regions the Bureau will be ready to recommend methods of fire protection and control for private land and, when called upon to do so, to suggest fire legislation for the various States.

Reclamation of Shifting Sands.

The protection of valuable property from the encroachment of shifting dunes and the reclamation of dune-covered land for economic uses have become important problems in some sections of the United States, particularly along the Atlantic and Pacific coasts, in the Great Lake district, and along the Columbia River in Washington and Oregon. The most effectual method of permanently reclaiming such land is to establish and permanently keep a forest upon it. European experience has abundantly shown that this can be done and that land which is not only useless but a source of grave danger will, when forested, yield returns.

For this reason the Bureau of Forestry has during the past year made examinations of some of the worst districts of shifting sand in the United States.

ATLANTIC COAST DUNES.

The dunes lying along the Atlantic coast between Cape Cod in Massachusetts and Cape Fear in North Carolina have received attention. The only extensive work yet done for the retention of sand in

this district is at the point of Cape Cod, where the State of Massachusetts owns a tract of several hundred acres known as the "Province Lands." Here at considerable expense the State has arrested the worst dunes by the planting of grasses. Grasses hold the sand temporarily, but it is only where trees have been used that the land may be said to be permanently reclaimed and to have attained practical value. The Bureau first considered most carefully the results of the work done on the Province Lands. This study assisted it in devising methods of reclamation in other places along the coast. As a result of this investigation it has begun to prepare tree-planting plans for owners of sandy areas along the coasts, under the general plan of cooperation in forest planting.

COLUMBIA RIVER DUNES.

Some of the most extensive and mobile sand dunes of the United States are to be found in the lower valley of the Columbia River, in Washington and Oregon. On the outer portion of the valley extensive farms and orchards have been developed on soil of great fertility, and between Pasco, Wash., and the Cascade Mountains the line of the Oregon Railroad and Navigation Company has been built. Both the railroad and the farming interests suffer great loss from the shifting sands. Bearing orchards have been completely engulfed, and valuable buildings have had to be moved because of it.

The sand of the Columbia River is much lighter than the sand of the Atlantic coast, on account of the quantity of mica which it contains. This makes it easily blown by the wind and also gives it great fertility when once fixed and supplied with water, so that with the reclamation of the sand dunes there are possibilities of profitable orchards and farm lands in connection with the belts of forest which will necessarily have to be established.

During the past year the Bureau has made a very careful investigation of the sand districts of the Columbia River. They have been mapped, and the trees which naturally thrive in sand in that region and which might be used were the work of reclamation begun have been closely studied. In addition a strip of land from 1 to 6 miles wide lying along the Columbia River, between Willow Creek and John Day River, has been withdrawn from settlement for experiment. This withdrawal contains some of the worst sand dunes of the entire river and will afford an opportunity for an extensive trial of the practicability of changing waste areas of this type into fertile agricultural land.

EXPENDITURES.

The expenditures in forest extension during the past year amounted to $41,977.69, or 14.4 per cent of the total appropriation for the Bureau.

WORK FOR THE ENSUING YEAR.

The lines of work which have been laid down in the past will be continued and strengthened during the coming year. The addition of several field assistants to the force engaged in forest-extension work will easily make this possible.

Cooperative work in forest planting between the Bureau and landowners is now firmly established and may be extended just so far as

the resources of the Bureau will permit. Not only will planting plans be made in increasing numbers, but more attention will be given also to the supervision of planting done under the plans and to the care of plantations after they are made.

The forest planting begun on two of the public reserves will be continued, and, if practicable, extended to several others during the next year. Work should be begun promptly on the Pikes Peak, Wichita, Prescott, and San Bernardino reserves.

Studies in the improvement of natural reproduction on the Pikes Peak Reserve and in northern New Mexico will be continued, as will also a study now in progress of the extension of the timber belts of western Kansas and an investigation of methods of restocking with forest the cut-over pine lands of southern Michigan. In southern New England the study begun last year on the improvement of the reproduction of White Pine is to be concluded. Other work in progress includes an investigation, in cooperation with the Forestry Association of Massachusetts, covering the problems of forest fires and reproduction and studies in cooperation with the State of California to determine methods of improving thin forest stands and to show the extent to which forest planting is practicable on mountain lands in that State. The growth and value for economic purposes of the planted Eucalypts in southern California will also continue as a part of this cooperative work. An investigation of methods of preventing and controlling forest fires under the same plan will soon be begun.

Special inquiries will be made into the causes of and damage from all serious forest fires which do not receive State investigation. The influence of fire on reproduction under the varying conditions prevailing in different forest regions will continue to receive attention.

The reclamation of shifting sand by forest growth will be vigorously prosecuted on the Atlantic coast, in the Lake region, and on the Columbia River. On private lands the Bureau will cooperate with landowners. On Government land the Bureau will itself begin work in a limited number of places.

FOREST PRODUCTS.

Timber Tests.

An investigation of the mechanical properties of timber was undertaken by this Bureau on September 1, 1902, in cooperation with the road-material laboratory of the Bureau of Chemistry. Its specific purpose is to determine the strength and durability of the merchantable timbers of the United States. In planning the work the effort has been to confine it to the solution of practical problems and to avoid those of purely scientific interest. A circular was prepared and printed stating in detail the methods to be employed and the results expected. This was sent to prominent engineers, manufacturers, and lumbermen, with a request for candid criticism and suggestion. The replies show a keen appreciation of the importance of the work and in almost every case approve the plan outlined in the circular. The intention of the Bureau to test actual commercial products in the form of full-sized sticks of structural timber received the commendation not only of practicing engineers but of eminent authorities on testing, such as Prof. G. Lanza, to whom the principal features of the plan were due.

The scope and purpose of the timber tests may be briefly summarized as follows:

SERIES A.—*Tests of the mechanical and physical properties of timber as found on the market:* Actual sizes and grades of commercial products will be used. The purpose is to determine moduli for design; to ascertain the value of woods now considered inferior; to determine the liabilty to knots and their reducing effect on the strength of timbers; to arrange a table of standard weights and rules of inspection and grading, and to compare the properties of the same species from different regions.

Tests to determine the effects of variations in the testing process:

SERIES B—Effect of rate of application of load, including impact tests.

SERIES C—Effect of moisture.

Studies of the effect and efficiency of technological processes:

SERIES D—Preservatives.

SERIES E—Methods of seasoning.

SERIES F—Fire retardants.

SERIES G—Effect of forest conditions.

The Bureau of Forestry is now conducting timber tests at three laboratories. The Washington laboratory, in addition to the execution of tests assigned to it, has general supervision over the other laboratories and the direction of their work. These are the laboratories at New Haven, in which the Bureau is cooperating in timber tests with the Yale Forest School, and the laboratory at Berkeley, in which similar cooperation is going on with the University of California.

The tests at present being made under Series A include tests of the Pacific Coast Red Fir and Hemlock, of Longleaf Pine, and of second-growth Loblolly Pine. An investigation of the mechanical properties of the Southern gums is planned for the immediate future. Series B and C are under way. Efforts are now being made to secure the cooperation of those interested in outlining a scheme for investigation under Series D. Work upon Series F and G has not yet begun.

Testing Longleaf Pine beams, measuring 12 by 16 inches, was the first work undertaken at the Washington laboratory. Thirteen full-sized beams were broken, and many small pieces taken from them were subjected to minor tests, such as those for resistance to compression and shearing. The testing was done in accordance with the standard practice; but new features were the photographing of all four sides and the two ends of each beam, and the recording of its actual market grade. After the series of tests is complete these additional records will be valuable in determining the reason for unusual strength or weakness. The tests of market timber will also serve to check the values obtained by the Division of Forestry in former tests of material, which were not conducted as described. During the year the results of the work upon Longleaf Pine were tabulated, and experiments were conducted to determine the moisture in the beams tested at Berkeley and New Haven. Tests upon second-growth Loblolly Pine were begun.

The work of the laboratory at New Haven, in cooperative work begun in September, 1902, comprised the testing of 14 Longleaf Pine beams, together with numerous minor tests of smaller specimens cut from them. The work of this laboratory for the immediate future will consist in an investigation to determine the best methods for making timber tests and the effect on the results of tests of such factors as speed of application of load and the amount of moisture and of volatile oils in the timber tested. The laboratory is equipped

with a 150,000-pound Riehlé testing machine and with the other apparatus necessary for thorough work.

At the Berkeley laboratory work in cooperation with the University of California began in April, 1903. The work during the year included the testing of 56 Red Fir beams, the first step in a series of investigations of Pacific coast timbers. The investigation has the enthusiastic support of lumbermen, engineers, and manufacturers. Two carloads of timber have been given to the laboratory as testing material, and many times that amount has been promised when needed. The timber is given free transportation by the railroads.

Wood Preservation.

The purpose of the work of the Bureau in wood preservation is to determine the best methods for the seasoning of construction, railroad, and other timbers, and for increasing their durability by the use of preservative processes. Particular attention is given to ascertaining methods of treatment by which the employment of inferior woods may be rendered profitable, and economy in the use of woods of more valuable kinds may thus be increased. The work has received throughout the enthusiastic support of the railroad companies. They have furnished free transportation to the agents of the Bureau; have provided material for experiment, and scales and other appliances; have transported material for treatment from place to place free of charge, and in other ways have rendered notable assistance in the work.

Studies to determine the best methods of seasoning Lodgepole Pine railroad ties and the time required to season ties cut in different months have been carried on at Bozeman, Mont. One hundred ties were weighed each month, immediately after they were cut, and then piled in variously constructed open piles to determine the best form for thorough and rapid seasoning. The ties were weighed again at the end of fifteen days, and at intervals of thirty days thereafter until thoroughly air dry. After the seasoning was completed the ties were shipped to Sheridan, Wyo., for treatment by different preservative processes. It was demonstrated that by proper seasoning before shipment the ties lose nearly 40 per cent in weight. It was also shown that when the timber was properly seasoned about one-third less time was required for treating it. All ties were marked with record nails showing the months in which they were cut and the treatment given them, and then placed in the track in order that their durability might be tested by actual trial.

Similar investigations are being made of railroad ties manufactured from the inferior oaks, the gums, and the beech of eastern Tennessee, Kentucky, Arkansas, and Mississippi. When seasoned these ties will be treated with preservatives and placed in service. More thorough seasoning in much shorter time has already been attained by improved methods of piling.

A study of Loblolly and Shortleaf railroad ties is being made in eastern Texas. About 2,000 ties have been cut each month under the supervision of an agent of the Bureau. These ties were taken from different localities and from different parts of the tree. They are so marked that a record can be made of the differences they show in water content, weight, strength, durability, and absorption of preservatives. A tie yard has been provided by the railroad company,

to which the ties are hauled and where they are weighed and piled in order to determine what form of pile will give the best results. The weights are recorded, and the ties are re-weighed at intervals of thirty days until air dry. From these tests accurate data will be obtained as to the time required to season Loblolly and Shortleaf Pine ties cut in any month of the year.

In cooperation with the American Telephone and Telegraph Company, the best methods for seasoning Chestnut telegraph and telephone poles are being thoroughly investigated. Fifty poles are cut each month, and under the supervision of an agent of the Bureau of Forestry are weighed and piled on skids to season. The poles are then weighed at intervals of thirty days to determine the rate of seasoning. Each pole is marked with a dating nail designating the month in which it was cut. When the poles are thoroughly air dry they are placed in position by the company, each pole being marked with nails indicating the date of cutting and the date the pole was put in use. Since in common practice the green poles are placed directly in the ground, it is expected that considerable increase in the length of life of the poles will result from the seasoning. In December an experimental line of poles was put in place by the company under the direction of an agent of the Bureau. The butts of 100 poles were treated and the poles set up in cement and broken rock in order to determine the effect of the surrounding medium upon the durability of the poles. Untreated poles were similarly placed for the purpose of comparison.

In southeastern Texas an exhaustive study is being made of the various methods of tie treatment in order to determine which is the most profitable for that region. Two years ago 8,000 ties were placed in the track of the Gulf, Colorado and Santa Fe Railway. These ties are of 13 different kinds of wood. They are impregnated by 12 separate processes in order to test the relative durability of each wood under each preservative treatment. A certain number of ties of each kind were put in the track without treatment. All ties are marked with record nails indicating the kind of wood, the treatment which the tie has received, and the date when it was placed in the track. These ties are examined every two months by agents of the Bureau. It has been noted that all of the untreated ties are already affected by decay. After another year this experiment will furnish, for the region in which it is made, reliable data for the length of life of ties of different kinds, both when untreated and when treated under different processes.

Study of Proposed Reserves.

This work, which includes studies of the boundaries of existing National forest reserves and of proposed forest reserves as a basis for recommendations, has been undertaken under the request of the Secretary of the Interior upon the Secretary of Agriculture for advice upon technical questions involved in the administration of the reserves.

In the summer of 1902 examinations and reports were made of the following proposed reserves and proposed additions to existing reserves:

Utah: Aquarius, Logan, Manti, Sevier, Salt Lake, Gunnison, and Beaver Forest reserves.

California: Stony Creek, and additions to the San Jacinto, Lake Tahoe, San Gabriel, Pine Mountain and Zaca Lake Forest reserves.

Oregon: Blue Mountain, and addition to the Cascade Range Forest Reserve.

New Mexico: Addition to the Gila River Forest Reserve.

Of these the Logan, Aquarius, and Manti reserves have been created.

Beginning with May, 1903, agents of the Bureau were in the field for examination and report on proposed forest reserves in New Mexico, Arizona, Utah, Colorado, Idaho, Washington, Oregon, and California. It is intended to examine over 20,000,000 acres during the field season. Twenty-nine men were engaged in the field work.

EXPENDITURES.

The expenditures in forest products during the past year amounted to $42,098.07, or 14.4 per cent of the total appropriation for the Bureau.

WORK FOR THE ENSUING YEAR.

TIMBER TESTS.

A station for timber testing has been established at Lafayette, Ind., in cooperation with Purdue University, and work will begin in September. The first problem to be attacked will be a determination of the mechanical properties of Red Oak, White Oak, Hickory, and Red Gum. At the urgent request of manufacturers the question of the best sizes and kinds of timber for box boards will be thoroughly investigated. The Washington laboratory will continue the work begun upon Longleaf and second-growth Loblolly pines. The New Haven laboratory will be occupied in a determination of the effect of moisture and volatile oils on the mechanical properties of timber. The effect of speed of loading upon the results obtained from timber tests will also be investigated. At the Berkeley laboratory tests of Red Fir will be continued and tests of Western Hemlock and Redwood will be taken up.

WOOD PRESERVATION.

During the coming year studies already begun to determine the best methods for the seasoning and treating of timber by preservative processes will be continued. An exhaustive experiment will be made to determine the suitability after preservative treatment of Adirondack hardwoods for use as railroad ties.

STUDY OF PROPOSED RESERVES.

The study of proposed reserves and of the boundaries of existing reserves, which is now the most urgent piece of work before the Bureau, will be pushed as rapidly as its resources in men and money permit.

RECORDS.

FOREST LIBRARY.

The usefulness of the forest library has grown steadily. During the year 664 books and pamphlets were added. The book catalogue was completed and now contains references to all books in the library of the Bureau of Forestry, to forest periodicals and serial publications in the Library of the Department, and to technical and other works of interest to foresters in the Library of the Department and in the

Library of Congress. Newspaper clippings to the number of 1,947 were added and classified. Articles of interest in the lumber trade journals and forest periodicals were indexed.

The collection of photographs now numbers 9,476. Of the 3,417 photographs added during the year, 3,052 are views taken in 41 States and Territories, while 365 were received from foreign countries. These include collections from Australia, Austria, and Denmark and valuable additions to the collections from Germany, India, and Switzerland.

The collection of lantern slides, which was increased during the year by 782, has been greatly improved by the coloring of slides. Loans of 908 slides to assist in lectures on forestry were made to 28 persons during the year.

Correspondence.

The correspondence of the Bureau continued to increase greatly and exceeded that of the previous year by 75 per cent. There were forwarded from the Bureau during the year 43,700 pieces of mail matter.

Mailing Lists.

The mailing lists of the Bureau are the following: (1) A special list of libraries; (2) a list of representative newspapers; (3) a small foreign list of scientific and governmental institutions; (4) a special list of persons engaged in forestry work in the United States; (5) a general list of persons interested in forestry.

The first four lists, which number 3,008 addresses, receive all publications of the Bureau as soon as they are available. To the general list are sent the reports of the Forester, reprints of the contributions from the Bureau of Forestry to the Yearbook of the Department, and circulars of information. Cards are also sent giving notice of the appearance of bulletins, with brief descriptions of their contents. Applications for bulletins made in response to the card notices are honored in the order of their receipt. The number of addresses on the general list at the end of the year was 8,778.

Publications.

During the year 18 new publications appeared, of which 237,000 copies were printed. The bulletins were as follows: The Western Hemlock; A History of the Lumber Industry in the State of New York; Eucalypts Cultivated in the United States; The Woodsman's Handbook, Part I; The Hardy Catalpa; The Redwood; Conservative Lumbering at Sewanee, Tennessee; A New Method of Turpentine Orcharding; Seasoning of Timber; and The Woodlot. The two circulars were: A New Method of Turpentine Orcharding; and Forestry and the Lumber Supply. Five reprints of Yearbook articles were issued, as follows: Grazing in the Forest Reserves; A Working Plan for Southern Hardwoods and its Results; Practicability of Forest Planting in the United States; Influence of Forestry upon the Lumber Industry; and Tests on the Physical Properties of Timber. There was also published the Report of the Forester for 1902.

In addition to these publications 23 press bulletins were issued during the year, with a total circulation of 113,200 copies.

Reprints of 14 publications were made to the total number of 76,500 copies.

On July 1, 1903, 6 bulletins, including Part II of A Primer of Forestry, were in the hands of the printer.

Photographic Laboratory.

Since the beginning of the fiscal year the photographic laboratory has been fully equipped for work in all branches of photography. With these improved facilities it was possible, with the same personnel as last year, to accomplish 25 per cent more work. The number of films and plates developed was 6,563; prints and copies made, 15,473; mounts, 4,747; lantern slides, 746, and blueprints, 167—a total of 27,696 items of work performed during the year.

Instruments.

The large increase in the field work of the Bureau made necessary the purchase of many additional instruments. The expenditure for instruments and field equipment during the fiscal year was $7,170.16, or 2½ per cent of the total appropriation.

Supplies.

Strict economy has been observed in the purchase of supplies, which were paid for entirely from the funds of the Bureau of Forestry. No supplies of any kind were furnished from the contingent fund of the Department. The expenditure for supplies was $9,752.59, or 3⅓ per cent of the total appropriation.

Accounts.

The system of accounts introduced in the Bureau of Forestry at the beginning of the fiscal year 1902 has continued in operation, with extremely satisfactory results.

Drafting.

With the rapid extension of the field work of the Bureau the demands for drafting increased considerably and the employment of two additional draftsmen became necessary. The work consisted of making maps for working plans and planting plans; illustrations, diagrams, and tables for bulletins of the Bureau; maps of forest reserves; maps of regions investigated; and entering silvicultural data upon maps. A record of all forest reserves, with their boundaries and descriptions, was kept posted, as heretofore.

Expenditures.

The expenditures during the past year in records, which includes printing, instruments, supplies, and rent, amounted to $90,264.55, or 30.9 per cent of the total appropriation for the Bureau.

The expenditures for Bureau supervision and control in salaries and traveling expenses amounted to $18,613.21, or 6.4 per cent of the total appropriation for the Bureau.

U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE FORESTER

FOR

1904.

BY

GIFFORD PINCHOT.

[From Annual Reports, Department of Agriculture.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY,
Washington, D. C., September 28, 1904.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Forestry for the fiscal year ended June 30, 1904, together with an outline of the plans for the work of the Bureau for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

INTRODUCTION.

During the past year the Bureau of Forestry has made notable progress in the efficiency, compactness, and simplicity of its organization, in the quality and amount of its work, and in the actual number and relative proportion of trained men in its personnel. It has been more successful than ever before in spreading both a knowledge of practical forestry and the desire to practice it among owners of timberland, and in collecting and digesting information about American forests on which to base the rules for conservative lumbering in different localities so as to make it pay. To the majority of forest owners forestry is necessarily a question of business, and the fact that the more progressive lumbermen have come to realize this truth and to act upon it is full of promise for the perpetuation of the forests and hence of the lumber supply. The number and efficiency of foresters trained in American schools is greater than ever before, and forestry as a profession is taking its legitimate place. Among the general public there is greater interest in forestry than at any former time, and it is steadily growing.

All this is encouraging, but the situation has another side. The available means to check forest destruction are increasing, but so are the forces which make for the obliteration of our forest wealth. Railroads are pushing steadily into new regions, bringing with them not only destructive lumbering but also fire, which is far more dangerous. The rise in the price of lumber and the dwindling supply of logs of the better grades both combine with the greater accessibility given by the new lines and lower rates of the railroads to make it profitable for the lumberman to extend his operations into regions farther and farther from his mill and his market. In addition, the rapid progress of settlement is constantly bringing the local market and the forest nearer

together, and the general consumption of lumber is growing steadily with the increasing population and prosperity of the United States.

It is evident that never before has forest destruction been so rapid as at present, that we have never been so near to the exhaustion of our lumber supply, and that vigorous measures have never been so urgently required as now. Judged in the light of its beginnings and opportunities, the progress of the Bureau of Forestry is perhaps not unsatisfactory. Judged in the light of the task which must be accomplished, if the United States is to escape the hardships of a prolonged lumber famine, its work has scarcely begun.

The problem of internal organization of the Bureau presented by the accumulation of data collected in the field was met by a thorough overhauling of the material now on hand and by new methods for bringing facts together and making them available in the most practical way. These facts, furnished by field parties working in every part of the country, consist of field notes, reports, surveys, and hundreds of thousands of counts and measurements, besides personal first-hand acquaintance with forest conditions in every part of the United States. How large a task the collection and working up of these facts was during the past year the statement of the work done by the section of Forest Measurements partly shows. The Bureau is now better equipped than ever before to handle and apply to practical forest problems the scientific knowledge which it has, to direct its future studies along fruitful lines, and to bring the results of its researches into published form.

A new classification of technical grades now applied in the Bureau is as follows:

Forester; associate forester (chief of the ranking office and assistant to the Forester); assistant forester (chiefs of offices and men occupying positions of similar responsibility); forest inspector (chiefs of the ranking sections of offices and men in charge of independent lines of work of similar importance); assistant forest inspector (chiefs of sections of offices, except of the ranking section, and men occupying positions of similar responsibility); forest assistant (men who enter the Bureau through the examination for forest assistant and have not yet been given charge of independent lines of work); forest agent (men without civil-service standing in charge of subordinate lines of work); forest student (men whose service is temporary and educational in character and whose training in forestry is incomplete).

Besides the work immediately centered, under the present scheme of organization, in the Office of the Forester, and which includes Reserve Boundaries, Cooperative State Forest Studies, Forest Law, and Editorial Work, the organization of the Bureau includes the subjects of Forest Measurements, Forest Management, Dendrology, Forest Extension, Forest Products, and Records.

RESERVE BOUNDARIES.

During the field season of 1903 examinations for new forest reserves were made in nine States and Territories of the West. Twenty-two men were engaged in this work. In addition, an extensive examination was made in Alaska. The general public recognition of the high character of the work has been and is most gratifying.

The purpose of the reserve boundary work of the Bureau is two

fold. It is carried on, first, to prevent the destruction of forest growth on public lands hitherto unreserved where these lands will be permanently most useful to the communities interested in them if kept under forest, and, secondly, to bring about the elimination from reserves of land worth more for agriculture, mining, or other purposes. The public domain has been passing so rapidly into private ownership that it was at first necessary in many cases to act hastily in making forest reserves if anything worth reserving was to be secured. These reserves will be the remnant of the vast empire that lay beyond the Mississippi which can still be handed down as a national heritage after all the rest of the public lands worth having have become private property. But it is the avowed purpose of the Government to withdraw no land from settlement for forest reserves which can be put to better use in other ways, and examinations are therefore made by the Bureau to secure the correction of boundaries which include too much as well as to discover where additional areas should be included.

One hundred and thirty-four maps in duplicate, or 268 maps in all, and 67 reports have been prepared in connection with reserve boundaries during the year. The total expenditure under this head was $60,282.91, including salaries, or 17 per cent of the total appropriation of the Bureau.

COOPERATIVE STATE FOREST STUDIES.

California.

The study of the forests of California begun last year in cooperation with the State was continued, occupying 28 men for four months. The field work comprised the mapping and description of the forest on approximately 20,500,000 acres. The types of land mapped were: Timberland, woodland, brush, pasture, farm, burned (restocking and not restocking), and cut-over land (restocking and not restocking). The descriptions of the forest include an account of its composition and condition and a rough estimate of standing timber, with particular attention to the effects of fire, grazing, and lumbering.

In making a study of the growth and value of planted eucalypts practically all the important groves in California were visited, and their rate of growth was determined. The results will show for the blue, red, manna, and sugar gums what growth and returns may be expected under various conditions in southern California.

A study was made in the San Gabriel and San Bernardino forest reserves to determine the possibility of improving the cover of chaparral on important watersheds. A reconnoissance was made of the entire area of the two reserves, but special attention was given to the Los Angeles, San Gabriel, and San Bernardino watersheds, which embrace the more important chaparral areas. The specific questions considered were the conditions under which forest replaces chaparral, the character and composition of chaparral on various slopes and elevations, the value of chaparral as compared with forest in water conservation, and methods of improving the chaparral cover of the watersheds by protection and planting.

The study is complete for the region named, and leads to several important conclusions, among which are the facts that there is very little tendency on the part of the forest to replace chaparral, but that chaparral replaces forest almost constantly as a result of fire; that the

two important methods of improving chaparral are protection from fire and planting; and that there is great need for both. Protection from fire must be assured first, since the success of planting depends upon it. Large areas in the interior of the mountains are especially in need of planting; because they lie at the head of important drainage basins and owing to recent fires are very nearly barren, although they formerly bore excellent timber. Isolated areas can also be found on the exposed south front of the mountains, where planting is urgent and can be successfully accomplished. The study will be continued in other portions of California.

A study of the replacement of the natural forest on denuded areas was in progress throughout the year in the Santa Barbara, San Gabriel, San Bernardino, and San Jacinto forest reserves. The most detailed work was done in the San Bernardino Reserve, where a field party worked during the winter months. Though the conditions present are in many ways similar, the mountains show extreme variations in forest reproduction. The main questions studied were the extent of forest in the past, the sufficiency of reproduction at present as compared with the necessary future forest area, the effect of fire upon forest reproduction, the contest between forest and chaparral on burned areas, and the rate of growth of young forest trees.

Taken with the chaparral study the results go far to establish the extent to which the mountain slopes on important watersheds are being covered by young timber. They also show the character of reproduction in localities which, like parts of the San Bernardino Mountains, have been fully protected from fire, and on which young growth is thrifty and abundant. A third practical result of this work is to show upon what important watersheds the forest cover is extremely poor, and where efficient protection and extensive planting are peculiarly needed in order to restore the mountains to a safe condition as watersheds.

The study of forest fires in California has been continued and is now nearly complete. Its results will be used in recommendations for the organization of a fire service which will reduce to the minimum the State's losses by fire.

Maryland.

A descriptive study (conducted in connection with the work under Dendrology) was made, in cooperation with the Maryland geological survey, of the forests of Worcester County. Based upon this a detailed forest type map and report have been prepared for publication in the annual report of the State geologist. The study is important, particularly as bringing out the commercial value of large areas of loblolly pine, which, owing to the presence of good local markets, may be profitably worked for fruit boxboards under a forty-year rotation. The report further deals with a classification of the woodland types, their extent, location, and composition, and with the available stand, consumption, and uses of timber. Recommendations for profitable management are also included.

Massachusetts.

At the beginning of the fiscal year the Bureau began, in cooperation with the Massachusetts Forestry Association, a study of forest conditions in Massachusetts. This study, while dealing with specific

problems of importance in the State, was organized on the part of the association as a preliminary step toward the formulation of a State forest policy.

An important part of the cooperative study has been a close examination of the damage done the forest by fire and the effectiveness of present laws to secure fire prevention. The study of this subject occupied three months of field work in 1903. A comprehensive report has been submitted, which describes the damage from fire and the efficiency of present means of fire control, and proposes an entirely new fire law.

A second part of the work is a study, the report upon which is now almost complete, of the forest planting which has been done on the watershed of the Wachusett Reservoir, near Clinton. This watershed gathers a large part of the water used by Boston, and was originally in large part open farm land. Within three years nearly 700 acres of open land nearest the reservoir have been planted to a mixture of white pine and sugar maple under a planting plan made by the Bureau. The forthcoming report is descriptive of the methods used in planting, the cost, and the results. The report gives a valuable exposition of practical forest planting in New England.

The results gained from the cooperative work have been used effectively in the Massachusetts State legislature in securing the passage of a law providing for a State forester. In consequence of the enactment of this law a forest system will now be established, and the Bureau's cooperation with the State forestry association will be closed with the end of the fiscal year.

New Hampshire.

The field work necessary to a study of the forests of northern New Hampshire, made possible by an appropriation of $5,000 by the State legislature and begun toward the close of the last fiscal year, has been continued and completed. The investigation covered the region north of Squam Lake and west to the farming lands along the Connecticut River, an area of 3,206 square miles, or approximately 34 per cent of the State. The lines followed by the investigation were—

(1) A study of the composition and quality of the forest, and an estimate of the present yield.

(2) A study of the characteristics of the more important trees and of the conditions of their successful reproduction.

(3) A study of the methods and extent of lumbering, of its effect upon the forest, and of practicable means to improve the condition of cut-over lands.

(4) An investigation of the value of the forest as a conserver of the water supply, made with the assistance of the Division of Hydrography, United States Geological Survey.

(5) A study of the magnitude, the value, and the character of the lumber industry.

The report, which will soon be published by the Bureau, includes a comprehensive and detailed description of the forest, and an exhaustive study of forest fires, with definite recommendations for fire protection. As a whole, it provides the means to answer questions of private and public policy in the management or disposition of forest lands within the region.

Hawaii.

In 1903 the legislature of Hawaii passed a bill providing for an insular forest service and creating a Board of Agriculture and Forestry, in the hands of which is placed the control of Territorial forest lands and the administration of forest affairs in the islands. Immediately upon its appointment the board sought the advice of the Bureau of Forestry in regard to the policy which should be inaugurated. The Bureau, to acquaint itself fully with the forest conditions and needs of the islands, detailed a representative to make a reconnoissance of the situation and to report with recommendations. The examination was made during August and September, 1903, and was followed by a report descriptive of the conditions and needs of the Hawaiian forests and recommending broadly a forest policy. The report was forwarded to the Board of Agriculture and Forestry, which has approved and adopted its recommendations. It was published as Bulletin No. 48 of the Bureau of Forestry and also in Vol. I, No. 4, of the Hawaiian Forester and Agriculturalist.

On the nomination of the Bureau, Mr. Ralph S. Hosmer, in charge of the forest replacement work in the Bureau, was selected by the board as superintendent of forestry, in which position he will manage, under the direction of the board, the forest affairs of the islands. Mr. Hosmer began his duties December 15, 1903, but retains connection with the Bureau of Forestry as collaborator.

Work of the Coming Year.

In California map work will be continued until the whole State has been covered; forest-fire work will be completed; studies of yield and growth of western yellow pine and sugar pine will be made; preliminary working plans for the management of State forest lands will be prepared; a study of the lumber market in the State will be undertaken; and recommendations for forest legislation and concerning the management of State forest lands will be drawn up.

FOREST LAW.

The great and increasing public interest in forest questions has led to a multitude of requests on the Bureau of Forestry for information with regard to existing forest laws, and for suggestions as to practical State laws for the encouragement of tree planting, the protection of forests against fire, and the establishment and administration of State forest reserves. Such information and advice have been given when possible, and for that purpose a careful study of forest legislation has been made during the last year. As a result, a bulletin containing an annotated compilation of the Federal and State forest laws in force July 1, 1904, together with carefully prepared suggestions based on the present experience of the Bureau, is now nearly ready for printing.

EDITORIAL WORK.

The editorial work of the Bureau includes the final revision of reports, the supervision of publications in the course of printing, and the giving out of such information of practical or educational value concerning forestry and the work of the Bureau as can best be diffused

through the periodical press of the country. It is believed that along this last line there is opportunity for a large increase in the service rendered by the Bureau as a source of useful knowledge, and steps have accordingly been taken to provide for the more frequent issue of press bulletins and to utilize more effectively this important and economical method of diffusing some of the information which the investigations of the Bureau supply.

In the revision of reports there has been a gain in effectiveness through closer internal cooperation to secure the most careful criticism, combined with plans for classifying, collating, and elaborating the material now on hand, and it is being followed by a decided increase in the amount of useful information made public by the Bureau, accompanied by the maintenance of a high standard in originality and value.

FOREST MEASUREMENTS.

Under the distribution of work in the Bureau which became effective at the beginning of the fiscal year, forest computation, forest maps, and silvics were assigned to Forest Measurements.

Forest Computation.

During the year the section of Forest Computation handled the results of 24,498 acres of valuation surveys, 33,295 analyses of trees, 16,090 height measurements, and 2,321 taper measurements. These data were collected in the preparation of eight working plans, studies of five commercial trees, two cooperative State forest studies, and five investigations of local problems in forest extension. They represent forest conditions in twelve States, and furnish information regarding thirty-nine species. Final tables of volume, height, age, and yield have so far been computed for twenty-two species. In addition to the computation of field measurements, the section now puts into final form all results which require computation obtained by the Bureau. These included during the past year, in addition to miscellaneous results, the data obtained in timber tests and in studies of the best methods for the preservation of commercial timbers. In spite of a decrease in its force, the section of Forest Computation handled notably more data in the year 1904 than in 1903.

Forest Maps.

To the section of Forest Maps is intrusted the making of maps, drawings, and diagrams, the custody of such as are not required for constant use, and the development of the best methods of mapping forest data collected by the Bureau. During the past fiscal year this section has completed approximately 250 maps and copies and 300 miscellaneous drawings. These have included the preparation of maps for working plans and planting plans, maps illustrative of the conditions influencing forest extension, and maps recording general land and forest conditions. Among the subjects illustrated by drawings and diagrams were timber-testing and wood-preserving apparatus, methods in tree planting and in forest management, and exhibits of the Bureau at the St. Louis Exposition. This work was supplemented by the plotting of valuation survey lines and forest surveys generally,

the computing of forest areas, the mounting of maps, and the classification of the map records of the Bureau.

Silvics.

The section of Silvics compiles and digests all silvic information obtained by the Bureau. This work has gone far enough to equip each man who will take up the study of a commercial tree during the coming season with a comprehensive record of the data already obtained, thus leading to added effectiveness in further work and to the early publication of results.

Work for the Ensuing Year.

The computation of the field results of the Bureau by the section of Forest Computation will continue, as will the preparation of maps, drawings, and diagrams in the section of Forest Maps. Through the section of Silvics, a definite system is being perfected and applied for the classification, under forest trees and forest regions, of all knowledge obtained by the Bureau concerning the behavior of trees in the forest.

Expenditures.

The total expenditures during the year under the head of Forest Measurements were $21,492.33, or 6 per cent of the total appropriation of the Bureau.

FOREST MANAGEMENT.

Public Lands.

The act of June 27, 1902, known as the Morris bill, provided that 231,400 acres should be selected by the Forester from certain lands of the Chippewa Indian Reservations in northern Minnesota, which should eventually become a National forest reserve. It was further specified that 200,000 acres of the designated total should be pine land, 95 per cent of the standing timber on which should be sold at public auction, to be removed under such regulations as the Forester should prescribe; that 25,000 acres should be selected from lands classed as agricultural land; and that the remainder, or ten sections, should be reserved from both settlement and the sale of timber. Work under this act has gone on steadily during the year. The ten sections have been selected and the selection has been approved by the Secretary of the Interior, their outer boundaries have been surveyed and marked plainly upon the ground, and notices against fire and cutting have been posted every 40 rods along these boundaries. The 5 per cent of timber to be left standing has been selected and marked upon approximately 55,000 acres. The timber to be removed was sold last December at public auction. In view of the fact that this timber is to be cut and removed under rules and regulations prescribed by the Bureau, it is worthy of note that the price paid for it is reported to be higher than has ever before been obtained for a considerable body of white pine timber, and in particular that it was higher than the price paid for similar timber adjacent, but not subject to the rules of the Forester.

Private Lands.

During the past year 136 applications were received for advice and assistance in the management of private forest lands under the offer of cooperation with private owners made in Circular 21. Forty-seven of these were for timber tracts, with a total area of 3,872,321 acres, and 89 were for woodlots, with a total area of 6,609 acres.

The total area of private lands for assistance in the management of which application has been made since the publication of Circular 21 is 9,500,024 acres, of which 9,478,265 acres are in timber tracts and 21,759 acres are in woodlots.

Preliminary examinations were made during the year of 25 timber tracts in the States of New Hampshire, West Virginia, Kentucky, Alabama, Louisiana, Texas, Idaho, Washington, and Wisconsin, and in the Territory of Arizona, covering a total area of 321,894 acres.

The preparation of detailed working plans for eight of these tracts was recommended and the recommendation approved by the owners. The estimated cost of these plans to the owners is $14,450.

WORKING PLANS FOR WOODLOTS.

In response to applications from owners of woodland, working plans based upon thorough study on the ground were made for 68 woodlots, with a total area of 18,718 acres, in the States of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, Ohio, Indiana, and Michigan. The purpose of the woodlot work is to assist the farmer or other owner in applying such management to his woodlands as will make them most productive and profitable, and to encourage by examples of forest management a more general understanding of the simpler principles of forestry. In almost every case owners have asked help of the Bureau because they had intelligent interest in the management of their forests and definite problems of their own to solve, as, for example, how and where they may best cut their annual supply of cord wood.

The wishes of the owner with regard to his forest, the amount and nature of the timber that was annually required or that could be sold, and the cost and facilities of labor and transportation are important considerations in these working plans. In every case a careful study of the forest was made on the ground. Sample areas were selected, and the trees on them were marked for cutting. These cuttings, both on the sample areas and in other portions of the forest, have in the great majority of cases been carried out at once, often with great skill and thoroughness.

WORKING PLANS FOR TIMBER TRACTS.

The field work for detailed working plans was completed during the year upon eight tracts, with a total area of 1,068,000 acres, in Minnesota, New Hampshire, West Virginia, Alabama, and Texas. The total amount estimated as the cost of these working plans to the owners was $13,150, and the total actual cost to them was $12,539.57.

MINNESOTA.

One of these working plans was for a tract of 65,000 acres in St. Louis County, Minn. The forest, which is typical of much of the remaining pine forest of the Lake States, consists chiefly of white and Norway pines. About two-thirds of the area is pine land, and the remainder hardwood land and swamp. Nearly one-half of the merchantable pine forest has been lumbered. The lumbered lands are now totally unproductive, and future crops of timber can not be expected from them within a reasonable time.

The field work occupied a party of nine men for three months, and included a careful determination of the rate of growth and merchantable volume of white and Norway pines, and the time required to produce a second crop of merchantable timber under conservative management. It is important in the management of this tract to secure reproduction of white pine after lumbering. The working plan provides for leaving a sufficient number of seed trees to insure reproduction without appreciably curtailing the present cut of timber, and outlines a practical system for protecting the logged-off lands from fire, which is essential to the successful management of the tract.

ALABAMA.

Two timber tracts in Alabama were selected for the preparation of detailed working plans with special reference to the work which the Bureau is doing in the Southern pine belt. The working plans were completed during the year. The smaller tract covers an area of 30,000 acres, and lies in Coosa County. The larger tract comprises 75,000 acres, situated mostly in Bibb County. The forest on both tracts, which are owned by the same lumber company, consists almost entirely of longleaf pine, and is virgin timber of excellent quality. The smaller tract is now being lumbered. The timber from the two tracts will be cut at separate mills, and the lumbering will require a period of twenty-five or thirty years.

The company wishes to leave the basis for a second crop of timber, in order to lumber a second time at the close of present operations. The working plan shows that this result may be accomplished by adopting a diameter limit of 18 inches, and cutting no smaller trees.

The field work on both tracts required the services of nine men for five months, and included the actual measurement of all trees on 5 per cent of the area. One thousand felled trees were measured to determine the rate of growth of longleaf pine and the volume of trees of different diameters. These data afforded the basis for an accurate estimate of the present cut of merchantable timber, as well as of the young trees which will remain on the ground after lumbering and the annual growth of timber on cut-over lands.

The working plan recommends changes in the present methods of lumbering which will practically prevent the destruction of promising young trees and will increase the quantity and improve the quality of the next crop. It outlines an inexpensive scheme for protecting lumbered lands against fire, which will insure the successful reproduction of the pine after lumbering, and will provide for a second and successive crops of timber from the same lands.

TEXAS.

During the year the field study of a tract of longleaf pine forest in southeastern Texas, begun in 1903, was completed. The total area covered by this working plan is 800,000 acres. The collection of data this year occupied sixteen men about four months. The results secured will be of great value in preparing working plans for longleaf pine lands throughout the South.

The measurements of 8,000 felled trees afford the basis for unusually reliable tables of merchantable volume and rate of growth of longleaf pine. These tables, combined with the results of the 19,076 acres of standing timber actually calipered, give an exceedingly accurate estimate of present and future yields of merchantable timber on longleaf pine timberlands under similar conditions of growth.

A part of the work was a detailed study of the waste in logging longleaf pine, in merchantable timber left in tops, windfalls, supposed culls, and high stumps, in destruction of young growth, and in the use of thrifty trees for skid poles and corduroy. An estimate of this waste was reached by survey and measurement on 330 acres of lands recently cut over. The results show that the great bulk of the waste is in merchantable timber left in tops, which averaged 667 board feet per acre. The smallest merchantable log was taken to be 16 feet long, with a top diameter of 8 inches. Proof that this timber was merchantable was obtained by marking logs cut from a similar class of timber, following them through the mill, and grading the lumber sawed from them, which in no case ran under No. 2 common.

WEST VIRGINIA.

A working plan was made for a tract of about 60,000 acres selected from 250,000 acres of rough mountain land in West Virginia. Ten men worked in the field for a period of three months. The forest is composed of hardwoods, hemlock, and spruce. All of the hardwood and mixed hardwood and hemlock forest has been heavily cut over, and the hardwood and spruce forest has been culled. The forest of pure spruce has been cut here and there. Destructive methods of logging and forest fires have left cut-over lands in a very unsatisfactory condition. The owners wish to know whether the condition of the remaining forest is sufficiently promising and the production of timber great enough to justify further logging and holding all or a portion of the area for the future production of timber and railroad ties.

The field work included a valuation survey of the 60,000 acres selected for study, the collection of data upon the rate of growth of the principal species, and an estimate of future yields of timber under conservative forest management. The data collected in the field are now being computed, and a map is being made of the Williams River watershed, showing the yield of merchantable timber on each stream, areas recommended for immediate logging, and the location of the railroads and mills which will be necessary to market the timber.

NEW HAMPSHIRE.

A working plan was made during the year for a tract of 25,000 acres of forest and abandoned farms in Sullivan County, N. H. The field work for the working plan occupied a party of seven men two and

one-half months, and furnished an estimate of the standing timber and the rate of growth of the principal species. With these data at hand it was possible to determine the amount of timber which may be cut annually without exceeding the actual production of the forest.

Market conditions are such that this annual production can be harvested in the form of thinnings and improvement cuttings, and a system of cuttings has been outlined which will gradually better the silvicultural condition of the forest and insure the reproduction of the desirable species. The successful application of the treatment advised requires the skill of a technically trained man, and a resident forester has been engaged by the owner.

Another tract of 2,500 acres in Grafton County, N. H., presents a problem in forest management which is exceedingly common in that State. The mixed forest of spruce, balsam, and hardwoods has been largely cut over, chiefly for the softwoods. Repeated cutting has reduced the proportion of the valuable spruce. The owners propose to hold this tract for the production of timber for the boxboards which their manufacturing business requires, and wish to manage the forest in such a way that its composition will be improved and its highest productive capacity maintained.

The field work occupied a party of six men for two months. Two types of virgin forest, three types of culled forest, and three types of second growth on land formerly cleared were distinguished and carefully mapped. A detailed system of thinnings and improvement cuttings, which will favor the reproduction of softwoods and improve the composition and condition of the forest, was outlined for each type. The working plan contained also an estimate of the amount of timber which may be safely removed, and recommendations as to where cuttings should be made for the next ten years.

A third tract in New Hampshire includes 10,000 acres in Coos County, in the heart of the White Mountains. Field work on this tract required the services of four men for two months, and a forester has been engaged by the owners to direct the work of carrying out certain of the recommendations of the working plan. The forest has been lumbered for the softwoods, and has greatly deteriorated as a result of the severe fires which have followed lumbering.

The chief object of the working plan was to devise a scheme for protecting the tract against forest fires. This includes a system of patrol to prevent fire, and the construction of fire lines as bases from which to fight fires which are not discovered in time to be easily put out.

The forest types were mapped, and thinnings and reproduction cuttings for the improvement of the forest were recommended for those types in which cutting can be done without financial loss. The working plan includes an estimate of the yield of merchantable timber which can thus be cut, a plan of administration for the management of the forest, and detailed directions for work on each compartment.

Studies of Commercial Trees.

The scope of the studies of commercial trees was greatly enlarged during the year, to include, besides the determination of volume and yield, investigation of their commercial possibilities, and to make the results applicable throughout their entire commercial range.

BALSAM.

The study of the balsam fir, begun in 1902 in New York State, was continued last year in new parts of that State and extended to various localities in Maine, New Hampshire, and Vermont, thus completing the study of this tree throughout the whole range of its commercial distribution. Eight men were engaged upon this work for three months.

The study of this species was timely, because of the constantly increasing use of it by the pulp and lumber industries as a substitute for spruce. The large volume of data obtained regarding the occurrence, cut, growth, yield per acre, and fitness of balsam fir for wood pulp and lumber will furnish much information of practical value.

BIRCH AND ASPEN.

A study was made of the white birch and aspen on burned-over and cut-over land in Maine, which required the services of ten men for two months. The increasing use of both woods in the trades—particularly the use of aspen for construction purposes—has produced a demand that now gives these once worthless trees a decided commercial importance. They almost invariably seed and take possession of burned-over land before other species can obtain a foothold, and the stands are even-aged. A great many sample plots were carefully measured in stands of various ages, from seedlings coming up on land burned four months before to old trees past maturity. Averages were thus obtained for all stages of growth, from which tables of yield were made which will be of great assistance to timberland owners in managing their lands, since from them they can find just how much timber their stands contain during each five-year period from seedling to maturity.

The uses to which these woods are now put and to which they may be put were carefully studied, and tests of their physical properties were made which it is hoped may bring them into even more prominent use.

Studies of important commercial hardwoods in North Carolina and Tennessee were continued during the year, occupying ten men organized in two parties for three months.

White pine and hemlock in Tennessee were added to the commercial trees studied in the southern Appalachians.

RED GUM.

During the winter the Bureau of Forestry carried on a study of the red gum in the South. The object of this study was to find out the actual commercial value of this hitherto little used wood, and to study its reproduction, rate of growth, and silvicultural characteristics. The region covered was the hardwood bottomlands of the Mississippi River and the lowlands along the Atlantic coast. The field work covered three months, and employed ten men.

The red gum grows on the hardwood bottomlands of the southern rivers. These lands are alluvial in character, and the soil is extremely fertile, making the land of great value for agriculture when cleared and drained. The growth of all the more important species of swamp timber trees is extremely rapid, and the object of this study was in part to determine how far practical forestry could be applied to these

lands. A market study of the gum was carried on in connection with the field work, and the value of the wood and best methods of handling it were ascertained. In the past the gum has been considered a very inferior wood because of the difficulties in handling and seasoning it. The boards tend to warp and twist. By care in drying, however, these defects can largely be overcome, and it is hoped that the present study will be of value in establishing this wood more firmly on the market. The wood is used chiefly for boxes, flooring, furniture, and interior finishings.

RAILROAD TIES.

The available supply of timber for railroad ties is rapidly dwindling away, and therefore it grows more important every day to find a cheap and still abundant material. With this aim in view the study of loblolly pine, which has been carried on in many parts of the South, was taken up in Texas, where the great area of young growth of loblolly pine furnished for this purpose an unexcelled opportunity. Particular attention was paid to the yield of loblolly pine land in ties and the advisability of holding it as a permanent investment for raising tie timber, as well as to the possibilities of avoiding the waste coupled with tie making and introducing economical methods of management of loblolly pine forests for ties.

THE MONEY VALUE OF A TREE.

A piece of work along entirely new lines is the determination of the money values of trees of different sizes, by selecting trees in the woods and following the logs through the mill to learn the amounts and grades of lumber they saw out. The result is a striking demonstration of the rapid yearly increase of small trees in actual cash value, and hence of the wisdom of preserving them. This determination has now been made for longleaf pine in Alabama and Louisiana, and for yellow birch, sugar maple, and beech in New York.

WORK FOR THE ENSUING YEAR.

WORKING PLANS.

At least eight working plans will be prepared during the coming year. They are as follows:

A working plan for a small tract in New Hampshire, chiefly important for the excellent opportunity it will afford to study methods of logging the mixed forest of white pine and hardwoods in such a way as to increase the proportion of the valuable white pine in the next crop. Under proper management the natural reproduction of white pine may be greatly increased.

Two working plans for tracts in West Virginia, where the important problem of management is to provide a continued supply of cheap mining timbers. The chief object of the working plans will be to devise a system of logging by which the annual requirement for mining timbers can be supplied without overcutting the forest.

A working plan in Kentucky for a tract of 40,000 acres of hardwood forest, which the owners wish to hold mainly for the permanent production of railroad ties. This is a problem which is rapidly assuming

importance, but as yet little accurate information is available on the subject.

A working plan in Alabama, including a study of less wasteful methods of lumbering white oak and hickory.

Conservative management of a forest of mountain cedar is the chief problem of a working plan for a tract of 20,000 acres in Paloduro Canyon, in western Texas. Wise use of the forests of this valuable tree is a matter of the greatest importance over a vast area of otherwise treeless country in the Southwest.

Two working plans, one in Washington and one in Idaho, will be made for very large tracts, in one case of two million acres, and in the other of over one million. The problem here is not, as is often the case in the East, so much to increase the yield of the forest as it is to devise modifications of logging which will prevent the total destruction of the productiveness of lumbered lands. These working plans afford the opportunity to make practical application of the studies of those Western commercial trees which the Bureau has made as the foundation for effective work in actual management. Continued attention will be given to the preparation of working plans for woodlots. The unique opening which this line of work affords for spreading among small owners, whose holdings are so important in the aggregate, a knowledge of how to get the most out of their woodland, gives special importance to these studies.

STUDIES OF COMMERCIAL TREES.

The purpose of the Bureau in its commercial tree work during the coming year is to complete as rapidly as possible the studies of those trees for which sufficient mathematical data have been collected. This will be done by giving to trained men the task of making practical application to specific problems of the large amount of information now on hand. The studies to be thus completed during the year are for yellow poplar, white, black, red, and chestnut oaks in the South, sugar pine in California, lodgepole pine in Montana and Idaho, and western yellow pine.

EXPENDITURES.

The total expenditures during the year under the head of Forest Management were $42,636.67, or 12 per cent of the total appropriation of the Bureau.

DENDROLOGY.

Forest Distribution and Resources.

FORESTS IN LONG ISLAND COUNTIES.

A descriptive forest study of Suffolk and Nassau counties, Long Island, N. Y., was begun and completed during the year. Its object was to supply information as to the desirability of a State forest reserve in that region. The report will be accompanied by a type forest map, and will contain the results of a thorough study of the forest conditions of these counties, with special attention to the economic value and importance of existing forest growth as a protection to local water supply.

MISSOURI SWAMP FORESTS.

A report which concludes the study of Missouri swamp forests in progress at the beginning of the fiscal year was completed on June 30, 1904. It contains a discussion of the influences which affect the distribution and growth of bald cypress, red gum (Liquidambar), and black gum and cotton gum (Nyssa). The information given will be of value in connection with other investigations of these species, and forms a useful contribution to a knowledge of the little known silvical requirements of these commercially important trees.

CALIFORNIA BIG TREES AND BRISTLE-CONE FIR.

Field studies have been finished and progress has been made toward the completion of reports on the above California species.

PACIFIC COAST TANBARK TREES.

The study of the distribution of Western tanbark oaks and of other tanbark trees was continued, together with a study of the tanning industry dependent upon these trees for tanning materials. Particular attention was given to mapping the range of the principal tanbark oak of the coast region and to the available stand, silvical requirements, and aids to reproduction on cut-over areas. Upon this information will be based important recommendations for a sustained yield of a tanning material which is indispensable to the Pacific leather industry.

Through hearty cooperation of Pacific bark dealers and tanners, a very large number of bark samples was collected for chemical analyses, which have been made by the Bureau of Chemistry. The unexpected discovery of several different types of bark, which yield widely varying quantities of tannin, led to the extension of the study considerably beyond the original plan of investigation. This study should prove exceptionally profitable in determining the requirements and the special forms of this species which produce the largest percentage of tannin.

In connection with a study of various oak barks much used to adulterate the standard bark, one or two untried kinds were found which are of genuine value. The possible future use of the abundant alder barks of the coast region has also been under investigation.

OHIO HARDWOOD FORESTS.

The study of this subject was terminated during the year. Valuable notes and data resulting from experiments on the water content of green and of air-dried saturated woods were secured.

TURPENTINE ORCHARDING.

The work, which the Bureau undertook three years ago, of replacing the ruinous "box" system of turpentining by a less injurious but equally productive system has been practically completed. The actual results obtained under the cup and gutter system are far beyond what was anticipated. They consist in a yield of nearly 40 per cent more turpen-

tine by the new than by the old method, the production of uniformly high grades of rosin, and, what is of the most vital importance to a continued existence of the American naval stores industry, in an indefinitely prolonged working life of turpentine orchards. The old system of turpentining was rapidly exterminating the pine forests tapped, and extinction of the naval stores industry was acknowledged by intelligent operators to be imminent. On a conservative estimate the Bureau's service in this work has added to the annual naval stores product an increased value of about $7,000,000, at a total cost of less than $14,000, and in addition has removed the greatest single cause of Southern forest destruction. The new system is now in very general use throughout the turpentine belt, and in the hands of as many operators as could secure the required equipment.

TURPENTINE DISTILLATION.

A study of European methods of distilling crude resin was made abroad during the year, and it has shown the need of experiments here for the purpose of improving American stills, which at best give unnecessarily impure spirits. Rosin and rosin oil are, through faulty construction and manipulation of our stills, commonly driven off with spirits of turpentine, thus becoming impurities in the latter. The presence of these was discovered when the Bureau began its preliminary studies of turpentine adulterants. The most improved turpentine stills in France are fitted with thermostatic regulators and operated by men of trained intelligence. The result is that uniformly pure grades of spirits and rosin are produced. The majority of American stills are without temperature gauges, and are operated by untrained men who have merely learned to apply certain rough, empirical tests. The results are impure and varying grades of spirits and rosin.

The distillation of rosin oil was found to be a paying and extensive industry in European countries. American consumers at present import nearly all of the considerable quantities of rosin oil used here. It is believed that this demand could be profitably supplied by home production.

DENDRO-CHEMICAL INVESTIGATIONS.

A laboratory study of turpentine adulterants was concluded in August, 1903, and the preparation of a report on methods of detecting their presence is under way. The subject is one of much importance to naval-stores dealers, who are now greatly embarrassed by their inability to detect spurious turpentine. The results of laboratory studies of native and exotic gums, resins, tanbarks, and pulp-wood fibers have been embodied in a report by Dr. H. W. Wiley, Chief of the Bureau of Chemistry, which concludes the investigations begun in cooperation by the Bureaus of Chemistry and Forestry three years ago.

BASKET WILLOW STUDIES.

A half-acre plantation of 5,000 willow cuttings established on the Potomac Flats in the spring of 1903 for the purpose of testing the fitness of different native and exotic kinds for basket work, and particularly for determining the relation of close and wide planting to the production of high-class basket rods, yielded valuable results, which were em-

bodied in a bulletin on the basket-willow industry. Further plantings on the Arlington Experimental Farm have permitted a wider range of experiments, which are establishing other important facts. It is intended to embody these in a circular to be issued during the coming winter.

STUDY OF SUGAR-MAPLE GROVES.

A careful field study was made in the eastern sugar-making districts of the needs of typical old forest-grown sugar-maple groves, and of the treatment required to convert dense seedling and pole-maple thickets into future sugar bushes. The results form the basis of helpful instructions which have been incorporated in the bulletin on the maple-sugar industry previously prepared for printing.

Expositions.

The Bureau's forest exhibit at the Louisiana Purchase Exposition, St. Louis, Mo., was installed in May, 1904. An indoor exhibit covers 5,000 square feet of floor space and comprises some 12 special features. Large photographic transparencies and colored bromide enlargements, relief maps, charts, timber and other specimens, instruments, etc., afford a complete survey of typical forest conditions and of the use of the forest and its destruction in the United States, as well as an exposition of the principles and practice of forestry as applied by the Bureau of Forestry. An outdoor exhibit covering 2½ acres illustrates tree-planting plans for farm woodlots and windbreaks adapted to different parts of the country and forest nursery methods. The allotment for preparing the display was $7,500.

Forest Library and Photographs.

The forest library contains 4,227 books and pamphlets, of which 543 were added this year. The forest photographic collection comprises 13,860 mounted and classified pictures and 2,320 lantern slides; 4,384 photographs and 502 slides were added this year. Photographs are taken in connection with the Bureau's field work, and constitute invaluable records for reference.

During the year 1,676 photographs (mainly unmounted) were given to educational institutions and to individuals for use in illustrating books and magazines and newspaper articles on forest subjects and in educational work, and 635 lantern slides were loaned. The requests for loans and gifts were from 27 States and 4 foreign countries and from 26 educational institutions.

Foreign forest photographs were obtained by exchanging sets of American pictures for those of other countries. Seventy-five sets of our photographs were sent and 73 sets received in exchange. In addition, upward of 200 foreign and home pictures have been presented to the collection by correspondents and friends of the Bureau. Notable among these is a valuable set of Chilean pictures from Mr. H. J. Elwes, of London, England; Georgia, Florida, and Texas views from Mr. R. M. Harper; and photographs of Michigan pine forests from the State agricultural college. A tabular record of the regions and subjects covered by the Bureau's photographs, now in preparation, will assist a system-

atic extension of photographic records over regions not now covered, and at the same time will prevent useless duplication. The photographic laboratory work will hereafter be in charge of the Office of Records.

Correspondence.

Three thousand eight hundred and fifty communications were prepared in response to correspondence, as against 3,650 the preceding year. A large number of wood and other tree specimens were received for identification, particularly from manufacturers, builders, and architects. Repeated attempts of certain manufacturers and contractors to substitute spurious for standard wood materials led to appeals to the Bureau of Forestry for expert information, which has been promptly given. Several serious impositions upon consumers have thus been averted.

Expenditures.

The total expenditures during the year under the head of Dendrology were $24,155.97, or 7 per cent of the total appropriation of the Bureau.

Work for the Ensuing Year.

A revision of Bulletin No. 17, "Check list of the forest trees of the United States," will be made to secure the addition of new and hitherto unrecorded tree species, the revision and extension of the list of common names of trees, and a revised statement of the geographical ranges of trees. Brief popular descriptions of species will constitute a new feature of the revised bulletin.

A series of bulletins descriptive and illustrative of indigenous and naturalized tree species in the United States will be begun.

A study of the acacias growing in the United States will be continued. Special attention will be given to the identification of species, their requirements with respect to soil and climate, and the economic uses of their wood and bark. The species which grow here give promise of great usefulness in arid southwestern regions because of their rapid production of fuel and their excellent tanbark.

Another study proposed is that of eucalypts suitable for cultivation in regions of little frost. A number of species of economic use are believed to be adapted for growth in the South Atlantic and Gulf States, and possibly in the Middle States, in which the species now cultivated in this country can not be successfully grown. The preparation of a bulletin descriptive and illustrative of these eucalypts is planned.

The range, habitat, and future usefulness of the insufficiently known Parry pine, Torrey pine, and swamp pine will be investigated. The ability of these trees to thrive and to propagate unaided both in extremely arid and in wet situations, unsuitable for other species, indicates their great usefulness for cultivation in treeless regions of the Southwest.

A study will be made of the range, habitat, and reproduction of cascara buckthorn, and of the relation of the existing stand to the demand for and production of bark. This little-known tree has become highly important in Oregon and Washington for the commer-

cial value of its bark, for which there is a widespread, permanent, and increasing demand. The extensive collection of bark now threatens the commercial disappearance if not the complete extermination of the species. Consumers are extremely solicitous for the future of an established industry. A careful investigation would permit recommendations looking to a maintenance of the supply.

Experiments will be made to determine the minimum wound necessary in tapping pine trees to produce a maximum yield of turpentine and rosin. It is believed that the experiments planned will result in a system of chipping which will increase the life of turpentined trees without decreasing their yield of naval stores.

Experiments with basket willows will be continued on the Arlington Experimental Farm to determine the best methods of culture and spacing for the production of high-grade basket rods. Both native and exotic willows will be tested with special reference to the soil and management required to secure the best quality and largest yield of stock. Methods of harvesting and preparing rods for market will also be studied, as well as the market value of each species.

FOREST EXTENSION.

Cooperative Planting.

The policy of cooperation with private owners in forest planting has been in force in the Bureau since July, 1899. Up to June 30, 1904, an aggregate of 345 examinations of separate pieces of land were made to determine their suitability for planting, followed by the preparation of 334 plans, for land in thirty-six States and Territories, with a total area of 13,668.8 acres. The cost of these plans was approximately 35 cents per acre. During the past year the Bureau examined land belonging to 53 owners and made 42 planting plans for an aggregate of 2,861.33 acres. Forty applications were on file awaiting attention at the beginning of the year, 65 were received during the year, and 52 are now awaiting attention.

The following table shows in detail the number of examinations and plans made, and the total area covered by the plans, by States, for the past year and since the inauguration of cooperative planting.

Planting plans.

State.	July 1, 1903, to June 30, 1904.			Total to June 30, 1904.		
	Examinations made.	Plans made.	Area.	Examinations made.	Plans made.	Area.
			Acres.			*Acres.*
Alabama				2	2	740
California	3	2	6	7	6	216.95
Colorado	1	1	4.55	13	13	56.30
Connecticut	1	2	150	9	9	410.13
District of Columbia	1	1	1	2	2	46
Florida				1	1	650
Illinois	1	1	9	5	5	89
Indian Territory				2	2	29.50
Indiana				12	12	1,038
Iowa				8	8	42.90
Kansas	4	4	181	48	48	928
Kentucky	2			2		
Maine				1	1	700
Maryland	1	1	1	1	1	1
Massachusetts				13	12	1,939.50
Michigan	2	1	1	8	7	320
Minnesota				9	9	48
Missouri	1	1	2.50	2	2	7.50
Nebraska	3	3	7.13	26	26	197.99
New Hampshire				5	5	84
New Jersey	2	1	45	2	1	45
New Mexico	1	1	131.88	3	3	571.88
New York	3	2	1,200	9	8	1,330.80
North Carolina				2	2	280
North Dakota				27	27	187.62
Ohio	7	6	181	11	10	198.40
Oklahoma	3	3	25.50	28	28	298.18
Pennsylvania	3	3	223.77	10	10	929.49
Rhode Island				4	4	289.20
South Carolina				2	2	100
South Dakota				31	31	252.23
Texas	4	2	128	22	21	284.23
Vermont	1	1	34	4	4	588
Virginia	4	4	63	6	6	159
Washington	1			1		
West Virginia	4	3	470	5	4	480
Wisconsin				2	2	130
Total	53	42	2,861.33	345	334	13,668.80

The Bureau does not furnish seeds or trees for cooperative planting. It participates in the expenses of planting only to the extent of defraying the salaries and, in certain cases, expenses for travel and subsistence of its agents while making the planting plan. Nor does it undertake to make either planting or working plans for all applicants.

Preference in time of examination is given to those applications which are likely to afford the most useful object lessons. When an application has been made and accepted, an examination of the land which it is proposed to plant is made by an agent of the Bureau. Upon small areas where prolonged study or the services of assistants are not required, a planting plan, if planting is recommended, is prepared by the agent before leaving the ground. In all cases the conclusions of the examination as to the advisability of planting are embodied in a report to the owner. If the preparation of a planting plan is recommended and the recommendation accepted, a thorough study is made on the ground and a detailed and comprehensive plan prepared, a copy of which, with all essential measurements, maps, and other data, is sent to the owner upon completion.

In July, 1903, reports from 118 persons for whom planting plans, covering 3,704 acres, had been made showed that 21 per cent of the area had been planted, and that on 2,352 acres more, or 63 per cent, the plans are considered valid. Plans for an aggregate of 550 acres

were abandoned or doubtful of execution. The ultimate planting of from 50 to 75 per cent of the area covered by the plans is to be expected.

In the past the method followed has been to send an agent to any locality after a sufficient number of applications have been received to warrant the expenditure. In addition, a plan of systematic regional studies has now been put into effect, the purpose of which is to enable the Bureau to handle by correspondence, as fast as the studies are completed, the applications for assistance, except in undertakings of special difficulty or unusual magnitude.

Examinations of two distinct regions made during the year resulted in the preparation of representative planting plans applicable to a large number of cases. The first was the plains of eastern New Mexico and western Texas. It is known that as a result of this plan 300,000 trees were planted on 237 acres in the region. The second examination covered the flood-damaged lands along the Kansas River, and resulted in the publication of Circular No. 27 on the "Reclamation of flood-damaged lands in the Kansas River Valley by forest planting." Copies of this circular were distributed to the farmers of the devastated district. A planting plan for the reclamation of these lands has been prepared and is sent to those who make application to the Bureau for assistance.

The planted timber of that portion of Kansas lying west of the ninety-ninth meridian was also studied during the past season. A large number of groves were measured, and from the copious notes secured in the investigation and previously a report of great practical importance to farmers of that region has been prepared and is being published as a bulletin.

Reports are now in preparation upon other field studies made in northwestern Texas, Oklahoma, Kansas, and western Nebraska. Field studies are being extended to other districts where they are urgently needed.

Along the same line sixteen circulars on the planting and growing of the commonly planted trees were printed during the year, and material for twenty others is now available. It is designed, when the remaining important species have been so treated, to embody the circulars in bulletins, each applicable to a definite region.

PUBLIC LECTURES.

In connection with the cooperative planting work sixteen public meetings were held in the Middle West for the discussion of tree-planting problems. In August, 1903, a course of six lectures was given before the Old Salem Chautauqua Association at Petersboro, Ill. Courses of about the same length were given at the South Dakota School of Mines and the University of Texas. Papers were also read before the Kansas Horticultural Society.

World's Fair Exhibit.

A field exhibit of forest planting has been installed and is being maintained at the Louisiana Purchase Exposition. The exhibit covers 2½ acres of ground and is in three parts. The first part consists of a model prairie farm laid out with suitable wind-breaks. The second part is a series of woodlots planned to show suitable trees for planting

in various sections of the United States. The third part consists of a demonstration of simple nursery methods applicable to the growing of forest seedlings in small numbers such as may be wanted on the average farm.

Reserve Planting.

DISMAL RIVER RESERVE.

In the spring of 1903 planting was begun on the Dismal River Reserve, in west-central Nebraska, by setting out 30,000 western yellow pine and 70,000 jack pine forest-grown seedlings. The yellow pine had been collected in the Black Hills the previous autumn, the jack pine in Minnesota in the spring of 1903. The yellow pine suffered great exposure in shipment, and failed entirely. Of the jack pine about 35 per cent survived. The trees were set in deep incisions made with a spade in the loose sand of the sandhills, without previous preparation of the soil.

The seedlings which were set in bare spots have grown far better than those set in the protection of grass and shrubs, probably on account of the more abundant moisture. All which survived last year started into vigorous growth early this spring. Many had grown 6 inches by May 25.

Several methods of seeding direct in the sandhills, such as broadcast sowing and seeding in hills by means of a hand corn planter, have been tried in the hope of finding rapid and economical methods of forestation, but without apparent result. As more favorable conditions than those under which the work has been done can scarcely be expected, the indications are that seeding can not be made successful.

Better results have been realized from growing seedlings in a nursery. The first seedbed, 1 acre in area, was planted in the fall of 1902 and spring of 1903, from seed gathered by the Bureau. The cost of raising 575,000 one-year-old seedlings in this seedbed was $1.20 per thousand. This includes collecting and planting the seed, cultivation and mulching, and one-tenth of the cost of clearing the ground and constructing the shade frames.

In the nursery the western yellow pine and piñon seedlings attained the first year the height of 3 inches, and produced finely developed roots 12 to 15 inches long. In the spring of 1904, 300,000 of these seedlings were planted on 335 acres, the trees being set at 6-foot intervals in the bottom of furrows plowed 8 feet apart. The cost of this planting was $746.95, or $2.48 per thousand. Adding to this the cost of growing the seedlings, $1.20 per thousand, the total cost for growing and planting was $3.68 per thousand. A high efficiency of labor was secured by careful systematization, and the whole operation was carried out with a combined attention to essential requirements, readiness in contriving practical methods, and economy, which make its execution an object lesson for similar work.

On June 6 counts were made on four sample-acre plots to determine the number of living trees. On three plots of western yellow pine 91, 90½, and 95 per cent were living and growing. On the fourth acre, which was of piñon, 94 per cent were living and growing.

In September and October, 1903, an acre of ground was cleared and prepared for an additional seedbed, at a cost of $77. The bed was then covered with woven-slat fencing which provides half shade, at a

cost of $1,363.09. In November, 1903, the new seedbed was planted to western yellow, jack, and lodgepole pine, and red and white fir, in drills 6 inches apart, at the rate of 50 to 60 seeds per linear foot. Planting the 1 acre required 25½ days' work and cost $44.62. This very low cost was the result of ingenious and labor-saving methods, and it is believed to compare very favorably with what any private nurseryman could accomplish the same work for. The bed from which the seedlings were taken for this year's planting has been seeded again, giving 2 full acres of seedbed, most of which will furnish trees for planting next spring. With ordinary conditions, 1,500,000 trees should be ready for planting at that time.

BRUNER PLANTATION THINNED.

This plantation, situated in the southwestern part of Holt County, Nebr., was planted under the direction of the Division of Forestry in 1890. It consists principally of jack pine. Its marked success has greatly influenced planting on the Dismal River Reserve and elsewhere on the Plains. As the trees had been thickly planted and never thinned, they had crowded so severely that to preserve the best growing condition it was necessary to thin the plantation during the past year. In this grove the dominant trees average 19.4 feet in height, and 3 inches in diameter breasthigh. The thinning has left the trees in excellent condition, and they should continue, if not excel, their good growth of the past.

NIOBRARA RESERVE.

This reserve also is situated in the sandhill region of Nebraska, and was established for the purpose of giving opportunity for large experiments in tree planting.

During the past year the reserve was surveyed and mapped. A report was made which includes, besides a description of conditions, recommendations for the protection of the present timber and for planting.

SAN GABRIEL RESERVE.

Planting on the San Gabriel Reserve, though in progress experimentally under the Bureau's direction for three years, has not yet resulted in the discovery of a sure and economical method of securing its forestation. A year ago the method of seed-spot planting was given a thorough trial. Seed so planted germinated readily, but the young seedlings were nearly all destroyed by birds and rabbits when only a few days old. A few hundred seedlings were also planted. These were very young and tender and nearly all died, but their endurance in transplanting indicated the probability of success with larger transplanted trees. A seedbed was therefore established in Pasadena, as stated in last year's report, and has resulted in 50,000 thrifty trees, 35,000 of which have already been transplanted, and all of which should be in prime condition for transplanting on the mountains next winter.

It was decided to establish a nursery also at a higher elevation, near where the planting should be done, and accordingly a site was chosen in the San Gabriel Mountains, on a bench 2,500 feet above sea level, known as Henninger's Flats. The tract, consisting of 80 acres, with

water right, is leased from the Mount Wilson Toll Road Company. A reservoir with a capacity of 23,000 gallons is situated 250 feet above and 1,700 feet distant from the nursery. The company furnishes with the land a cottage of four rooms and a stable.

The site of the nursery was cleared, grubbed, plowed, cleaned of roots and rocks, and fenced with rabbit-proof wire netting. A seedbed 48 by 160 feet was prepared. It is now covered by a stationary lath shade, 6 feet above ground, made to permit half sunlight, the cost of which was $219.80.

The area within the frame was seeded in the latter part of March to bigcone spruce, Coulter pine, knobcone pine, incense cedar, sugar pine, Jeffrey pine, gray pine, deodar, piñon, and Monterey pine. A small quantity of each of these species, together with some of the largest species of chaparral, was also planted in open ground, to determine their ability to stand direct sunshine in germination.

Thirty thousand trees have been transplanted from the seedbed in Pasadena to the nursery at Henninger's Flats, with a loss not exceeding 3 per cent.

PIKES PEAK RESERVE.

The study of forest replacement on the Pikes Peak Reserve, described elsewhere, has prepared the way for the establishment of small nurseries and the beginning of experimental planting on that reserve. A report which is now in preparation describes in detail areas on which planting is recommended, discusses the trees which should be used, and locates available nursery sites. The beginning of planting forms the subject of a recommendation for next year's work.

SEED COLLECTING.

The seed used on the reserves has all been collected by the Bureau. An abundant crop in the case of several species which the Bureau is planting extensively, and in which seed production is irregular, made it desirable to collect in quantities beyond the needs of the current year. A total of 5,350 pounds of seed was collected in California, Colorado, Michigan, Minnesota, and New Mexico, of western yellow and Jeffrey pine, goldencup oak, simpleleaf sumach, bigcone spruce, jack pine, knobcone pine, hollyleaf cherry, red fir, white fir, and sugar pine.

Forest Replacement.

Studies of the action of the forest in reoccupying ground which had been denuded of trees have been carried on in Colorado, Kansas, New Mexico, and southern New England.

An examination of the problem of reforestation on the Pikes Peak Reserve, Colo., was conducted on the watershed which supplies Colorado Springs, in the southern part of the reserve. Attention was mainly given to the history of fires which denuded the mountains, the distribution of young growth which has succeeded fires, the productive power and rate of growth of the principal trees, the conditions which influence forest replacement on the burned areas at high altitudes, and the necessity of supplementing natural reproduction by planting.

The study shows that the most serious fires took place at least fifty years ago, and that some of the burns have been fairly stocked with

valuable young trees, while others have been occupied by quaking aspen, and still others have remained practically barren. The young trees are irregularly distributed and grow slowly. Unless planting is resorted to, there is no hope for a restoration of the forest on some slopes within a reasonable time.

A map is being made to show the distribution of old and young timber in relation to this very important watershed, the location of areas naturally reforesting, and the tracts, practically devoid of reproduction, upon which planting is recommended.

Coordinate with the study of planted timber in western Kansas, an examination was made of the tendency of the narrow belts of natural timber which border the streams to wrest from the prairie contiguous tracts of ground, now that prairie fires, less frequent than formerly, no longer give grass the advantage over forest which it once had. The object of the study is to direct attention to the latent tendency toward forest extension and to its manifest value in the region. A similar study has been completed in western Nebraska, and a report for the two regions is now awaiting publication.

A tract of 200,000 acres, comprising most of the watershed of the Vermejo River, in northern New Mexico, was studied for the purpose of finding methods of improving the reproduction of the forest, which consists mainly of an open stand of western yellow pine, deficient in reproduction on account of fire, excessive grazing, and insufficient seed. Plans were made to repair the damage from fire and stock, and a series of experimental plantations was recommended. The experiment should show what methods are most successful and economical for establishing the stand of timber required.

For the past two field seasons a study of the replacement of white pine on old fields and pastures in central New England has been under way. Field work which has been completed has yielded data of scientific interest and high practical importance. Around three different centers in New England the tendency of white pine to take possession of abandoned farm lands is so strong that it may be depended upon by the landowner to restock his land with forest without any effort on his part.

Forest Fires.

Work of large practical public benefit was a study of the extent and effect of great forest fires, such as those in Washington and Oregon in 1902, and of fires in the Adirondacks in 1903.

So serious were the fires in the Adirondack Mountains from April 20 to June 8, 1903, that the Bureau without delay began a study on the ground of their extent, causes, and effects. Agents of the Bureau traveled extensively through the region, made careful examinations of many of the burned areas, and gathered information from guides, cruisers, lumbermen, pulp manufacturers, and superintendents of private preserves. Reports were also obtained from the fire wardens of all towns within or near the Adirondack Park. A careful study of the burned-over lands along the lines of the New York Central and the Delaware and Hudson railroads was also made.

It was found that over 600,000 acres of timberland were burned over. About $175,000 had been spent in fighting the fires. The total direct loss from these fires was approximately $3,500,000, with an incalculable indirect loss, due both to the destruction of young growth

which was to form the future forest and to the injury to the forest soil from the burning out of its humus. A summary of the information gathered was published by the Bureau as Circular No. 26. The circular has been most useful not only in supplying information to a deeply concerned public, but also in giving the legislature of the State of New York a sound basis for undertaking needed improvements in the State system of fire protection.

Dunes.

The application of forestry to the reclamation of shifting sand was considered during the past year, principally in connection with the sandhill districts of southern Michigan, where a small party worked for two months gathering data on the extent of shifting sand and the trees and shrubs which are adapted to grow upon it. Methods of reclamation which have been employed were closely examined. Opportunity has not yet been afforded to put the data which have been obtained on this subject into form for publication. Until this can be accomplished field work will be suspended.

Additional Cooperative Work.

The office of Forest Extension participated in several lines of work described under State Cooperative Studies. It made the examination of the Hawaiian forests, and conducted the work in cooperation with the Massachusetts Forestry Association. It also conducted the investigations of the growth and value of planted eucalyptus, of forest replacement, and of chaparral conditions and their improvement in southern California, carried on by the Bureau in cooperation with the State of California, as well as the work done toward the inauguration of an effective forest-fire policy for that State.

Expenditures.

The expenditures in forest extension during the past year amounted to $57,119.19, or 16 per cent of the appropriation of the Bureau.

Work for the Ensuing Year.

The making of planting plans under the slightly modified plan of cooperation will continue during the ensuing year. Field studies for extensive planting plans will be made of Griffith Park, near Los Angeles, Cal., and parts of the Paloduro Canyon, in northwestern Texas. Studies of the success of planted timber will be made in eastern Nebraska, eastern North and South Dakota, and northern Illinois.

Planting will be extended on the Dismal River Reserve, continued on the San Gabriel Reserve, and begun on the Pikes Peak Reserve. Study will be made of the replacement of the forest on the Salt Lake Reserve, which may lead to the beginning of planting there. The studies in progress on forest replacement and chaparral conditions in southern California will be concluded and the data compiled for publication. In connection with the study of the success of planted timber in Nebraska, North Dakota, South Dakota, and Illinois, examination will be made of the encroachment of the natural forest upon new areas. The study of methods of controlling forest fires in California will be

completed, and the recommendations resulting from it will be presented to the State legislature for its consideration.

FOREST PRODUCTS.

General Aim of Work.

Work under Forest Products during the past year followed two lines: First, studies of methods of timber preservation; and, second, tests to determine the strength of timbers. Timber-preservation studies were grouped by regions into Western, Central, and Eastern. The timber test work was conducted at New Haven, Conn., Washington, D. C., Lafayette, Ind., and Berkeley, Cal.

In addition, a three-months' investigation was made by the chief of the division in various European countries, of the methods there in use for seasoning and treating woods and for fastening rails to ties. The latter subject is one of vital importance in connection with the use of soft timbers in the United States at the present time. A large amount of information was collected, part of which was published in Bulletin No. 50 of the Bureau. A further bulletin is in preparation dealing with some problems relating to treatment. As a result of this trip, tests are now being made in various parts of the United States to determine methods for more economically treating timber and to ascertain how screw-spikes and screw-dowels may be made to increase the service of softwood ties.

An obscure cause of deterioration of ties treated with zinc chlorid, when laid in the track, was made the subject of investigation. A deleterious action which had been observed to affect both the tie and the spike, and which was ascribed to a supposed production of hydrochloric acid, was found to be really due entirely to electrolysis. Microscopic study of spikes from various mills which were found to behave differently from one another led to further discoveries which indicate that in the light of these experiments makers of spikes can be so instructed as to produce, at a cost not greater than that now paid for the ordinary spike, a spike which will entirely resist the action of zinc chlorid.

An investigation of the production and use of creosote oils in this country and in Canada, and of the causes of their differences in quality, has brought out the fact that these differences are due to different methods both of treating the coals and of distilling the coal tar. It has also disclosed that market conditions in this country are at present unfavorable to the production of very high grade oils here, because such oils must be distilled at a high temperature. Pitch and creosote oil are both products of the same operation, and distillation at a high temperature ruins the soft pitch which is now in great demand here, and produces a hard pitch which can not here, as it can abroad, be profitably marketed. With a market for hard pitch, high-grade oils could be obtained.

It was found that the large Canadian supply of these oils which exists is unfortunately of such a character that its use can not be recommended excepting for the impregnation of railroad ties.

One of the most difficult tasks which this office has undertaken has to deal with the action of various chemicals on wood. Numerous experiments were carried on in order to test the formation of insoluble

compounds in wood, and also the action of the timber-destroying organisms on such compounds. The investigations are complex in character, but their practical import is the light which they shed on the various problems of wood preservation.

In consequence of the discovery that the methods of analysis employed by various chemists to determine the amount of zinc chlorid in samples of treated timber do not secure uniform results, the cause of the variation was investigated and discovered, and new methods were proposed which will avoid the error.

Studies in Timber Preservation.

WESTERN.

This work consisted of seasoning and treatment tests of certain inferior woods. The use of many of the inferior woods in the West will depend upon successful methods for drying them rapidly and evenly so as to prevent decay, excessive checking, and warping. With the rapidly increasing use of the softer woods, the Bureau was called upon to give information concerning them, particularly as to how to prevent rapid decay. During the past year ties of various timbers were experimented with. The reasons for selecting ties for these experiments were that large numbers were obtainable, without cost to the Bureau, from various railroad companies interested in the results, that the subject of tie preservation is in itself of main importance, and that in this way conclusions of general application may be secured.

Tests were made of ties of the following woods: Longleaf, shortleaf, and loblolly pine, at Silsbee and Somerville, Tex.; red and black pine, spruce, and fir, at Rociada, Las Vegas, and Pecos, N. Mex.; lodgepole pine, at Sheridan, Wyo., and Bozeman, Mont.; and fir, at Tacoma and Pasco, Wash.

TESTS OF LOBLOLLY AND SHORTLEAF PINES IN TEXAS.

The loblolly pine investigations at Silsbee, Tex., were carried on in cooperation with the Atchison, Topeka and Santa Fe Railroad. It has been commonly supposed that loblolly pine timber could not be held successfully for any length of time before use. Various species of fungi attack the wood very soon after cutting, and render it valueless with great rapidity. In the tests at Silsbee 500 ties of loblolly pine were cut every month, and weighed immediately. They were then piled in open piles of various forms, some with and some without a roof. All ties were reweighed at regular monthly intervals to determine their rate of drying. The same process was carried on with shortleaf pine, and to a certain extent with longleaf pine.

As a result of the year's work it can be asserted that loblolly pine timber when properly piled can be held in Texas for eight months or more without decaying. In that time it will lose approximately 40 per cent of its weight by the evaporation of the water contained in the wood. These results have an important bearing upon the use of loblolly pine. A bulletin on this subject is in preparation.

Further experiments with methods of piling loblolly were carried on at Somerville, Tex. Some 250,000 sawed and hewed ties were piled in various ways to determine the possibility both of reducing the cost

of handling and of forming piles which more rapidly dry out the timber. It is believed that a form of pile extensively used in Germany was proved to be not only a better form of pile for seasoning the ties, but somewhat more economical than the old form. A report as to the result of these tests was prepared.

In connection with the seasoning of loblolly pine, treatment tests also were carried on at Somerville. These related chiefly to details in the manner of treating this timber with zinc chlorid. It was thought that by omitting the steaming process a more favorable penetration could be obtained. These tests have simply been begun, only 2,500 ties having been treated, but have so far shown a greater absorption by weight when ties are steamed than when the steaming process was omitted.

TESTS OF NEW MEXICO PINES.

Two stations for tests of seasoning and one for tests of treatment of New Mexico pines were established during the year. The seasoning tests were conducted at Pecos and Rociada, N. Mex. Eight thousand ties of western yellow pine, balsam, and spruce, cut in the vicinity of the former place, and some 4,500 of western yellow pine, spruce, and white fir near the latter were weighed at monthly intervals to determine their rate of seasoning. Some of them dried out in four months. The general results show that open piles cause New Mexico timbers to dry out too rapidly, so that many of them check excessively, and that in this region all timbers should be closely piled. The tests prove that the seasoning of New Mexico timbers is a paying operation.

Other tests were carried on at Las Vegas to determine the best methods for treating New Mexico timbers. These tests show that with the very dry ties obtained in the high altitudes of New Mexico a greater absorption of the preservative follows from treating the timbers without a preliminary steaming. This process has since been followed at the Las Vegas plant. A similar result was obtained from a number of tests made during the months of December and January at the treating plant of the Santa Fe Railroad.

TESTS OF LODGEPOLE PINE AND RED FIR IN THE NORTHWEST.

Many timbers in the Northwestern States require to be treated chemically in order to resist decay. Two years ago experiments were begun to determine the effect on seasoning of cutting timber in the Northwest at different seasons of the year. The tests began near Bozeman, Mont., with the lodgepole pine, a timber hitherto very little used because of its softness and its rapid decay when in contact with the ground. These tests were continued during the present year. One hundred ties of lodgepole pine were cut every month and weighed at monthly intervals. The results show that this timber can be seasoned in five or six months, with a great saving in freight and considerable improvement in quality, compared with unseasoned timber. During the coming year some 2,000 ties will be treated to determine the relation between treatment and the season of cutting.

Attention was called during the past year to the fact that small trees of the lodgepole pine when properly peeled and dried make excellent mine props. Acting upon this suggestion, a number of mine props have been made in Montana and shipped into Wyoming for use in coal

mines, and it is probable that this timber will be increasingly utilized for this purpose. Investigations on a small scale have been carried on to determine the best sizes for this use.

Little is known at the present time as to how to preserve the red or Douglas fir. In cooperation with the Northern Pacific Railroad, tests were begun in March to determine the actual weights of green and dry wood as the first step in a comprehensive study of this tree.

It has already been found that at Pasco, in a semiarid region, ties evaporate water in the first few weeks after cutting nearly six times as rapidly as at Tacoma, in a region of very heavy rainfall. Various forms of piles have been constructed, preliminary figures obtained, and important results are expected.

A series of important treating tests were carried on in cooperation with the Chicago, Burlington and Quincy Railroad, at Sheridan, Wyo., chiefly as to the treatment of lodgepole pine timber with zinc chlorid, with and without preliminary steaming, which appears, so far, to have little effect on penetration. A beginning was also made in testing red fir and western yellow pine from the Black Hills, South Dakota, and this work will be vigorously followed up during the coming year.

A second series of investigations carried on at the Sheridan treating plant dealt with the rapidity with which zinc chlorid leached out from treated ties. The results show that all timbers treated with zinc chlorid should be seasoned until approximately air dry. Recommendations to this effect have been generally followed by those employing this form of preservative treatment.

CENTRAL.

The studies in timber preservation carried on in the Central States were in general aim similar to those already described. In the Mississippi Valley a large number of timbers, especially red, pin, water, and other oaks, beech, red gum, sycamore, etc., are being considered as possibilities for use in many industries, because of the rapid exhaustion of the supply of white oak and hickory. In cooperation with the St. Louis and San Francisco and the Illinois Central railroads a general investigation was begun during the year as to the utility of these timbers for ties and bridge structures. With chemical treatment it was found perfectly practicable to use them both for ties and for other forms of construction, and it is proposed to extend these investigations to strength determinations during the coming year.

A series of tests was inaugurated similar to those carried on in the West to determine the relation between seasoning and the season of cutting. The chief object is to ascertain how to season these woods so that they will not check, split, or warp excessively, and to protect them against excessive rainfall. Approximately 500 ties of as many different timbers as could be obtained were cut each month at various stations, and weighed at regular intervals until they were air dry. A distinction was made between swamp timber and that cut on high ground.

Tests of hill red oak were made at Black Rock and Imboden, Ark., and of bottom red oak and red gum at Portia and Beggs, Ark. In six to eight months the red oaks have lost from 25 to 30 per cent in weight. Ties under roofed piles have shown little tendency to check, split, or warp. Most of the timbers lost the bulk of their moisture in

the first six months. Similar results were obtained in Kentucky, Tennessee, and Mississippi with red oak, beech, and red gum.

In Illinois and Indiana tests to determine the rate of seasoning of white oak ties, which have been in progress almost two years, were brought to a close, and the results are being prepared for publication. The seasoned ties were laid in the track near Brownstown, Ind., and careful record will be kept of their resistance to decay.

Tests conducted in cooperation with the Ayer & Lord Tie Company demonstrated in the case of red oak ties treated with zinc chlorid the importance both of thorough preliminary seasoning and of thorough drying out after treatment, not only in order to increase the effectiveness of the preservative treatment, but also to obviate the loss from splitting due to the freezing of their water content.

EASTERN.

Studies in preservative treatment in the East during the past year were concerned largely with telephone poles, in continuation and enlargement of work begun during the previous year. As a rule, poles are set almost at once after cutting. The poles are of a larger diameter at the butt than is at first necessary to carry the anticipated load of wires and cross-arms, because the diminution in size due to rot at or near the surface of the ground has to be taken into consideration. Should it prove possible to treat poles at the butt economically, very much smaller trees could be used because allowance for weakening by decay would be unnecessary, and the poles could be grown in a shorter time.

The subjects studied were, first, seasoning of telephone poles, and second, treatment of cross-arms. The poles experimented with were of chestnut and white cedar and belonged to the American Telephone and Telegraph Company, in cooperation with whom the work was done. Five stations were maintained, at each of which 50 poles cut each month were carefully weighed and measured, and reweighed and remeasured at monthly intervals to determine the loss of weight and shrinkage.

Preservative tests were carried on at Norfolk, Va., to determine whether it would be possible to treat loblolly pine cross-arms with creosote in such a way that a uniform amount of creosote would be injected into the arm in quantities not over 12 pounds per cubic foot. It was found that under the ordinary method of creosoting, some arms took up but 1½ pounds and others as much as 35 pounds of creosote, resulting in the latter case not only in a waste of material, but also in much damage to property from subsequent dripping of creosote from the arms in hot weather. By omission of the steaming process and a classification of the cross-arms into three groups, it was found possible to bring about a more uniform treatment in less than half the time that had usually been required. The bearing of these tests on the general problem of creosoting is emphasized, for similar results would presumably be obtained with other classes of material.

Cooperative tests of the Rüping process for creosoting was carried on at Perth Amboy, N. J. This process claims to treat timber with creosote at a very small cost. Ties of loblolly, shortleaf, and lodgepole pine, beech, red oak, and red fir were shipped to Perth Amboy.

These tests were not completed. The results have not yet been entirely formulated.

A preliminary investigation, begun in May, 1904, to determine the best methods for seasoning beech, maple, and birch ties, from the Adirondacks, so as to prevent excessive checking and to bring them into a condition fit for treatment, is now under way.

Timber Tests.

During the past year the programme for a series of timber tests was completed. The work thus far accomplished was largely of a preliminary character. Additional laboratories were located, further equipment was purchased, and additional investigations were undertaken. The programme has been submitted for criticism to the American Society of Civil Engineers and the American Society for Testing Materials, and has received their hearty indorsement.

A large volume of data concerning the strength of structural timber in actual market forms and sizes was obtained, which will be useful in economizing the use of timber, perfecting specifications, and establishing rules for inspection. The relative strength of red fir, western hemlock, loblolly pine, and longleaf pine, with characteristic defects, was in part determined. A study of the mechanical properties of red gum wood was made, and its availability for carriage manufacture was established. Studies of the relative strength of tie fastenings, in order to determine the proper form for inferior timbers, have also been made.

An impact testing machine was designed and built, and proper methods of test were developed to determine the brittleness of timber preparatory to a study of the effects of preservative processes on its mechanical properties. The law governing the influence of moisture on the strength of timber was developed with a completeness of detail and scientific precision hitherto unknown. It remains to extend this inquiry to the degree of moisture existing in large timbers, and to ascertain if any increase in strength may be counted on in the case of large sticks as found partially dried on the market. A preliminary examination has been made of the problem of determining the strength of boxboard lumber of various species.

The tests of red fir and western hemlock were made at the timber-testing station of the University of California. The work at the Yale Forest School station included a determination of the effects of moisture and resin on the mechanical properties of timber. This work requires great care in detail.

The tests of loblolly and longleaf pine were made in cooperation with the Bureau of Chemistry, United States Department of Agriculture, at Washington.

The work at the Purdue University station included the study of the mechanical properties of red gum. The relative strength of sapwood and heartwood, both clear and mill-run, the relative strength of mature and immature timber, and the ability of red gum wood to withstand the operations of kiln drying, steaming, and bending which are necessary in the application of the wood to carriage stock, were determined. Other subjects investigated at this station were the pulling strength of the screw-spike as compared with the common spike when driven into railroad ties, a method of test to determine

the brittleness of wood with an impact testing machine developed by the Bureau, and a method for testing the resistance to abrasion of wooden paving blocks.

Expenditures.

The total expenditures during the year under the head of Forest Products were $42,525.20, or 12 per cent of the total appropriation of the Bureau.

Work for the Coming Year.

The seasoning tests in cooperation with the Atchison, Topeka and Santa Fe Railway at Silsbee will be continued, and a number of ties already seasoned at this place will be marked with dating nails and placed in the track, together with unseasoned ties, to determine their relative lengths of life. The piling and treating experiments at Somerville will likewise be continued, and a number of seasoned and green ties will be laid in the tracks of the Southern Pacific Railway and frequently inspected. The seasoning tests with New Mexico timbers will go on in cooperation with the Atchison, Topeka and Santa Fe Railway at Pecos and Rociada, and further treating experiments will be made at Las Vegas.

Treating tests in cooperation with the Chicago, Burlington and Quincy Railway at Sheridan, Wyo., and Bozeman, Mont., will be continued. One of the principal questions to be determined by these experiments is the penetration of preservatives into seasoned wood previously subjected to the steaming process, as compared with the penetration into wood that has not been subjected to steam.

The seasoning experiments already in progress in cooperation with the Northern Pacific Railway at Tacoma and Pasco, Wash., and in cooperation with the St. Louis and San Francisco and Illinois Central railways in Kentucky, Arkansas, Mississippi, and Tennessee will also form part of the work of the year.

Other timber treating and testing work will be conducted in cooperation with the Louisiana Purchase Exposition Company at St. Louis. A complete impregnating plant and several timber-testing machines have been installed on the grounds of the St. Louis Exposition, and a large number of ties, principally of loblolly pine and red oak, will be treated and tested at this station.

Seasoning and treating experiments in cooperation with the American Telephone and Telegraph Company will be continued in New Jersey, Pennsylvania, North Carolina, Maryland, and Virginia, and further experiments will be conducted at Marinette, Wis., and Escanaba, Mich., in cooperation with the Postal Telegraph-Cable Company, the Wisconsin Central Telephone Company, the Wisconsin Central, the Chicago, Milwaukee and St. Paul, and the Chicago and Northwestern railway companies, and with the State of Wisconsin. Particular attention will be paid to the effect which soaking in water exerts upon the rate of seasoning of cedar and tamarack.

Experiments will be made to determine the best method for piling and classifying cross-arms in order to season them in the shortest time. These experimental arms will afterwards be treated at Norfolk, Va. The seasoning experiments on ties made from Adirondack hardwoods

will be continued at Utica, N. Y. These ties will afterwards be treated and laid in the track.

The tests of red fir and western hemlock at the Berkeley laboratory will be continued, and, if possible, another laboratory for their study will be established at Seattle, Wash., in which case work at the Berkeley laboratory will be directed especially to a determination of the mechanical properties of redwood.

At the Purdue laboratory the study of red gum from Missouri and from the Atlantic coast, of the methods of testing wood under impact and abrasion, of the effect of preservatives and preservative processes, of methods of testing paving blocks, and of the strength of boxboards will go on.

The work of the Yale Forest School station will continue along the present lines for a time. The problem of the strength of large timbers and their moisture content will be pursued. Cooperative work in determining the strength of cross-arms for telegraph poles and the effect of the so-called Weed process on the strength of wood will probably be undertaken.

RECORDS.

At the beginning of the fiscal year it became necessary to secure an additional floor of the Atlantic Building for offices. The need of the Bureau for office room increases, not only with the slow increase in the purely office force, but also with the rapid increase in the number of field men who must spend a part of their time in the office preparing reports on their field work. This increase of space during the last year afforded great relief, and it will probably be sufficient for the needs of the Bureau for the next fiscal year (1904–5). Upon the request of the Bureau the owners of the building have erected in the basement a fireproof vault in which may be stored important records, maps, negatives, etc., belonging to the Bureau.

Steps were taken during the past year to reduce the fire hazard. Among them was the installation of a fire-alarm station on the first floor, directly connecting the building with the fire department of the District government. To this an auxiliary station on each floor of the building was connected. Fire extinguishers of approved pattern were installed—16 on the floors occupied by the Bureau and 10 on the floors below.

At the request of the Bureau an inspection of the building was made by the chief engineer of the District of Columbia fire department, accompanied by the chief inspector of the Underwriters' Association, and their report and recommendations were transmitted to the owners of the building. As a result the installation of new fire hose, changes in pumping apparatus, important changes in the electric-light wiring, and other necessary alterations were undertaken by the owners.

Accounts and Supplies.

During the year a radical change was made in the system of accounting for Government property. The system adopted was based on a modification of that in use in the Quartermaster's Department of the United States Army. It included the adoption of a Bureau regulation that every transfer of property between members of the Bureau

must be accompanied by an exchange of an invoice and a receipt, and the record of such exchanges upon a property book by the property clerk. It provided for a form of board of survey to account for property lost or worn out in service, and for a semiannual property return by the property clerk.

No radical departure was made in the purchase of instruments or supplies. Every effort was made to standardize the field instruments and equipment, and this effort has added to their effectiveness and resulted in a considerable saving of money. The requirements of the law and the fiscal regulations of the Department concerning competition have been closely observed whenever practicable.

Files and Filing.

An increase in efficiency and security was effected by several minor changes in the system of filing correspondence in the Bureau. The system as a whole continues to give general satisfaction, and its economy of operation is noteworthy.

Correspondence.

During the year 28,518 official communications were received in the Bureau, and 33,125 sent out.

Stenography and Typewriting.

During the month of January, 1904, all stenographers and typewriters not specially assigned to offices were transferred to this section. In it manuscript is copied and general typewriting is done, and from it stenographers are temporarily detailed when required. The result of this concentration was a noteworthy gain in economy of clerical labor and in uniformity of work. From its inception to the end of the year, 849 items of work were performed, comprising a total of 9,837 typewritten pages, of which 1,413 pages were in tabulated form; 6,888 mimeographed sheets, and a large amount of miscellaneous work. In addition 105 temporary details of stenographers were made for a total of 451 days. The average number of stenographers assigned to this section was 10.

Photograph Laboratory.

During the past year the effectiveness of the photograph laboratory was considerably increased by a rearrangement of the equipment heretofore in use and the installation of new equipment. The new equipment provided for velox or line work, blueprinting by electric light, and for making bromide enlargements and transparencies. The use of electric light was introduced also in making wet-plate negatives for maps. In consequence, the laboratory gained largely in efficiency and in economy of time and labor.

Publications.

There were issued during the year 9 new publications, of which 77,000 copies were printed. The bulletins were as follows: A Working Plan for Forest Lands in Hampton and Beaufort Counties, South

Carolina; The Diminished Flow of the Rock River in Wisconsin and Illinois, and Its Relation to the Surrounding Forests; The Planting of White Pine in New England; and Cross-Tie Forms and Rail Fastenings, with Special Reference to Treated Timbers. The circulars were: Forest Fires in the Adirondacks in 1903; Reclamation of Flood-Damaged Lands in the Kansas River Valley by Forest Planting; and Practical Assistance to Users of Forest Products. Two reprints of Yearbook articles were issued: Recent Progress in Timber Preservation; and Relation of Forests to Streamflow. There was also published the Report of the Forester for 1903.

In addition to these publications 8 press bulletins were issued during the year, with a total circulation of 44,000 copies.

Reprints of 10 publications were made to the total number of 39,000 copies.

On June 30, 1904, 11 bulletins and 3 circulars were in the hands of the printer.

The mailing lists of the Bureau are the following: (1) A special list of libraries; (2) a list of representative newspapers; (3) a small foreign list of scientific and governmental institutions; (4) a special list of persons engaged in forest work in the United States; (5) a general list of persons interested in forestry.

The first four lists, which number 3,143 addresses, receive all publications of the Bureau as soon as they are available. To the general list are sent the reports of the Forester, reprints of the contributions from the Bureau of Forestry to the Yearbook of the Department, and circulars of information. Cards are also sent to the general list giving notice of the appearance of bulletins, with brief descriptions of their contents. Applications for bulletins made in response to the card notices are honored in the order of their receipt. The number of addresses on the general list at the end of the year was 9,860.

Expenditures.

The expenditures during the past year in Records, which include instruments, supplies, and rent, amounted to $59,032.08, or 17 per cent of the total appropriation for the Bureau.

The expenditures for Bureau supervision and control in salaries and traveling expenses and for printing amounted to $42,755.65, or 13 per cent of the total appropriation for the Bureau.

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U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE FORESTER

FOR

1905.

BY

GIFFORD PINCHOT.

[From Annual Reports, Department of Agriculture.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

CONTENTS.

REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., July 1, 1905.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1905, together with an outline of the plans for the work of the Service for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

INTRODUCTION.

For the Bureau of Forestry, or, as it has now become, the Forest Service, the event of first importance during the past fiscal year was the transfer to its care of the National forest reserves. The act of Congress which accomplished this transfer took effect on February 1, 1905. Upon that day, therefore, a Bureau the duties of which had up to that time been confined to the giving of expert supervision and advice, and which had never had charge of one acre of Government land, was given full administrative control of 63,000,000 acres of public forest, with all the business arising from it.

An administrative system already existed and was transferred with the reserves from the Department of the Interior, together with the appropriation for its support. But the task presented was not merely to coordinate two related organizations, for the transfer was made in order that the National forest reserves might be administered along lines of technical, practical forestry, and so be given their fullest permanent usefulness. It was therefore necessary to merge the former Division of Forestry of the General Land Office in the Bureau of Forestry of the Department of Agriculture.

The absorption by the Bureau of Forestry, without disturbance and without the need of any radical change, of the entire administrative organization and lines of work brought out by the transfer is evidence of the character of its work. Its field investigations and accumulation of forest data had been training its men to effective capacity and had built up its organization on broad, practical, and executive lines.

During the past few years the Forest Service has pushed its field investigations and gathered facts in every part of the country. The practical utility of these studies is now made evident. Without the

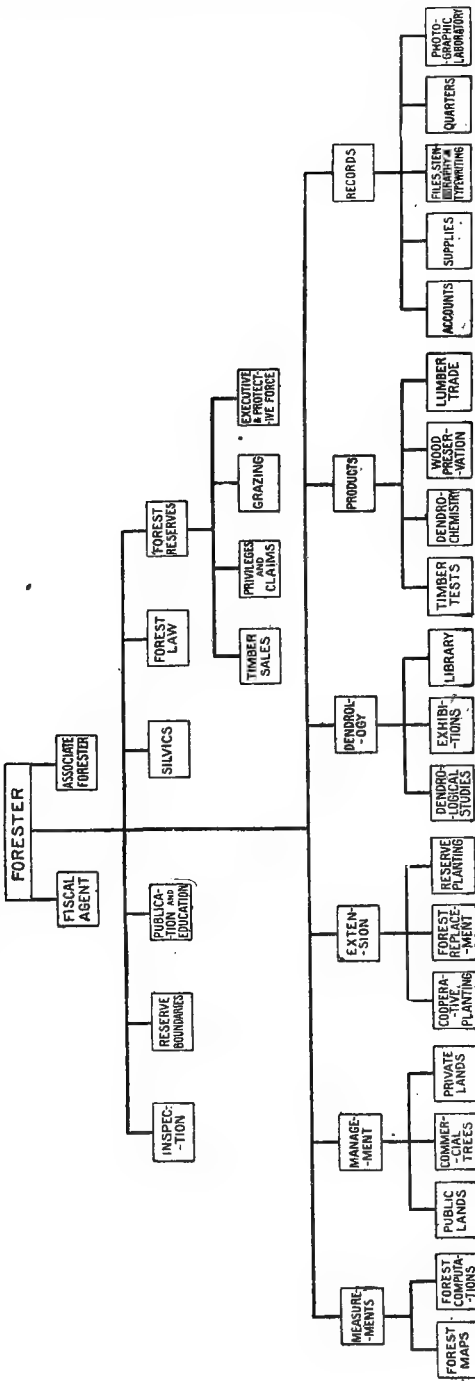
knowledge thus secured the Service would be unequal to the task of applying forestry on the reserves along the lines already begun.

The Forest Service aims to bring the administration of the reserves near to the people whose wants they serve, and to do business quickly without neglecting any of the necessary safeguards. Under its methods large executive authority is given to local officials, the work is kept at a high standard by frequent inspection on the ground, vexatious delays are avoided, and the practical usefulness of the reserves is vastly increased.

With these changes public approval throughout the West of the reserve policy strengthens from day to day. Assaults upon the reserves will continue from self-seeking interests, as well as from short-sighted persons who are unable to distinguish between an immediate small advantage and a great permanent good.

I wish to bear emphatic testimony in this report to the unremitting steadiness and devotion with which the members of the Forest Service accepted and discharged the new duties laid upon them by the transfer of the forest reserves. The change of method and point of view which followed the transfer brought to many of them new and

ORGANIZATION OF THE FOREST SERVICE.



heavy responsibility, and the mass of the new work made demands which could only be met by giving to it for months many hours a day beyond the regular hours. How well they met all the demands upon them is shown by the fact that the new methods were applied and showed results at once upon the transfer, so that the usually unproductive period of adjustment was conspicuous by its absence.

The organization of the Forest Service is shown by the chart on page 200.

INSPECTION.

The Section of Inspection examines and reports on the conduct and progress of the whole field of work conducted by the Forest Service. The inspection work was not formally set apart in a section until after the beginning of the present fiscal year, and therefore calls for no more specific mention in this report. The inspection work of the Service lies at the foundation of its efficiency. It is believed to be in thoroughly good condition.

RESERVE BOUNDARIES.

Examinations for reserve boundaries were conducted during the past year with a combined efficiency and economy which will produce results out of all proportion to the cost, and which would have been altogether impossible of attainment but for the ability and the devotion of the men intrusted with the work. All forest reserves created during the past year had previously been examined by this section. Fourteen men were engaged in this work during portions of the field seasons of 1904 and 1905 in nine of the western States and Territories.

PUBLICATION AND EDUCATION.

During the past year it has become more evident than ever before that to secure the full benefits of the progress in technical forestry made by the Service an active campaign of popular education is called for. The large owners of timber land form a class quick to see the practical bearing of forestry upon their own interests. The small owners, whose aggregate holdings constitute so large a portion of our forest wealth, are less easily reached. Through the press, through the avenues of education opened by school instruction and industrial training, through concrete example, and through the regular publications of the Service, popular opinion must be formed and the knowledge of what constitutes the right use of forest land must be widely inculcated.

The Forest Service has now reached the point at which it can undertake with confidence to advise and guide the forest owners of this country in wise and safe methods of forest management. But not all of the forest owners have yet reached the point at which they are ready to seek and to adopt this advice. During the past year definite plans were made and put in effect to open more widely the stores of information which have been gathered, and this work, than which none more important lies in the immediate future, will be extended and pressed forward just as rapidly as men and means will permit.

SILVICS.

The work of this section comprises the coordination and classification of all the data gathered in the United States, either by the Forest Service or through other channels, which can be made to contribute to ordered and scientific knowledge of our forests. One of its important functions will be to direct future investigations into the most fruitful lines by making clear where the results already secured are insufficient or inconclusive. The formulation of methods and digestion of the mass of material already accumulated, begun during the past year, is still incomplete, but enough has been done to demonstrate the great value of this work along lines of permanent usefulness.

FOREST LAW.

During the past year the legal work of the Service developed along thoroughly sound lines. Preparation was made for the demands upon it which the transfer would occasion, and when the latter was made it was found possible to deal with the legal work incident to the management of the forest reserves without undue strain. The safety and stability which flow from efficient and conservative legal advice are essential in the kind of work which the Forest Service is called upon to perform.

FOREST RESERVES.

TRANSFER OF ADMINISTRATION.

On February 1, 1905, the administration of the National forest reserves was transferred from the jurisdiction of the Secretary of the Interior to that of the Secretary of Agriculture, except for matters affecting the surveying, prospecting, locating, appropriating, entering, relinquishing, reconveying, certifying, or patenting of lands. By order of the Secretary of Agriculture the Forester assumed immediate charge of the reserves.

The policy of the Forest Service in the administration of the forest reserves has already found expression in the following specific achievements:

(1) Improvement of the technical standards in forest reserve management, by securing the judgment of trained foresters in all questions relating to the reserves.

(2) The reorganization of the Forest Reserve Service, with the specific result that reserve questions are now settled so far as possible on the ground and not in Washington; and the establishment of a corps of trained inspectors, without administrative authority, who constantly and thoroughly inspect all phases of forest reserve work and report upon it to the Forester.

(3) The publication of revised regulations and prompt business methods have brought about a general understanding that the forest reserves are for the use of the people, with a large consequent increase in the business of the reserves and the revenue from them.

AREA.

The total area of the National forest reserves on June 30, 1904, was 62,582,428 acres. During the past fiscal year new reserves have been created, with a total area of 23,507,934 acres (including additions to existing reserves amounting to 4,356,655 acres), and eliminations were made to the extent of 396,940 acres. The total area on June 30, 1905, was, therefore, 85,693,422 acres. A detailed statement of these changes follows.

Forest reserves, showing new reserves, additions, and eliminations, July 1, 1904, to June 30, 1905.

State.	Reserve.	Area July 1, 1904.	Proclamations July 1, 1904, to June 30, 1905.	Eliminations July 1, 1904, to June 30, 1905.
		Acres.	*Acres.*	*Acres.*
Arizona	Black Mesa	1,658,880		
	Prescott	423,680		
	Grand Canyon	1,851,520	456,000	
	San Francisco Mountains	1,975,310		
	Santa Rita	387,200		
	Santa Catalina	155,520		
	Mount Graham	118,600		
	Chiricahua	169,600		
	Pinal Mountains		45,760	
California	Tahoe	136,335		
	Stanislaus	691,200		63,420
	Sierra	4,057,310	335,530	
	Santa Barbara	1,838,323		
	San Bernardino	737,120		
	San Gabriel	555,520		
	San Jacinto	668,160		
	Trabuco Canyon	109,920		
	Warner Mountains		306,518	
	Modoc		288,218	
	Plumas		579,520	
	Trinity		1,243,042	
	Klamath		1,896,313	
	Lassen Peak		897,115	
Colorado	Battlement Mesa	805,720	52,160	60,160
	Pikes Peak	184,320	678,528	14,880
	White River	970,880		
	San Isabel	77,980	243,247	
	Gunnison		901,270	
	Leadville		1,219,947	
	Medicine Bow		1,155,909	
	San Juan		1,437,406	
	Park Range		757,116	
	Wet Mountains		239,621	
	Cochetopah		1,133,330	
	Montezuma		576,719	
	Uncompahgre		478,111	
	South Platte	654,499		
	Plum Creek	179,200		
Idaho	Bitter Root	3,345,760	515,200	
	Priest River	541,160		
	Pocatello	49,920		
	Yellowstone		177,960	
	Sawtooth		1,947,520	
	Weiser		324,964	
	Henrys Lake		798,720	
	Payette		1,460,960	
	Cassia		326,160	
Montana	Yellowstone	1,229,680		
	Bitter Root	572,480	133,520	14,080
	Gallatin	40,320		
	Lewis and Clark	4,670,720		
	Madison	786,640		16,640
	Little Belt	501,000		
	Highwood Mountains	45,080		
	Elkhorn		186,240	
Nebraska	Niobrara	123,779		
	Dismal River	85,123		
New Mexico	Gila	2,327,040		
	Pecos River	430,880		
	Lincoln	500,000		
Oklahoma	Wichita	57,120		

Forest reserves, showing new reserves, additions, and eliminations, July 1, 1904, to June 30, 1905—Continued.

State.	Reserves.	Area July 1, 1904.	Proclamations July 1, 1904, to June 30, 1905.	Eliminations July 1, 1904, to June 30, 1905.
		Acres.	*Acres.*	*Acres.*
Oregon	Bull Run	142,080		
	Cascade Range	4,424,440		
	Ashland	18,560		
	Baker City	52,480		
	Wallowa		747,200	
	Wenaha		413,250	
	Chesnimnus		220,320	
	Maury Mountain		54,220	
South Dakota	Black Hills	1,163,320		
	Cave Hills	23,360		
	Slim Buttes	58,160		
Utah	Fish Lake	199,040		
	Uintah	842,000		
	Payson	111,600		
	Logan	182,080		
	Manti	584,640		
	Aquarius	639,000		
	Grantsville	68,960		
	Salt Lake	95,440		
	Sevier		357,000	
Washington	Priest River	103,960		
	Mount Rainier	2,027,520		84,000
	Olympic	1,466,880		
	Washington	3,426,400	560,120	33,680
	Wenaha		318,400	
Wyoming	Yellowstone	6,580,920		
	Black Hills	46,440		
	Big Horn	1,216,960	44,800	110,080
	Medicine Bow	418,759		
Alaska	Afognak	403,640		
	Alexander Archipelago	4,506,240		
Porto Rico	Luquillo	65,950		
	Total	62,582,428	23,507,934	396,940

OFFICERS.

On June 30, 1905, the following number of officers were on duty: Inspectors, 6; superintendents, 2; supervisors, 49; rangers in charge, 5; rangers, 379; guards, 87; laborers, 5; forest assistants (assigned as technical assistants to supervisors), 5.

REORGANIZATION AND POLICY.

The whole Forest Reserve Service was classified under the civil-service law by the President's order of December 17, 1904. The permanent field force now contains the grades of forest inspector, assistant forest inspector, forest supervisor, deputy forest supervisor, forest assistant, forest ranger, deputy forest ranger, assistant forest ranger, and forest guard. All officers will gradually be brought under this new classification as the necessary funds and as men with the required training and experience become available. The object of the reorganization is that the force shall hereafter consist of men of a higher standard of training and experience, appointed and promoted on merit alone, or, in other words, that it shall be as useful to the public which it serves as it is possible to make it.

The old regulations were thoroughly revised. They are now much simpler and more direct and with much unnecessary office work abolished. This revision went into effect on July 1, 1905.

Under the new regulations the responsibility of the men on the

ground has been largely increased, so that local questions may be decided on local grounds. The work on the reserves is closely and frequently examined and reported on by the inspectors. Rangers are authorized to transact much of the minor business. Trained foresters are or will be assigned as technical assistants to the supervisors on all of the more important reserves. In addition to the regular inspectors, all officers in charge of special lines of work in the Forest Service act as inspectors on the reserves in their lines, and these assistants work under them on the preparation of forest surveys, plans for lumbering and planting operations, plans for protection against fire, and many other matters.

The form of organization places the whole administrative authority in the office of the Forester, and at the same time provides for the conduct, by every other office of the Service, of work on the reserves within its special field.

LEGISLATION.

The act of February 1, 1905 (33 Stat. L., 628), besides providing for the transfer of forest reserves to the Department of Agriculture, stipulates that forest supervisors and rangers shall be selected when practicable from qualified citizens of the States or Territories in which the reserves are situated. It also provides that rights of way within forest reserves for the construction and maintenance of dams, reservoirs, water plants, ditches, flumes, pipes, tunnels, and canals, for municipal or mining purposes, are to be granted by the Secretary of the Interior. The last section provides that all money received from the sale of any products or the use of any land or resources of forest reserves shall be covered into the Treasury for a period of five years and form a special fund for the protection, administration, improvement, and extension of the reserves, to be expended as the Secretary of Agriculture may direct.

The laws providing for the relinquishment, selection, and patenting of lands in lieu of tracts covered by unperfected claims or patents within forest reserves were repealed on March 3, 1905. This removes one of the most troublesome questions connected with the creation and administration of forest reserves.

By the act of February 6, 1905 (33 Stat. L., 700) all persons employed in the forest reserve and National park service are given authority to arrest for the violation of laws, rules, and regulations governing forest reserves and National parks, and persons taken in the act of violating such laws, rules, and regulations may be arrested without process. This act also provides for the export of timber and other forest products from reserves in the United States and Alaska, except from those in Idaho and the Black Hills Reserve in South Dakota.

The President was authorized by the act of January 24, 1905 (33 Stat. L., 614), to set aside suitable areas in the Wichita Forest Reserve as a game refuge, these areas to be under such special regulations as the Secretary of Agriculture may make, provided they do not interfere with the State or Territorial game laws. This was done.

TIMBER AND WOOD.

During the past fiscal year applications for the purchase of timber were received, and 411 sales were made of a total of 96,060,258 feet, board measure, and 35,202½ cords, for which $85,596.47 were received.

Approximately 40 per cent of the timber and wood sold was dead or damaged by insects, and every effort has been made to dispose of this class of material. The prices obtained were generally low, partly because until February 1, 1905, no timber or wood could be exported from the State or Territory in which the reserves were situated, and for this reason the purchases were for local use and wide competition was lacking. With the law as now amended the sales should soon greatly increase.

No trespass of any magnitude occurred during the year.

GRAZING.

Grazing permits to the number of 7,981 were issued for the season of 1905, for a total of 632,793 head of cattle, 59,331 horses, and 1,709,987 sheep.

No great changes in the number of stock allowed to graze in the different reserves were made. In some of the older reserves, where grazing has been under control for a sufficient length of time to secure an improvement in range conditions, the number of stock allowed was correspondingly increased; in other cases, where the forage crop of the reserves was not being fully utilized, additional allowances were made to accommodate the stock of new settlers and to provide for the natural increase in the herds of those previously occupying the range. In the reserves created at a more recent date, where the ranges were found to have been overstocked, a reduction was made in the number of stock allowed. The result was a marked improvement both in the condition of the range and in that of the stock occupying it.

In reserves recently created all stock which were occupying the range at the time the reserves were established or which were grazed in them during the past season were allowed to graze during the season of 1905 without permits.

CROSSING PERMITS.

Five permits issued under paragraph 22 of the circular of May 22, 1903, allowed 30 head of cattle and horses and 13,200 head of sheep to cross reserve lands to reach areas of private lands within the Sierra, Warner Mountains, and Mount Rainier forest reserves.

Under the regulation allowing stock to be driven across the forest reserves in transit between summer and winter ranges and to reach points of shipment, 341 permits were issued by the forest supervisors for the crossing of 15,136 head of cattle and horses and 749,924 head of sheep. In granting this privilege it is the policy to allow the use of such width of driveway as is necessary and to give sufficient time in crossing to permit the proper handling of stock.

Whenever it is necessary to cross regularly any portion of a reserve which is closed against the grazing of any class of live stock, a regular driveway is established, and the limits and time allowances

under which it may be used are defined. Such driveways were established in the San Francisco Mountains and Black Mesa forest reserves of Arizona, the Stanislaus and Sierra forest reserves of California, the Big Horn Forest Reserve of Wyoming, and the Salt Lake and Manti Forest reserves of Utah.

HEALTH INSPECTION AND DIPPING REGULATIONS.

The regulation requiring the owners of stock, in districts infected with contagious disease, to submit their stock to inspection by the inspectors of the Bureau of Animal Industry before entering the reserves was willingly complied with in almost every case. The inspection service was efficient, and very little delay was caused by the inspection or treatment of the stock. The forest supervisors were instructed to use every means to facilitate the inspection work, and in some cases additional rangers were employed temporarily to assist in prompt handling.

PREVENTION OF GRAZING TRESPASS.

Several district courts sustained the decision of Judge Wellborn (116 Fed. Rep., 654) that a criminal prosecution did not lie to punish a person who took stock into a forest reserve in violation of the rules. The Attorney-General held that the decision of Judge Wellborn was erroneous, and suggested that prosecutions be proceeded with in other districts, so that a case might be taken to an appellate court for determination. This was done in the case of Dent *v.* United States (76 Pac. Rep., 455), on appeal before the supreme court of Arizona. The supreme court of Arizona, in rendering its final decision, said that the circuit court of appeals for the ninth circuit in the civil case of the United Staes *v.* Dastervignes (122 Fed. Rep., 30) had held that the act of June 4, 1897, did not delegate legislative power to the Secretary and was not unconstitutional; and "that inasmuch as under the act creating the circuit courts of appeal such court exercises appellate jurisdiction over this court in criminal cases such as the one at bar, we feel that a decision of that court, although made in a civil and not a criminal case, expressly holding that the act in question is constitutional * * * is binding upon us in this case;" and ordered judgment in favor of the United States.

The act of Congress approved February 6, 1905, gives the forest officers the right to arrest persons found violating the laws and the rules and regulations relating to forest reserves. This act will result in better protection to the forest reserves.

SPECIAL PRIVILEGES.

The rule of requiring permits for the construction and operation of sawmills within the boundaries of forest reserves was willingly complied with by owners, and worked well. The holders of permits gave valuable assistance in cases of fire.

During the past year 239 applications were received for permission to occupy and use, for various purposes, forest-reserve land under the act of June 4, 1897 (30 Stat. L., 34–36), for which there is no

other specific provision of law. These and all applications which were not finally disposed of within the preceding year were passed upon, except 18 which required necessary amendment or further report and 9 of such recent date that they have not yet been reached for action. The year's record shows that in the seven months preceding February 1, 1905, action was taken upon 127 applications, and in the five following months upon 161 applications.

In response to requests by the Interior Department for report on applications filed there under the several special acts of Congress relating to rights of way for irrigation, mining, and electrical and other specified purposes, approval of the application has been recommended in 32 cases. In 13 other cases referred to the forest supervisors action is awaiting their report on the effect which approval would have upon forest-reserve interests.

FREE USE OF TIMBER.

The demand for the free use of forest-reserve timber continues to increase. During the fiscal year 3,381 applications were received and 3,363 applications were approved and permits issued by the forest officers and the Department, for a total of 6,263,611 board feet and 40,652 cords, of a total value of $22,925.53.

FOREST MEASUREMENTS.

FOREST COMPUTATION.

The Section of Forest Computation is charged with the computation and final statement of all forest measurements. During the year this section handled the results of 2,301 acres of valuation surveys, 21,234 tree analyses, 9,135 height measurements, and 2,549 taper measurements. Of these data 1,599 acres of valuation surveys, 9,280 tree analyses, 5,141 height measurements, and 2,549 taper measurements were taken in the field during the fiscal year in connection with four working plans, studies of five commercial trees, and four investigations of local problems in forest extension, covering twelve species in ten States. The remainder were data selected from measurements made during previous years in order to make tables of stand, growth, and yield for regional studies of commercial trees. The final tabulating of the public-domain statistics in the appendix to the report of the Commission on the Public Lands was done in the Section of Forest Computation.

FOREST MAPS.

The Section of Forest Maps is intrusted with the making of maps, drawings, and diagrams, the custody of those which are not required for constant use, and the development of the best methods of mapping the forest data collected by the Service. During the past year this section has completed 333 maps and copies, made 85 miscellaneous drawings, mounted 764 maps, and rendered assistance by temporary detail to a total of 563 working days. The work of the year has included the preparation of maps showing conditions upon actual and proposed forest reserves, maps for working plans and planting plans,

and maps showing the distribution of commercial species, general land and forest conditions, the movements of lumber, and the progress of conservative lumbering. The drawings and diagrams illustrate, among other subjects, the methods and results of testing and preserving timber and methods and appliances employed in forest extension and forest management. The Section made the necessary diagrams and drawings for the exhibit of the Forest Service at the Lewis and Clark Exposition.

WORK FOR THE ENSUING YEAR.

The Section of Forest Computation will continue to put into final form all forest measurements obtained by the Forest Service. Although the number of measurements taken each year is not increasing, this section has large work before it in rendering available for every possible form of use the great volume of forest measurements already on hand. The Section of Forest Maps faces not only the steadily growing demands upon it from investigative and cooperative lines of work, but also the task of building up, so far as this falls within its province, the work in forest mapping essential to the effective management of the forest reserves.

EXPENDITURES.

The total expenditures during the year under the head of forest measurements were $30,158.99, or 7 per cent of the total appropriation of the Forest Service.

FOREST MANAGEMENT.

PUBLIC LANDS.

Immediately upon the transfer of the National forest reserves to the care of the Bureau of Forestry (now the Forest Service), on February 1, 1905, steps were taken to put them under forest management. To permit the use of the standing timber and at the same time to maintain the full productive power of the forest for the future, working plans were needed wherever cutting was to take place. Twenty-six trained foresters were therefore detailed to take charge of this and other technical work on the ground. Five of these foresters were assigned to duty as forest inspectors and twenty-one as technical assistants to forest supervisors, five of whom were on duty by July 1, 1905. The practice of forestry, which makes it possible to harvest the standing timber for the supply of present needs without destroying or diminishing the future usefulness of the forest, has now definitely begun on the National reserves.

Commercial tree studies of western yellow pine and sugar pine in California, western yellow pine in Colorado, Montana, and South Dakota, and lodgepole pine in Wyoming were carried on during the past year. This work is intended to furnish definite information as the basis for careful management of forest reserves on which these trees are the important species and for establishing better rules for lumbering the reserves.

The work on the Chippewa Indian Reservation, in northern Minnesota, which will eventually become a National forest reserve, has been steadily carried on during the past year, under the act of June 27, 1902, which provided that these lands, with a total area of 231,400 acres, should be placed under forest management. The land on which it was specified that 95 per cent of the timber should be sold at public auction is now being logged. All trees to be left standing on these sections have been or will be marked, and regulations to govern the cutting have been prescribed. The work of removing the timber is going on as rapidly as possible, and is under the constant supervision of the Service.

During the year approximately 10,000 acres were marked for cutting and 6,000 acres were cut. Altogether 50,000 acres have been marked since the work began. Brush burning was completed on 5,645 acres at the end of the year, at an approximate cost of 15 cents per thousand feet of lumber, which was less than one-tenth of what was commonly predicted.

The success of the plan adopted to secure the perpetuation of the forest is entirely assured. Already young seedlings are springing up in abundance, and there can be no question that an ample supply of young growth will be established over the entire forest area. Notwithstanding an extraordinarily unfavorable season, the loss by windfall in the 5 per cent of seed trees left standing has not even endangered reproduction. The loss by windfall was less among the seed trees than in the body of the uncut forest. Even the loss which took place is not a loss of the lumber nor a permanent loss of seed trees, for most of the trees blown down have been logged, and the existence of timber yet to be cut in their near neighborhood has generally made it possible to select others which will be left in their stead.

PRIVATE LANDS.

During the past year the number of applications for advice and assistance in the management of timber lands and wood lots under the offer of cooperation outlined in Circular No. 21 has increased materially. But still more significant and satisfactory than the increase in the number of applications is the wide territory and new localities from which they come. Interest in conservative lumbering and the best utilization of timber lands is undergoing a rapid growth, and nowhere more so than in the West. Both from the Coast States and from the Middle West many applications for assistance have been received during the past year, and the rapid growth of interest has been very marked.

During the year 167 applications were received for advice and assistance in the management of private forest lands. Of these, 45 were for timber tracts, with a total area of 1,439,763 acres, and 122 were for wood lots, with a total area of 7,509 acres. The total area of private lands covered by applications for assistance in management since the publication of Circular No. 21 is 10,947,246 acres, of which 10,917,978 acres are in timber tracts and 29,268 acres in wood lots.

In the case of timber tracts a preliminary examination must precede the preparation of a working plan. Such examinations were made during the year of 22 timber tracts in the States of New York,

New Hampshire, Pennsylvania, Virginia, West Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Arkansas, Missouri, Michigan, Wisconsin, Washington, and California, covering a total area of 500,043 acres. In every case a report was made to the owners giving advice for the management of the tract. For 9 of these tracts the preparation of detailed working plans was recommended and the recommendation approved by the owners. The total estimated cost of these plans to the owners is $10,220, or an average cost of 2 cents per acre.

WORKING PLANS FOR WOOD LOTS.

Working plans based on a thorough study on the ground were made for 81 wood lots, with a total area of 5,340 acres, in the States of New York, New Hampshire, Connecticut, New Jersey, Pennsylvania, Ohio, Maryland, Virginia; North Carolina, Missouri, Alabama, Louisiana, Michigan, and California. The object of this wood-lot work is to give advice and suggestion to farmers and other small owners of timber land, whose holdings in the aggregate form a large part of the productive forest of the country, and for whom forestry can often make a far greater increase of profit in proportion to the capital invested than for large owners. Advice is given the owner personally in the field, and wherever possible thinnings or other operations are actually started under the supervision of the agent making the examination. A written report is then sent to the owner, embodying the recommendations made and giving the reasons for them. Particular attention was paid during the year to wood lots in Ohio, Michigan, and the Lake States, where the question of wood and timber for the farm is often of the greatest importance.

Much valuable information concerning the growth, volume, and yield of different timber trees was gathered in the course of this work, and is now available for use elsewhere. This is the great economy effected by conducting such studies for the public benefit at the public charge. The knowledge which it would not pay the single small owner to gather for himself becomes immensely valuable when, once gathered, it can be broadly applied.

In connection with the wood-lot examinations a number of illustrated lectures were given to various organizations, followed by discussions which proved of great educational value. Much information was also collected as to market conditions, local demands for timber, and the cost of the various logging operations. This information is of special usefulness to farmers, who are often unfamiliar with the timber market.

WORKING PLANS FOR TIMBER TRACTS.

The field work necessary for detailed working plans was carried on during the year upon 8 tracts, with a total area of 1,982,000 acres. The total amount estimated as the cost of these working plans to the owners was $8,575. The 8 tracts included a hard-wood tract in West Virginia, to be managed for a continuous supply of mining timbers; a Kentucky tract, which must be so managed as to yield a continuous revenue and at the same time build up the condition of a badly depleted forest; a tract in northwestern Texas, valuable for the production of fuel and fencing in a region almost destitute of timber;

a tract in New Hampshire on which a present hemlock and hardwood forest can be converted into one of white pine, with a promise of largely increased profits; a tract in western Washington, the study of which disclosed important facts concerning the usefulness of forestry in connection with the production of Pacific coast fir; a tract in eastern Washington on which it was found that a fair second cut can be obtained within a reasonable period by the application of proper methods of handling; an Idaho forest likely to become an important source of supply of mining timbers as well as a protective agency for the water necessary to the development of the surrounding country, and a northern California tract on which it appeared that management would pay well if fire could be kept out, and for which a plan to secure fire protection was made.

STUDIES OF COMMERCIAL TREES.

During the past year much attention was given to studies of commercial trees. The purpose of these studies is to secure full and accurate knowledge of the requirements and habits of each individual species of our more important forest trees. Not only are such studies valuable contributions to our knowledge of North American forests, but they are of material service for forest management and the successful preparation of working plans. It is the present aim to supplement the determination of volume and yield by thorough investigation of the value and uses of the timber, demand, general market conditions, the best methods of lumbering and handling, and the most profitable means of utilizing the trees under various circumstances. Such information as this has already been of great value in showing where waste, both in logging and in utilization of the timber, can be avoided.

SOUTHERN APPALACHIANS.

The Southern Appalachian region is of foremost importance to the hard-wood interests of the United States, because of the great extent and value of its hard-wood forests. The Forest Service has collected during a number of years volume and growth measurements for several species in various parts of this territory, chiefly in connection with the making of working plans. During the past year the work of correlating and rounding out the data previously collected was undertaken.

Yellow poplar, white, red, black, and chestnut oaks, chestnut, white pine, and hemlock were studied in West Virginia, Kentucky, and Tennessee, and the mountainous portions of Maryland, Virginia, North Carolina, South Carolina, Georgia, and Alabama. In addition to the field work, a careful market study was also made of all the species under consideration. The demand for these timbers has increased enormously within the last ten years, the available supplies are rapidly diminishing, and stumpage prices are rising very fast. A comprehensive market study is thus of special timeliness.

In preparing this market study, a general canvass was made of the lumbering centers of the Southern Appalachian region. Information was obtained at each point concerning the remaining stand of timber of each species and its quality, the annual cut and its uses,

new uses and substitutions, the market supplied, and land and stumpage values. Special attention was paid also to the cost and methods of logging and milling, and to current grades and specifications. Sixteen localities, believed to be typical of the forests of the region, were then selected for detailed studies of silvics and lumbering. In addition, four other typical localities were studied by special parties, two in connection with the second-growth problem and two for the cooperage industry. Careful studies were made of the characteristics of the forest, the individual habits and requirements of each species, the effects of fire and grazing, and the methods and effects of lumbering upon the forests, more especially as regards waste in logging and means of preventing this waste. Upon these various studies are based plans for conservative forest management under varying forest conditions.

The report upon this great hard-wood region, which is now nearing completion, will contain a large amount of information concerning commercial and forest conditions and their relation to the lumber, cross-tie, tight and slack cooperage, mining, timber, tan-bark, and chestnut extract wood industries. Based upon this information, definite suggestions will be given as to methods of utilizing the forest products to better advantage and as to practical means of managing forest properties more conservatively.

COTTONWOOD AND ASH.

During the winter the Forest Service carried on a study of cottonwood and ash in the South. This study was supplementary in part to the study made the preceding year of the red gum, and combined with this, furnishes a complete basis for the forest management of hard-wood bottom lands in this region.

Nowhere is forest management more promising than on these hard-wood bottom lands. The growth of all species, particularly the cottonwood and ash, is here extremely rapid, and nearly all the species are now easily merchantable. The measurements taken on the cottonwood show it to be one of the fastest growing trees native to the United States. Ash, while not so fast in growth as either cottonwood or red gum, will make saw logs in about fifty years, and can be used when much smaller for many purposes. The chief obstacle to be overcome is, in many localities, the dense growth of canebrake, which often renders reproduction difficult, if not altogether impossible. Burning will undoubtedly prove the most efficient means of destroying this growth.

LODGEPOLE PINE.

A study of the lodgepole pine in Montana, Utah, and Wyoming was carried on during the summer and fall. The object was to collect exact information with regard to silvics, commercial status, and methods of lumbering, which information, combined with the large number of growth and volume measurements obtained by the Service during the past four years, will furnish a basis for the correct forest management of this species.

At present lodgepole pine, despite its wide geographical distribution and the fact that it forms four-fifths of the forests of the Rocky Mountain region, is not commercially a well-known tree. It is,

however, rapidly gaining in general utility. For example, experiments have already shown that railroad ties of this tree, when impregnated with a proper preservative, satisfy the necessary requirements as to length of service, and its utilization for this purpose, as well as for mining timbers, seems to be assured.

The chief obstacles to forest management on lodgepole lands is the repeated forest fires that annually burn over large areas, and one of the main objects of this study was to discover how to control and prevent these fires. Particular attention was also given to the matter of waste in logging and to the disposal of slash and tops. This slash left after logging forms one of the greatest obstacles to fire prevention, for it becomes very dry and inflammable in summer and makes a very hot fire. With an efficient system of fire protection forest management promises to be highly successful for lodgepole pine timber lands.

WESTERN YELLOW PINE.

A study of one of the most important commercial timber trees of the West, the western yellow pine, completed during the year, was made to determine the best methods of management of this species, based on its reproduction, rate of growth, and silvicultural characteristics. Measurements of sample plots and of the rate of growth and actual volume of felled trees were made in South Dakota, Colorado, Montana, and California. The tables obtained will be of great assistance to timber-land owners in estimating the amount of standing timber on their lands and the rate at which it will grow.

In addition, the commercial distribution of the species was mapped, and a careful study was made of market conditions, methods of lumbering, uses of the wood, and the characteristics of the tree, including its requirements as to soil, moisture, elevation, etc.

SUGAR PINE.

In connection with the study of the western yellow pine in California, the study of sugar pine in that State, begun in 1902, was completed. The sugar pine is one of the important timber trees of the coast, but a difficult species to manage under prevailing conditions. Fire protection on cut-over lands is the most important consideration. The report on this species will contain volume and rate of growth tables and carefully prepared silvicultural notes, and will furnish much information of practical value.

SCRUB PINE.

During the spring months the Forest Service carried on a study of the scrub pine in Virginia and Maryland, in order to furnish information to farmers and timber-land owners in these States, where there are large areas of abandoned farm land, covered with dense stands of this species. Particular attention was given to market conditions and present and possible uses of the species, especially for pulp wood and lumber.

SPECIES USED FOR RAILROAD TIES.

The tie problem in this country is becoming more important every year. The study of loblolly pine in eastern Texas, with special refer-

ence to tie production, was completed during the year, and a similar study was begun in the hard-wood region of the Southern Appalachians, westward to the Mississippi River. White, black, and chestnut oaks were the species principally studied. The fact that the tie industry in that region is confined almost exclusively to second-growth forest made desirable a general study of the second-growth land, its extent, character, and annual production, and of the proper methods of managing it for a sustained yield of the timber demanded in the region, both for ties and for the mining and other industries dependent upon wood.

DETERMINATION OF TIMBER VALUES.

A piece of work which the Forest Service has carried on during the past year and which makes a strong appeal to lumbermen is that of determining the precise money value of trees of the different diameters. This work, begun less than two years ago, has been steadily developed. It furnishes in many cases the strongest possible argument for conservative forest management.

The timber owner who undertakes to practice forestry must make up his mind to leave a certain percentage of his trees uncut as a basis for future timber crops. Hence the first question he wants answered is, What are these trees worth now, and what will they be worth when they have reached a larger size? In brief, will it pay to let them alone for a while?

This study supplies the exact information required. The trees are marked in the woods as they are felled, and then traced through the sawmill to learn what they saw out. From the figures thus obtained tables are constructed which show the number of board feet of each grade of lumber yielded by trees of different diameters. By applying a lumber price list the exact money value of the trees may then be determined.

This study at sawmills also shows exactly how the actual amount of lumber sawed out of a log or tree compares with the amount credited to it by the log scale. This is a matter of considerable importance, especially to lumbermen who contract for their logging. The tables showing money values can be applied with peculiar effectiveness to those tracts on which detailed estimates have been made of the standing timber. Knowing the number of trees of each diameter and species on his lands, and the profits per thousand feet of logging each diameter, the lumberman is in a position to put a far more accurate valuation on his property than if he had resorted to the customary method of having it cruised and had then applied a stumpage price. Success in the lumber business depends largely on the ability to figure closely on all operations. The mill studies of the Service thus furnish the precise information necessary for very important calculations.

WORK FOR THE ENSUING YEAR.

PUBLIC LANDS.

During the coming year the preparation of working plans for those parts of the National forest reserves where there is an urgent demand for timber and where large timber sales have been made will

be carried on as rapidly as the resources of the Service will permit. Studies of the more important species occurring on the reserves will be pressed forward. Those species which are of commonest occurrence or of most importance to correct forest management will be studied first.

WORKING PLANS.

Working plans will continue to be made for private tracts. Several working plans, which will be completed during the coming year, have already been begun. They are as follows:

Two working plans for small tracts in New York, on which the actual carrying out of the recommendations to be made will be started by the Service. The present stand and distribution of the timber will be shown by forest maps, and the future stand will be estimated from growth figures collected on the tracts. The execution of these plans will afford practical examples of forest management for residents in the vicinity.

A working plan for a tract of 100,000 acres in northern New York, which the owners wish to manage so as to obtain the largest returns from continued cutting and on which present returns are not the first requirement.

Three working plans for small tracts in California. The protection of the forest from fires is here most important, and the results of this work will be of the greatest value to timber-land owners in that region.

The working plan for the tract of 1,300,000 acres in western Washington begun last year. The chief object of this work will be to outline an efficient fire-protection system and to perfect plans for future lumbering, so as to obtain continued cuts of timber.

A working plan for a tract of about 7,000 acres on an island in Lake Michigan. The work will include the making of a forest type map showing the distribution and character of the timber, an estimate of the present stand, plans for the removal of mature timber and for improvement cuttings and thinnings in second growth, and a planting plan for open and burnt areas. The situation of this tract, on a small island, renders the question of fire protection particularly easy.

In addition to these working plans, which are already under way, a working plan will be made for a tract of land in Kentucky and Virginia, which the owners wish to hold mainly for the permanent production of mining timbers. The forest is as yet practically uncut, and the opportunities for successful forest management are very great.

Working plans will be made for at least two large tracts of longleaf pine land in Arkansas, including studies of fire protection and less wasteful methods of lumbering. A working plan will also be made for a tract of longleaf and loblolly pine land in South Carolina.

A detailed plan for protection of forest lands from fire will be made for one of the large railroad companies in California and Oregon. The essential features of this work will be the adoption of a system of fire patrol and the prevention of fire from starting by improved methods of logging and by burning brush and slash left after logging.

In addition to these working plans for timber tracts attention will be given, as in the past, to working plans for wood lots. The oppor-

tunity which this work affords of introducing better forest management throughout the country is very great, and the examples of thinnings and other work furnished by these wood lots are of great advantage to neighboring timber-land owners.

STUDIES OF COMMERCIAL TREES.

The Forest Service will continue its commercial-tree studies during the coming year. It will be the object to complete as rapidly as possible the studies of those trees which are of the greatest importance commercially, or in the management of forest lands. Work will also be carried on along special lines of investigation, such as the production of railroad ties and studies of second growth in various parts of the United States. The study of lodgepole pine will be continued during the coming year so as to cover its entire range, special attention being given to market conditions, waste in logging, and the best methods of reproduction of lodgepole pine forests. Other commercial trees to be taken up will be the Engelmann spruce in the West, the red cedar in the South, the red pine in Minnesota (for which sufficient field measurements have already been collected), and the white fir as a source of supply for pulp wood in Oregon and Washington.

A cooperative study of future supply of railroad ties will be carried on in Wisconsin and Minnesota. The investigation will determine the possibility and cost of producing ties in these States on lands tributary to the cooperating road.

The mill studies to determine the actual money value of trees of different diameters and the amounts of each grade of lumber cut from the trees will be continued, and the longleaf and loblolly pines in South Carolina will be studied.

Studies of second-growth white pine will be carried on in New England, and a study of second-growth hard woods will also be made. This work is of particular importance from its bearing upon the management of small timber tracts and wood lots.

COOPERATIVE STATE FOREST STUDIES.

MAINE.

A descriptive study of forest fires was carried on and completed during the past year in cooperation with the State of Maine forest commission. Particular attention was given to the causes of fires and to the effect of fires on the forest, reproduction, and second growth. The present methods of fighting fires and the efficiency of these methods were also studied, and figures were collected to show the actual damage done to the forest. On this work are based recommendations for the prevention and control of fires.

WORK OF THE ENSUING YEAR.

In cooperation with the New Hampshire forest commission, a study will be made of forest conditions in the southern part of that State. This work will be a continuation of the work already done in the northern part of New Hampshire. The lines to be followed are:

(1) A study of the composition and quality of the forest and the completion of the forest map of New Hampshire.

(2) A determination of the actual yield of merchantable timber possible from second-growth forest under forest management.

(3) A study of the present methods and extent of lumbering in the southern half of the State, and of practicable modifications to improve the condition of cut-over lands.

(4) A study of the values and uses of the various woods, and of the returns which can be expected from second-growth forest and wood lots.

(5) The completion of the stream-flow measurements in cooperation with the United States Geological Survey.

EXPENDITURES.

The total expenditures under forest management during the past year amounted to $57,082.25, or 13¼ per cent of the total appropriation for the Forest Service.

FOREST EXTENSION.

The forest planting operations conducted during the past year by the Forest Service fall into two main classes—cooperative planting, which concerns itself with planting on private land under the cooperative arrangement outlined in Circular No. 22, and reserve planting operations and forest replacement studies, both of which are concerned directly with the work of reforestation on the forest reserves.

COOPERATIVE PLANTING.

The same general policy of cooperative forest planting which has been followed since July, 1899, was continued during the past year. Upon application, examination is made, whenever practicable, of lands upon which the owners contemplate forest planting. If after this preliminary examination a planting plan seems advisable, detailed instructions as to what and how to plant are given. In case extensive planting is to be undertaken its supervision by an agent of the Service is usually recommended. The assistance offered does not include the preparation of plans for landscape gardening or decorative planting of any kind, and such work is entirely outside the province of the Forest Service.

RESULTS OF COOPERATIVE PLANTING.

During the past year 50 landowners applied for assistance under the terms outlined above, and at the beginning of the year 52 applications were awaiting attention. Of these applications 49 were acted upon during the year, and 46 planting plans were made, covering an aggregate area of 36,570 acres, in 21 States. There are now 46 applications on file to receive attention during the coming year. The following is a summary, under fiscal years, of operations from the inception of the cooperative forest-planting policy, in 1899, to June 30, 1905:

Fiscal year.	Applications received.	Examinations made.	Plans made.	Area covered by plans.
	Number.	*Number.*	*Number.*	*Acres.*
1900	117	62	59	482.55
1901	75	118	114	2,574.45
1902	70	55	51	3,467.27
1903	63	69	68	4,283.20
1904	70	53	42	2,861.33
1905	50	49	46	36,569.70
Total	445	406	380	50,238.50

INCREASE OF COOPERATIVE FOREST PLANTING.

The most notable phase of the cooperative planting work during the year has been the increasing requests for assistance made by cities, water companies, railroads, and other large owners. A forest nursery was established and a planting plan is being made for some 25,000 acres of denuded land along the Chateaugay division of the Delaware and Hudson Railroad in the Adirondacks, while for the Baltimore and Ohio Railroad an examination was made of several parcels of land in West Virginia, Ohio, and Pennsylvania. A planting plan was made and planting was begun on a 3,000-acre forest park for the city of Los Angeles, Cal., and application was received for a similar plan for a large forest park in the city of Helena, Mont. Watershed planting is receiving increasing attention, and the practical bearing of reforestation upon irrigation and various industries is becoming more thoroughly recognized. The Fort Bayard Military Reservation was examined for the War Department. A planting plan was made for 4,000 acres of the reservation, and a nursery was established. The development of these large projects indicates the increasing scope of cooperative forest planting, and is a natural result of earlier educational work and of increasing needs.

INVESTIGATIONS OF PLANTED AND NATURAL TIMBER.

The field studies to accumulate all available data on forest planting have been continued in the Middle West, in order to determine for definite regions the best species for commercial and protective planting, the best cultural methods, and what may be expected from the species planted. Such studies were completed last year in North and South Dakota, western Minnesota, Illinois, eastern Nebraska, and western Texas. A similar study is being made in Iowa.

POPULAR INFORMATION.

Leaflets on the planting range, silvical qualities, proper methods of propagation and care, and economic uses of such trees as can be recommended for commercial and protective forest planting, and on common subjects of inquiry, such as spacing, transplanting, heeling in, packing and shipping young trees, and the cultivation of forest plantations, have been prepared and printed. To supplement the planting leaflets a mimeographed sheet for each important species has been prepared, giving the range of quotations for seed, seedlings, and transplants, and list of dealers from whom planting material may be obtained.

To further the work of cooperative forest planting, public meetings were held and lectures were given in North Carolina, Iowa, Illinois, and Nebraska.

RESERVE PLANTING.

SAN GABRIEL FOREST RESERVE.

During the past year the two established nurseries in the San Gabriel Forest Reserve were consolidated by the removal of the lath house of the Pasadena nursery to Henningers Flat. By this change the productive capacity of the Henningers Flat nursery was increased about one-third. There are now about 11,520 square feet of ground under lath. This area has been replanted to seed beds since the removal of the 1-year-old stock to open ground. The seeds sown should produce about 300,000 plants. The species mainly used were the Jeffrey pine, big cone spruce, knob cone pine, and Coulter pine, in the order named. For field planting in the San Gabriel Reserve 2-year-old trees once transplanted are most desirable. During March of this year 210,700 1-year-old seedlings, chiefly of these species, were transplanted from the seed beds in the lath house to nursery beds and the loss will not exceed 0.047 per cent.

To check the rapid height growth of certain species, as the Coulter and Monterey pines and big cone spruce, and thereby to secure stocky plants which rabbits will not molest, "topping" was tried. Several thousand trees were cut back three-fourths of their length before transplanting, and others when transplanted, with very satisfactory results. A root-pruning knife was devised, with which the roots can be cut at any depth from 3 to 10 inches. It has been used only experimentally, but thus far with gratifying success.

During April and May of this year 37,000 trees, chiefly 2-year-old transplants, were set out, in greater part for experimental purposes. For the protection of the Henningers Flat nursery and the new forest plantations, a system of fire lines was laid out and constructed after the completion of the planting.

To promote the reforestation of the watersheds and to extend the range of experimental planting, 8,560 trees were given to the city of Los Angeles for planting in Griffith Park and 3,106 to individuals in lots of from 150 to 1,500. All the trees were planted under instructions from the Service, and, except in two cases, were set on watersheds within forest reserves.

SANTA BARBARA FOREST RESERVE.

In view of the extremely high value of water in the vicinity of Santa Barbara and of the denuded condition of the important drainage basins, reforestation work was begun in the Santa Barbara Forest Reserve in March, 1905. A forest nursery was established within the reserve, at an elevation of 2,000 feet, on the San Marcos road, 13 miles from the city of Santa Barbara. The necessary land and water privileges were secured by lease. A lath house covering 5,760 square feet of ground space was erected, in which seed beds were prepared and seed sown.

A detailed planting plan for the watersheds in urgent need of reforestation will be completed during the summer. The Mono Basin and the watersheds of the Santa Ynez River above the Gibraltar reservoir site will receive first attention.

PIKES PEAK FOREST RESERVE.

During the field season of 1904 three nurseries were established in the southern portion of the Pikes Peak Forest Reserve to furnish seedlings for planting on the fire-denuded slopes of that region. In the fall about one-fifth of an acre of seed beds was planted with seed of Engelmann spruce, blue spruce, Douglas spruce, limber pine, western yellow pine, and bristle-cone pine. Forty thousand western yellow pine and 10,000 Douglas spruce seedlings from the Government nursery at Halsey, Nebr., were planted on the mountain slopes near Clyde.

GILA RIVER FOREST RESERVE—FORT BAYARD MILITARY RESERVATION.

An examination of the adaptability of the Fort Bayard Military Reservation for forest planting, made in cooperation with the War Department in April, 1905, was followed by the selection and leasing of a nursery site at Stevens ranch, north of the military post, at the only point where the necessary water rights could be obtained. An acre of ground was prepared as a nursery, and seed beds with a productive capacity of 3,000,000 seedlings were sown. About 300 pounds of seed of western yellow pine were used. They were sown with a seed drill, at a cost of less than 5 cents per pound; hand sowing would cost about 50 cents.

BLACK HILLS FOREST RESERVE.

Reforestation work was begun in early June. On 32 acres western yellow pine seed was sown broadcast. An area of 8 acres was planted to seeds of the same species with a hand corn planter, improved for the purpose, and 30,000 western yellow pine and 10,000 red fir seedlings raised in the Dismal River Forest Reserve nursery were set up, 2,000 to the acre. The operations were in the vicinity of Custer Peak, near Roubaix, on the site of an old burn.

DISMAL RIVER FOREST RESERVE.

Created primarily as a tree-planting reserve, the Dismal River Forest Reserve was the first on which planting was begun, and is still the scene of the most extensive reserve planting directed by the Forest Service.

NURSERY WORK.—In September, 1904, a careful estimate based on sample-plot counts showed that the nursery stock at that time consisted of 990,000 western yellow pine, 1,119,000 jack pine, 7,800 red fir, and 50,000 white fir seedlings. Of these the western yellow pine, red fir, and white fir came through the winter with probably less than 5 per cent loss. The jack pine suffered a loss of about 75 per cent through winter killing and the attack of a fungus.

The cost of raising these seedlings to one year old, including cost of the seed and one-tenth of the cost of constructing the shade frames, amounted to not more than 85 cents per thousand. These seedlings, as well as the other trees, are prospering.

The area devoted to seed beds is now $2\frac{1}{2}$ acres. One-half of this area was sown to western yellow pine and jack pine this spring. The remaining $1\frac{1}{4}$ acres contain one-year-old seedlings of western yellow

and jack pine and red and white fir, which will be left in the beds another year before transplanting.

FIELD PLANTING.—Field planting was begun on April 11 and finished in early May. A total of 396,100 trees of jack pine and western yellow pine was planted in the sand hills at an average of $2.15 per thousand trees. The method of planting was practically the same as that followed the previous year, described in the 1904 report. All of the jack pine was planted in the grass sod without previous preparation. Of the 274,700 western yellow pine 80,400 were planted in sod and the remaining 194,300 in furrows. The trees planted this year are in a thrifty condition and appear to be making a good start.

SEEDS AND TREES FURNISHED FOR PLANTING OUTSIDE OF THE DISMAL RIVER FOREST RESERVE.—In May 300 pounds of western yellow pine seed, 30,000 seedlings of the same species, and 10,000 red fir seedlings were furnished for reforestation in the Black Hills Forest Reserve. Fifty thousand western yellow pine seedlings and 10,000 red fir seedlings were shipped to the Pikes Peak Forest Reserve, and 400 pounds of western yellow pine seed were sent to the newly established nursery at Fort Bayard, N. Mex.

EXPERIMENTAL PLANTING.—Although the work up to the present has been very successful, sand-hill planting is yet in an experimental stage. To secure further data a quarter section of typical sand-hill country was set aside for experimental purposes. Planting was done on this area with different species, both in and out of furrows, and each tree and block was carefully staked and recorded, so that accurate counts can be made at any time. In addition certain trees and blocks in the larger field plantations were staked, that the results may be more accurately determined.

COLLECTING AND TESTING OF FOREST TREE SEEDS.

It is the policy of the Service to collect the seeds used in reserve planting, though as a large quantity gathered in 1903 was on hand at the beginning of the last fiscal year no collecting was needed in 1904. In this connection germination tests and data as to the vitality and methods of preservation of the seeds are essential. Cooperative work was carried on with the Seed Laboratory of the Department through a series of experiments, field germination tests were made at Halsey, Nebr., and Henningers Flat, Cal., and a report on preliminary results was prepared. On the whole, the seed collected by the Service was of better quality than that purchased of seed houses.

FOREST REPLACEMENT.

The study of forest replacement on areas where tree growth is wanting or deficient was continued in the Wichita, Prescott, Pikes Peak, Santa Barbara, San Gabriel, San Bernardino, San Jacinto, and Sierra reserves. Studies similar in character, although less exhaustive, were carried on in connection with reserve and cooperative planting and with the studies of natural forest encroachment.

Forest-replacement studies serve as a preliminary reforestation plan. Through such studies the areas on which planting is advisable

are definitely determined, species selected, nursery sites located, disposal of brush and dead timber considered, preliminary fire plans made, and an estimate is given of the cost of the several operations.

During the year the field investigations of forest replacement in the Santa Barbara Forest Reserve, inaugurated and carried nearly to completion in the fiscal year 1904, were finished, and the preliminary office report was compiled in the form of locality and reproduction studies.

The forest-replacement studies in the Sierra Forest Reserve were completed in December, 1904. A full office report describes the types of the Sierra forest, the extent to which natural reproduction may be depended upon to reclaim chaparral and reforest denuded areas, the areas on which planting is advisable, and the species suitable for planting.

An investigation of the advisability of forest planting for timber supply and water conservation in the Salt Lake Forest Reserve was made during the summer field season. One valuable result was the beginning of hearty cooperation with the municipality of Salt Lake in the interest of the city's water supply. The eastern part of the Lewis and Clark Forest Reserve was examined to determine whether the condition of the watersheds, the state of settlement, and the value of the water and timber supplied by this region are sufficient to warrant the preparation of a reforestation plan. An examination was also begun to determine the advisability of forest planting on denuded slopes in the Gunnison Forest Reserve, in Colorado, in connection with the Uncompahgre Valley irrigation project of the Reclamation Service.

STATE COOPERATIVE WORK.

The forest investigations in cooperation with the State of California which began in July, 1903, were finished. Studies were conducted by the Office of Forest Extension on the chaparral, its growth, extension, functions, and the means of controlling it, and on forest fires. The latter resulted in completed reports on fire conditions in the San Bernardino, San Gabriel, Santa Barbara, San Jacinto, and Trabuco Canyon forest reserves, and in Monterey County, on the western slope of the southern Sierras, and in the Lake Tahoe region. In addition, a systematic plan of fire protection was made and put into operation on a lumber tract in Butte County, and reports on slash burning and general fire protection were prepared. Most important of all, a State forest code, based on a thorough field study, was submitted to the legislature, and was passed in somewhat amended form. It provides for the protection and management of forests within the State, and creates a State board of forestry and a technical administrative force consisting of a State forester and two assistants. A general report on fire conditions in California is in preparation.

EXPENDITURES.

The expenditures of the Office of Forest Extension during the past year amounted to $53,970.96, or 12½ per cent of the appropriation of the Forest Service. Contributions amounting to $3,792 were received

and expended on cooperative work. Among the contributors were the State of California, the Los Angeles Chamber of Commerce, the Pasadena Board of Trade, and the Solar Observatory, Mount Wilson, Cal.

WORK FOR THE ENSUING YEAR.

COOPERATIVE PLANTING.

The preparation of planting plans under the provisions of Circular No. 22 will be continued, and effort will be made to extend the work by bringing the cooperative offer to the attention of a greater number of landowners. The study of planted groves in Iowa will be completed. It is expected to lead to more active cooperation between the Service and railroads, pulp companies, and others interested in forest planting. Attention will be given to planting over the coal beds in the Ohio Basin which are unproductive or giving only small returns from agricultural crops. The black locust will be studied with care, because it is the species in greatest favor for planting in this region.

RESERVE PLANTING.

The reserve planting projects on the San Gabriel, Santa Barbara, Pikes Peak, Gila River, Black Hills, and Dismal River forest reserves will be continued and extended. In connection with this a large quantity of tree seeds will be collected this fall.

In the Garden City Forest Reserve, created primarily as a tree-planting reserve in June, 1905, active operations will begin this fall by locating the site and preparing the ground for a nursery. The planting of seed beds will follow next spring.

If favorable reports are submitted for the reserves on which preliminary reforestation plans are now being made, the establishment of additional forest nurseries will be advisable in the spring of 1906. These reserves are the Salt Lake, Prescott, Lewis and Clark, Gunnison, Modoc, Warner Mountains, Cassia, and possibly the Malad.

DENDROLOGY.

FOREST DISTRIBUTION.

FOREST MAP OF THE UNITED STATES.

The collection of data for mapping the forest types and the distribution of tree species in the United States was continued during the year. A map showing the great types, prepared for the Louisiana Purchase Exposition, was printed, and marks a considerable advance in accurate knowledge. But the satisfactory completion of this most important undertaking must be the work of years. Until it is completed, knowledge of the extent and economic possibilities of our forest resources must remain fragmentary.

STUDIES OF SPECIAL REGIONS, GROUPS, AND SPECIES.

A study of the distribution, composition, and commercial value of bottom-land forests in the "Big Thicket" region of southern Texas was conducted during the year.

Progress was made in a study of important indigenous and exotic acacias growing in the United States. Through the unfortunate loss of field notes by the burning of the Santa Monica Experiment Station buildings, however, much of the work done will have to be undertaken anew.

A study of eucalypts for growing where there is little frost is in progress. New and definite knowledge has been obtained of the exact limits within which various species can be successfully cultivated in parts of the West and Southwest.

PACIFIC COAST TAN-BARK TREES.

Material has been collected for a complete report on the present and probable future supply of western tan-bark oak, of the extent to which it is likely to meet the demand of the Pacific tanning industry, of new species capable of supplying tan bark, and of the various barks which have been used as adulterants.

BASKET WILLOWS.

The basket-willow holts established last year on the Arlington Experimental Farm yielded their first crop of rods from 10,000 stools in the spring of 1905. Some of this stock was peeled, some dried with the bark on, and the remainder used for cuttings to extend the plantation. The peeled and unpeeled rods will be made into various forms of produce and farm baskets and placed in actual service to determine whether they are enough more durable than the cheaper but comparatively much shorter-lived splint-wood baskets to make them more economical in the end.

From the total crop of rods valuable comparative data were obtained as to the production of different willows on different soils, and the effect of different treatments on the quality and quantity of the rods, and, in cooperation with the Bureau of Entomology, on means of preventing insect ravages.

The holts now contain 20,000 stools, distributed in 30 plats, and the plantation is well equipped. The Bureau of Plant Industry, which assigned the land for these experiments, has rendered most cordial and helpful cooperation in preparing the ground and in many other ways.

The appearance of Bulletin 46 (The Basket Willow) awakened an interest in willow growing, and many requests are received for cuttings of approved strains of basket willows. It is planned to meet this growing demand by distributing from 50,000 to 100,000 cuttings during the spring of 1906.

TURPENTINING METHODS.

The series of experiments to secure an improved system of turpentining begun in 1902 was completed in December, 1904, and the final results were published in Circular 34. These experiments made known a means by which the length of life of the turpentined pine forests is greatly lengthened and at the same time both a larger and a better product is obtained. The study already made has received the hearty commendation of the body of operators who produce the

major part of our naval stores and has led to the offer of willing cooperation in further studies.

PURPOSE AND CHARACTER OF NEW EXPERIMENTS.—A promising field for still further improvement in turpentining methods was opened by the likelihood that by diminishing the wound caused by chipping the injury to the tree might be still further reduced without decreasing the yield. The problem is essentially to discover the effect of chipping on the physiological activities of the tree, upon which depend the secretion and flow of resin. To test this matter experiments were begun on March 1, 1905, with four crops of approximately 8,000 trees each.

These experiments are being conducted on a longleaf pine tract near Greencove Springs, Lake County, Fla., about 30 miles south of Jacksonville. The work is under the constant observation of the most progressive turpentine operators, a number of whom have already modified their methods in the light of such conclusions as the work itself has suggested, even at its present early stage.

The special thanks of the Forest Service are due to the Hilman-Sutherland Land Company, of Jacksonville, Fla., for the disinterested cooperative arrangement under which these experiments are being carried out. It is planned to continue the work for the regular commercial period of three years.

SYSTEMATIC STUDIES OF FOREST FLORA.

REGIONAL STUDIES.

The preparation of material for a series of bulletins descriptive and illustrative of the tree species of the different regions of the United States has been undertaken. The first installment of this work will be published, when ready, under the title of "Part I. Trees of the Pacific States."

FOREST HERBARIUM.

Response to the demands for technical information about trees made by individuals and by schools, colleges, and other institutions has become a considerable part of the duties of the Dendrologist. To facilitate this work the assignment of about 1,000 of the Forestry Division's original collection of tree, seed, bark, and wood specimens was secured. This material is needed not only for reference, but also to supply models for drawings to illustrate proposed studies of the tree floras of the United States.

FOREST LIBRARY AND PHOTOGRAPHIC COLLECTION.

By a change of quarters of the forest library and the photographic collection made in November, 1904, better facilities for practical use and enlarged space for filing books and photographs were gained. Adequate room for readers, however, is still lacking. Books and pamphlets to the number of 3,851 were added during the year, bringing the forest library to a total of 8,078 volumes. This marked increase is due mainly to a large accession of books and pamphlets previously in the Department library, for which the shelves of the Forest Service did not formerly afford space.

The use of the library was markedly greater this year than last. Monthly announcements of all new forest literature received are regularly and prominently posted on the Service and library room bulletin boards. The library committee is now preparing for publication, in cooperation with the general library of the Department, a classified list of forest literature.

FOREST PHOTOGRAPHS AND LANTERN SLIDES.

The photograph collection contains 19,052 photographs, of which 5,192 were catalogued and filed during the past year—808 more pictures than were added during the previous year. The total collection comprises pictures from 43 different States and Territories and 9 foreign countries.

Lantern slides in the collection number 2,881, of which 561 were added during the year.

Duplicate photographs (mainly unmounted) to the number of 4,137 were given to 47 educational institutions, to 52 applicants for illustrations to be used in books and articles on forest subjects, and to 39 individuals who had extended assistance and courtesies to members of the Service doing field work, or were exchanged for sets of views from 4 foreign countries. Selections of lantern slides, numbering in all 1,861, were loaned for educational purposes.

As an aid to filling gaps in the collection and to prevent duplication, a map was prepared showing by counties the number of photographs already filed.

EXPOSITIONS.

The exhibit described in the last report of the Forester was displayed at the Louisiana Purchase Exposition until its close, November 1, 1904, when most of the material was safely returned to Washington. A few articles were shipped to Portland, Oreg., in anticipation of use at the Lewis and Clark Centennial Exposition; a large glass case and contents, illustrating methods of turpentining, was loaned to the museum of the College of Pharmacy, St. Louis, Mo., and all of the living trees and nursery stock, comprising the outside tree-planting exhibit, were presented to the Missouri Botanic Garden, St. Louis.

For the Lewis and Clark Centennial Exposition a practically new exhibit of the Forest Service was prepared. This was installed, together with the exhibit of the Reclamation Service, in a special Government building. Approximately 5,600 feet of floor and wall space was devoted to the forest exhibit. The two displays were planned to show clearly the direct and vital relationship between the fields of the two organizations, which, especially in the West, work hand in hand to secure, in the interest of the people at large, the wood and water resources of the country against waste and monopoly. The forest exhibit was ready and open to the public on the opening day of the exposition, June 1, 1905. The cost of preparing and installing it was approximately $7,600. Large colored and uncolored transparencies and colored bromide photographs effectively illustrated forest conditions and problems and the work of the Forest Service throughout the country. Maps, charts, instruments, models, wood specimens, and a timber-testing machine in operation were also

important parts of the display, and helped to make it altogether the most successful and instructive portrayal of the whole field of forestry and its bearing upon public and private welfare which has ever been made in the United States.

WORK OF THE ENSUING YEAR.

The experiments in methods of turpentining already outlined will be continued on the lands of the Hilman-Sutherland Land Company, in Florida. The study of basket willows will also be continued, with special reference to the effects of different kinds of soil and of its moisture content upon the quality and quantity of rods produced, and to the behavior of newly imported European willows under the influence of strange soils and acclimation. In the studies of special groups and species of trees the Monterey pine and cypress will be added to the list of little-known desert pines of California already under investigation, the promised study of *Cascara sagrada* will be begun, and the brown-wooded junipers of Texas will be taken up. The study of certain kinds of acacias and eucalypts will be continued. In the regional studies of North American trees the preparation of Part I, Trees of the Pacific States, will be pressed forward, and that of Part II, Trees of the Rocky Mountain States, will be begun.

EXPENDITURES.

The total expenditures for the year under the head of Dendrology were $15,086.44, or 3.5 per cent of the total appropriation for the Forest Service.

FOREST PRODUCTS.

During the present fiscal year it became plain that a complete reorganization of the lines of work comprised under the head of forest products was needed. In consequence of the rapid expansion of this work, the aggressiveness with which problems of great magnitude had been attacked, the multiplication of stations, the extension of field work, and the failure of the office organization to keep pace with it, the need for better control and a firmer coordination of parts became imperative. To accomplish this work Mr. William L. Hall, previously the Chief of the Office of Forest Extension, was put in charge.

The investigations in progress at the beginning of the year were chiefly of two kinds—studies of wood preservation and tests of the strength of timbers. The wood preservation studies were grouped into three sections—Eastern, Central, and Western—with a central office in St. Louis, from which they are directed. The timber-test work was conducted at Lafayette, Ind.; New Haven, Conn.; Berkeley, Cal., and Washington, D. C., and was directed from the laboratory at Lafayette, Ind. A section of dendro-chemistry was also maintained, with headquarters at St. Louis, chiefly to assist and supplement the work in wood preservation.

On January 1, 1905, the reorganization of the office began. The system of handling cooperative funds was changed entirely. Accounts were submitted for all such funds expended during the first half of the fiscal year, and all balances in the hands of the field men

were turned over to an agent of the Forest Service duly appointed to receive and disburse them, with the provision that all subsequent payments of cooperative funds must be made direct to this agent. The headquarters of the wood preservation and dendrochemical work were changed to Washington, and the three sections of wood preservation were combined.

The main energies of the office are now directed toward two ends—the finishing of much incomplete work left over from the previous year and from the early part of the present year, and the development of an adequate organization for handling the extensive and diversified work which the Forest Service must take up looking toward the economical use of wood. The present organization recognizes three sections—wood preservation, timber testing, and dendro-chemistry.

WOOD PRESERVATION.

COOPERATIVE RAILROAD WORK.

Several extensive lines of cooperative work with railroad companies, in progress at the beginning of the year, have for the most part been completed. In all cases the companies contributed to the expenses of the field work incident to the investigations.

(1) In cooperation with the Atchison, Topeka and Santa Fe Railway there was made an extensive study of seasoning and preservative treatment of tie timbers in New Mexico and Texas. The company has now adopted throughout its system the policy of preservative treatment for tie and bridge timbers. The field work with this company closed in May, and a report on the results was completed.

(2) An investigation to determine the best methods of handling and treating lodgepole pine, red fir, and western yellow pine was made in cooperation with the Chicago, Burlington and Quincy Railway. This work also was completed. It resulted in the adoption by the Burlington Railway of the policy of treating with zinc chloride all of the above-mentioned kinds of ties. A report on the results of seasoning and treating lodgepole pine was prepared.

(3) The St. Louis and San Francisco Railroad assisted in investigating methods of handling and treating red oak tie timber.

(4) With the Northern Pacific Railway an investigation of methods of handling railroad ties of red fir was made. Seasoning experiments at Tacoma and Pasco, Wash., and Sandpoint, Idaho, are still in progress.

(5) A cooperative study of methods of seasoning red oak, beech, and gum in Tennessee and Mississippi, carried on with the Illinois Central Railroad, was practically completed at the close of the fiscal year.

In cooperation with the Chicago and Northwestern Railway a series of tie-seasoning experiments with hemlock and tamarack is being conducted. This is the most carefully designed experiment in the seasoning of timber which the Forest Service has undertaken.

Other experiments on tamarack ties are being conducted in cooperation with the Wisconsin Central Railway. This work opens a large field of usefulness in the Lake States.

COOPERATIVE TELEPHONE POLE WORK.

During the past year the American Telephone and Telegraph Company and the Postal Telegraph Cable Company have assisted in work having for its object the determination of the best methods of handling and treating telephone and telegraph poles. Several hundred poles of chestnut and juniper were cut and carried through a full year of seasoning at Dover, N. J., Thorndale and Paoli, Pa., and Pisgah and Wilmington, N. C. Separate lots of these poles were then treated with several different preservatives. The treated poles, carefully numbered and labeled, have now been set in an experimental section of the line of the American Telephone and Telegraph Company between Savannah and Meldrim, Ga. Each treated pole is set between a green and a seasoned untreated pole for comparison.

Special open treating tanks were designed by the Service to permit of the treatment with creosote of 30-foot poles. So far as is known, this is the first apparatus constructed in the United States for impregnating the butts of telephone and telegraph poles. It was used with entire success.

A report on the seasoning and treating of telephone poles is now under way.

EXPERIMENTAL TREATING PLANT AT ST. LOUIS.

A special appropriation of $10,000 made it possible to carry on at the Louisiana Purchase Exposition experiments in the use of creosote as a preservative. Experiments were made to determine whether cheap and quickly grown timbers like cottonwood, willow, elm, and maple could be made durable enough for fence posts by creosoting. The treatments were made in an upright tank with heat applied direct. The work was too brief to be conclusive, but gave the best indications of success.

A second series of experiments was on loblolly pine and red oak cross-ties, to determine how these important and abundant timbers can be most economically treated. Both were found readily capable of treatment, and both, when treated, are fully satisfactory for ties. In connection with these treatments a series of tests on loblolly pine, to determine the effect on the strength of wood both of the preliminary steaming process and of the preservatives (zinc chloride and creosote) themselves, gave definite results. A complete report is to be submitted.

DENDRO-CHEMISTRY.

A large part of the work was the determination of the amount of zinc in timbers treated by the zinc chloride process. Analyses in the St. Louis laboratory of borings or sections of treated ties from all points in the field where treatments have been carried on gave most valuable results. A method of analysis was worked out which is recommended for general adoption, and a report setting forth this method was prepared.

Much attention was given during the year both to the examination of various coal-tar creosotes and to the methods of analysis for such creosotes. With the increasing use of coal-tar creosote for preserving timbers, the necessity for some standard method of determining its

character has made itself felt with increasing force. A method was developed which it is believed will be widely adopted for the analysis of coal-tar creosote, and a report upon it was prepared.

TIMBER TESTS.

The work in timber testing during the past year has progressed toward a closer relation to other work in forestry, especially toward serving the interests of conservative forest management by showing the structural value of rapid-growth timber. Progress has also been made in promoting the use of preservatives by studying their effect on the strength of timbers and in studying the means by which preserved railroad ties can be protected against the abrasive action of traffic. Other useful work has been done in determining the mechanical properties of proposed substitutes for timbers like white oak and hickory, supplies of which for vehicle construction are rapidly disappearing; in supplying data which will enable more satisfactory and more accurate rules to be drawn up for the grading of structural timber; in supplying information on the technical properties of unfamiliar woods; and in placing on a scientific basis the technique of the methods of testing timber.

The Forest Service now has a well-organized system of laboratories and a trained staff of testing engineers. As yet, however, only a beginning has been made on a few timbers, such as longleaf and loblolly pine and red fir, but the greater part of the problem has not been touched.

The work of the year may be summed up as follows:

At the Yale laboratory a bulletin entitled "The Effect of Moisture on the Strength and Stiffness of Wood" has been prepared, based upon a long series of tests. The study will serve to establish correct methods of thinking on many fundamental matters in wood technology.

The tests on red gum collected from Missouri and from Alabama were, with the exception of certain tests on air-dried material, completed, and the results were published.

At the laboratory at Berkeley, Cal., preliminary tests of the mechanical properties of red fir collected from Washington, Oregon, and from the San Francisco market, and tests of western hemlock collected from Washington and Oregon were completed. The tests of western hemlock have given this timber the right to appear in the market on its merits.

The laboratory at Washington, D. C., completed a preliminary study of the mechanical properties of loblolly pine and longleaf pine. Already the results have aided manufacturers in the introduction of these woods in foreign markets. With the tests on red fir they have been of direct service to the Isthmian Canal Commission. They are now being continued at Charleston, S. C.

These various tests produced not only figures on large sticks for structural purposes useful both to engineers and to lumbermen, but also data which will result in the formulation of rules for determining the effect of various kinds of knots and other defects, and of the various rates of growth on the strength of timber.

A preliminary publication, entitled "Progress Report on the Strength of Structural Timbers," served a useful purpose. Various

addresses and lectures were given at engineering associations and universities throughout the year. Exhibits showing the actual results of timber tests and actual test pieces of various species were prepared for the exhibit of the Forest Service at the Lewis and Clark Exposition at Portland.

A carefully planned series of tests was made to determine the relative value of various kinds of lumber for the making of boxes, in which the ability to hold nails, as well as the actual strength of the lumber, is involved. At the request of the Chief of the Philippine Bureau of Forestry, a report was prepared on the strength of four species of wood from the Philippine Islands.

Tests were made to determine the spike-holding capacity and the mechanical strength of certain specimens of *Catalpa catalpa* and *Catalpa speciosa*, and of treated red oak.

An investigation of the effect of the rate of loading upon the strength of wood is well under way at the laboratory of the Yale Forest School. It should have, when completed, nearly the same technical value as the work done by that laboratory on the moisture-strength problem.

In connection with the timber-testing plant at the Louisiana Purchase Exposition, a long series of tests was made on loblolly pine to determine the effect of steaming and of preservatives on strength.

The work of the various laboratories has included not only the collection, description, and testing of material, but the computation of the data, analysis of results, and preparation of charts to show conclusions—work which takes at least as much time as the tests themselves. The data not only serve the immediate purpose for which the tests were designed, but will form the basis of replies in a rapidly increasing correspondence from lumbermen, contractors, and engineers.

In all, 8,210 mechanical tests were made during the year, and an equal number of moisture determinations. Each test involves on the average about thirty-five measurements in addition to the description and drawing of the stick before and after the test.

ORGANIZATION AND WORK FOR THE ENSUING YEAR.

The office during the next year will comprise the four sections of lumber trade, timber tests, wood preservation, and dendro-chemistry.

LUMBER TRADE.

A section of lumber trade is being organized to study the supply, transportation, markets, and use of lumber and other forest products.

LINES OF WORK.

GRADING SPECIFICATIONS.—A preliminary study of specifications was made and the work is now being planned in detail, not so much for the purpose of suggesting modifications of present rules as to bring various specifications together for comparison by both buyers and sellers of lumber, just as has been done already in the case of log rules.

STATISTICS OF MANUFACTURE.—Heretofore a decennial census of the lumber industry has been taken by the Bureau of the Census. Congress has provided for a quinquennial census, beginning with the year 1905. There is great need for a yearly statement of the amount of lumber cut and marketed, and the Forest Service will attempt to make such a statement, beginning with the cut of the year 1905. The work will be conducted principally by correspondence, after the methods followed by the Geological Survey in obtaining yearly statistics of the mineral products. The National Lumber Manufacturers' Association and other associations will cooperate with the Service in getting and publishing the figures.

STUDIES OF WOODS FOR SPECIAL USES.—Plans are ready for the study during the present year of cooperage and box woods, vehicle and implement woods, and wooden paving blocks. Similar studies are planned upon furniture and cabinet woods, railroad ties, fence posts, and piles and poles.

TIMBER TESTS.

The testing of timbers of commercial use will be carried on by a system of laboratories, with a central laboratory and office at Lafayette, Ind., as at present, or at Washington, D. C. The proposed system embraces six laboratories, whose location and work are as follows:

PURDUE LABORATORY, LAFAYETTE, IND.—Tests of the effects of preservatives and preservative processes on the strength of loblolly pine, tests of box lumber, tests of red gum which has been air seasoning for nearly two years, the study of the methods of testing wood for their properties of resisting abrasion, the determination of the ability of various woods to resist the action of a blow, showing different classes of defects, and determination of the mechanical properties of the possible substitutes for the hard woods now used in the vehicle industry. A study will be made of the proper design for two new testing machines, the first to be a large machine of great capacity for testing the strength of posts or columns, for which now no machine exists, and the second to test the life of wood under such vibrations and repetitive stresses as come on stringers and other structural forms under the passage of a rolling or live load.

WASHINGTON LABORATORY, WASHINGTON, D. C.—Tests of loblolly pine for structural purposes, including the effect on strength of knots, air seasoning, kiln drying, rate of growth, sapwood, and age, and tests of the structural value of various hard woods of the southern Appalachians, and of the value of loblolly and shortleaf pine for cross arms.

YALE LABORATORY, NEW HAVEN, CONN.—Tests of the effect of the rate of application of a load on the strength of wood, and a study of the effect of different methods of drying on the strength of wood.

BERKELEY LABORATORY, BERKELEY, CAL.—Tests of western yellow pine as a structural timber and for telephone and telegraph poles and railroad ties, and of eucalypts, especially blue gum and red gum.

EUGENE LABORATORY, EUGENE, OREG.—Tests of various grades of red fir for structural purposes, and of cedar for telephone poles.

SEATTLE LABORATORY, SEATTLE, WASH.—Tests of western hemlock for structural purposes, and of western spruce, western hemlock, and other timbers of the North Pacific region for cross-ties and telephone poles.

At all points the organization for the timber-test work will be alert to come into touch with the consuming interests of the country, in order to promote the use of inferior timbers in the place of rare and expensive ones, the economy of material, and the general interests of forestry.

WOOD PRESERVATION.

Probably not more than 10 per cent of the ties laid for renewal in the United States are treated. Yet railroad engineers almost unanimously agree that treatments must be applied generally within the next decade. And the variations in climatic and other conditions will make it necessary to adopt different processes of treatment in different parts of the country. Evidently the time is at hand for the fullest study of the problem. The facilities now available are inadequate for a thorough study of the subject. It is therefore proposed to establish a treating plant at Washington, D. C.

The question of handling timber to secure the maximum benefits of preservative treatment includes questions like the effect of the time of year of cutting, the effect of soaking, the effect of various forms of piling, and the effect of air seasoning. It is planned to conduct experiments on poles or ties, or both, of chestnut, northern white cedar, southern white cedar, western red cedar, eastern tamarack, southern cypress, and western yellow pine.

As a part of its work in wood preservation the Service will test the effect of paints and other applications which are applied externally to wood to preserve it. Another subject of great importance is that of methods of kiln-drying lumber. The present practice is admittedly ineffectual in many cases. A preliminary study of this problem is already under way.

DENDRO-CHEMISTRY.

The dendro-chemical work which the Service has previously conducted at the laboratory of the Missouri Botanical Garden closed at the end of the year. The study of chemical problems connected with the utilization of wood products will be conducted temporarily at a laboratory at New Haven, Conn., in cooperation with the Sheffield Scientific School of Yale University. The work to be taken up has the possibility of high value, and the search for suitable woods for pulp, the study of ways to utilize the present enormous sawmill waste, the improvement of processes of wood distillation, and the analysis of wood preservatives and of treated woods will be carried forward.

In view of the open field for this work and of the dependence of the general public and business interests upon the Forest Service for the solution of these and kindred problems, there will be established in Washington during the next year a laboratory with adequate equipment to handle the work.

EXPENDITURES.

The expenditures under forest products amounted to $56,881.22, or 13¼ per cent of the total appropriation.

RECORDS.

SECTION OF ACCOUNTS AND SUPPLIES.

Upon the transfer of the forest reserves on February 1 it became necessary to appoint a special fiscal agent to be custodian of the funds derived from the sale of their products. In order to simplify the handling of this money the same officer was later made disbursing officer for the Forest Service, thus avoiding delay in the transmittal of accounts and in auditing and making payment, and reducing the amount of bookkeeping. Salary, reimbursement, and miscellaneous vouchers are now audited and paid in the Forest Service.

On February 1 arrangements were also made for the disbursement of cooperative funds, which amount to about $2,000 a month, by the special fiscal agent. The manner of handling cooperative vouchers now conforms to the fiscal regulations of the Department in every particular. A system of cost keeping was introduced to secure a complete and detailed record of the cost of each study and project undertaken, and of the cost of administering each forest reserve.

PHOTOGRAPHIC LABORATORY.

The map-copying equipment was of effective service, especially in securing maps of the forest reserves. A new map case and a system of indexing maps on file were installed. Specific instructions for taking forest photographs were furnished the members of the Service, and other steps to improve the general standard of forest views were taken.

QUARTERS.

No considerable increase in the rental of office rooms has been made during the past year. Arrangements have been made for the occupancy of three rooms on the first floor of the Atlantic Building as storage rooms for instruments, field equipment, and office supplies, which permits the loading and unloading of shipments direct to and from the property rooms.

FILES AND FILING.

The system of filing correspondence was found satisfactory both in security and in economy of operation. A fireproof vault installed in the basement of the Atlantic Building at the beginning of the year provided a convenient and safe place of storage for valuable records.

CORRESPONDENCE.

During the year 65,861 official communications were received in the Forest Service, and 61,713 were sent out.

STENOGRAPHY AND TYPEWRITING.

The concentration in this section of stenographers not assigned to offices continued to show a marked gain in the amount and character of the work done. It has resulted in developing a corps of skilled stenographers and copyists capable of meeting with promptness the various needs of the Service. During the year 1,451 items

of work were performed, involving 25,211 typewritten pages (including 3,797 pages tabulated), 43,143 mimeographed sheets, and an increased amount of miscellaneous work. In addition, 390 temporary details of stenographers were made to offices for a total of 1,960 days. The average number of stenographers and copyists assigned to this section was 14.

PUBLICATIONS.

There were issued during the year 20 new publications, with a total of 366,500 copies printed. The bulletins were: The Basket Willow; The Forests of Texas; The Forests of Hawaii; The Timber of the Edwards Plateau of Texas; Report on the Condition of Treated Timbers Laid in Texas, February, 1902; Forest Planting in Western Kansas; Chestnut in Southern Maryland; The Luquillo Forest Reserve, Porto Rico; Forest Conditions in Northern New Hampshire; Federal and State Forest Laws; and Report on an Examination of a Forest Tract in Western North Carolina. The circulars of information were: Exhibit of Tree Planting on a Model Prairie Farm at the Louisiana Purchase Exposition; Exhibit of Forest Planting in Wood Lots at the Louisiana Purchase Exposition; Exhibit of Forest Nurseries at the Louisiana Purchase Exposition; Progress Report on the Strength of Structural Timber; What Forestry Means to Representative Men; and Practical Results of the Cup and Gutter System of Turpentining. Three reprints of Yearbook articles were issued: The Attitude of Lumbermen Toward Forest Fires; The Determination of Timber Values; and Progress of Forestry in 1904. The Yearbook article Forest Planting and Farm Management will be reprinted by the Department in the form of a farmers' bulletin. There was also published the Report of the Forester for 1904. In addition, 200,000 copies of the Preliminary Report and Second Partial Report of the Public Lands Commission were printed.

During the year 28 press bulletins were issued, with a total circulation of 156,900 copies.

Reprints of 8 publications were made, to the total number of 71,000 copies.

On June 30, 1905, 9 bulletins and 1 circular were in the hands of the printer.

The mailing lists of the Service comprise: (1) A special list of libraries; (2) a list of representative newspapers; (3) a small foreign list of scientific and governmental institutions; (4) a special list of persons engaged in forest work in the United States; (5) a general list of persons interested in forestry.

The first four lists, which number 4,081 addresses, receive all publications as soon as they are available. Cards are sent to the general list giving notice of the appearance of bulletins, with brief descriptions of their contents, and to this list certain publications of general interest are sent without notice. Applications for bulletins made in response to the card notices are honored in the order of their receipt. During the year the general list was thoroughly revised, and an effort was made to increase it conservatively by including persons specially interested in forest preservation. This work will be continued during the ensuing year. The addresses on this list now number 15,197.

A large extra list of persons interested in lumbering and woodlands, farmers, educators, and professional people in various lines is now being compiled. This list will be carefully classified and will be representative of all sections of the country. It will be used to distribute material of importance to certain sections and to particular classes of people, and in general to stimulate a widespread interest in forestry.

EXPENDITURES.

The expenditures for the year under the head of Records amounted to $90,881.98, or 22 per cent of the total expenditure of the Service. In this are included large items for such general expenses as supplies, instruments, rent, and printing, which are incurred, at least in part, in the execution of productive work, not in the routine maintenance of office administration.

The expenditures of the Office of the Forester for the year, including the examination of reserve boundaries, State forest studies, publications, etc., was $121,078.16, or 28½ per cent of the appropriation.

January 12, 1907.

U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE FORESTER

FOR

1906.

BY

GIFFORD PINCHOT.

[From Annual Reports, Department of Agriculture.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1907.

CONTENTS.

REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., November 15, 1906.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1906, together with an outline of the plans for the work of the Service for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

SUMMARY.

The most important facts concerning the Forest Service during the past year were:

A marked improvement in the efficiency of the force on the forest reserves, due to the progressive education of the men in their duties and the removal of incompetent or otherwise undesirable members.

A marked increase in cooperation between office and field men and the disappearance of any divergence in their points of view and attitude toward the common work. In this all the offices of the Service have cooperated, but special mention should be made of the Office of Record.

The collection for the first time of a fee for grazing on the forest reserves. After the first protests, unavoidable but remarkably few in number, the fees were paid without friction or ill will, thanks in large part to the appointment of advisory boards by local associations of stockmen at the invitation of the Forest Service.

A remarkable increase in the amount of timber sold from the forest reserves and given away in free use, and a still more remarkable decrease in forest fires. But three-tenths of 1 per cent of the forest reserves suffered from fire during the summer of 1905.

A very striking increase in the use of the reserves by the people of the West and in their good will and support to the forest policy. Opposition to the forest reserves is substantially at an end. It has been replaced by a rapidly growing cooperation and approval.

It is due to members of the Forest Service to say that, in spite of the greatly increased responsibilities and pressure of other work which followed the transfer of the forest reserves to the care of the Forest Service, they contributed notably to the work of the assistant committees of the Committee on Department Methods.

PUBLICATION AND EDUCATION.

There was received in this section 40 manuscripts, containing, in all, 1,981 typewritten pages. Of these manuscripts 29 were sent to the printer, 3 were returned to the originating offices for forwarding to persons outside the Service, 3 were returned or withdrawn for emendation or the addition of further matter, and 5 were found unavailable for publication.

There were also prepared 17 original articles as memoranda for reports, addresses, and similar purposes.

Proofs of 38 publications, aggregating 892 printed pages, were handled.

On March 12 this section was assigned the preparation of printing requests and care of the file and record of routine printing, including the review of all forms. During the remainder of the year 255 printing requests were made out. The total number of printing requests for the year was 795.

Nine new publications were issued, with a total of 198,000 copies. Bulletins issued were: Forest Reserves in Idaho; A Working Plan for Forest Lands in Central Alabama; and Grades and Amount of Lumber Sawed from Yellow Poplar, Yellow Birch, Sugar Maple, and Beech. Of circulars of information there were issued: The Forest Service—What It Is, and How It Deals with Forest Problems; Forest Planting in the Sand-Hill Region of Nebraska; Instructions for Use of Instruments in Surveying; Revised Regulations and Instructions in Reference to Grazing; and The Use Book. Four reprints of Yearbook articles were issued: How to Grow Young Trees for Forest Planting; Waste in Logging Southern Yellow Pine; Prolonging the Life of Telephone Poles; and Progress of Forestry in 1905. Reprints of 24 bulletins, 15 circulars, and 6 Yearbook extracts were made, with a total of 191,000 copies.

On June 30, 1906, 3 bulletins and 2 circulars were in the hands of the printer.

During the year 58 press bulletins were prepared and issued, with a total circulation of 406,100 copies.

There were printed, for use in supplementing correspondence, 11 forest planting leaflets, with a total circulation of 27,000 copies. Near the close of the year a series of trade bulletins, embodying news of a technical nature, was begun.

Educational work thru addresses was greatly extended during the year, both in the number of meetings held and in the territory covered. Systematic work was carried on in Kansas, Oklahoma, and Alabama, and 23 individual meetings were addrest upon special request in 14 States and 1 Territory. Many of these addresses were illustrated by lantern slides. On several occasions a representative of the Service accompanied the "corn specials" which were run to carry exhibits of progressive farm methods.

WORK OF THE COMING YEAR.

Besides handling printing requests, reviewing all forms and other work submitted for printing, reading proofs, revising manuscripts, and preparing such occasional articles as may be required, the work of the coming year will spread information concerning our forest

resources and forest use thru making ready special publications in popular form, thru cooperation with teachers and officers of public instruction, and thru further systematization and extension of lectures and addresses.

SILVICS.

The work of the year in Silvics followed two main lines—collecting, critically examining, and systematically organizing the data already gathered by past studies of the Forest Service or accessible from other sources, and establishing permanent sample plots for gathering new data.

A knowledge of the requirements of the various species which form the forests of the United States, and of their behavior under varying conditions, is the foundation of intelligent forest management. Yet the vastness of our forested area, the wide range of climatic and other conditions, and the great number of species found make the gathering of this knowledge a huge task, which systematic study by foresters has only begun to attack. The problems of management which the care of the national forests imposes upon the Service makes the need of such knowledge urgent.

During the year data were compiled for 67 species. Their range, rate of growth, light, moisture, and soil requirements, reproduction, and behavior in pure stands and in competition with other species were among the subjects treated. At the same time notes were gathered as to the silvical conditions of 41 of the forest reserves.

Work on permanent sample plots was done chiefly on loblolly pine in South Carolina and Maryland, white pine in Massachusetts and New Hampshire, and red spruce in New Hampshire. A less amount of work was done on thinnings in chestnut coppice in mixture with white and red oak and other species in Connecticut; on yellow birch in mixture with paper birch, sugar maple, black cherry, and other species in New Hampshire, and on scrub pine in Maryland.

The study of loblolly pine in Maryland was to learn, first, what different densities of seedling stands will produce, and what constitutes a full stand; second, the effects of thinnings in even-aged stands at various stages. Separate series of plots were established in pure stands on several different soils. A few plots were taken in stands where loblolly was growing in mixture with hardwoods. The plots are in Worcester County, where the growth is rapid, where the greater part of the land is probably better suited for growing pine than for agriculture, and where much land formerly under cultivation is now going back into even-aged stands of loblolly.

The South Carolina plots deal also with the effects of fire.

The white pine plots in Massachusetts and New Hampshire will furnish data concerning thinnings in young stands, the effect of thinning upon partially suppressed trees and their ability to recover after the removal of larger trees, and thinning in an overcrowded stand of pine.

WORK OF THE COMING YEAR.

New sample plots will be laid out in the North and Middle Atlantic States. Data will be gathered concerning red spruce, balsam, white pine, and mixt hardwoods. Among the subjects of investigation will be the effect of different methods of planting, thinning, and lumbering upon the present and future forest.

LAW.

During the year highly satisfactory progress was made in the legal work of the Forest Service. Actions for trespass were better handled than before; settlements for trespass were secured in large amounts and upon conditions just both to the Government and the trespasser, and cooperation between the Forest Service and the United States district attorneys was made effective. Trespassers who refused to make adequate settlement were refused privileges upon the reserves. The general result was to reduce the number of court prosecutions and to collect damages of $39,224.96 for the year.

In a few aggravated cases suits were brought and resulted in settlements for damage, ejectment from the forest reserve, restraining injunctions, fines, and imprisonment. A supervisor in southern California was convicted for continued falsification of his accounts prior to the transfer of the forest reserves to the Department of Agriculture, and was sentenced to three years' imprisonment, with a fine of $7,000. Immediately upon the creation of the Hell Gate Forest Reserve a timber trespass was discovered and stopt, and tho the damages were settled for nearly $20,000, it is worthy of note that this trespasser has since purchased $200,000 worth of timber from the same reserve.

Thru the Section of Law the Forest Service asserted the right to charge for use of forest reserve resources, contrary to the position previously held in the Interior Department. The Attorney-General upheld this right, which is the basis for all forest-reserve receipts except those from timber, amounting to $522,306.47 during the fiscal year of 1906. This decision was and is of extreme importance.

The transfer of the forest reserves made it necessary to determine the respective jurisdictions of the Departments of the Interior and of Agriculture. After long and careful consideration it was agreed that the administration of all laws affecting the title to forest-reserve land remained with the Department of the Interior, and that of other laws, which govern the administration, protection, and use of the forest reserves, fall to the Secretary of Agriculture. The cooperation made necessary by this division of jurisdiction was conducted thru the Section of Law. A thoro study was therefore required of all the public-land laws and previous administrative regulations, and particularly of right-of-way and land claims of all kinds.

The President expressly asked both the Secretaries of Agriculture and the Interior to cooperate fully in the administration of laws affecting forest reserves. Accordingly certain modifications of policy and practise were secured to protect Government rights and interests and to give effect to the intent of Congress in its later land legislation. The following necessary and important changes followed:

(1) The acceptance of the Forester's finding of facts concerning land claims within forest reserves. (2) Definite notice to be given by the General Land Office to the Forest Service of a claimant's intention to make final proof. (3) Refusal by the General Land Office to issue final certificate or allow final entry for any land claim within a forest reserve, against which a forest officer has protested, until full hearing before the local land officers. (4) The requirement of such stipulation and bond as the Forester may demand to protect forest-reserve interests before the approval of rights of way

within forest reserves. (5) The recognition of the right of the Government to withdraw from all appropriation areas within forest reserves needed for administrative use. (6) The right of the Government to withdraw specific land from coal entry. (7) The right of the Government to withdraw for public use land already withdrawn or reserved, when the purposes of the two withdrawals are not inconsistent. (8) The principle that withdrawals for prospective forest reserves do not interfere with the use of the land, except to save the title to the Government. (9) The right of the Secretary of the Interior to investigate and determine the validity of mining locations or settlement claims, especially on forest reserves, prior to entry or application in his Department.

The Section of Law scrutinized all contracts before they past to the Forester for his signature, and constantly advised other officers of the Forest Service upon matters involving questions of law.

Many acts and joint resolutions affecting the Forest Service were past by the Fifty-ninth Congress at its first session, and approved by the President, which may be briefly summarized as follows:

Provisions of the homestead laws extended to certain lands in Yellowstone Forest Reserve (34 Stat. L., 62). Permit granted to the Edison Electric Company for power plants in the San Bernardino, San Gabriel, and Sierra Forest reserves (34 Stat. L., 163). Cutting, chipping, or boxing of trees on the public lands for turpentine forbidden (34 Stat. L., 208). Historic and prehistoric ruins, monuments, and objects of antiquity, many of them on forest reserves, protected; permits for excavation and collection (34 Stat. L., 225). Agricultural lands in forest reserves to be examined for opening under the homestead laws (34 Stat. L., 233). Lands granted to the State of Wisconsin for forestry purposes (34 Stat. L., 517). A game preserve within the Grand Canyon Forest Reserve to be designated by the President (34 Stat. L., 607). The forest reserve special fund continued until otherwise provided by law; to be expended after June 30, 1908, only in accordance with specific estimates for each succeeding fiscal year (34 Stat. L., 684). Ten per cent of receipts from forest reserves to be paid to the States for public schools and roads in the counties in which the forest reserves are situated (34 Stat. L., 684). Sales of forest-reserve timber in California made uniform with other States (34 Stat. L., 684). Exportation of timber from the forest reserves in Idaho and of dead and insect-infested timber from the Black Hills Forest Reserve authorized (34 Stat. L., 684). Refund of excess payments to depositors authorized from forest reserve special fund (34 Stat. L., 684). Purchase of law books for the Forest Service authorized (34 Stat. L., 685). Fifteen thousand dollars appropriated for fence and sheds on the Wichita Forest Reserve for a buffalo herd (34 Stat. L., 696). Five thousand dollars appropriated to enable the Secretary of the Interior to pay the expense of advertising the restoration to the public domain of lands in the forest reserves (34 Stat. L., 724). One hundred thousand dollars appropriated for continuation of the survey of public lands in the forest reserves (34 Stat. L., 728). Lands in Leadville Forest Reserve granted to the town of Tincup for cemetery purposes (34 Stat. L., 796). Granting to the city of Los Angeles rights of way for the city water supply thru the Santa Barbara, San Gabriel, and Sierra forest reserves (34 Stat. L., 801). The re-cession by the State of

California of the Yosemite Valley grant and the Mariposa Big Tree Grove accepted, and these lands included in the Yosemite National Park; certain lands excluded from the park and added to the Sierra Forest Reserve (34 Stat. L., 831). Protecting copyrighted matter in Bulletin No. 71, "Rules and specifications for the grading of lumber adopted by the various lumber manufacturing associations of the United States" (34 Stat. L., 836).

After the transfer of forest reserves to the Department of Agriculture there were increased efforts to secure rights on the reserves, both by perfecting title to the land and by obtaining special privileges and rights of way. Supervision of matters of this kind has been in the hands of a section called "Claims and Privileges," which, before the middle of the fiscal year, was, for administrative reasons, divided into two sections under the Section of Law in the Office of the Forester. On July 1, 1906, the sections of Law, Claims, and Privileges were combined to make the Office of Law.

CLAIMS.

From February 1, 1906, to the end of the fiscal year 486 claims reports were obtained from the field and transmitted to the General Land Office with recommendations.

Steps were successfully taken to secure an investigation of alleged fraudulent mining claims in the different forest reserves, in one of which an association of eight persons has located 265,000 acres under the placer mining laws. Until the validity of these locations has been determined the Forester can neither sell nor grant the free use of timber from them, while the locators are restrained by law from cutting timber except to develop the particular claim where it grows. Under these conditions the business of this locality must stagnate, for few of these claims can be worked for mineral. The Secretary of the Interior has detailed three geologists, an attorney, and a special agent to examine the validity of these locations, in cooperation with an attorney from the Section of Law.

The Section of Claims handles in the office all applications under the agricultural settlement act of June 11, 1906. Applications under this law to July 1 indicate that their number will finally reach well into the thousands. Steps were taken to examine the land as promptly as possible.

The Section of Claims furnished information to all branches of the Forest Service concerning title to lands in established or proposed forest reserves.

PRIVILEGES.

The Section of Privileges has received an ever increasing number of privilege applications. After this section was joined to the Section of Law a carefully considered effort was made to restore, as far as necessary, the policies under which privileges should be granted.

The underlying principles to be followed, set forth in the first edition of the Use Book, were:

(1) That forest reserve resources are for the use of the people and no privileges will be denied unless their exercise materially interferes with reserve interests or threatens harm to the public.

(2) That a reasonable charge should be made for all such use whenever the permit involves withdrawal of the particular resource or land from use by the people in general.

(3) The charge, however, may probably be remitted (*a*) when the use granted will result in direct benefit to the forest reserve or its administration, as with telephone lines, wagon roads, trails, etc.; (*b*) when the use is by another branch of the Government, by a State, county, or municipality, or by private individuals or associations of persons for the use of water to develop their own land and not to be sold commercially.

The basis upon which charges in connection with the use of water should be calculated was definitely determined as follows:

(1) A charge per mile for the length of the ditches, conduits, pipe lines, transmission lines, etc. This applies when no greater width is allowed than that actually necessary at any one point for the enjoyment of the privilege.

(2) A charge per acre for land actually granted for occupancy, as areas flooded by reservoirs, land for power houses, residences, hotels, fenced pastures, etc.

(3) A charge for the conservation of the water supply and the use of advantageous locations and other privileges. The water itself is granted by the State, not by the United States.

Thus, in a permit for a project to develop electricity the charge would be based upon: First, the length of the conduits, transmission lines, etc.; second, the area occupied by power houses, reservoirs, etc.; third, the conservation of the water supply and the advantageous location which makes it possible to obtain a fall to turn the waterwheel. The policy assumes that amount of water used is a proper measure of its conservation by the forest reserve, and that the horsepower developed at the wheel, since it results from the water conserved and from the fall furnished, is a proper measure of the entire conservation furnished by the Forest Service to the permittee.

During the fiscal year just ended 965 privilege applications were received. Of this number 662 were approved, 35 were rejected, and 268 were awaiting reports from the forest supervisors, either because recently received or because depth of snow prevented intelligent field examination.

The work of the Section of Law during the past year was of the utmost advantage to the Forest Service.

FOREST RESERVES.

During the past year the chief effort of the Forest Service was to increase the usefulness of the National forest reserves. Definite progress was made along the following main lines:

(1) The division of the reserves into three districts, with an officer in charge of the organization, equipment, protection, and other purely administrative matters for each district. These district officers are stationed in Washington, directly under the Forester, and act thru him. They cooperate in all matters under their charge with the various offices of the Service. The chiefs of these offices issue instructions in their own lines of work to all field officers on the forest reserves in all matters except such as require action by the Forester. To insure uniformity of action and to avoid possible conflict,

all instructions and letters from the separate offices pass over the desk of the district officer concerned. In questions involving subjects in more than one office a decision is reached thru cooperation.

(2) The organization of the inspection, both of the technical and business management of the forest reserves and of all other branches of the Forest Service. The section of inspection was not intended to reduce the actual supervision of field work by the separate offices, but to concentrate general inspection directly under the Forester. As rapidly as practicable, men who by special training and experience are fitted to inspect forest work, in one or more of its branches, were assigned to the Section of Inspection. The inspectors in no case give orders, but make themselves useful on the ground by consultation with the men whose work they inspect. They report directly to the Forester on the efficiency and integrity of the personnel.

(3) Marked improvement in all branches of forest reserve work, resulting from the assignment of specific duties upon the reserves to each office in the Service within its own field.

(4) Greatly increased responsibility laid upon reserve officers. As rapidly as possible the duties of the Washington office toward the forest reserves are being reduced to general administration, scientific investigations, inspection, and record.

(5) The publication of a second edition of The Use Book, or regulations and instructions for the use of the National forest reserves, in which the whole service cooperated. This edition shows a gratifying advance over the first edition in simplicity and the practical application of general policies to the settlement of questions on the ground, and goes far to standardize technical methods on the forest reserves. It has greatly promoted the use of the reserves.

(6) Increase in the spirit and effectiveness of the reserve force by constant intercourse between field and office, by the vigorous application of civil-service rules, by the removal of unfit members of the force, and by frequent inspection, which gives help and encouragement to local officers.

Six supervisor's meetings were held at convenient points, whose attendance included nearly all forest supervisors. At these meetings the regulations and instructions of The Use Book were fully explained, and unsettled questions arising in the local administration of the forest reserves were thoroly discust.

The total area of National forest reserves on June 30, 1905, was 85,693,422 acres. During the past fiscal year new reserves have been created, with a total area of 21,586,957 acres (including additions to existing reserves amounting to 9,163,458 acres), and eliminations were made to the extent of 281,241 acres. The total area on June 30, 1906, was therefore 106,999,138 acres.

Forest reserves, showing new reserves, additions, and eliminations, July 1, 1905, to June 30, 1906.

State.	Reserve.	Area July 1, 1905.	Changes in area by proclamations, July 1, 1905, to June 30, 1906.	
			New reserves and additions.	Eliminations.
		Acres.	*Acres.*	*Acres.*
Arizona	Tonto		1,115,200	
	Black Mesa	1,658,880	371,360	
	Prescott	423,680		
	Grand Canyon	2,307,520		
	San Francisco Mountains	1,975,310		
	Santa Rita	387,300		
	Santa Catalina	155,520		
	Mount Graham	118,600		
	Chiricahua	169,600		
	Pinal Mountains	45,760		
California	Diamond Mountains		626,724	
	Sierra	4,392,840	658,160	1,066
	Tahoe	136,335	702,502	
	Shasta		1,377,126	
	San Gabriel	555,520		125
	Yuba		524,287	
	Monterey		335,195	
	San Luis Obispo		363,350	
	Stanislaus	627,780		
	Santa Barbara	1,838,323		
	San Bernardino	737,120		
	San Jacinto	668,160		
	Trabuco Canyon	109,920		
	Warner Mountains	306,518		
	Modoc	288,218		
	Plumas	579,520		
	Trinity	1,243,042		
	Klamath	1,896,313		
	Lassen Peak	897,115		
Colorado	Holy Cross		990,720	
	La Sal		29,502	
	Fruita		7,680	
	Battlement Mesa	797,720		
	Pikes Peak	847,968		
	White River	970,880		
	San Isabel	321,227		
	Gunnison	901,270		
	Leadville	1,219,947		
	Medicine Bow	1,155,909		
	San Juan	1,437,406		
	Park Range	757,116		
	Wet Mountains	239,621		
	Cochetopah	1,133,330		
	Montezuma	576,719		
	Uncompahgre	478,111		
	South Platte	654,499		
	Plum Creek	179,200		
Idaho	Weiser	324,964	734,556	
	Bear River		415,360	
	Bitter Root	3,860,960		
	Priest River	541,160		
	Pocatello	49,920		
	Yellowstone	177,960		
	Sawtooth	1,947,520		
	Henrys Lake	798,720		
	Payette	1,460,960		
	Cassia	326,160		
Kansas	Garden City		97,280	
Montana	Madison	770,000	188,800	
	Little Belt	501,000	82,560	
	Big Belt		630,260	
	Hell Gate		1,581,120	
	Gallatin	40,320	848,340	
	Helena		782,160	
	Yellowstone	1,229,680		
	Bitter Root	691,920		
	Lewis and Clark	4,670,720		
	Highwood Mountains	45,080		
	Elkhorn	186,240		
Nebraska	North Platte		347,170	
	Niobrara	123,779		
	Dismal River	85,123		
	Tahoe		59,115	
Nevada	Ruby Mountains		423,660	
New Mexico	Gila	2,327,040	496,860	

Forest reserves, showing new reserves, additions, eliminations, etc.—Continued.

Date.	Reserve.	Area, July 1, 1905.	Changes in area by proclamations, July 1, 1905, to June 30, 1906.	
			New reserves and additions.	Eliminations.
		Acres.	*Acres.*	*Acres.*
New Mexico—Cont'd.	Portales		172,680	
	Lincoln	500,000	196,404	151,148
	Jemez		1,237,205	
	Pecos River	430,880		
Oklahoma	Wichita	57,120	3,680	
Oregon	Blue Mountains [a]	52,480	2,623,140	
	Bull Run	142,080		
	Cascade Range	4,424,440		
	Ashland	18,560	2,560	
	Wallowa	747,200		
	Wenaha	413,250		
	Chesnimnus	220,320		
	Maury Mountains	54,220		
South Dakota	Short Pine		19,040	160
	Black Hills	1,163,320		160
	Cave Hills	23,360		
	Slim Buttes	58,160		
Utah	Uinta	842,000	1,376,216	69,706
	Payson	111,600	55,680	
	Dixie		465,920	
	Sevier	357,000	353,920	
	Manti	584,640	193,280	
	Fish Lake	199,040	89,760	
	Beaver		261,593	
	La Sal		128,960	
	Vernon		68,800	
	Filmore		399,600	
	Bear River	182,080	85,840	
	Aquarius	639,000		
	Grantsville	68,960		
	Salt Lake	95,440		
Washington	Priest River	103,960		
	Mount Rainier	1,943,520		
	Olympic	1,466,880		
	Washington	3,952,840		
	Wenaha	318,400		
Wyoming	Uinta		63,632	59,036
	Yellowstone	6,580,920		
	Black Hills	46,440		
	Big Horn	1,151,680		
	Medicine Bow	418,759		
Alaska	Afognak	403,640		
	Alexander Archipelago	4,506,240		
Porto Rico	Luquillo	65,950		
Total		85,693,422	21,586,957	281,241

[a] Baker City with additions, now Blue Mountains.

On June 30, 1906, there were 82 officers in charge of 104,831,211 acres, leaving only 10 reserves, with an area of 2,168,212 acres, not yet under organized administration.

The field force on the reserves on July 1, 1905, consisted of 379 rangers, 87 guards, and 5 forest assistants (assigned as technical assistants to supervisors).

By June 30, 1906, the force was increased to 511 rangers, 247 guards, 18 forest assistants, and 30 laborers. On some of the reserves the volume of business made it necessary to give clerical assistance to the supervisor.

The important work of providing rangers with headquarters was pushed as rapidly as the funds available would permit, and in all 92 cabins were built at an average cost of $53.

Good progress was made in building trails, which greatly simplified and improved the patrol of the reserves.

A decided advance was made in establishing and marking the boundaries of reserves, in cooperation with the United States Geological Survey. This work is essential to the discovery and prevention of trespass.

The damage done by forest fires has been greatly lessened. Approximately 279,000 acres were burned over—less than three-tenths of 1 per cent of the total area of the forest reserves.

On the passage of the act, on June 11, 1906, providing for the settlement of agricultural lands in the reserves, arrangements were immediately made for the examination, as provided in the law, of the lands applied for, by a corps of men especially qualified for the work.

The examination of lands for proposed reserves and additions to and eliminations from existing reserves has gone on rapidly. More than 30 million acres were examined during the year.

INSPECTION.

The work of the Section of Inspection during the past year aided greatly in increasing the effectiveness of the reserve force, both upon existing reserves and in organizing administration upon new reserves. Forty-one reserves already under administration were thoroly inspected, and inspectors assisted greatly also in the organization of the reserve force upon 10 new reserves. The number of inspectors was increased during the year from 8 to 14.

ADMINISTRATION.

Under the new organization described above, the following reserve districts were established:

Northern District: Idaho, Montana, Wyoming, South Dakota, Minnesota.

Southern District: Utah, Colorado, New Mexico, Arizona, Nebraska, Kansas, Oklahoma.

Western District: Washington, Oregon, California, Alaska.

Of the 93 reserves in existence on July 1, 1905, 77, with a total area of 73,565,691 acres, were under administration, in charge of 54 supervisors or other officers. During the year 31,265,520 acres were placed under administration, with an increase of 28 officers in charge.

GRAZING ON THE RESERVES.

RANGE CONDITIONS.

The crop of forage on the forest reserves was better during the past season than for years before. Favorable climatic conditions resulted in an abundance of early feed, and the lamb crop was the largest reported for many years. Altho some ranges have in the past been overstocked, the large amount of feed now on the ranges will probably make unnecessary any very great reductions next spring.

The abundance of feed outside of the reserves has, in some localities, lessened the demand for forest-reserve range, and has made the settlement of controversies in new reserves easier than it would otherwise have been. Yet in the old reserves the regular users applied for permits to graze about the same number of stock as the previous year.

The control of grazing has brought a marked improvement in range conditions on a number of the reserves, and there is no longer any doubt that a large part of the forage crop which was formerly wasted by improper handling of the stock is now saved and utilized.

Range conditions in general are very satisfactory, and the stockmen are enjoying a prosperity which gives them confidence in the future.

GRAZING FEES.

The announcement that a moderate charge would be made for grazing on the reserves after January 1, 1906, roused objection in some localities. Meetings were held and petitions were presented asking for modifications in the rates, and in a few cases for the entire remission of the fee.

By firm yet considerate action on the part of the Forest Service, and with the strong support of yourself and the President, all serious conflict was avoided. Stockmen realized the benefits of a proper system of range control, and have shown willingness to bear a just portion of the expense. When the regulations were modified better to meet existing conditions and a one-half rate was given to settlers for a limited number of cattle, all active opposition to the grazing fee ceased, and it has been paid almost everywhere without complaint.

The total amount received for fees on grazing permits during the year was $514,086.74, of which about two-fifths was on account of permits for cattle and horses and three-fifths for sheep and goats.

PERMITS ISSUED.

The creation of 38 reserves available for grazing under regulation during the past season, and large additions to 14 of the old reserves, added greatly to the carrying capacity of the forest ranges. Slight increases in the number of stock were made in some of the older reserves, where the range conditions showed a marked improvement, and in others, after careful investigation, new areas were opened. In some of the newer reserves, where the range has been overstocked, reductions were made in the number allowed.

In the 92 reserves which were under administration before May 1 a total of 18,040 applications for grazing permits were approved by the forest officers in charge, and 16,593 permits were issued, as follows:

State or Territory.	Cattle and horses.			Sheep and goats.	
	Number of permits.	Number of stock for summer season.	Number of stock for year-long season.	Number of permits.	Number of stock for summer season.
Arizona	581	30,096	67,718	87	347,208
California	1,979	132,256	20,529	190	403,688
Colorado	2,774	231,060	8,605	185	420,009
Idaho	385	29,053	531	182	878,550
Kansas	16	3,245			
Montana	1,373	93,514	6,862	79	249,908
Nebraska	62	26,806	405		
New Mexico	878	10,274	53,454	234	312,035
Oklahoma	37	384	2,153		
Oregon	915	75,656	1,242	352	1,124,539
South Dakota	433	13,041			
Utah	3,376	93,255	294	888	1,148,771
Washington	512	25,520	1,209	108	282,793
Wyoming	772	85,543	2,443	195	594,699
Total	14,093	849,703	165,445	2,500	5,762,200

The total number of sheep and goats includes about 3,000,000 lambs and kids, which in the issuance of permits have been counted as equal to 1,500,000 grown animals, leaving a net number of 4,262,200 grown sheep and goats covered by permit.

Only 1,447, or 8 per cent, of the applicants failed to pay the fees and accept the permits applied for, and many of these will make payment before the close of the season. The abundance of feed outside of the reserves was one cause of the failure to use permits.

In reserves established or put under administration after May 1, all stock on the reserve ranges at the time of their creation or whose owners had regularly used the range during previous years were allowed to graze without permit during the season of 1906.

CROSSING PERMITS.

Applications were made by 244 owners or lessees of private lands within 20 of the reserves for the privilege of driving a total of 18,823 head of cattle and horses and 118,438 head of sheep across reserve lands to reach 574,397 acres of private land. In 177 cases the owners of the land made special agreements waiving the right to the exclusive use of 387,930 acres of this land, and allowing all stock permitted to graze on the reserve to enter upon it. In exchange for this concession, permits were issued allowing the number of stock the private land would support to be grazed upon the reserve free of charge.

Under the regulation allowing stock to be driven across reserve lands in transit between summer and winter ranges and to reach points of shipment, 259 permits were issued by the officers in charge of 29 reserves for the crossing of 12,696 head of cattle and horses and 693,540 head of sheep.

No permit is required for stock which is driven along the public highway or when reserve lands will not be grazed upon en route.

QUARANTINE AND LIVE-STOCK LAWS.

The Bureau of Animal Industry has required all sheep permitted to graze upon the forest reserves of Arizona, New Mexico, Colorado, Utah, and Idaho to be inspected before entering the reserves, and to be dipt when they were found to have been exposed to or infested with scab. In South Dakota this inspection was made to include cattle, and all diseased stock were debarred from entering the reserves.

In most cases stockmen willingly complied with quarantine regulations and marked improvement in health of stock has followed. Continued enforcement of strict quarantine will entirely eradicate disease from the reserve ranges.

In several of the reserves the forest officers have rendered valuable assistance to the stockmen in the enforcement of local live-stock laws, particularly as to the grade and number of bulls turned upon the range and the prevention of loss by theft.

GRAZING TRESPASS.

There has been little trespass by grazing without permit. Except where the trespass was wilful, settlement by the payment of reasonable damages has been accepted. When the trespass required exemplary action or when reasonable propositions of settlement were

rejected by the trespassers, the Department of Justice was asked to secure an injunction to prevent the stock from entering the reserve, and to bring suit for damages.

In a few of the new reserves, where the regulations were not understood or stockmen did not realize that they must be obeyed, stock which entered without permit was allowed to remain on payment of double the regular grazing fee. This method of settlement was received as fair and right. It has inflicted no serious hardship, while it has shown that the regulations must be obeyed and that forest reserve control means real protection to the range.

Occasionally stock trespassed upon closed areas or upon range to which it was not assigned. Where such trespass was wilful the permit was canceled, a portion of the stock was removed from the reserve, and the amount paid for grazing fees was forfeited.

DEPREDATIONS OF WILD ANIMALS.

The loss of cattle in Wyoming and southern New Mexico during recent years from wolves has caused much alarm. It was thought by many that the wolves were breeding in the reserves, and that the protection of game increased their number. In response to an appeal from stockmen, the Forest Service, in cooperation with the Biological Survey, is studying the habits of wolves and coyotes, the locations of their dens, and the most practical method for their extermination. It has already been found that the breeding grounds are not within the reserves, but in the foothills outside, and that they simply follow the cattle into the mountains during the summer. A large number of dens were located and steps were taken to kill both the old and the young wolves. It is confidently believed that the result of this investigation will be of great benefit to live stock interests.

LIVE STOCK ASSOCIATIONS.

Some of the live stock associations organized by western stockmen for the protection of their joint interests sought during the year official recognition of advisory boards to confer with forest officers on grazing matters. Much had already been done by the attendance of forest officers at the meetings of these associations to promote a right understanding of the purposes of forest reserves, and the benefits to be derived from their proper use. The justice of this request for recognition was seen at once, and authority for it was given by the Secretary of Agriculture on March 31, 1906. Before the end of the fiscal year, advisory boards of live stock associations in Oregon, Wyoming, and Colorado had sought and received official recognition. Thru them, satisfactory solutions of local problems, which might have led to serious difficulty, have already been reached. A marked improvement in sentiment among stockmen has followed, and the cooperation of the live stock associations with the Forest Service to secure the very best use of the reserve ranges is made certain.

FOREST MEASUREMENTS.

FOREST COMPUTATION.

The broadened activity of the Forest Service has materially increased the scope of the work of the section of forest computation, which undertakes the computation and final statement of all forest

measurements. During the year this section worked up results for 7 working plans, 7 studies of commercial trees, 2 tallies of log products, 2 reconnaissances of planting sites, 5 pole, 2 tie, and 1 cross-arm seasoning experiments, and 13 miscellaneous projects. It included the computation of 5,517 valuation surveys, 27,700 tree analyses, 3,885 seedling analyses, 1,560 stump analyses, 13,156 height and 5,750 taper measurements, graded mill tallies of 14,300 logs, weights and measurements of 3,200 poles, 6,900 ties, and 10,800 cross-arms, and 18,700 reports from manufacturers and consumers of wood, as well as the compilation of figures for the number of live stock on the reserves from approximately 16,500 grazing permits.

FOREST MAPS.

The section of forest maps is charged with the preparation of maps and drawings, and with the custody of those not needed for constant use. The work of the year included the completion of 1,128 maps, showing forest conditions of the forest reserves and of areas proposed for forest reserves, and illustrating working plans, planting plans, the distribution of trees and forests, the progress of logging, and many other subjects. Two hundred and one drawings were made, illustrative of methods, appliances, experiments, and results in many branches of forest work. One thousand seven hundred and sixty maps were mounted and 2,408 maps supplied to the field from outside sources.

FOREST MANAGEMENT.

TIMBER SALES.

In accordance with the policy which aims to satisfy every legitimate demand for the use of the forest reserves, more than five times as much timber was sold during the past fiscal year as during the previous one. The following table shows for each State the amount and value of the timber sold:

Timber sold from July 1, 1905, to June 30, 1906.

State or Territory.	Feet B. M.	Cords.	Linear feet.	Posts and poles.	Value.
Alaska	2,252,616	1,132	43,229	.....	$1,423.80
Arizona	27,596,349	5,977	.....	1,200	70,126.28
California	10,302,282	430	.....	57,600	13,170.57
Colorado	27,281,329	19,900	.....	29,913	38,531.84
Idaho	8,858,102	2,123	.....	16,407	13,381.50
Montana	53,512,895	7,072	61,012	151,119	109,560.94
New Mexico	1,024,356	8,321	38,921	7,110	3,761.10
Oklahoma	.....	3	.....	100	12.00
Oregon	438,500	291	80,000	100	710.85
South Dakota	72,951,730	29,328	.....	42,450	85,265.87
Utah	10,677,484	2,025	.....	1,100	14,715.35
Washington	1,989,500	1,997	.....	2,100	2,877.50
Wyoming	71,255,683	1,550	.....	3,850	147,408.16
Total	288,140,826	80,179	223,162	313,049	500,945.76

The time allowed for cutting was from one to five years, and much of the timber sold has not yet been cut. Receipts for timber actually cut and removed amounted to $242,668.23.

In every case the cutting of live timber under sale, or for free use, was allowed only after careful study on the ground which showed that the timber applied for could be cut without injury to the forest or the water supply, and indicated the best method of cutting to insure another growth of timber and safeguard the permanent forest cover. Applications for the purchase of reserve timber called for detailed examinations during the year of over 100,000 acres.

Only trees marked for removal by the forest officers were allowed to be cut. Contracts for the sale of timber stipulate that all brush and débris caused by logging shall be piled in openings for burning, and other precautions are taken to protect the forest from fires during logging. Complete utilization of all merchantable parts of the trees is enforced by requiring the cutting of low stumps, the sawing of logs well into the tops, and the use of all material of value for any purpose. Forms of waste such as the use of thrifty trees for skid-poles and corduroy and the destruction of promising young growth by careless felling are prevented by close supervision. Payment for timber sold is always required on the basis of the actual scale, and scaling is always done by the forest officers.

Small sales greatly outnumbered large sales. Over 100 sales each of less than 5,000,000 feet were made for every sale of more than that amount. A marked improvement took place in the prompt consideration of applications for the purchase of timber, especially in small amounts.

The largest sales were made in the lodgepole pine forest of the Rocky Mountains in Wyoming and Montana. Lodgepole pine occurs at high altitudes and in inaccessible locations, and is very largely within the forest reserves. The success with which it is being treated chemically has created a great demand for lodgepole pine ties by the railroads in the Northwest. This demand and the increased value of timber of every description has made a strong market for this tree, which but recently was considered valueless and in many localities is still so regarded. The prices of lodgepole stumpage ranged from $2 to $5 per thousand feet.

Encouraging progress was made during the year in disposing of dead and beetle-infested timber on the Black Hills Forest Reserve in South Dakota. Sales were made to the amount of 73,000,000 board feet, for which over $85,000 will be realized. The only way to control the beetle is to cut the infested trees while the insects are still in them. A special effort is being made to sell, before it decays, the large amount of timber which has already been killed.

In Colorado and Utah sales were largely confined to fire-killed timber, of which there are vast amounts in the mineral districts. The demand for dead timber comes largely from the mines, and from operators of small sawmills, which supply towns and ranches located away from the railroads.

In Arizona and New Mexico, timber was mostly sold in small quantities to mines and small mills. Twenty-five million board feet were sold at from $2.50 to $3 stumpage on the San Francisco Mountains Forest Reserve, where a very large amount of mature timber, within easy reach of railroad transportation, can be cut without injury to the forest.

In the Pacific Coast States the demand for timber has been supplied almost entirely from forests in the hands of private owners, and sales from the reserves were small.

WORKING PLANS.

The Forest Service prepares detailed working plans for the conservative use of the forest reserves as rapidly as its funds permit and trained men are available for the work. But the area for which working plans can be prepared at present is small. Every timber sale entails a careful advance examination, including an estimate of the timber, the preparation of a forest map, a description of the forest, and regulations for the conduct of the logging. So urgent and so widely scattered is the demand for timber that the resources of the Service have been absorbed in caring for these sales, and few independent working plans have been attempted.

The preparation of a working plan was begun for a large portion of the Henrys Lake Forest Reserve, in Idaho. The forest contains a very limited supply of mature timber, which is in great demand for the development of a rapidly growing agricultural community.

TIMBER TRESPASS.

Of the total of $242,668.23 received during the year from timber, $39,334.96 was collected in settlement for timber trespass. This sum was in settlement chiefly of trespass on public lands afterwards thrown into reserves. As soon as a reserve is created and placed under administration, timber trespass practically ceases.

INSPECTION.

Systematic inspection of timber sales by a corps of special inspectors was organized early in the year. The forest reserves were divided into districts and an inspector held responsible for the standard of the work in his district. Assistance and advice is given the local forest officers in initiating new sales and in the technical conduct of the cutting under current sales and free use. Inspectors report regularly to the Washington office the condition of timber-sale operations on the reserves within their districts.

COOPERATION WITH PRIVATE OWNERS.

During the past year, 99 applications were received for advice and assistance in the management of small woodlots, comprizing an area of 8,058 acres, and 61 from owners of timber tracts covering an area of 761,965 acres. These applications came from 30 States and Territories. The total area of private forest lands, in the management of which assistance has been asked, since the publication of Circular 21, is 11,717,269 acres, of which 37,326 acres is in woodlots.

During the past year examinations were made of 54 timber tracts, in 26 States, covering a total of 2,076,085 acres. Detailed working plans were recommended and begun on 11 of these tracts; on the others final reports could be and were prepared with recommendations for the conservative management and protection of the forest without making special working plans. This was a result of the knowledge of forest conditions thruout the country gathered by past work. On many of the tracts the recommendations have been already put into effect.

WOODLOTS.

Working plans based on a thoro examination on the ground were prepared for 100 woodlots, with a total area of 7,104 acres, located in 16 States. The object of this work is to give free of cost to farmers and other small owners advice and assistance in the use and improvement of their woodlands. During the past year particular study was given to woodlots in southern Michigan, Ohio, and Indiana, in continuation of the work begun the previous year. The woodlots of this region present very different problems from those of the Atlantic States. The object was to collect information enough for a publication on the problems and methods of treatment for woodlots in the Middle West.

Inspection in New England was made to ascertain whether the recommendations of previous working plans have been carried out. It was found that they had been either in whole or in part, particularly for recent plans and where trees were actually marked for thinning. Woodlot working plans are no longer made without marking trees for thinning on sample areas.

WORKING PLANS FOR TIMBER TRACTS.

In New York three working plans were prepared, two for small tracts belonging to country estates, which yielded knowledge of the rate of growth of second-growth hardwoods, and one for a tract of 100,000 acres in the northern part of the State, which included a scheme of fire protection and a plan to correct the previous wasteful logging and lax supervision. In Michigan a working plan for a tract of 8,000 acres, maintained in connection with a summer resort, provided, by a system of selection cutting and of planting on unstocked sandy areas, for a fair profit from the sale of timber combined with improved condition and appearance of the forest. A plan for a tract of virgin hardwoods on coal lands in the Southern Appalachians, in Kentucky and Virginia, provided for maintaining a supply of mining timbers, for marketing for other uses the mature timber of valuable kinds, and for reproduction of the best species after lumbering; also for planting open areas with trees which will produce valuable lumber, such as black walnut and yellow poplar, and mine props; and it indicated simple but effective methods of protection against damage from grazing and fire. Lastly, on a tract of 27,000 acres made up of small holdings of mixt pine forest in South Carolina, already heavily cut over, a study of the present and future values showed that in most cases it would pay to hold the timber rather than to cut it now.

A combined fire-protection and working plan was put into operation upon a large tract in California. It aimed to prevent fires from starting by means of patrol along a carefully laid out route. Telephone and tool stations were located to strengthen the patrol. To check fires once started and furnish bases for back firing, broad fire lines on which the slash was burned were run thru the cut-over lands. The cost of all this was about 2 cents per acre per annum.

Experiments were also made in slash burning. The character of the logging made it possible to burn the slash without piling, at a cost of only 1½ cents per thousand feet of timber logged. The plan was so successful in operation that it has been extended to all the

holdings of the company for which it was prepared. Virgin timber on the tract was marked for removal. A diameter limit of 30 inches left enough trees standing to insure a second cut.

STATE COOPERATIVE STUDIES.

Cooperation was carried on during the year with California, New Hampshire, and North Carolina.

The work in California included a commercial-tree study of white fir, a market study of the chief commercial trees, and an estimate of the North Calaveras grove of big trees. The latter was a careful estimate of the standing timber, both of sequoia and other species, on 640 acres including and surrounding the North grove.

A white-fir study in California was begun as part of a larger study undertaken by the Forest Service, in cooperation with the State, to ascertain the present uses and possible new uses of this tree. Tho not at present of great commercial value, the white fir is so abundant that to find better uses for it will greatly simplify the management of the Sierra forests. The work included a careful study of the silvics of the tree, its growth in height, diameter, and volume, its present uses, and methods for managing it on areas where it is the sole or the prevailing species. Its mechanical and physical properties will next be studied, and the possible use of the timber for pulpwood and other purposes will be determined.

A market study in California covered the most important commercial trees of the Sierras. The cost of logging, milling, and transportation in typical forest regions thruout the State was determined, the value of forest land and the cost of protection and taxes were studied, and the average cost of manufacture and the prices obtained for manufacturing lumber at important distributing points were ascertained. The results of the investigation are being prepared for publication in cooperation with the State.

In cooperation with New Hampshire a study of the forest conditions of the southern part of the State was begun. Maps were prepared showing the distribution and the composition of the forests, the percentage of forest and cleared area, and the distribution of the chief species. The study will include:

(1) A study of the silvical characteristics of all the forest trees.

(2) Volume tables, in cords and in board feet, for trees of all diameters and heights for all the commercially important species.

(3) Yield tables for second-growth white pine, showing the best-paying period for cutting.

(4) Methods of management best adapted to different conditions, based on a study of present methods of lumbering.

(5) Suggestions for a State policy for fire, taxes, and the encouragement of practical forestry.

(6) A mill-scale study, showing the actual amount and grades of lumber sawed from chestnut and white pine of different diameters.

The swamp lands belonging to the State of North Carolina were carefully examined at the request of the State, to determine the advisability of selling the timber under restrictions and holding the land. The examinations showed that it would be much better to sell the timber alone, and that by cutting to a diameter limit future crops of timber would be produced within reasonable time.

OTHER STUDIES.

At the request of the Office of Indian Affairs, thru the Secretary of the Interior, the Forest Service supervised the logging on the Wisconsin Indian Reservation. Under the direction of an agent of the Forest Service seed trees were marked on over 4,000 acres, and the slash was piled for burning and the ground cleaned up along the logging railway on all land cut over during the season.

At the request of the Secretary of War an examination was made of the timber on the Fort Wingate Military Reservation in New Mexico. The examination showed the amount of merchantable timber, chiefly western yellow pine, on the reservation and the amount which should be cut, and recommended rules for the sale and logging of the mature and overmature timber on over 23,000 acres.

The object of a tie-production study, undertaken in cooperation with the Northern Pacific Railroad, was to determine the present supply of tie timber in northwestern Wisconsin and northern Minnesota, and discover what practical steps can be taken to provide for a future supply. The investigation showed that the present supply of tie timber is limited, but that the character of the timberlands available will not at present warrant purchasing standing timber and managing it for a continued supply. Norway pine, both in rate of growth and value as a tie tree, under practical management, was shown to be the best tree for planting. It will produce ties in from fifty to sixty years, at a cost of 12 to 18 cents per tie, by planting it 8 by 8 feet on the rolling, sandy pine soils, which are unsuited to agriculture.

In cooperation with the Hydrographic Division of the United States Geological Survey the extent and character of the forested areas at the headwaters of the chief tributaries of the Potomac River and their influence on the water supply were studied. It was found that most of these streams head in well-wooded regions, where the forest conditions are satisfactory, the water-flows fairly regular, and the water itself pure. The muddiness and other impurities of the Potomac water come almost entirely from the lower courses of its tributaries, where a large percentage of the area is tilled land, and from the towns along the Potomac itself. The present objections to Potomac water will increase as the watershed is further settled and developed. Forest reserves about the headwaters of certain important tributaries and the use of the water directly from the points where it is abundant and still pure are the most practical means of solving the present difficulty.

In cooperation with the Bureaus of Chemistry and Entomology a study was made in the vicinity of Ducktown, Tenn., to determine the character and extent of damage upon the forest from the sulfur fumes produced in smelting copper. It was shown beyond a doubt that fumes from the smelters were doing great and increasing damage to vegetation.

WORK FOR THE ENSUING YEAR.

TIMBER SALES.

During the coming year the timber-sale work will be carried on along the same lines as in the past year, particular attention being given to the adjustment of prices for lumber.

Plans for disposing of timber infested by the Black-Hills beetle on the Black Hills Forest Reserve in South Dakota, already under way, will be carried out. Particular attention will be given to stopping the spread of this insect, in accordance with recommendations made by the Bureau of Entomology. In Colorado, also, where this beetle has appeared, steps will be taken to remove the insect-infested trees before the beetles can spread to green timber.

The sale of dead timber on the reserves will be pushed, and where possible it will be sold rather than green timber. Sales of mature green timber, however, will be encouraged where the timber can be removed without injury to the interests of the reserves.

COOPERATIVE.

During the coming year cooperation will be carried on with the agricultural experiment station of the State of Ohio, with a view to determining the best management of small timber tracts and the most profitable disposal of timber by small woodland owners.

Work will be carried on in cooperation with the Indiana State Experiment Station, and will be completed early in the year. The results will be of great value in the management of woodlots thruout the State.

Among others, a working plan will be prepared for a tract of 65,000 acres in Arkansas. The chief object will be to outline a plan for the continued cutting of timber and efficient protection from fire.

Inspection and assistance will also be given in the States where working plans prepared by the Forest Service are being carried out by the owners. This work has great value.

Examinations of woodlots and assistance to timberland owners will be continued as in the past.

FOREST EXTENSION.

The urgent need for the reforestation of denuded forest reserve watersheds and of the treeless reserves in the Middle West and the increasing realization that timber growing is profitable have greatly broadened the field of forest planting during the past year. The planting work of the Forest Service embraces, first, extensive nursery and planting operations on the National forest reserves, and second, cooperative assistance to landowners. The organization of the work is unchanged, except that in March the section of forest replacement was consolidated with reserve planting.

RESERVE PLANTING.

Great impetus was given to forest reserve planting by the transfer of the reserves to the Forest Service. But since most of the nurseries are new, extensive field planting has not yet been possible, and seedling production was the main work. About 493,000 trees were planted this year, and over 3,000,000 are now in the nurseries, of which at least 1,500,000 will be large enough to set out next season. Seed enough to produce 6,000,000 seedlings was planted in nursery beds last spring. The six nurseries now comprize a total of 13.15 acres, of which about 8 acres are in seed beds and the remainder is used for

transplants. The annual productive capacity of the Forest Service nurseries at present is approximately 8,000,000 trees.

The cost of the several items of nursery and planting work is encouragingly low. Except at the California stations, where the difficulties are great, the expense of growing and planting does not greatly exceed that in Germany, with its cheap labor and long experience. The average cost per thousand of the 1-year-old seedlings now in seed beds outside California is $0.81. Transplanting from seed beds to nursery rows costs an average of $1.04 per thousand, while seed sowing costs 15 cents per pound. Field planting in the reserves of southern California is very expensive as yet, because of the natural difficulties. The average cost per thousand of setting 62,000 trees on chaparral-covered watersheds in the Santa Barbara and San Gabriel forest reserves was $17.22; while on the Dismal River Reserve, where conditions favored rapid work, 319,000 trees were planted at a cost of $1.63 per thousand.

The progress of the year's work at each of the planting stations may be briefly indicated.

SAN GABRIEL FOREST RESERVE (HENNINGER'S FLAT STATION).

The working equipment was increased by the erection of a combination tool house and sleeping quarters for laborers, and by enlarging the transplant nursery 0.75 acre. The lath house, which covers approximately 0.27 acre of seed beds, was worked to its full capacity. The 336,760 seedlings it contained were transplanted to open-nursery rows during the winter, and in the spring the beds were resown with about 222 pounds of seed of 11 species. The nursery rows now contain about 387,000 trees.

During January and February 32,000 two-year-old trees were set out in the mountains. The blanks in previous plantations were filled in and small experimental plantations were made at intervals of 500 feet in altitude up to the summit of Mount Wilson. One new site was planted and an arboretum of 3,500 trees was established. The nursery and planting sites are protected by 12 miles of fire lines, built in 1905. Planting in the San Gabriel Reserve must remain a difficult and expensive operation, yet the cost was reduced to $15.82 per thousand trees, a reduction of $29.34 over last year.

Approximately 30 per cent of the trees set out this year have been eaten off by rabbits and a remedy applicable on a large scale has not been found. A careful study of the situation has been asked of the Biological Survey.

Besides furnishing plant material for local use, the Henninger's Flat nursery supplied 30,000 trees for planting in the Santa Barbara Reserve, 3,100 for Griffith Park, Los Angeles, and 11,900 for planting by individuals on watersheds within forest reserves or for experimental purposes.

DISMAL RIVER FOREST RESERVE (HALSEY STATION).

The Halsey station is producing trees for extensive forest planting on nonagricultural lands in the Middle West. An additional acre of lath house was built, about 0.5 acre was set out to transplants, and 1.5 acres of open seed beds were sown with broadleaf species. The nurs-

ery now covers 5.5 acres, with 3.5 acres under lath, contains 1,680,000 trees, nearly two-thirds of which will be ready to set in the field next year, and has an annual productive capacity of about 3,000,000 trees. About 540 pounds of seed were sown during May and early June. A hand seed drill reduced the cost of sowing to 5 cents per pound.

Field planting was somewhat curtailed to allow the nursery stock to attain larger size. Previous losses were largely due to the use of too small plant material, and in the future only selected stock 2 or 3 years old will be planted. About 319,000 two-year old seedlings, 93 per cent of which were western yellow pine, were set out.

A total of 154,000 trees was shipped from Halsey for planting elsewhere, including 30,000 sent to Helena, Mont., for use in Helena Forest Park, and 50,000 furnished to the Reclamation Service for planting along the interstate canal in Wyoming and Nebraska.

PIKES PEAK FOREST RESERVE (CLYDE AND BEAR CREEK STATIONS).

The Rosemont nursery site, established in 1904, will be abandoned, leaving Clyde and Bear Creek as permanent stations. At the Clyde nursery the half acre under lath contained about 410,000 seedlings when spring opened. Since seed sowing in 1905 was delayed until July, awaiting the completion of the lath house and water system, the seedlings were too young to withstand well the severe winter. The beds which failed wholly or in part were resown.

To secure a lower elevation and a longer growing season, an additional half acre of seed beds on a 1.8-acre nursery site was prepared and sown in Bear Creek Canyon, and a water system was installed.

Since the seedlings in the Clyde nursery were not old enough to set in the mountains, 20,000 red fir seedlings were shipped from the Halsey nursery. They were planted in two sites under good weather conditions, and promise to grow with slight loss.

Altho the high elevation and rough slopes in the Pikes Peak Forest Reserve make difficult conditions, there is every indication of ultimate success. Several important watersheds need planting, and the work is supported by public sentiment.

SANTA BARBARA FOREST RESERVE (SAN MARCOS STATION).

The nursery, which was established in San Marcos Pass in the spring of 1905, contains 181,000 one-year-old seedlings in transplant beds. The 5,760 square feet of beds under lath from which the transplants were removed were resown with 127 pounds of seed, mainly knobcone, Jeffrey, and gray pine.

The first field planting in this reserve was done this year, with 30,000 two-year-old seedlings from the Henninger's Flat nursery. The sites selected were at elevations varying from 1,400 to 3,500 feet. Two and one-half months after the trees were planted over 95 per cent were in good condition.

GILA FOREST RESERVE (FORT BAYARD STATION).

The half acre of seed beds sown in July, 1905, produced about 385,000 seedlings, 300,000 of which were transplanted to nursery rows. The beds were resown this spring with 15 species, to give a thoro test of southern California conifers and of native trees.

The work at the Fort Bayard station aims to reforest 7,000 acres in the military reservation, as well as to improve reserve catchment basins. The War Department, in December, 1905, granted the use of 275 acres in the northern part of the reservation, on which a transplant nursery of 1.4 acres has been prepared and an adobe station building is under erection.

None of the seedlings in the local nursery were large enough to be set out this year, but 425 conifers were shipped in and field sowing was tried with Mexican walnut and three native oaks on 48 plats, aggregating 13.4 acres.

SALT LAKE FOREST RESERVE (WASATCH STATION).

This station was established last spring in Big Cottonwood Canyon, near large areas in urgent need of reforestation. The nursery site contains about 4 acres, one-half acre of which was covered with a lath house and devoted to seed beds. Good planting sites and the high value of water in Cottonwood Creek make forest planting on this catchment basin promising and important.

GARDEN CITY FOREST RESERVE.

In May 51,000 western yellow pine from the Halsey nursery, and 40,000 red cedar, Osage orange, Russian mulberry, and honey locust, purchased from dealers, were planted in four strips across one quarter section. Experiments to learn whether cultivation is necessary will be carried on during the summer.

BLACK HILLS FOREST RESERVE.

In the Custer Peak region the experimental broadcast sowing of western yellow pine seed in May, 1905, had produced in October an average stand of about 12,000 seedlings per acre. Last spring an additional 500 pounds was sown in the same region, part on the late melting snows and part on the bare ground immediately after the snow had melted. If continued success follows this work it will be possible to reforest the denuded portions of the Black Hills Forest Reserve rapidly and at a very low cost.

WICHITA GAME RESERVE.

The first planting in this reserve was undertaken this spring on an experimental scale, with 1,000 western yellow pine seedlings from the Halsey nursery. A report from the supervisor, late in May, stated that every one was growing.

SEED COLLECTING.

Most of the seed needed in the various nurseries was collected locally. For the Halsey station it was necessary to collect jack pine in Minnesota and western yellow pine in the Black Hills and western Nebraska.

Over 4,500 pounds of seed was on hand at the planting stations on January 1, part of which was collected in 1903 and 1904. Of the 15 species represented, about 2,200 pounds was yellow pine, gathered at a cost of only 33 cents per pound.

Since most of the trees used in reserve planting bear full seed crops only at intervals of from two to seven years, surplus seed must be stored. Storage tests to determine how best to preserve the germinative energy were begun at five of the stations and at Washington.

A series of tests on the vitality, germinative energy, weight, volume, and purity of 27 species of pine seeds was carried on in cooperation with the Seed Testing Laboratory of the Department.

RECONNAISSANCE.

Extensive preliminary examinations for reserve planting plans were finished during the year in the Lewis and Clark, Modoc and Warner mountains, Cassia, Malad, Salt Lake, Gunnison, and Gila forest reserves. Favorable openings were found in the Salt Lake Reserve, where a nursery has since been established; in the Malad Division of the Bear River Forest Reserve, and in the Gila Forest Reserve.

Planting for the improvement of city watersheds located within forest reserves is an urgent duty of the Forest Service. A preliminary reconnaissance was made on reserves in the Southwest, and examinations were completed of the water systems of Pueblo, Colorado Springs, Denver, Boulder, Longmont, Loveland, Fort Collins, and Greeley, Colo.

OFFICE WORK.

A plan was devised and adopted for indexing in condensed form the data on nursery work and planting for each reserve. The essential data of former planting station reports were transferred to cards indexed under subjects and years.

COOPERATIVE PLANTING.

The cooperative work was continued under the general provisions of a revised edition of Circular 22. An entirely new outline for planting-plan studies and reports was adopted.

As a rule planting plans were made without charge for small landowners, public and educational institutions, and Departments of the Federal Government. For large private holdings the preliminary examination was made free, but the field expenses of the detail plan was charged to the cooperator, as was the cost of supervising the execution of the plans.

A set of index cards was compiled giving data on 1,325 forest plantations in 26 States, and another giving notes on seed production, seed preservation, germination percentage, methods of propagation, etc., for 72 species. Incomplete data on 49 additional species are also filed.

PLANTING PLANS.

During the fiscal year there were made 33 detailed plans for planting on 10,233 acres in 19 States, 5 preliminary examinations, covering 103,895 acres, where planting was not recommended, and 6 examinations, covering 212,660 acres, where planting plans were advised, but action is still pending. In North Carolina a plan for fire protection was prepared for a tract of 1,200 acres. There are 34 applications now on file for lands aggregating 13,711 acres.

The request made for supervision of nursery and planting operations show that the planting plans are being carried into execution. Such work was done this spring for 11 cooperators, including the Reclamation Service, two coal and coke companies, two railroads, two cities, and a city water company.

Cooperative funds to the amount of $2,267.50 were received during the year from 17 landowners for use in preparing planting plans or supervising their execution.

PRESENT STATUS OF COOPERATIVE PLANTING.

During the past year large landowners, especially railroads and coal companies, have shown a marked tendency to undertake forest planting on a commercial basis. Their motives are purely economic and arise from the increasing difficulty of getting ties and construction timbers, even at high prices, and from a desire to utilize and improve their lands.

At least 11 railroad companies are directly interested in procuring a future wood supply and have actually begun forest work. Examinations were made of 18 railroad plantations in Virginia, Kentucky, Illinois, Indiana, Michigan, and Pennsylvania, and of a tract in Virginia on which planting was contemplated. For the Illinois Central Railroad a planting plan was made for lands in Iowa, and improvement cuttings in their catalpa plantations in Louisiana and Illinois were supervised. The Union Pacific Railroad entered into an agreement and provided funds for an examination of certain of their holdings to learn the advisability of forest planting for tie production. The Pennsylvania Railroad paid the cost of an investigation to lay down a future forest policy, which will insure a permanent tie supply for their lines east of Pittsburg. This work included a study of their present holdings and the preparation of a planting plan for various tracts in Pennsylvania. The Baltimore and Ohio, Santa Fe, and New York Central railroads will take up forest planting in the near future, and an application is on file from the Long Island Railroad for an examination of its waste lands.

Planting plans made for two coal and coke companies in western Pennsylvania last summer were carried into execution under Service supervision this spring. The field work for a planting plan on a 36,000-acre watershed in eastern Pennsylvania, owned by a coal company, was started in June. Another large eastern coal company is expected to apply for assistance in planting their waste lands as the result of a preliminary examination in November. The report made after the examination was published in full by the company.

For the improvement of city watersheds cooperative assistance was rendered to the Johnstown Water Company, in Pennsylvania, and to the Bridgeport Hydraulic Company and East Hartford Fire District in Connecticut. In southern California plans were prepared for planting four tracts where watershed improvement was one of the prime objects. The plans for city forest parks for Helena, Mont., and Los Angeles, Cal., were carried into effect under the direction of the Service.

Increased assistance was given to other branches of the Federal Government. Planting plans were made during the year for portions of the Fort Bayard, Fort Riley, and Fort Stanton military reserva-

tions, together with an examination of the reservations around San Francisco to learn the advisability of planting. In Vermont a planting plan was prepared for lands around a station of the Bureau of Fisheries. For the Reclamation Service recommendations were made for planting along the interstate canal in Wyoming and Nebraska, and around the reservoir and along the canals of the Salt River project, Arizona. Planting along the interstate canal was begun in May with 50,000 trees from the Halsey nursery.

To aid settlers in newly irrigated regions, forest-planting investigations were started in the North Platte and Truckee-Carson projects. These studies will also cover the questions of planting for the protection of Government canals and on waste lands. In North Dakota recommendations for handling certain timberlands on the Buford, Trenton, Williston, and Nesson irrigation projects were prepared for the State engineer.

Farmers have been given all possible assistance. Planting plans were made as formerly, and much effective work was done thru lectures at farmers' institutes. A lecture at Amarillo, Tex., was followed by the formation of a tree-planting association with about 600 members, who have already set out about 200,000 trees, under advice from the Service, and will set out many more.

SPECIAL INVESTIGATIONS.

The possibilities of forest planting on coal lands were studied in the upper Ohio Basin, with special reference to black locust and the danger of damage by borers. Such planting promises to be profitable, but the use of locust was found unsafe unless the trees are cut for posts when small, or methods are found and applied which will insure control of the insect pest.

A study of planted and natural timber in Iowa was finished.

The following investigations were a part of the State cooperative work in California:

(1) Study of forest planting in agricultural regions. The nearly completed work will cover the field of forest planting for protection and wood supply in the agricultural valleys.

(2) The relation of forest cover to stream flow. The importance of water for power and irrigation in California led to this investigation, in which many valuable observations were made.

(3) Study of State lands. This work was entirely completed during the year. The report, as submitted to the California State Board of Forestry, gives information on the location and extent of the State forest lands, with recommendations for legislative action.

(4) Study of the silvical characteristics and methods of propagation of eucalyptus. This was undertaken because of the newly appreciated value of eucalyptus for posts, telephone poles, piling, and ties.

COOPERATIVE EXPERIMENTAL PLANTING.

In various regions more exact knowledge is needed as to the effect upon species of soil and climate, the adaptability of new species to planting, and the best silvicultural methods. To secure this the Forest Service will carry on systematic experiments in cooperation with various colleges and State forest commissions. The cooperators in all cases furnish the land free and the expenses for plant material and labor are divided equally. This work is now under way in

cooperation with Berea College, Kentucky, the New York Forest, Fish, and Game Commission, the University of Michigan, the Michigan Forestry Association, the Iowa State Agricultural College, the University of Nebraska, the North Dakota Agricultural College, and the Mississippi Agricultural College.

PLANTING LEAFLETS AND ADDRESSES.

The planting leaflets for use in correspondence now number 36 for single species and 12 on general subjects, such as how to transplant forest trees, fence-post timbers, etc. The mimeographed sheets giving lists of dealers and range of prices for plant material, which are used as supplements to the leaflets, were brought up to date. The total number now available is 41.

Information on farm forestry was disseminated in the West by means of farmers' institute lectures. A Forest Service representative accompanied institute parties on extensive trips thru eastern and western Colorado and parts of Nebraska. Lectures were also delivered before various farmers' meetings in Iowa, Texas, and Mississippi. Addresses on special forest topics were given at public meetings in Illinois, North Carolina, Georgia, Maryland, Vermont, Kansas, Colorado, New Mexico, and California. At the Iowa State Agricultural College, the University of Nebraska, and the Mississippi Agricultural College, technical Service men are furloughed during the winter to give instruction in forestry.

WORK FOR THE ENSUING YEAR.

COOPERATIVE PLANTING.

The preparation of planting plans will be continued under a somewhat revised plan. Small landowners, public and educational institutions, and branches of the Federal Government will be given gratuitous or cooperative aid as in the past. Corporations and large landowners, however, will be called upon to pay all the expenses, unless the work is of high educational value. It will be the aim to get in closer touch with the farm thru farmers' associations and farmers' institutes. Special investigations will be limited to fields where immediate practical results will accrue. The most important work of this kind under way is a forest-planting reconnaissance in reclamation projects. Other important tasks are the improvement of city watersheds in the East and an investigation of artificial methods of timber propagation in the South.

Experimental planting will be continued in cooperation with State forest commissions and colleges, and begun on the areas withdrawn for this purpose within reclamation projects.

RESERVE PLANTING.

The present reserve planting stations will be made more permanent by the erection of suitable station houses, and the productive capacity of the nurseries will be increased where advisable. New stations will be established as required, and small nurseries under the charge of the reserve officers will be started wherever plant material is needed for local use. The investigation of city watersheds within forest

reserves should lead to several new nurseries and to extensive planting by the rangers under technical supervision. The new plantations will demand complete fire protection, which will be planned for by technical men and executed by the reserve officers.

Planting on all the treeless reserves in the Middle West should be started next spring with plant material from the Halsey nursery. The Niobrara, North Platte, and Portales reserves need large experimental plantations to determine whether local nurseries are called for. In the Black Hills Forest Reserve broadcast sowing will be conducted on a larger scale if it continues to give promising results. A large quantity of tree seed for use at the planting stations will be collected again this fall.

DENDROLOGY.

A large correspondence is entailed by requests for technical information, especially as to the distinguishing characters of tree species, native and foreign, and their economic products. Many identifications of wood, seed, and other specimens of native and foreign trees are called for by individuals and educational institutions, and especially by builders, architects, and engineers, in consequence of the frequent substitution on the market of inferior woods for standard building materials. In all, 3,366 letters were prepared on dendrology.

TURPENTINE INVESTIGATIONS.

Experiments were continued during the turpentine season of 1905 to discover the effects of different methods of chipping on the yield and on the life of the trees. Final results in such experiments require data for several years, but the indications are that by chipping a "streak" half as deep and half as high as in the present practise an equal or greater yield of turpentine per year can be obtained, and the working period can be doubled.

Experiments to compare the results of the present method of working and one under which only trees over 10 inches in diameter are chipped with fewer "faces" showed that over 20 per cent more turpentine was obtained from the latter method. If these results are confirmed they will lead to a radical change of method, under which a tract may be worked indefinitely. At present turpentining lasts for but three or four years and virtually destroys the forest.

A chemical study of the distinguishing characteristics of turpentines from different species of pines was begun in cooperation with the University of North Carolina. Commercial turpentine is distilled without distinction from the resins of longleaf, Cuban, shortleaf, loblolly, and pond pines, tho mainly from the first two. The products of these several species differ chemically and otherwise, which doubtless explains past failures to find a method for detecting adulterated spirits. The study will throw light on this matter, but is expected to be chiefly valuable by showing which of the species now worked (and possibly, also, new species) yield turpentine in paying quantities, and which yields the most. This is important in forest management, to determine which species should

be favored in the future forest. Already it has been shown that loblolly and shortleaf, believed by many operators not to yield turpentine, equal the yield of longleaf. The experiments include tests, also, of the resins of Virginia ("scrub") and western yellow pine.

FOREST DISTRIBUTION AND RESOURCES.

Studies of the forests of five Maryland counties, in cooperation with the State geological survey, were completed and will be published by the survey. The study of one other county is in progress. A silvical study of the "Big Thicket" region of south-central Texas was completed, and one of the brown-wooded cedar forests of Texas is under way. Information was furnished the Canadian geological survey as to the range in the United States of commercially important Canadian trees. A report on the identification and uses of American woods was prepared.

BASKET WILLOWS.

The basket-willow holts now contain 25,000 vigorous stools. Some 200,000 green rods were cut from them in February and yielded 1,400 pounds of basket stock as good as the finest imported rods, together with 5,000 choice cuttings for extending the plantation, and 12,000 for free distribution.

Manufacturers have studied the methods by which rods equal to the best imported stock were grown at home, and in some cases are preparing to establish holts of their own, while numbers of small producers have been led to enter the field of willow production.

Samples of bark from the different varieties of willow under experiment were analyzed for the Forest Service by the Bureau of Chemistry, and it was found that the purple and almond willows yield 8.73 and 11.39 per cent of tannin, respectively, or about the same as the standard tanbark oaks. Other willow barks gave results sufficient to justify their use. The bark from next year's crop will be analyzed to determine, also, its production of salicine.

The experiments have yielded valuable information as to cultural methods, which will be published.

TREES OF THE PACIFIC STATES.

Progress was made in preparing for publication the first of the regional studies promised, the "Trees of the Pacific States." It will tell in untechnical language how to identify the species, where they are found, and what their silvical characteristics are. It is much needed by the local forest officers and the general public.

The revision of Bulletin 17, "Check List of Trees of the United States," has made progress.

The collection of wood specimens, preparatory to the work on the identification of woods of the United States, was begun. It will meet the actual needs of wood users, who are now sometimes imposed upon by material falsely named.

Great confusion now exists in distinguishing the various species and varieties of catalpa grown for timber, to the frequent injury of

the buyer of seed or stock. A circular is being prepared which will set forth the distinguishing marks and safeguard the planter.

CARE OF STREET AND PARK TREES.

Many demands for advice in caring for shade trees are made upon the Service. In the absence of any satisfactory treatise on the subject, material for an illustrated circular dealing with it is being collected. Examples of correct methods are now furnished by trees in Washington, D. C., which have been cared for under the advice of the Service.

An offer of assistance to cities in naming and labeling their trees brought a number of requests for this help. The city of Richmond asked and received an examination of its trees and recommendations for their care.

FOREST HERBARIUM.

This collection contains specimens of typical foliage, fruits, seeds, bark, and wood of approximately 400 of the 645 native species, and 150 foreign trees, or about 3,500 specimens altogether, besides a collection of 1,000 thin sections of foreign woods. Special effort is being put forth to make the collection of our native forest trees complete. The National Herbarium relies upon this office for tree identifications, and the Service herbarium is considered a part of the National Museum collection. It is widely and constantly used by members of the Service.

FOREST LIBRARY.

The forest library contains 9,291 books and pamphlets, of which 1,213 were added during the year. One hundred and seventeen volumes were bound. Plans for extending the use of the library to field officers are under way. The headquarters of 84 field officers will be supplied with bound copies of all Service publications likely to be of use, and of certain other standard forest books.

There was a notably increased use of the library by members of the Service this year. The library committee, in cooperation with the Librarian of the Department of Agriculture, completed a classified catalog of forest literature, including the literature of important auxiliary sciences accessible in the library of the Department. The whole presents a concise view of forest and related literature prepared for persons not trained in forestry. Constant requests received for lists of works on forestry suitable for general library and educational use show the need for such a publication.

FOREST PHOTOGRAPHIC COLLECTION.

The Service now has 24,462 mounted photographs, including 1,600 from foreign countries, of which 5,410 were cataloged and filed during the year, and 935 unmounted pictures. They are from 53 States and Territories and insular possessions, and 26 foreign countries. They are indexed by States, countries, and subjects, and are also platted by symbols on a map to show what regions they cover and to indicate where additions are most needed.

During the year 1,677 unmounted photographic prints were given away in response to requests from 28 different States, chiefly to 51 educational institutions and for illustrating 57 books and articles on forestry. Two hundred and ninety-seven prints were received by exchange.

One hundred and fourteen prints, 209 slides, 23 transparencies, and 8 bromide enlargements were sold.

The lantern-slide collection contains 3,581 slides, 700 of which were added during the year. One thousand slides and 31 transparencies were colored this year. The colored slides made by the Forest Service greatly surpass in truthfulness any others known to us.

Loans of 2,355 lantern slides were made for educational use to 56 applicants from 26 different States, as against 1,861 last year.

EXPOSITIONS.

The exhibit made by the Forest Service at the Lewis and Clark Exposition was closed October 15, 1905, and the material returned to Washington.

About 200 transparencies and bromide enlargements were sent to the New England Forest, Fish and Game Exhibit at Boston, Mass., beginning December 27, 1905.

WORK FOR THE ENSUING YEAR.

It is planned to continue for the regular period of three years during which a turpentine crop is worked, the study begun in 1905–6 of the effects of shallow and deep chipping and varying width of faces on the flow of resin and the life of the trees.

Much inquiry has been received from Western timberland owners as to the possibility of turpentining Western pitch pines. An investigation of this question will be undertaken. A study of the characteristics of turpentines will be continued. One result will be to show that untried pines may be profitably worked for commercial turpentine.

In connection with the experiments in basket willow growing already under way, an attempt will be made to ascertain whether, by the use of European stock, strains superior to any now grown here can be made available.

Special studies of various forest tree species and of forest types and their distribution will seek more accurate knowledge and data for mapping our forests and for regional manuals.

FOREST PRODUCTS.

The year has been marked by a higher standard of efficiency, combined with simpler and less laborious methods. The work is classified under the four sections of Wood Preservation, Dendro-Chemistry, Timber Tests, and Lumber Trade.

WOOD PRESERVATION.

The importance of preservative treatment of wood—railroad ties, mine timbers, telephone and telegraph poles, cross-arms, piles, fence posts, and even shingles and other forms exposed to rapid decay—

now receives marked and growing recognition. Treating plants are multiplying, and new methods and processes are being taken up. In this work the Forest Service has become a recognized source of aid and information.

The study of fence-post treatment with creosote in open tanks was carried further by experiments in southern California with eucalyptus, and in Iowa, in cooperation with the State college, with rapid-growth hardwood posts.

The seasoning of red fir, western hemlock, and western larch railroad ties in Washington and Idaho, in cooperation with the Northern Pacific Railway, is now finished, and the seasoned ties, part of which have been treated, are ready to be laid in the track for a durability test.

Seasoning and treating experiments with hemlock and tamarack ties in Michigan, in cooperation with the Chicago and Northwestern and Wisconsin Central railways, have shown that seasoning before treatment is highly advantageous. These experiments, which include tests of the effect of soaking before seasoning, will be continued for the coming year.

Arborvitæ and chestnut telephone poles, cut each month of the year, are now seasoning in Michigan and Maryland, respectively. In the latter State a soaking test is included. When seasoned, part of these poles will be treated and their comparative durability tested in service alongside of untreated and unseasoned poles. At Norfolk, Va., loblolly pine cross arms, cut each month, are undergoing experiment in soaking, seasoning, and grading preliminary to treatment. The importance of grading as the proportion of sapwood varies has been demonstrated. Both these classes of experiments are conducted in cooperation with the American Telephone and Telegraph and the Postal Telegraph-Cable companies.

A cooperative study of seasoning and treating poles and ties of California western yellow pine, western red cedar, and eucalyptus, and a similar study of loblolly pine mining timber used in Pennsylvania, were begun. The latter has already shown that timber should be peeled and seasoned for at least two months before shipment, and that open-tank treatment gives remarkably complete penetration of the preservative.

Addresses were given before the annual meetings of the Wood Preservers' Association, the American Railway Engineers and Maintenance of Way Association, and the North Carolina Pine Association.

The Forest Service does no work in wood preservation except in cooperation with those interested in the results. Every project has been subjected to careful and frequent inspection. The cost of the investigations are borne mainly, and in new work must be met almost entirely, by the cooperators, but the results are for the public use and are controlled by the Service, which seeks only the solution of problems of broad and general importance.

DENDRO-CHEMISTRY.

During the study of Michigan hemlock and tamarack ties, already mentioned, there were made chemical analyses resulting in over 580 zinc estimations, to discover the penetration of zinc chlorid, and microscopic examinations and measurements to learn the value of glue

tannin in treatment. A field test of the strength of zinc chlorid solution was devised, and preliminary work was done on the methods of analyzing and extracting creosote. This included the devising of a new method of estimating tar acids, comparative distillations, and tests to determine the best solvent for extracting creosote from treated timbers. A study of wood distillation, begun during the year, promises a new means of utilizing much of the present waste in lumbering.

A pulp-testing laboratory was installed at Boston, Mass., to investigate the paper-making possibilities of woods hitherto unused for pulp, especially of certain species abundantly supplied by the forest reserves. An anti-stain process of treating white pine sapwood in Michigan was investigated and found effective with proper piling.

TIMBER TESTS.

In all 12,033 mechanical tests were made, and as many moisture determinations, as against 8,210 last year. Each test involved an average of 35 measurements, a description and sketch of the stick before and again after the test, and the necessary computations and drawings. The tests were made at the various laboratories as follows: Yale, 1,856; Charleston, 190; Berkeley, 2,496; Purdue, 6,156; Portland, 259; Eugene, 872; Seattle, 204.

Tests were completed during the year upon loblolly pine to show the influence of sapwood and knots on the strength of structural timber; on red fir (in cooperation with the University of California); on Minnesota tamarack and Norway pine in large and small pieces; on the holding force of railroad spikes in treated and untreated loblolly pine and white and red oak; on the effect of preservative treatment on loblolly pine; on strength as affected by the speed at which a load is applied; and on the influence of defects upon loblolly pine harvester poles, which led to improved specifications.

There are still in progress tests of the strength of California eucalypts (in cooperation with the State of California) to learn whether the wood can be used in place of such structural timbers as hickory and oak; of the strength of red fir as modified by knots and other defects, rate of growth, and sapwood; of western hemlock from various localities of the Northwest, including Alaska, and of untried woods from the forest reserves; of the effect upon strength of various methods of seasoning; of the bending of beams under constant loads for long periods; of the behavior under a blow of buggy spokes, axles, and wagon tongues; of resistance of street-paving woods to abrasion, indentation, and water absorption (in cooperation with the Office of Public Roads); of the bearing value of different forms of washers on wood stringers, and of the relative strength of live oak and black locust insulator pins.

Reports submitted for publication and now in press were: "Instructions to engineers of timber tests," "Effect of moisture on the strength and stiffness of wood," and "Experiments on the strength of treated timber." Reports were also prepared on the strength of various woods in the form of boxes, the strength of Philippine woods, the strength of timber treated by a nonsteaming process, the strength of loblolly and pitch-pine mine props, the strength of common and hardy catalpa, and the strength of African yew and red cedar.

Addresses were given before the Western Society of Engineers, the Engineering Congress at the Lewis and Clark Exposition, American Railway Engineering and Maintenance of Way Association, American Society for Testing Materials, American Car Builders' Association, National Advisory Board on Tests of Field and Structural Materials, and before Purdue University and the University of Illinois.

The Advisory Board on Tests of Fuels and Structural Materials, appointed by the President during the year, considered and approved the general plan of the timber tests conducted by the Forest Service.

The year fully demonstrated the need of a wood-testing laboratory. Such a laboratory will benefit the wood users of almost every class. A strong tendency to reform the traditional methods of handling and judging wood as a material, and to put commercial standards upon the more accurate basis of actual test is widespread. Plans have been drawn for a laboratory providing for tests along the three lines of preservative treatment of timber, the strength of wood and wooden materials, and the chemical problem of wood utilization.

LUMBER TRADE.

The Section of Lumber Trade was organized during the year. Its work has been of peculiar value both in giving the Forest Service systematic touch with large classes of wood users whose problems have not in the past been considered by the Forester and in enabling foresters to gain a thoroly practical idea of the problems confronting the makers and users of forest products. The manufacturers of lumber and other forest products have been brought to realize more fully than ever before the possibilities of direct practical usefulness to them of the Forest Service. At all meetings of associations of wood users attended by members of the Service committees on forestry were appointed to further the work of the Service. Real progress is being made in promoting the most economical utilization of the forest products of this country.

With the aid of the National Lumber Manufacturers' Association the hearty cooperation of the secretaries of the leading associations of lumber manufacturers was secured early in the year in an effort to collect statistics of the annual production of lumber and other forest products, beginning with 1905. These statistics cover lumber, lath, shingles, slack and tight cooperage stock, pulp wood, cross-ties, tan bark, veneer stock, mine timbers, wood distillates, and other products. The reports upon mining timbers were secured thru cooperation with the Geological Survey. The statistical work has aroused great interest among the lumbermen, and is of distinct value to them, as to the Forest Service.

The principal grading rules of lumber manufacturers in the United States have been compiled. To bring them together in one publication will show their inconsistencies and promote the movement toward the unification of grades, so desirable to both the producer and the user of lumber.

Field studies of the manufacture of slack and tight cooperage stock were made in the Northern and Southern States, with particular reference to possible economies in manufacture, the substitution of less valuable species, and the utilization of waste. Tables showing

the relative value of staves and lumber from trees of various diameters were prepared. These tables are of direct value to the owners of timber, cooperage-stock manufacturers, and lumbermen. A special study was made of methods of kiln-drying red gum heading.

A study of the woods used (including amounts and prices) in box making in the New England States indicates that the future of the industry in this region depends upon the control and conservative operation of timberland by the manufacturer.

A study of the woods used in vehicle and implement manufacture, made in the Central States, led to the extensive tests upon spokes, tongues, and axles now in progress at the Purdue laboratory, to determine the proper basis for grading hickory spokes and the effect of defects and methods of manufacture upon the strength of the parts. Arrangements were also made for tests of the suitability of several western woods for wagon manufacture.

A study of methods of treating and laying woods used for street paving was made in all the principal eastern cities where any considerable quantity of such paving is in use. A cooperative experiment with the city of Minneapolis, two creosoting companies, and several lumber manufacturers is in progress, to determine the value for paving of various kinds of northern woods.

A study of the methods of kiln-drying hardwood lumber was carried on in the North Central States. The report upon this subject will furnish a valuable contribution to the theory and practise of kiln-drying. Practical knowledge likely to be of great use to the Service was obtained.

A brief study of the conditions under which tupelo is manufactured in Louisiana and Alabama resulted in a series of practical recommendations for air seasoning this wood. An experiment in kiln-drying tupelo lumber has made it certain that this problem also will be satisfactorily solved. The manner in which the market for tupelo has expanded since announcement of this study was made furnishes a striking illustration of the practical value of the work.

Current prices, by grades and species, of practically all the commercial kinds of lumber in the United States, have been compiled for office use, and the prices of the leading species for the past twenty years have been printed. Because of the rapid changes now going on in lumber prices this compilation is particularly useful.

Fieldwork for a study of the possible means of utilizing dead and mature timber on reserves began May 1, 1906. It is expected to furnish practical recommendations for the use of a large amount of reserve timber which has heretofore gone to waste and been only a menace to the welfare of the forest.

A study of utilization of sawmill waste began July 1, 1905, but was dropt before results were obtained, for want of men to carry it on. Some important phases of the subject have been touched upon in a concrete way in connection with the study of cooperage and vehicle woods.

Addresses were made at well-attended meetings of the Mississippi Valley Lumber Manufacturers' Association, the Pacific Coast Lumber Manufacturers' Association, the Yellow Pine Manufacturers' Association, the Southern Cypress Manufacturers' Association, the National Lumber Manufacturers' Association, the National Slack Cooperage

Manufacturers' Association, the International Slack Cooperage Manufacturers' Association, and the National Box Manufacturers' Association.

WORK FOR THE COMING YEAR.

With the beginning of the fiscal year 1906–7 the organization of the Office of Forest Products will be considerably changed. Dendrochemistry will be designated Wood Chemistry. Timber Tests and Lumber Trade will be combined into the Section of Wood Utilization, and sections of Forest Measurements and Reserve Engineering will be added.

The Section of Forest Measurements, during the coming year, will work up analysis of white pine in Massachusetts and graded mill tallies of softwoods and hardwoods in New Hampshire; compute periodic weights and measurements from pole, tie, and cross-arm experiments; work up data on western species likely to be valuable in the work on the reserves, and compile statistics of forest products. Efforts will be made to gather new and supplemental figures on important trees. Rearrangement of data files on the basis of species and localities, already begun, will continue.

The principal work in map making will concern new forest reserves, timber sales, and working and planting plans.

Since the Office of Forest Products is in large touch with engineers and engineering work, it will be made responsible in the future for the more technical engineering work on the forest reserves. The work immediately ahead is that of telephone construction. The reserves are greatly in need of telephone service. Wherever possible the commercial telephone companies will be given permits to construct lines on the reserves on condition of reduced rates for official business, exclusive lines to reserve headquarters, and the privilege of tapping commercial lines with reserve branch lines. The use of water powers and the construction of roads may also demand technical attention during the year.

The Section of Wood Preservation will consider: Wood above ground, such as railroad ties, paving blocks, cross-arms, etc.; wood in water, such as piles attacked by the teredo; and wood underground, such as mine props, and the butts of fence posts and telegraph and telephone poles.

In the Section of Wood Chemistry the Boston pulp laboratory, now ready for operation, will test the quantity and quality of pulp obtainable from many different American woods, particularly those from the forest reserves. A study of the distillation of wood will be resumed. A careful study of creosote as a preservative will include methods for quantitative estimations of creosote in timbers, for detecting adulterations of coal-tar creosote, and for analyzing creosote by fractional distillation. The leaching properties of timber will be studied, including tests to determine the constitutents of woods at different seasons, the nature and quantity of materials removed by soaking, changes of insoluble wood constituents during soaking, and the effects of leaching on the subsequent growth of attacking fungi and on seasoning. There is an increasing tendency among commercial companies to seek the help of the section in solving chemical problems concerning the use of wood. Problems of this kind, the so-

lution of which will be generally useful, will be undertaken when the cooperator will bear the expense.

The various timber-test laboratories will continue work already begun. The studies of cooperage woods, box-board woods, and vehicle woods, and of lumber movements, specifications, and prices will also be continued. Annual statistics of forest products will be collected in cooperation with the Bureau of the Census and the lumber associations interested. The use of dead timber on the forest reserves will be given much attention. This timber, of which there are vast amounts, has been considered commercially useless. It increases the danger to the reserves from fire. Much of it is still sound, and every effort will be made to use it.

RECORD.

ACCOUNTS.

Accounts include the three subsections of receipt, disbursement, and bookkeeping. All funds derived from the sale of products of the forest reserves, from the use of the reserves, or from cooperation are received in the first; all disbursements for the Forest Service are made in the second; while all administrative bookkeeping, liability and cost keeping, and property accounting is done in the third.

Up to November 25, 1905, all moneys received from the forest reserves were deposited and held in the Central National Bank, Washington, D. C., a United States depository, until transferred, by order of the Forester, to the Treasurer of the United States, to be credited as unofficial moneys to the appropriation "Administration, etc., Forest Service." All moneys received since that date were deposited directly with the Treasurer of the United States, to the credit of this appropriation. This method materially reduced the labor, cost, and chance of loss involved in handling the receipts, and promoted effective inspection.

SUPPLIES.

The work formerly done by the property clerk was divided, and those duties which relate to accountability for property were assigned to a property auditor. The property clerk retained the custody of supplies in stock, and issues them on requisition. Improved methods of packing and shipping were introduced to keep pace with the increasing needs of the Service.

PHOTOGRAPHIC LABORATORY.

A new system of informing field members of the Service of the results of their photographic exposures led to a marked improvement in the views. A table which will enable field members to time their exposures correctly was compiled, and specific instructions for taking forest photographs were prepared. The increased photographic needs of the Service during the year were fully met without increase in the number of persons employed in the laboratory.

QUARTERS.

Twenty-two additional rooms were rented during the year. Eleven of these were for office use, 7 for the storage of instruments, machinery, field equipment, and office supplies, and 4 for the accommodation of a newly installed lithographic printing press and for map mounting. The increased office work connected with forest reserve administration will make necessary a further extension of quarters during the coming year.

CORRESPONDENCE.

During the year 145,468 official communications were received in the Forest Service, and 252,092 were sent out.

STENOGRAPHY AND TYPEWRITING.

The value of the concentration of stenographic work was shown in the readiness with which the needs of the Service were met. The proportion of the cost of stenography and typewriting to the entire expenditure of the Service was reduced from 4 to approximately 3 per cent. During the year 2,142 items of work were performed, comprizing 31,936 typewritten pages (including 5,018 pages tabulated), 644,425 mailing-list cards, 141,220 mimeographed sheets, and a largely increased amount of miscellaneous work. In addition, 571 temporary details of stenographers were made to offices for a total of 5,266 days. The average number of stenographers and copyists assigned to this section was 34.

The concentration of clerical work was extended during the year by including in this section a number of clerks for routine work and for detail to offices in emergencies. The result was a high degree of efficiency in the clerical force without a proportionate increase of expense. During the year ninety-five details of clerks were made, for a total of 1,207 days. The average number of clerks assigned to this work was 9.

MAILING LISTS.

The mailing lists of the Service comprize: (1) A special list of libraries; (2) a list of representative newspapers; (3) a small foreign list of scientific and governmental institutions; (4) a special list of persons engaged in forest work in the United States; (5) a general list of persons interested in forestry; (6) a large extra list of lumbermen, timberland owners, farmers, and members of various professions.

To the names of the first four lists, numbering in all 4,870, all publications issued were sent. Those on the general list received notice of the appearance of bulletins, with brief descriptions of their contents, and also circulars of information and certain other publications of general interest. The addresses on the general list now number 20,100.

The extra list is classified, and is representative of all sections of the United States. Effective use was made of it during the year in bringing the work of the Service to the attention of those most interested in the results.

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Issued January 30, 1908.

U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF

THE FORESTER

FOR

1907.

BY

GIFFORD PINCHOT.

[From Annual Reports, Department of Agriculture.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

CONTENTS.

REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., December 3, 1907.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1907, together with an outline of the plans for the work of the Service for the current fiscal year.

Respectfully,

GIFFORD PINCHOT, *Forester.*

Hon. JAMES WILSON, *Secretary.*

SUMMARY.

EVENTS OF THE YEAR.

The salient facts of the year in connection with the work of the Forest Service were:

A radical change of organization to secure closer cooperation of allied lines of work with one another and better control by the Forester through a large reduction in the number of administrative heads reporting directly to him.

A decided extension and improvement in the system of inspection, through which the Office of the Forester is kept informed as to the efficiency of work in the field.

The creation of six inspection districts, with headquarters at Missoula, Denver, Albuquerque, Salt Lake City, San Francisco, and Portland.

Closer touch between office and field and a more unified service through a system by which supervisors are brought in turn from their Forests to fill, for periods of two or three months, the positions of the six district foresters at Washington.

A marked growth in the heartiness of support to the National Forest policy by the people of the West, who have now definitely made that policy their own.

An increase of the National Forests, held and managed by the National Government to serve the best interests of the public, both now and always, from 107,000,000 to 150,000,000 acres.

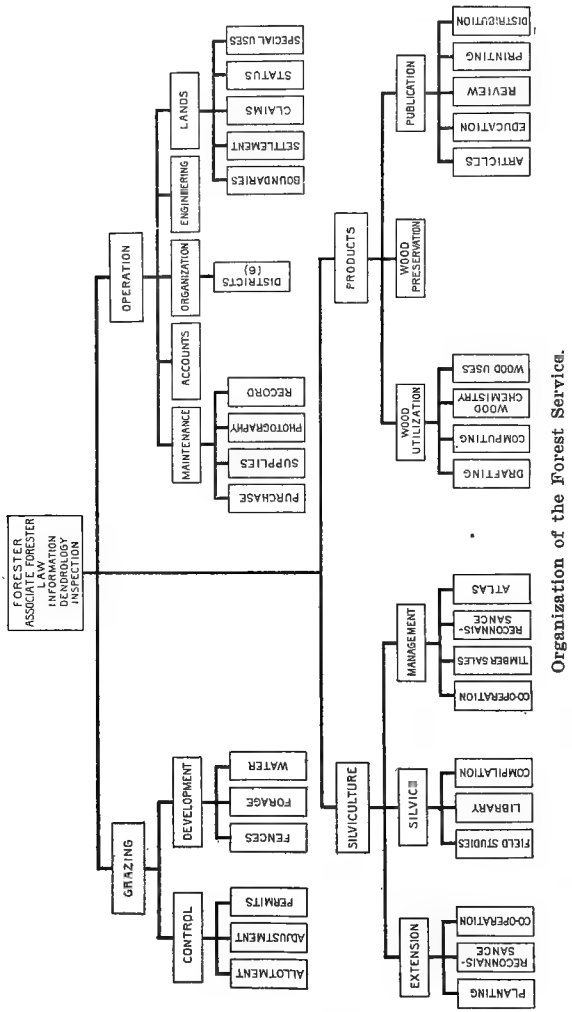
Better adjustment of the relations between the National Forests as sources of wealth and the citizens who benefit by them, together with a very much wider use of the Forests.

Notable success in the control of grazing on the Forests, to the satisfaction of those entitled to use of the range, the advantage of

the owners of stock, and the protection and improvement of the range itself.

A still further and very striking reduction of loss through forest fires from that of the preceding year, which had itself shown a most remarkable decrease from years that preceded.

The application of better methods for securing reproduction after lumbering, on the National Forests.



Organization of the Forest Service.

A far more active and intelligent realization on the part of the public throughout the entire country of the practical importance of forest preservation and the need of concerted action to avert the calamity of an exhausted timber supply.

A growing discernment of the far-reaching principle that the national welfare demands the conservation of all natural resources,

including the forests themselves, the water needed for agriculture, domestic supply, power, and navigation, which the forests largely control, and the soil which they hold in place.

SCHEME OF ORGANIZATION.

The chart on page 4 shows the present organization of the Service. This organization became effective April 17, 1907.

OFFICE OF THE FORESTER.

LAW.

On March 22 Mr. George W. Woodruff, Chief of the Office of Law, resigned to become Assistant Attorney-General of the United States, assigned to the Department of the Interior. His work for the Service was of very great value, not only in purely legal matters, but also in solving administrative problems and important questions of policy, especially in the sections of claims, special uses, and settlement, which were under his charge. These sections, with status, were in April transferred to the new Office of Lands, under which their activities for the year will be reported, and the law officer and his force were transferred to the Office of the Forester.

During the year the work was defined and systematized. The law officer now disposes of the following classes of business: Correspondence concerning forest legislation, State and Federal; litigation, including contested land claims; communications with the Department of Justice, including cases submitted to the Attorney-General for his opinion; submissions to the Comptroller of the Treasury for his decision. He scrutinizes regulations proposed to the Secretary of Agriculture for the Forest Service; proposed new proclamation forms; proposed new business forms; all contracts, bonds, and stipulations, including the sufficiency of their execution by the adverse party. He also advises the Forester, the fiscal agents, and branches and offices in legal questions incidental to the business of the Service, including questions of policy having a legal bearing.

In trespass, 73 cases were referred to the law officer, of which 48 were settled without court proceedings. Sixteen criminal and 8 civil suits were brought and 13 are pending in the hands of the United States attorneys. Two injunction suits to prevent grazing trespass and 2 to prevent unpermitted special use were decided, all in favor of the Government. Six civil and 18 criminal cases were closed, 9 of the latter by trial and conviction and 9 by discontinuance.

In the cases of United States *v.* Domingo (152 Fed. Rep., 566) and United States *v.* Daguirre (152 Fed. Rep., 568), the constitutionality of that part of the act of June 4, 1897, which makes it a criminal offense to violate the regulations of the Secretary of Agriculture made under that act, was again upheld. The criminal appeals act of March 2, 1907 (34 Stat., 1246), will enable the Government to appeal this question to the Supreme Court in case of an adverse decision. In the case of United States *v.* Shannon (151 Fed. Rep., 863) it was decided that the National Forests need not be fenced to restrain unauthorized grazing upon them, though State laws require this in the case of private lands.

Every effort was made to cooperate with the General Land Office of the Department of the Interior in securing settlement in civil cases and conviction in criminal cases of trespass upon lands included within National Forests since the trespass took place. A number of the civil cases were transferred to the Office of Law and $5,004.91 was recovered through settlement.

Very few cases of trespass upon State school sections, surveyed or unsurveyed, within National Forests were reported. Friction with the States which claim the right to sell timber from or to lease these sections has been avoided, because both the States and the Forest Service have refrained from making such sales and leases. Federal and State legislation was outlined for the relief of the States which claim school sections within National Forests.

The law officer cooperated with the Office of Lands in dealing with invalid land claims in National Forests. Within the Plumas National Forest claims amounting to 18,000 acres, alleged to be invalid under the mineral laws, are now being contested.

When the National Forests were transferred to the Department of Agriculture several protests were pending against the granting of special use applications, most of them rights of way for water and hydraulic electric plants, usually on the grounds of a speculative purpose and absence of a prior water right. Inquiry into these questions involved long and expensive hearings in the field, followed by successive appeals, and entailed voluminous records, wearisome delays, and heavy costs to the contestants. The Forest Service now requires the beginning and completion of construction within definite times and beneficial use for a fixed period each year, referring decision as to the priority of water rights to the courts. Under this policy, which was devised by Mr. Woodruff, most of the protested special use applications were promptly disposed of.

The increased National Forest business required the preparation of new forms for a number of instruments. Special contracts were prepared for the cooperative management of Utah State lands in National Forests and for miscellaneous permanent improvements in and protection of the National Forests, especially against fire, in the San Bernardino Forest.

Correspondence with citizens and members of State legislatures was carried on and advice upon forest legislation was asked and given in Alabama, Georgia, Idaho, Illinois, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Vermont, West Virginia, and Wisconsin. The most important State legislation of the year was a general forest law for Tennessee and fire laws for Pennsylvania and Oregon.

The agricultural appropriation act of March 4, 1907 (34 Stat., 1256), contains (pp. 1269–1271) the following new provisions affecting the Forest Service: Increase of the Forester's salary to $5,000 per annum; forest reserves to be known hereafter as National Forests; authorizing payment of expenses incurred for the transportation and care of fish and game supplied to stock the National Forests; authorizing the purchase of technical books and technical journals for officers stationed outside of Washington; Forest Reserve special fund abolished, with a compensating increase from $900,000 to $1,900,000 in the appropriation to protect, administer, improve, and

extend the National Forests; the creation of new Forests and additions to existing Forests in the States of Oregon, Washington, Idaho, Montana, or Colorado forbidden, except by special act of Congress, and (p. 1281) appropriation of $25,000 for investigation, survey, and report upon the proposed Appalachian and White Mountain National Forests.

Other acts of Congress included: An appropriation of $100,000 to continue surveys of National Forests (act of March 4, 1907, 34 Stat., 1336); certain townships within the Black Hills National Forest brought within the Forest homestead act of June 11, 1906 (act of February 8, 1907, 34 Stat., 883); lands within the San Juan National Forest granted to the city of Durango, Colo., for water-supply purposes (act of May 1, 1907, 34 Stat., 1053); certain lands within the Medicine Bow National Forest granted to Boulder, Colo., for water-supply purposes (act of March 2, 1907, 34 Stat., 1223); United States allowed to appeal directly to the Supreme Court in criminal cases decided against the Government on demurrer to indictment, arrest of judgment, or special plea in bar (act of March 4, 1907, 34 Stat., 1246).

WORK FOR THE ENSUING YEAR.

In the protection of the Forests from trespass through legal advice and action, the oversight of contracts and forms, the giving of advice to officers of the Service in all matters of law, and the response to requests for assistance or information concerning forest legislation, the law officer will continue to carry out the lines of work of the past year. Steps will be taken, in cooperation with the Department of Justice, to secure the fullest measure of protection for members of the Service in the performance of their duties and for permittees in the exercise of their privileges. National Forest officers will be instructed in their legal powers and duties through conferences at supervisors' and rangers' meetings, and on occasion a representative of the law officer will visit and advise members of the protective force needing aid or support in their official work.

INFORMATION.

This line of work, organized as a part of the Office of the Forester in May, is an outgrowth of work formerly carried in the Office of Publication and Education. Its purpose is to advise the Forester as to the general policy of the Service in matters of publication, to gather from the originating offices and furnish on demand information concerning the work of the Service and forestry in general, and to prepare for unofficial use matter of educational value which the Service may properly and effectively bring to the attention of the public through other channels than its regular publications.

One of the purposes for which the Forest Service exists is to educate the public as to the importance of conserving our forest resources and the best methods of handling woodlands and utilizing forest products. This can often be acomplished by being prepared to furnish the information in the form in which and at the time when the means of greatest publicity demand it. To depend solely on official publications, written without regard to the special requirements of this kind of work, would often miss the opportunity. For certain

kinds of information relating to forestry millions of readers can be reached through newspapers and magazines for thousands who could be reached at a much greater expense and much less effectively through official publication and distribution of the same matter. The Service therefore definitely seeks to give publicity through these channels to much of the useful information which it discovers.

The Government's work in promoting the best use of our forests, public and private, is recognizedly a matter of general and deep interest to the people of the country. One result of this interest is an increasing demand for information from representatives of the press concerning investigations under way, administrative work and policy, statistics of forest resources and products, and all kinds of facts related to the need and practice of forestry. This demand can not be ignored, and can not be satisfied without special provision to meet it. The result of making such provision is evident in lessened friction, less interruption of the work of administrative officers of the Service, a better response made to demands for information on matters concerning which the public has a right to expect publicity, and an important furthering of one of the ends for which the Service exists in the dissemination of knowledge of practical value concerning forest protection and use.

WORK FOR THE ENSUING YEAR.

Special attention will be given to popularizing technical information concerning forests, the requirements and life activities of forest trees, and the practice of forestry. Economical methods of utilizing wood and other forest products will also be presented. But above all the relation between the public welfare and the perpetuation of the forests, the loss of which would mean an impairment of the Nation's wealth, will be illumined to the fullest possible degree.

DENDROLOGY.

A very large part of the work of the Office of Dendrology is the giving of technical information through correspondence. This mainly concerns the identification of commercial woods for architects, builders, railroad companies, and others, and of seeds and other material from native and foreign trees. In all, 3,576 letters were prepared.

TURPENTINE INVESTIGATION.

It was definitely established by the turpentine investigation that shallow chipping with the ordinary hack yields more turpentine, makes it possible to work the trees an average of one and one-third years longer, and detracts less from their value for lumber than the old method. The discovery was made that by beginning chipping one month earlier than has been the custom the flow of resin during the following month is decidedly increased, and also that a cause of disturbance and loss in the process of distillation hitherto unexplained is the mixing of pond-pine resin with longleaf. This produces a boiling over in the stills which makes it necessary to throw away the entire charge. Progress was made toward a determination of the exact kind of turpentine yielded by the different species of southern

pines, knowledge of which will afford a basis for detecting adulteration of turpentine spirits, a matter hitherto impossible. The chemical studies involved in these investigations were made in cooperation with the University of North Carolina.

BASKET WILLOWS.

The experimental willow holts yielded 1,432 pounds of high-grade peeled rods and 15,000 choice cuttings for free distribution. The increase of interest in willow growing on the part of farmers and others is very marked.

SPECIAL DENDROLOGICAL STUDIES.

A report on the distribution and commercial importance of mahogany in Florida and adjacent coast islands was prepared, and the distinguishing characteristics of oak woods were studied.

Part I of the four tree books planned to cover the forest flora of the United States was brought nearly to completion. It describes 152 forest tree species of the Pacific slope, with accurate information as to their range, occurrence, soil and climatic requirements, tolerance, reproduction, and longevity, and is designed to be primarily a manual for National Forest officers. Part II, "Forest Trees of the Rocky Mountains," is in preparation. Progress was made in revising Bulletin 17, "Check List of Forest Trees of the United States," and in preparing a bulletin on the care of street and park trees.

FOREST HERBARIUM.

Approximately 1,500 specimens (foliage, fruits, and wood) were added to the collection, which numbers about 4,500 specimens of native and 1,000 of foreign trees.

Two new tree species were discovered, a brown-wooded New Mexican timber juniper (*Juniperus megalocarpa* Sudw.) and a California live oak (*Quercus pricei* Sudw.). Many sets of foliage, fruits, and seeds were presented to public schools.

FOREST DISTRIBUTION RECORDS.

Systematic compilation of authentic records of the range of trees was pushed, and the Service now has the largest and most complete record of North American tree ranges in existence. Substantial additions to earlier information were secured through field notes of Service officers, and notably by the contribution of distribution notes on California trees made by Dr. C. Hart Merriam, based on twenty years of field observation. The result has been to extend remarkably the known ranges of many forest trees, in some instances by hundreds of miles. These data will help greatly toward the preparation of a general forest map of the United States.

EXPOSITIONS.

Two hundred forest transparencies were loaned for use at the Pittsburg Sportsmen's Exhibit, 20 to the exhibit of the Newark, N. J., Tree Planting Society, and 80 to that of the New England Forest, Fish, and Game Association in Boston.

WORK FOR THE ENSUING YEAR.

Field studies of various western and southwestern tree species will be carried on, and preparation of publications already in hand and of a forest map of the United States will be pressed forward.

OPERATION.

ORGANIZATION.

A distinct advance was made in the practical management of the National Forests. Wider application was given to the policy of local control, business methods were simplified, and the personnel was strengthened to the fullest extent permitted by the funds available.

The wisdom of dividing the National Forests into administration and inspection districts was amply vindicated, and the number of districts was increased to six. The office work of the districts was superintended in rotation by 19 different members of the field force temporarily transferred to Washington to act as district foresters. The value of this plan was seen in closer working relations between the office and the field, and wider views of National Forest interests on the part of these field men than could be gained in the work of a single Forest.

The districts as now constituted are as follows:

District 1.

Montana.
Northern Idaho.
Northwestern Wyoming.

District 2.

South Dakota.
Southeastern Montana.
Eastern Wyoming.
Minnesota.
Nebraska.
Kansas.
Colorado.
Southeastern Utah.

District 3.

Southern Arizona.
New Mexico.
Oklahoma.

District 4.

Southern Idaho.
Western Wyoming.
Eastern Nevada.
Utah.
Northern Arizona.

District 5.

California.
Western Nevada.

District 6.

Washington.
Oregon.
Alaska.

The responsibility of forest supervisors was very materially increased. They were given full direction of all work on their Forests, and all members of the Service assigned to work there, except inspectors and administrative officers from Washington, were placed under their instructions.

A third edition of The Use Book was printed, with revised regulations to take effect July 1, 1907. The revision was made in the light of experience, and it is believed that a marked gain is made in clearness of statement and in the better business methods prescribed for Forest work. The most important changes in regulations were those which provide for increasing the responsibility of forest supervisors. The Use Book will be distributed only to Forest officers and to actual

users of the Forests. Information suitable for wide distribution to the general public is given in more compact and simple form in a separate publication entitled "The Use of the National Forests."

Five supervisors' meetings were held at convenient points in Oregon, California, Arizona, Colorado, and Utah, and were largely attended. These meetings had an excellent effect. They were of special benefit in giving opportunity for the discussion and settlement of problems arising in the regular day's work on the Forests and in bringing about a better understanding of the general policy of the Service in matters connected with National Forest administration.

National Forests, showing new Forests, additions, and eliminations, July 1, 1906, to June 30, 1907.

State.	Forest.	Area July 1, 1906.	Changes in area by proclamations, July 1, 1906, to June 30, 1907.	
			New Forests and additions.	Eliminations.
		Acres.	*Acres.*	*Acres.*
Arizona	Baboquivari		126,720	
	Black Mesa	2,030,240		
	Chiricahua	169,600	117,920	
	Dragoon		69,120	
	Grand Canyon	2,307,520	7,000	56,600
	Huachuca		314,125	
	Mount Graham	118,600	22,280	
	Pinal Mountains	45,760		
	Prescott	423,680		
	San Francisco Mountains	1,975,310		
	Santa Catalina	155,520		
	Santa Rita	387,300	103,258	
	Tonto	1,115,200		
	Tumacacori		203,550	
California	Diamond Mountain	626,724	48,647	25,533
	Inyo		221,324	
	Klamath	1,896,313		
	Lassen Peak	897,115		
	Modoc	288,218		
	Monterey	335,195		
	Pinnacles		14,108	
	Plumas	579,520	208,222	
	San Bernardino	737,120		
	San Gabriel	555,395		
	San Jacinto	668,160	1,083,279	
	San Luis Obispo	363,350		
	Santa Barbara	1,838,323	143,777	
	Shasta	1,377,126	146,644	
	Sierra	5,049,934		
	Stanislaus	627,780	669,020	
	Stony Creek		937,569	
	Tahoe	838,837	31,648	
	Trabuco Canyon	109,920		
	Trinity	1,243,042		
	Warner Mountains	306,518		
	Yuba[a]	524,287		
Colorado	Battlement Mesa	797,720		
	Cochetopah	1,133,330		
	Fruita	7,680		
	Gunnison	901,270		
	Holy Cross	990,720	70,560	
	La Sal	29,502		
	Las Animas		196,140	
	Leadville	1,219,947		
	Medicine Bow	1,155,909	190,246	
	Montezuma	576,719	1,035,427	
	Ouray		273,175	
	Park Range	757,116	376,890	320
	Pikes Peak	1,681,667		
	San Isabel	321,227		
	San Juan	1,437,406	766,512	
	Uncompahgre	478,111	141,317	
	Wet Mountains	239,621		
	White River	970,880		

[a] Yuba included in Tahoe Sept. 17, 1906.

National Forests, showing new Forests, additions, and eliminations, July 1, 1906, to June 30, 1907—Continued.

State.	Forest.	Area July 1, 1906.	Changes in area by proclamations, July 1, 1906, to June 30, 1907.	
			New Forests and additions.	Eliminations.
		Acres.	*Acres.*	*Acres.*
Idaho	Bear River	415,360		
	Bitter Root	3,860,960		
	Big Hole		304,140	
	Caribou		733,000	
	Cabinet		494,560	
	Cassia	326,160		
	Coeur d'Alene		2,331,280	
	Henrys Lake	798,720		
	Kootenai		165,242	
	Lemhi		1,344,800	
	Palouse		194,404	
	Payette	1,460,960		
	Port Neuf		99,508	
	Pocatello	49,920		
	Priest River	541,160	273,940	
	Raft River		293,044	
	Salmon River		1,879,680	
	Sawtooth	1,947,520	1,392,640	
	Weiser	1,059,520	81,600	14,691
	Yellowstone	177,960	128,880	3,840
Kansas	Garden City	97,280		
Montana	Big Belt	630,260	11,840	640
	Big Hole		1,612,960	
	Bitter Root	691,920		
	Cabinet		1,566,400	
	Crazy Mountains		234,760	
	Elkhorn	186,240		
	Ekalaka		33,808	
	Gallatin	888,660		
	Helena	782,160		
	Hell Gate	1,576,000	6,400	
	Highwood Mountains	45,080		
	Kootenai		887,360	
	Lewis and Clark	4,670,720	870,460	
	Little Belt	583,560	478,560	8,960
	Lolo		1,211,680	
	Long Pine		111,445	
	Little Rockies		31,000	
	Madison	958,800		
	Missoula		194,430	
	Otter		590,720	
	Pryor Mountains		204,320	125,587
	Snowy Mountains		126,080	
	Yellowstone	1,229,680	137,280	14,720
Nebraska	Dismal River	85,123		
	Niobrara	123,779		
	North Platte	347,170		
Nevada	Charleston		149,165	
	Independence		135,019	
	Monitor		572,640	
	Ruby Mountains	423,660		
	Tahoe	59,115		
	Toiyabe		625,040	
	Toquima		368,000	
New Mexico	Big Burros		156,780	
	Gallinas		78,480	
	Gila	2,823,900		
	Guadalupe		283,065	
	Jemez	1,237,205	223,040	
	Lincoln	545,256	129,472	47,293
	Las Animas		480	
	Magdalena		154,882	1,100
	Manzano		459,726	
	Mount Taylor		110,525	
	Pecos River	430,880		
	Peloncillo		178,977	
	Portales[b]	172,680		172,680
	Sacramento		881,841	
	San Mateo		424,663	
	Taos		233,200	
Oklahoma	Wichita	60,800		

[a] Portales National Forest abolished Mar. 16, 1907.

National Forests, showing new Forests, additions, and eliminations, July 1, 1906, to June 30, 1907—Continued.

State.	Forest.	Area July 1, 1906.	Changes in area by proclamations, July 1, 1906, to June 30, 1907.	
			New Forests and additions.	Eliminations.
		Acres.	*Acres.*	*Acres.*
Oregon	Ashland	21,120	151,680	
	Chesnimnus[a]	220,320		
	Blue Mountains	2,675,620	874,080	
	Bull Run	142,080		
	Cascade	4,424,440	1,462,400	
	Coquille		148,317	
	Fremont		1,235,720	
	Goose Lake		630,000	
	Heppner		292,176	
	Imnaha		782,720	
	Maury Mountains[b]	54,220		
	Siskiyou		1,132,582	
	Tillamook		175,518	
	Umpqua		798,400	
	Wallowa[a]	747,200		
	Wenaha	413,250	81,692	
South Dakota	Black Hills	1,163,160		
	Cave Hills	23,360		
	Short Pine	19,040		
	Slim Buttes	58,160		
Utah	Aquarius	639,000		
	Bear River	267,920		
	Beaver	261,593	25,106	
	Dixie	465,920		
	Fillmore	399,600		
	Fish Lake	288,800	74,537	
	Glenwood		173,896	
	Grantsville	68,960		
	La Sal	128,960		
	Manti	777,920	8,160	
	Monticello		214,270	
	Payson	167,280		
	Raft River		117,203	
	Salt Lake	95,440		
	Sevier	710,920		
	Uinta	2,148,510	39,040	
	Vernon	68,800		
	Wasatch		85,440	
Washington	Colville		869,520	
	Olympic	1,466,880	127,680	
	Priest River	103,960	302,560	
	Rainier	1,943,520	701,600	79,360
	Washington	3,952,840	2,358,380	480
	Wenaha	318,400		
Wyoming	Big Horn	1,151,680		
	Bear Lodge		136,784	
	Black Hills	46,440		
	Caribou		7,740	
	Crow Creek[c]		56,320	
	Medicine Bow	418,759	164,605	
	Sierra Madre		370,911	
	Uinta	4,596		
	Yellowstone	6,580,920	87,800	6,080
Alaska	Afognak	403,640		
	Alexander Archipelago	4,506,240		
Porto Rico	Luquillo	65,950		
Total		106,994,018	44,396,531	557,881

[a] Chesnimnus and Wallowa included in Imnaha Mar. 1, 1907.
[b] Maury Mountains included in Blue Mountains Mar. 2, 1907.
[c] Included in list of National Forests by decision of Acting Secretary of Interior August 9, 1907.

Grand total, June 30, 1907, 159 National Forests, 150,832,665 acres.

At the end of the fiscal year all the National Forests in the United States and Alaska were under organized administration. They comprise 183 administrative units, under the supervision of 116 officers in charge. Fifty-six new Forests were put under administration during the year.

The local administrative and protective force on the National Forests on June 30, 1907, was 96 supervisors, 11 deputy supervisors, 639 rangers, and 464 guards. Each field officer engaged in patrol covered, on the average, 132,236 acres.

Aid in technical matters was given to supervisors by 25 forest assistants and 10 planting assistants.

The transfer to the local officers of administrative details formerly handled in Washington, together with the routine work arising from the larger use of Forest resources, made it necessary to increase the number of clerks in the offices of supervisors from 6 to 29.

Protective measures against forest fires on the National Forests were highly effective. The area burned over during the calendar year 1906 was restricted to 115,416 acres—less than 7.7 acres in 10,000, as against 26 for the preceding year. The number of fires reported was 1,133, and the average burned area less than 102 acres. The estimated value of the timber destroyed was $76,183, as against $101,282 for the preceding year. The cost of fighting fires, exclusive of the salaries of Forest officers, was $8,768. This small damage from fires, many of which were started by lightning and other unavoidable causes, in immense stretches of mountainous country, is evidence that the measures adopted for detecting and extinguishing fires on the National Forests are efficient. It is certain that loss by fire can be virtually eliminated if appropriations for the Forests provide adequate means of communication and sufficient protective force.

Provision was made for establishing a buffalo pasture on the Wichita National Forest in Oklahoma. The New York Zoological Society inaugurated the project on March 25, 1907, by offering to send 18 American bison of pure breed from the New York Zoological Park to the Forest in order to provide for the perpetuation of the species, if appropriate provisions were made for their protection and care. An appropriation by Congress of $15,000 provided funds for the necessary fence and buildings. Substantial progress was made with the work of fencing an area of about 8,000 acres and erecting suitable buildings. This work will be completed early in the ensuing fiscal year, and the herd placed under the care of a Forest officer experienced in handling buffalo.

WORK FOR THE ENSUING YEAR.

The National Forests will be redistricted with a view to their more economical administration and to making the headquarters more accessible to users. This redistricting will involve the creation of many new administrative units. The Forests will be divided by watersheds and natural boundaries rather than by legal subdivisions.

Steps will be taken to afford rangers opportunity to receive instruction along lines which will add to their efficiency. This will be done either by short winter courses in local institutions or by lectures at ranger meetings.

Joint meetings of the supervisors and rangers of groups of Forests will be held throughout the West. Hitherto rangers' meetings have been held by each supervisor for the men on his own Forest merely.

The responsibility of the field officers will be largely increased by moving into the field more of the work now handled in Washington, so that questions of local administration may be settled at closer range.

ENGINEERING.

In the appropriation act of March 4, 1907, a fund of $500,000 was provided for permanent improvement work on the National Forests, $125,000 of which was made available for use during the then current fiscal year. Urgent need existed for the construction of telephone lines to expedite the administrative work of the Forests, and especially to make it possible for supervisors to get prompt notice in case of fire or trespass; trails, roads, and bridges to develop the resources of the Forests by opening up regions now inaccessible; cabins to shelter members of the protective force and to safeguard Government property; pasture fences to protect the stock of Forest officers; and drift fences to prevent confusion in the handling of grazing herds.

Estimates of needed improvements were received from supervisors aggregating $400,000, and expenditures amounting to $170,000 for cabins, fences, fire lines, 700 miles of telephone lines, 900 miles of roads and trails, and other improvements were authorized before the end of the fiscal year. Active work was begun in carrying out projects chargeable to the fund of $125,000 made immediately available.

Five commercial power plants on two National Forests were inspected and found to be in accordance with permit stipulations.

WORK FOR THE ENSUING YEAR.

The work planned includes the construction of over 3,500 miles of telephone line, 3,000 miles of trail, 200 miles of road, 250 bridges, 500 miles of drift and boundary fences, and 500 cabins and barns. The large number of Forests upon which the work will be carried on simultaneously will make necessary a large increase in the force of supervising engineers.

A number of the roads will be built in cooperation with States and counties. In Idaho, for example, $4,000 will be expended in cooperation with the State to build a State road from Boise to Atlanta, and $3,000 to open a wagon road from Harpster to Elk City and to reconstruct the old and well-known Salmon River trail. About $4,000 will be spent in reopening and repairing the Lolo military trail, which many years ago made accessible a territory rich in possibilities, and which will shorten the route between the eastern and western portions of the State by many miles. Road work in cooperation with counties will be undertaken in Colorado, Oregon, and Idaho, and probably in other States.

Fire lines to cost $10,000 will be built on the San Bernardino National Forest in cooperation with the State of California.

ACCOUNTS.

An annual statement was prepared for the accounting officers of the Treasury showing receipts from sales of products on the different National Forests. This statement is used by the Secretary of the Treasury in determining the 10 per cent required by law to be deducted and turned over to the States and Territories in which the Forests are situated for the benefit of public schools and public roads.

The amounts to be paid to the States and Territories, as shown by the statement, are as follows: Alaska, $367.15; Arizona, $17,307.92; California, $16,064.29; Colorado, $15,791.67; Idaho, $19,591.66; Kansas, $119.39; Montana, $20,655.42; Nebraska, $1,017.61; Nevada, $2,133.98; New Mexico, $9,614.06; Oklahoma, $125.50; Oregon, $13,980.89; South Dakota, $2,752.23; Utah, $13,557.38; Washington, $3,731.55; Wyoming, $16,221.49; total, $153,032.19.

The number of accounts rendered for settlement was greatly lessened by the adoption of a new form of certificate of service and a corresponding pay roll for each National Forest, instead of the individual salary voucher hitherto used.

The discontinuance of the duplication of vouchers has materially reduced the amount of work involved in the preparation of accounts, both in the field and in Washington. This method of settlement has been in use one year, long enough to show its manifold advantages.

In addition to the regular work of the Office an annual statement showing under twenty special headings the disbursements of all the appropriation of the Forest Service was prepared for the report of the Committee on Expenditures in the Department of Agriculture, House of Representatives.

Changes in personnel, including appointments, promotions, resignations, etc., numbered 4,649, and the temporary employment of 1,826 persons was reported for the approval of the Secretary of Agriculture.

The liability system in use by the Forest Service was so extended that the expenditure of practically every cent is anticipated and provided for.

The system of cost keeping was made more comprehensive, and now includes the cost of individual projects on the National Forests. By it standards of cost were made available for use in the planning of new work.

MAINTENANCE.

SUPPLIES.

Improved methods of handling requisitions and keeping account of stock resulted in increased promptness in getting supplies into the field. Delays of shipments occurred during the winter months because of snow blockades in the Northwest and the consequent congestion of traffic, but the inconvenience to the Forest Service was comparatively slight. By the system of semiannual requisitions, Forest officers were furnished with all needed supplies which could be anticipated, during the time of year when the movement of traffic is free.

The number of kinds and sizes of instruments and articles of stationery carried in stock was reduced, and lists of standard materials were issued for the guidance of members of the Service in making requisitions.

PHOTOGRAPHY.

The extension of administrative and investigative work on existing National Forests and on new Forests created during the year involved a more general use of maps and blueprints. The increased use of photographs in connection with applications made for lands

for agricultural settlement and other special uses also added to the volume of work for the laboratory. To meet these demands the facilities were increased and one additional photographer was employed.

Equipment for mounting maps was installed, enabling the Service to furnish members engaged in field work maps mounted on cloth in convenient and durable form.

RECORD.

The concentration of stenographic and typewriting work and other routine clerical labor was continued with good results. The average number of stenographers and typewriters available for copying and typewriting and for temporary detail to offices was 32. In addition, 16 clerks, assigned to ordinary routine work, were available for detail to offices in emergencies. This elastic system of supplying temporary clerical help to offices resulted in a high degree of efficiency, with a marked gain in economy of time and cost.

During the year 158,191 official communications were received, and 299,610 were sent out.

The depreciation of field equipment and instruments in the hands of Forest officers was less than 5 per cent of the total value of all such property in use.

WORK FOR THE ENSUING YEAR.

Additions will be made to the facilities of the laboratory, which will enable the photographer to furnish maps and blueprints more promptly than ever before.

Supply depots will be established at convenient shipping points in the West. The proximity of these depots to the National Forests will facilitate the furnishing of supplies to Forest officers.

The plan of concentrating the routine clerical force will be extended.

LANDS.

BOUNDARIES.

The examination of lands for new National Forests and for additions to and eliminations from existing Forests led to the changes tabulated on pages 11, 12, and 13. A total of 16,324,880 acres was still under temporary withdrawal for exemption, while 11,331,916 acres were released from withdrawal during the year.

Sites for 1,552 rangers' headquarters on 96 National Forests were selected and withdrawn from entry during the year. The headquarters were needed to facilitate the local administration of the Forests and to afford centers for protective work against fires and depredations.

AGRICULTURAL SETTLEMENT.

The act of June 11, 1906, which opened to entry all land within National Forests chiefly valuable for agriculture and not needed for administrative use, brought 3,871 applications from actual and prospective settlers. Examination of the lands applied for was

promptly begun in the summer and fall of 1906, but before it could proceed far winter interrupted the work. Before spring came a large number of applications had accumulated. Under the supervision of the chief inspectors in the different districts the field work was pushed as rapidly as possible by experienced men. These examiners, almost without exception, were western men, thoroughly familiar with local conditions. The examiners were accompanied by the applicants whenever this was possible. Detailed surveys were made of areas for listing which were not covered by the public-land surveys. A full report was made upon each tract; it considered markets, transportation facilities, topography, soil, cover, and economic possibilities.

Applicants with prior rights are permitted to occupy lands chiefly valuable for agriculture and not needed for administrative use, pending the formal listing of the lands. Settlers already occupying lands in good faith are not required to apply for permission to continue their occupancy and use. The only restrictions are that the land must be chiefly valuable for agriculture and not needed for administrative use, and that the interests of any previous applicant for the same land must not be injuriously affected.

CLAIMS.

Although lands included within National Forests are withdrawn from all forms or entry or filing, except under the mining laws and the agricultural settlement act of June 11, 1906, many claims are valid because initiated prior to the creation of the National Forest. All alleged claims must be examined and reported upon in order that the Commissioner of the General Land Office may be informed if there appears to be reason why patent should not issue.

Three geologists detailed by the Geological Survey assisted the forest supervisors in examining mining claims.

Reports on 2,473 claims inside National Forest boundaries were received from examiners. Of this number 1,093 mining, 705 homestead, 50 desert land, 42 timber and stone, and 29 miscellaneous claims were transmitted to the General Land Office for final action; 200 mining, 100 homestead, 10 desert land, and 29 timber and stone claims were held for further report, and 215 required no action.

The General Land Office ordered 91 hearings on recommendations of the Forest Service that claims be rejected.

SPECIAL USES.

The business of special uses was approximately double that of the preceding year. Applications were received for 1,763 permits, and 100 applications for rights of way amounting to easements were referred to the Forest Service by the Department of the Interior for recommendation. Of the permits applied for, 1,668 were issued, 50 were refused, and 45 were received too late to be acted upon before the close of the year.

STATUS.

There were obtained from the General Land Office records relating to tracts of land concerning which information was needed, and data

concerning alienations and the status of titles needed to determine whether the land was National Forest land or held in private ownership were furnished to forest supervisors and to the offices in the Service.

WORK FOR THE ENSUING YEAR.

The need of examining lands for the creation of new National Forests and for additions to and eliminations from existing Forests will be materially less than last year, and the number of examiners will be correspondingly decreased. Selection and withdrawal from entry of administrative sites for rangers' headquarters will be continued. In regions where the National Forests are confined largely to the higher elevations the sites selected will usually be on ground low enough to permit of residence throughout the year.

A large force of experienced men will continue the work of examining lands applied for under the agricultural settlement act of June 11, 1906, and the work will be vigorously carried to completion.

Under the revised regulations effective July 1, 1907, supervisors will be authorized to grant permits for the use of the National Forests, except upon applications for permits for the installation of commercial power plants and other uses of large importance, which will be reserved for the action of the Forester.

Examinations of mining claims on the National Forests will be made by an increased number of geologists from the U. S. Geological Survey. The work of examining nonmineral claims will be assigned to a trained force of Forest officers familiar with local conditions.

The work of examining the records of the General Land Office and obtaining data as to land titles within the National Forests will be carried on by an increased clerical force, to meet the growing demands of the Service for information of this character.

SILVICULTURE.

FOREST EXTENSION.

A distinct advance in efficiency was made in the work of this office. Nursery and planting operations in the National Forests present many difficult problems which the experience gained, both of success and failure, now make it possible to attack more vigorously and extensively. It is clear that some of the methods which at first seemed promising should be discarded, that the natural difficulties of establishing new Forests in the more arid parts of the Southwest must be overcome by measures of special care, and that in such regions it is false economy to make the first cost too small. Thus a firm foundation is being laid for future work.

Forest planting by private persons under advice from the Forest Service increased remarkably during the year.

PLANTING.

Stock for National Forest planting is now being grown at 8 stations, of which 2, the Fort Stanton and Las Gallinas, were established during the year. The following statement shows the size and

estimated capacity of the seed beds, the amount of young stock on hand, and the amount furnished for field planting:

Forest planting stations: Size and estimated capacity of seed beds, young stock on hand, and young stock furnished for field planting.

Planting station.	Forest.	Seed bed.	Estimated seedling capacity.	Number of 1-year transplants.	Number of 2-year transplants.	Number of trees furnished for field planting.
		Acres.				
Pasadena	San Gabriel	0.20	300,000	150,000	230,000	103,900
San Marcos	Santa Barbara	.10	200,000	127,000	18,500	59,000
Pikes Peak	Pikes Peak	.60	400,000	7,800	----------	----------
Halsey	Dismal River	4.00	4,000,000	250,000	----------	241,500
Fort Bayard	Gila (S)	.50	400,000	89,800	23,000	40,500
Wasatch	Salt Lake	.70	800,000	119,000	----------	----------
Fort Stanton	Lincoln	.30	400,000	----------	----------	----------
Las Gallinas	Pecos River	.30	400,000	----------	----------	----------
Total	----------	6.70	6,900,000	743,600	271,500	444,900

The following field planting was done on National Forests:

Tree planting on National Forests.

Forests.	Number of trees planted.	Forests.	Number of trees planted.
San Gabriel	43,000	North Platte	19,000
San Bernardino	42,000	Niobrara	19,000
Santa Barbara	63,100	Garden City	24,000
San Luis Obispo	5,100	Gila	30,500
Monterey	4,700		
Pikes Peak	20,450	Total, 11 Forests	418,850
Dismal River	148,000		

The stock planted in the field in earlier years suffered severe losses from special causes, of which the principal were unusual drought and attacks of animals. On the San Gabriel Forest rabbits and wood rats did great damage. All efforts to protect against or exterminate these pests have hitherto proved futile. Rabbits are less common on open land and at higher altitudes, where in consequence most future planting will be done. Of the trees planted in 1905 the small percentage which were not destroyed by rabbits or other pests are in good condition, and from 24 to 36 inches high. More than 90 per cent of the trees planted in 1906 and nearly 50 per cent of those planted in 1907 were destroyed, while in the brush 95 per cent were seriously injured.

At the San Marcos station the weather conditions for nursery and planting work were especially favorable. Transplanting cost $1.78 per thousand. The seed beds were resown mainly with Jeffrey and Coulter pine.

On the Santa Barbara Forest planting near the nursery cost $10.65 per 1,000, but from a temporary camp $16.92 per 1,000. On June 1 the trees were in good condition and from 90 to 97 per cent were alive. Damage from rabbits and field rats is very slight in the Santa Barbara Forest, hence the only danger of loss is from drought. Dry weather through July, August, and September of 1906 caused a loss of 66 per cent in the planting of that year, but the live trees are in excellent condition.

The Pikes Peak station has included nurseries at Clyde, Rosemont, and Bear Creek. The Clyde site has proved too small and too high for extensive nursery work, and will be abandoned. The suitability of the Bear Creek nursery site is also uncertain, since the seedlings of Engelmann spruce, blue spruce, and lodgepole pine were all winter-killed. A small new nursery at the Mount Herman ranger station has proved to have a far more favorable site than either the Clyde or Bear Creek nurseries, and it will therefore be developed into a planting station, with the idea of finally concentrating at this point all nursery work on the Pikes Peak National Forest.

Yellow pine, Douglas fir, and Scotch pine 2-year-old seedlings from Halsey were experimentally planted on six widely differing sites in the Pikes Peak Forest, at a cost of $5.44 per 1,000.

The 1905 field planting suffered seriously from drought. None of the yellow pine and only 5 per cent of the Douglas fir is alive. Of the 1906 field planting about 56 per cent of the trees were alive on June 1. The loss was due to drought and trampling of cattle.

At the Halsey station measures were taken to grow hardier and stronger plant material. Trees planted in the sandhills are exposed to very adverse conditions. The first step was to remove the lath roofing from over all one and two year old yellow pine seedlings. To secure trees hardened to wind and sun, and possessing more fibrous roots, all seedlings will in the future be transplanted to unshaded beds when one year old. With this new method of treatment some of the 4 acres now under lath will be converted to open transplant beds.

Slower but more careful methods of planting raised the cost from $1.68 to $3.95 per 1,000. The weather conditions were extremely unfavorable. On June 1, 55 per cent of the jack pine and 82 per cent of the Scotch pine planted during April and May were alive. Of the trees planted in 1906, 47 per cent are living. A test planting of 40,000 Scotch pine purchased from nurserymen and set out carefully is in good condition and shows considerable growth this season.

There were shipped from Halsey for planting elsewhere 94,000 trees, chiefly to the North Platte, Niobrara, Garden City, and Pikes Peak Forests.

Important experiments under way include the use of commercial fertilizer on the seed beds to induce more vigorous growth, shearing the needles of trees before planting in the field, and impregnating the seed beds with formalin solution to prevent "damping off."

At the Fort Bayard station the cost of transplanting was $1.63 per 1,000 or $0.79 per 1,000 more than last year. The increase is due to the use of larger seedlings and wider spacing to permit of irrigagation for small ditches between the rows. The first field planting with stock grown at this station was during April. Jack pine and Douglas fir 2-year-old seedlings, from Halsey, Nebr., were also planted experimentally on selected sites. The average cost of planting was $5.75 per 1,000. One month after planting 82 per cent of the trees were in good condition. A considerable loss will probably result, however, from the dry weather of June and July. Of 450 transplants planted in December, 96 per cent were alive and in a thrifty condition in May and had grown from 1 to 2½ inches.

A new planting station known as the Fort Stanton station was established early in May on land near the Fort Stanton military post. A lath house 80 by 160 feet was constructed.

The Las Gallinas station was established in the Las Gallinas Canyon, 17 miles northwest of Las Vegas, N. Mex. A lath house 80 by 160 feet was built, a water system installed, and seed sown. The station is well located for distributing stock to other Forests.

The Wasatch station is proving extremely well suited for nursery purposes. All seedlings wintered remarkably well. The transplant ground will be enlarged before the next planting season.

At 52 ranger headquarters small nurseries were established with an average size of about 400 square feet. Two larger nurseries were established, one on the Mount Graham Forest, with an area of 14 acres, and one with an area of 12 acres on the Pocatello. The latter will be enlarged into a planting station during the summer.

On the Garden City Forest it was planned to plant 160,000 trees this season, but unfavorable weather forced abandonment of part of the work. Of the 91,000 trees planted in the spring of 1906, most were destroyed by drought, rabbits, and a severe prairie fire. The recurrence of such a disastrous fire can be prevented by a better system of fire lines.

Experimental plantings were made by rangers on the Monterey, San Luis Obispo, Chiricahua, Santa Rita, Tonto, Mount Graham, Pinal Mountains, Lincoln, Pecos, Grand Canyon (S), Yellowstone (Shoshone Division), Pocatello, and Wichita Forests. This work both tests the value of different kinds of trees for various regions and situations and trains the field force of the Service in planting.

On the Black Hills Forest an exceedingly interesting attempt to secure forest renewal through broadcast sowing of seed is being tested. The sowings made in 1905 and 1906 show, on the whole, fairly satisfactory results. In 1907 a new line of experiments was begun by selecting twenty different situations, ranging from plowed land to bare hill tops and slopes, and sowing them with varying quantities of seed. If a way can be found of sowing broadcast successfully in this region, a discovery of great importance to forestry in the Northwestern States will have been made.

RECONNAISSANCE.

Investigations were made as to the need for planting both in the National Forests and elsewhere. City and irrigation watershed studies were carried on in more than 30 Forests. Immediate planting can and should be undertaken on the Uinta, Pocatello, Lincoln, and Pecos Forests. The Pocatello watershed in the Pocatello Forest, Big Cottonwood in the Salt Lake Forest, Santa Ynez in the Santa Barbara Forest, Santa Fe in the Pecos Forest, and the watersheds of the cities of Pueblo and Colorado Springs in Pikes Peak Forest, all show denuded slopes on which rise streams that feed city water supplies. Large denuded areas in the Lincoln Forest furnish water both for the Hondo Reclamation Project and for the town of Roswell, N. Mex. Outside of the National Forests, information was gathered on tree planting in regions where assistance had been asked and the necessary data for advice were lacking, notably on irrigated lands in the North Platte and the South Platte valleys and on the Truckee-

Carson Reclamation Project. A study of tree planting in California was completed, and one covering Ohio and Indiana was begun and nearly finished.

COOPERATION.

The increasing volume of data from completed studies is leading more and more to the giving of assistance to private owners through correspondence and publications instead of by planting plans, which entail study on the ground. There were made, during the year, 23 planting plans in 15 States, covering 19,600 acres, 10,000 acres of which were covered by a single plan for the United States Reclamation Service, for lands in the North Platte Project. Another important plan was for planting eucalypts on 4,000 acres in California. In Pennsylvania plans were made for the Lehigh Coal and Navigation Company and the Monroe Water-Supply Company.

Advisory letters written to persons seeking assistance through correspondence numbered during the single month of May 288. Letters were received from every State and Territory in the United States, with California, New York, Illinois, Pennsylvania, Indiana, and Massachusetts in the lead, and from 10 foreign countries. The information furnished was specific, and one letter often brought extensive tree planting throughout a locality.

Valuable experiments in nursery and planting work are being conducted in cooperation with nine universities and State agricultural experiment stations in the East and the Middle West, at slight expense, which is equally divided between the Forest Service and the institutions. These experiments are to learn what species are best adapted to different regions, to improve methods of nursery planting, cultivation and thinning, and to test different spacings and mixtures. Among other matters which it is important to investigate through this means are the questions of species useful for protective and commercial planting on irrigated lands and of forest planting in connection with dry-land agriculture.

Experiments to learn how to combat the damping-off fungi, which so seriously affect forest nurseries, were begun in cooperation with the Bureau of Plant Industry at the Halsey planting station and with the New York forest, fish, and game commission at its nursery at Saranac, N. Y.

Publication of a series of regional circulars to set forth clearly and concisely the best advice that the Forest Service can give forest planters in each region has been begun.

WORK FOR THE ENSUING YEAR.

Nursery practice at the present stations will be closely studied, better stock grown, and the seed-bed area brought to a higher state of production. Greater care will also be given to choosing planting sites and perfecting field planting.

Plans are under way to transfer the Pasadena station to Lyttle Creek, the San Marcos to the Santa Ynez Valley, and to relocate the nurseries of the Pikes Peak station. These changes will secure better and more accessible sites without appreciable loss of equipment or permanent improvements.

Experimental sowing and planting will be carried out on a large number of Forests. Additional planting stations will be called for

if the scope of planting upon the National Forests is to be broadened to meet the opportunity opened by this work, but it is of most immediate importance to perfect methods and solve the difficult problems involved rather than to extend the work prematurely.

Particular attention will be given to study of the field for planting in the National Forests. Forest planting on irrigated lands, especially in Idaho, the Dakotas, Montana, and Wyoming, will also be studied further, in the field. The many applications received for assistance in tree planting in the southern States indicate a probable need for field studies in this region during the year.

The compilation of data will be carried on under an improved method for office reference, and with plans for the publication of useful information now gathered. The experimental work under way in cooperation with several colleges and two forest commissions will be systematized to secure the most practical and broadest results, and if possible extended to include some western institutions. Cooperation is planned with the Bureau of Plant Industry, both at some of its dry-farming experiment stations and at some of its experimental farms on irrigation projects.

Several planting plans which have been asked for by owners of large areas will be prepared.

SILVICS.

The best management of the National Forests and of all forested lands in the United States must be grounded on careful and extensive silvical investigations. Because of the growing scope and volume of these studies the former section of silvics was made an office now organized in three sections—field studies, compilation, and library.

FIELD STUDIES.

A study of old cuttings and burns of lodgepole pine was begun in the Rocky Mountains, to find out how fast reproduction takes place and how the method of cutting and the brush disposal affect it. This will give knowledge as to what is the best treatment of lodgepole pine in the different forest types. A special study of the life history of Colorado forests was begun. General silvical records were started at the office of every National Forest supervisor to secure the history of each cutting, and the following reproduction. These will enable the working out of a final plan of silvicultural treatment for each forest type. Field studies of second-growth yellow poplar in Virginia, pointing to the profitableness of growing this species for wood pulp and box lumber, at least in the Middle Atlantic States, and of the aspen, valuable for book and magazine paper, excelsior, and silviculturally as a nurse tree to spruce and white pine, were finished. An extensive field study of all important species of hickory, the present supply of which is nearly exhausted, was begun to determine which kinds have the best wood, and how best to grow a second crop.

There were established in five eastern States, 145 large and 126 small permanent sample plots for studying silvical problems of reproduction, growth, fire, and thinnings, and in the west, 22 sample plots, in 4 National Forests. There are now 458 sample plots in the east, with a total area of 73.22 acres.

FOREST INSECT INVESTIGATIONS.

During the year special explorations were made in cooperation with the Bureau of Entomology in the National Forests of Colorado, to locate old and new work of the Black Hills beetle, make estimates of the amount of insect-infested and killed timber, and determine how to control the insect. One result was to show that an outbreak of this insect can be controlled. The prompt and radical measures adopted by Gen. William J. Palmer in cutting and barking beetle-infested timber during the summer and fall of 1905 and the spring of 1906, in the vicinity of Colorado Springs and Palmer Lake, checked the spread of the beetle.

Maps showing the exact location of the beetle-infested and killed timber were prepared for the Forest Atlas, and these made it easier to get rid of this timber by sale. An important result of these explorations in the different National Forests was to teach forest supervisors and rangers how to detect evidences of insect depredations and the importance of reporting them, with specimens of the insects or their work.

COMPILATION.

The section of compilation collects and systematically organizes for practical use existing silvical information from all possible sources. During the past year silvical notes were compiled for 113 new species. These notes now cover 180 species, including practically all the western and most of the important eastern trees. They comprise data classified as to range, character of distribution by regions, associated species, habit, soil, moisture, and light requirements, reproduction, planting and thinning, rate of growth, yield, sprouting, and diseases of the various species. Besides the notes on species, general silvical data are on file for 60 National Forests.

An increasing amount of silvical data is procured in connection with the regular work of the Service. Special annual reports on the silvical conditions on National Forests are now required from technical assistants. Thirty-one of these reports were received in 1906.

To place its classified data in the most available form for use in the field, the section has begun the publication of silvical leaflets upon the various species. These leaflets contain compilations of all available silvical knowledge and are designed by future revision and addition to form the basis for an American silviculture. During 1906 more than thirty compilations on the silvics of western conifers were prepared for subsequent publication as silvical leaflets. Another line of work pursued by this section was the compilation of silvical data on Pacific coast trees in connection with the forthcoming manual of Pacific coast trees.

LIBRARY.

Of 13,791 books and pamphlets in the library, 4,500 were added during the year and 3,326 were placed in 109 branch libraries established in the offices of National Forest supervisors. Service manuscript reports are being indexed with the general library index.

The photographic collection gained 3,009 mounted prints from the States and Territories and 27 foreign countries, and now contains 27,471 such prints. Rapid growth has been curtailed by restricting

the use of field cameras, setting a higher standard of selection, and designating the subjects especially in need of further illustration. There were sold 882 prints, 163 slides, 5 transparencies, and 7 bromides. Gifts were received of 190 prints and 1 lantern slide, 253 prints were purchased, and 297 were exchanged. Gifts were made of 2,709 prints (as against 1,677 last year) to 32 educational institutions, applicants for illustrations for 118 books and articles, and 18 other applicants. The offices of field men, chiefly on the National Forests, received 949 mounted duplicates. Useful duplicate collections are being made ready for the offices of supervisors.

The collection of lantern slides now contains 3,956 slides, 376 being added this year. The demand for lecture illustrations led to loans of 4,065 individual slides—1,710 more than last year.

WORK FOR THE ENSUING YEAR.

The investigation of logged-over areas will be continued and extended to the yellow pine region. Studies of white and yellow birch and ash will be undertaken. New silvical leaflets will be prepared upon the most important western conifers and a series of leaflets describing the silvical conditions on the National Forests will be begun. The silvical notes on species will be added to, with special attention to methods of silvicultural treatment in practice on the National Forests.

MANAGEMENT.

TIMBER SALES.

The past year showed marked progress in the handling of timber sales on the National Forests, through the added experience of Forest officers and increase in the number of trained men available for the work. Mistakes were less frequent than for the previous year, although the best standard attainable with the means at hand is still too low. Particular attention was given to the location and control of cutting areas and to the marking of timber, in order to leave those parts of the Forests which were lumbered in the best possible condition. Only those trees have been marked for cutting which a Forest officer has determined could be removed without endangering the permanence and productive capacity of the future forest. All healthy young trees of desirable species have been carefully preserved in the logging, and where they were not sufficient as a basis for a second crop, older trees of the same species have been left standing to seed up the ground. Wherever practicable, mature trees of kinds which yield inferior timber have been harvested to improve the quality of the stand. During the past year this gradual elimination of undesirable trees from the Forest was carried much further than before, since markets were found for large quantities of material which had hitherto been considered unsalable or of little value. For example, the use of white fir, heretofore considered unmerchantable throughout the West, has increased until in many localities it is practically equal in value to species which have long had standing in the lumber trade.

Similarly, a market was found in Utah for aspen, which has heretofore been regarded as unsalable. On the Pacific coast western hemlock sold for prices which indicate that its value as a commercial species has been well established by Forest Service tests.

In timber sales on the National Forests it is invariably required that the brush from the felled trees be disposed of so as to reduce both the danger from fire and the damage to the Forest should fire occur. Experiments conducted during the past year show that the best way to dispose of brush is not everywhere the same. Where the fire danger is great, it has proved most effective to pile all brush away from living trees and to burn it during the wet season. Where the fire danger is slight, the brush is lopped and left scattered on the ground, where it soon decays and adds to the organic constituents of the soil. In every timber sale, therefore, local conditions are carefully studied to determine how best to dispose of the brush and débris after logging.

Full use of the merchantable portion of every tree cut is insisted upon. As a result, lumbermen in the West have come to realize that the cutting of low stumps and the using of all trees as far into the tops as they are merchantable is of actual financial benefit to them, and the close utilization of all timber felled is spreading from the National Forests to private holdings.

During the past year applications were received to purchase timber on nearly every National Forest. The greatest demands were for timber from the lodgepole pine forests of the Rocky Mountains in Wyoming and Montana. A number of applications were received for timber on the Forests in the far Northwest, where the stand of timber is particularly heavy. These Forests have previously been considered too removed from recognized lines of transportation to justify logging operations. Moderately large sales were made in Idaho, Washington, and Oregon, and the demand from these regions is likely to increase.

Timber on Forests where the supply is very limited is reserved entirely for the use of settlers living in or near them, who would otherwise be put to great expense to meet their needs. Sales to supply the general market were made only where the supply of mature timber exceeds the local need.

The use of the timber resources of the National Forests was encouraged throughout the year. Three times as much timber was sold as in the fiscal year 1906. The following table shows for each State the amount and value of the timber sold. Since in many sales more than one year is allowed for removing the timber, the amount sold largely exceeds the amount cut and paid for.

Timber sold on the National Forests, July 1, 1906, to June 30, 1907.

State or Territory.	Amount.			Value.
	Feet B. M.	Cords.	Linear feet.	
Alaska	4,032,020	1,541	32,300	$2,426.50
Arizona	110,898,350	13,464	1,500	385,098.28
California	174,054,537	14,702	49,140	321,353.47
Colorado	42,205,077	11,121	40,100	77,536.88
Idaho	76,156,276	8,422	90,900	165,430.54
Montana	134,104,057	71,274	6,700	529,294.71
Nevada		7		21.75
New Mexico	59,097,988	6,853	514,318	159,196.74
Oklahoma		29½		103.76
Oregon	28,643,589	2,311	3,377	48,526.50
South Dakota	18,533,092	12,622		24,695.27
Utah	19,877,095	4,151	38,000	49,327.05
Washington	49,014,300	11,164	398,000	125,061.89
Wyoming	233,726,210	593		644,202.26
Total	950,342,591	158,257½	1,174,335	2,532,275.60

For every timber sale the actual value of the timber has been determined through study of the timber itself, its accessibility, and the market conditions of the region. Great care was taken to avoid the fixing of arbitrary values not justified by local conditions. The advertisement for competitive bids in all sales of timber for more than $100 in value still further insured the disposal of timber from National Forests for neither more nor less than its actual market value.

When rights of way are granted within National Forests, payment is required for the actual value of all timber necessarily cut or destroyed. The most important case of this kind during the past year was that of the Chicago, Milwaukee and St. Paul Railway Company. The right of way of this railroad, 200 feet wide, runs through the Helena, Lolo, Coeur d'Alene, and Washington Forests. The company agreed to clear, and keep clear, as a safeguard against fire, additional strips from 50 to 150 feet wide, according to the fire risk, on each side of its right of way, and to pay the market value for all merchantable timber cut.

Not only is timber sold from the National Forests, but it is also given away under the regulations providing for the free use of timber by settlers, prospectors, miners, and others who may not reasonably be required to purchase. Full advantage of these regulations has been taken by the people living in the vicinity of National Forests, and large quantities of saw timber, fuel, and fencing are taken every year for use on ranches and in developing mining claims and for other domestic use. During the past year more than 15,000 permits to take timber free of charge from National Forests were issued. The timber involved was valued at more than $75,000. The cutting of timber given away under free-use permit is carefully regulated so as to provide for the safety of the Forests, as in timber sales, but particular attention is given to insure that settlers obtain timber which they desire, easily and quickly.

The readiness with which timber may be had by purchase and under the free-use regulations has resulted in the almost complete absence of timber trespassing on National Forests during the past year. By far the larger number of the trespasses reported during the year were committed before the timber involved was included within a National Forest. Some of the trespassers themselves notified the Forest officers that they had cut the timber, and offered settlement. The total receipts from the settlement of timber trespasses during the year were $65,536.32.

RECONNAISSANCE.

To guide the Service in selling National Forest timber, systematic estimates of the total stand of merchantable timber of the different species were carried forward vigorously. A detailed working plan was prepared during the past year for Henrys Lake National Forest, in Idaho, to determine how much timber may be cut from it annually, without impairing the supply required to provide for local needs. Plans for regulating the cut on all National Forests were also taken up on the basis of the best available estimates and the present demand.

Data were collected for the preparation of volume tables of western yellow pine, and a careful study of the amounts and grades of lumber sawed from National Forest timber was begun.

COOPERATION.

At the request of the Secretary of War, recommendations were made for the conduct of a sale of part of the dead and mature timber on the Fort Wingate Military Reservation in New Mexico. Supervision of the cutting was placed in the hands of a member of the Forest Service, which also involved the running of interior lines and the marking of the timber to be cut on 1,240 acres. This work will probably continue for several years.

At the request of the Secretary of the Interior, field examinations of logging conditions and timber values were made on Indian lands which under the law were to be sold. In Indian Territory recommendations were made for the sale of timber on certain allotments in accordance with the act of April 26, 1906. As a result of the investigation the Indians, for whose benefit the timber is to be sold, will receive a sum greatly in excess of what otherwise would have been realized by them.

Cooperative State forest studies were carried on with California, Delaware, Missouri, and Kentucky. The work in California included a commercial tree study of the redwood and the completion of a series of studies of the forests of the State.

In Delaware a careful study of the forest resources of the State was made and a report issued, in cooperation with the Delaware Agricultural Experiment Station. A report was prepared discussing the present conditions and making recommendations for their improvement. Special attention was paid to the comparative value of the forested lands for agriculture and for the production of timber.

Cooperation with the Missouri Agricultural Experiment Station secured information concerning the forest resources of the Ozark region and a basis for recommendations concerning a State forest policy.

In Kentucky work was begun on a study of forest conditions of the State in cooperation with the State Board of Agriculture, Forestry, and Immigration.

During the year 46 owners of timberlands and 45 woodlot owners applied for field examinations and advice for the management of their property in 20 States and Territories. In addition to the request for field work, a large number of private owners received advice concerning the use and improvement of their forest lands.

It was learned through letters of inquiry sent to private owners for whom working plans have in the past been made that fully 75 per cent have adopted the plans laid down for them and are now lumbering conservatively or in some other way applying practical forestry.

THE FOREST ATLAS.

During the year a radical change was made in the methods of recording, classifying, and making available for reference upon maps the information concerning the forests of the country, and especially

the National Forests, gathered by the Service. A scheme was adopted which improved and standardized the methods employed, both in field and in office work. By the use of graphic symbols like those of the U. S. Geological Survey and the Coast and Geodetic Survey, record is made of the character of the land and of the forest, its ownership, grazing conditions, and other matters. To take charge of the maps on which appear the data thus gathered and to keep them always up to date, a special section, that of "The Forest Atlas," was created.

Folios of the more important Forests are being printed for the use of the field men. Others are duplicated by photography, and copies are furnished to supervisors. The work of preparing these maps of the National Forests was done in cooperation with the U. S. Geological Survey, which already had carefully prepared topographic maps of much of the country now included within the National Forests.

GRAZING.

RANGE CONDITIONS.

The favorable conditions of the preceding year continued through the past season. The crop of grass and other forage was unusually good. Stock grazed upon the National Forests made good weight, and losses were very small, except that the extremely cold weather in the early spring caused in some localities a heavy loss of lambs, of which the crop was generally only fair.

The heavy fall of snow during the last winter made it impossible to reach many of the summer ranges on the usual opening date, and in many cases the feed was from two to three weeks late. In consequence the summer grazing season on the higher ranges this year will be a short one and there will be an abundance of feed for the stock which regularly graze there.

The general conditions on the National Forest range are very satisfactory. Many letters from users of the range report an improvement in the weight and condition of their stock and a decrease in losses from straying and other causes. Most of the stockmen who use the range are well satisfied with the results of regulating the grazing, and are giving hearty support to the Forest officers in their work of administration.

CONTROL.

The regulation of grazing was applied on 50 new Forests. On all the National Forests which were created after March 1, 1907, and on all additions to the older Forests which were made subsequent to that date, the stock which had regularly occupied the range were allowed to remain during the season without the payment of any grazing fee.

In some of the Forests which have been under administration a sufficient length of time to secure an improvement in forage conditions an increase was made in the number of stock allowed, while in a few newly created Forests it was necessary to make reductions in order to stop damage from overgrazing.

PERMITS ISSUED.

In the 142 Forests which were under administration prior to March 1, 23,662 applications for grazing permits were approved by the Forest officers in charge, as follows:

Grazing permits approved.

State or Territory.	Cattle and horses.			Sheep and goats.	
	Permits.	Stock for summer season.	Stock for year-long season.	Permits.	Stock for summer season.
Arizona	769	36,517	80,153	103	287,368
California	2,268	128,761	21,621	282	386,142
Colorado	2,757	213,670	8,845	224	446,917
Idaho	2,035	115,126	3,973	609	1,825,484
Kansas	15	2,190	600		
Montana	1,836	126,730	13,371	160	480,852
Nebraska	58	24,686	1,133		
Nevada	142	16,448	373	19	89,450
New Mexico	1,283	11,173	61,010	465	376,408
Oklahoma	32	222	2,017		
Oregon	1,255	111,819	3,207	495	940,154
South Dakota	453	13,475	20		
Utah	4,076	115,489	891	1,150	917,963
Washington	367	19,551	113	104	172,323
Wyoming	633	65,148	1,826	198	734,022
Total	17,979	1,001,005	199,153	3,809	6,657,083

The average number of cattle and horses grazed under each permit was 67 head and the average number of sheep 1,748 head. This shows conclusively that the small owners have preference in the use of the National Forest ranges.

The total receipts on account of the above permits were $857,856.83.

Only 8 per cent of the applicants failed to pay the grazing fees and to accept the permits applied for, and without doubt many of these will accept their permits before the close of the season. This is exactly the same percentage as last year, which shows the steady condition of business and indicates general satisfaction with the management of grazing upon the Forests.

That stock might be driven across the National Forests in transit between summer and winter ranges and to reach points of shipment 833 crossing permits were issued by the officers in charge of 66 Forests, covering 36,807 head of cattle and horses and 2,051,881 head of sheep and goats.

No permit is required for stock which is driven along a public highway, or when National Forest lands will not be grazed upon en route.

Applications were made by 616 owners or lessees of private lands, within 52 Forests, to drive 35,674 head of cattle and horses and 182,622 head of sheep and goats across Forest lands to reach 836,014 acres of private land. The owners or lessees of 730,855 acres of this land made special agreements, waiving the right to the exclusive use of the land and allowing stock permitted to graze on the National Forests to enter upon it. In exchange for this concession permits were issued allowing 29,170 head of cattle and horses and 159,851

head of sheep and goats to graze upon the National Forests free of charge.

Under a cooperative agreement entered into with the land board of the State of Utah, by which the State in return for the use of its lands within National Forests sells permits to graze a stipulated number of cattle, horses, and sheep upon the National Forests within that State, 85 permits were issued allowing 747 head of cattle and horses and 12,242 head of sheep to be grazed upon 8 Forests.

ADVISORY BOARDS.

The advisory boards of live stock associations, representing the majority of the users of certain defined ranges, were recognized by the Forester for 20 of the National Forests, and satisfactory adjustments of important grazing questions were made by the Forest officers in cooperation with them.

GRAZING TRESPASSES.

During the past fiscal year 183 cases of grazing trespass were reported by the officers in charge of 44 of the National Forests. In 165 of these cases propositions to make settlement by the payment of damages were accepted, and civil action was closed. The total amount collected for grazing trespass damages was $5,576.80.

Of the unsettled cases, 3 are those of trespassers who are under bond to appear before the United States jury on a charge of criminal trespass, 2 are pending in court, and the remaining 13 were reported during the months of May and June, when the time was too short to secure settlement before the close of the year.

QUARANTINE LAWS AND REGULATIONS.

The Bureau of Animal Industry required all sheep permitted to graze upon the National Forests of Arizona, New Mexico, Colorado, Utah, Idaho, Nevada, and Oregon, and also upon the Tahoe, Stanislaus, and Diamond Mountain National Forests of California and the Wenaha National Forest of Washington, to be inspected before entering the National Forest ranges and to be dipped when found to have been exposed to or infected with scab. Upon the Medicine Bow National Forest of Wyoming, on account of the prevalence of scab among the stock grazed upon the adjoining ranges, all cattle were required to be dipped before entering.

The State and Territorial authorities have in all cases heartily cooperated with the Government inspectors, and this disease will soon be entirely eradicated from the stock grazed upon the National Forest ranges.

WORK OF THE ENSUING YEAR.

The regulation of grazing along the same lines followed in the past will be continued and extended to the Forests created since March 1. As fast as improved condition of the range makes it possible the number of stock permitted to graze will be increased. No change will be made in the general scale of charge, but in certain cases local changes will be made to equalize the rate.

To give the stockmen the very best possible use of the National Forest ranges, special effort will be made to encourage the organization of associations, so that through advisory boards the stockmen may assist in the settlement of matters affecting their interests. Through cooperative work great improvement can be made in the condition of the ranges and the method of using them, and the result will be beneficial to all interests concerned.

DEVELOPMENT.

FORAGE INVESTIGATIONS.

Because of the urgent need for improvement in the production of forage upon ranges which have been injured by overgrazing, the question of reseeding received special attention during the past year. Investigations were commenced in cooperation with the Bureau of Plant Industry to discover under what conditions and in what localities it will be possible to secure natural reproduction of the valuable forage grasses and plants, and also how and where it will be possible to plant new seed successfully.

WORK OF THE ENSUING YEAR.

Studies will be made of the manner in which stock is now being handled upon the ranges, with a view to stopping any unnecessary damage and ascertaining during what period each range can be used with the most economy, and also of the life of the grasses and plants to learn how to secure natural reseeding of the ranges.

Experiments will be made in fencing certain ranges and in trying new methods of handling stock within the pastures. Experiments will also be made in planting both natural and imported seed upon sections of the range which will be open to grazing, as well as upon fenced areas, from which stock will be excluded.

It is expected that by the close of the next fiscal year it will be possible to report the results of the first season's investigations and experiments.

PRODUCTS.

In each of the three offices of this Branch—Wood Utilization, Wood Preservation, and Publication—the volume of work handled was greater and the results obtained were better than ever before.

WOOD UTILIZATION.

The Office of Wood Utilization is rapidly becoming a recognized authority throughout the United States upon the subjects which it handles. Its efforts to ascertain the amount of the annual drain upon our forests and to point out the most economical means of utilizing forest products are doing much to bring about a public realization of the necessity for taking prompt and vigorous measures to insure a future timber supply.

WOOD CHEMISTRY.

The work on zinc estimations, to discover the penetration of zinc chlorid in treated timber, was completed, and analyses were also made of a number of samples of treating-plant solutions.

The physical properties of creosote oils were carefully studied, with a view to perfecting methods for grading creosotes and detecting the presence of substances other than the distillates from pure coal tar. Methods for the detection of oils of the paraffin series in the presence of creosote and for estimating the moisture in creosoted wood were worked out.

A study to determine the variation of the soluble constituents of chestnut during the different seasons of the year, and the rate at which these materials leach from the cut timber, was begun.

Wood distillation was studied at the leading commercial plants in both the North and the South. Particular attention was given to the possibility of utilizing waste material by means of distillation, and the uses of the resulting products. A laboratory study was made of the turpentine obtained by the distillation of southern pine, which lays the foundation for scientific methods of grading it.

The technical methods of analyzing tanning materials received attention, and a study in cooperation with a San Francisco lumber company to determine the amount of tannin present in the waste from redwood lumbering was begun.

The equipment of the wood-pulp laboratory at South Boston was completed. The woods from which pulp was prepared include red spruce, white fir, loblolly pine, scrub pine, tupelo, hemlock, tamarack, and cypress. It was shown that all of these woods can be made to yield a merchantable pulp. The samples obtained were in some cases superior to ordinary commercial grades of unbleached pulp.

COMPUTING.

The section of computing received and tabulated a very large volume of data, including 21,000 log tallies, 11,850 tree analyses, 1,980 acre surveys, 590 sample plots, 10,100 card schedules, monthly weights for twelve months, of 1,550 poles, 10,000 ties, and 10,000 cross-arms and computations for 1,250 timber tests. Miscellaneous work included the checking of scale books, for timber sales on the National Forests, and numerous less important items.

The compiling and editing of forest tables covering all measurements thus far collected has been undertaken, supplementary measurements to be collected during the coming field season, with a view to the preparation of tables of stand, growth, volume, and form for all the more important timber trees in the National Forests. Similar data for the important trees of the Southern, Central, and Northeastern sections will be compiled as soon as possible.

DRAFTING.

The section of drafting made maps and did general graphic work for 100 distinct projects, about 90 per cent of which were directly connected with the National Forests. The output for the year included 1,489 maps of different kinds and 302 miscellaneous drawings. Map files for reference were also kept. Maps of the National Forests were prepared for publishers of maps and school geographies.

TIMBER TESTS.

Information on the mechanical and physical properties of wood is in strong demand. The structural timber tests were put to immediate use by the American Railway Engineering and Maintenance of Way Association and the American Society for Testing Materials in drawing up standard specifications of such timbers. The work promoted interest in a more scientific use of wood, which is synonymous with a more economical use.

The tests were made at laboratories run in cooperation with Yale University, Purdue University, the University of California, the University of Oregon, and the University of Washington. To coordinate closely the work of these different laboratories an office having general supervision over all the work was established at Washington early in 1907.

WORK COMPLETED DURING THE YEAR.—There were made during the year 10,726 mechanical tests, of which 1,871 were in bending, 7,957 in compression, and 898 in shearing.

These tests developed, among other facts, that white fir and Engelmann spruce have about the same strength as eastern spruce, while lodgepole pine is almost as strong as loblolly pine; that in small pieces sound dead timber of these species has about 85 per cent of the strength of live, and that these woods are suitable for many purposes for which more valuable woods are now being used; that various species of eucalypts compare favorably in strength with our strongest native woods, and will probably make suitable material for vehicles and implements; that insulator pins of live oak and rock elm have, respectively, 75 and 65 per cent of the strength of locust pins; that in railroad ties of white and red oak, loblolly pine, hardy and common catalpa, and chestnut, with spikes of the common, channeled, and screw types, the channeled spike has 12 per cent more holding power than the common spike and the screw spike about twice that of the common spike, while white oak has the greatest holding power of the species tested; that western hemlock timber has much structural merit, being a little stronger than loblolly pine; and that Norway pine is weaker than tamarack, and both are weaker than Douglas fir, longleaf pine, loblolly pine, and western hemlock.

Tests of loblolly pine bridge stringers secured, with the previous work upon this species, sufficient data to form the basis of an authoritative future report upon its mechanical and physical properties. Data were secured as to the effect of knots and other defects, rate of growth, specific gravity, proportion of summerwood, and various other qualities on the strength of large Douglas fir timbers. Tests on vehicle woods covered spokes, axles, wagon and cultivator poles, and buggy shafts, and developed that the discrimination made by the trade against red hickory is not justified in so far as its strength is concerned. Tests on wagon axles showed the relative value of maple and hickory, and the benefits derived from various forms of trussing. The results of these tests will enable vehicle manufacturers to use material more economically and assist them to find satisfactory substitutes for woods that are now hard to secure.

Tests to determine the fiber-saturation point and moisture strength relations for loblolly pine, Douglas fir, *Eucalyptus globulus*, western

hemlock, tamarack, and Norway pine furnished helpful information on the amount and influence of water absorbed by different woods, and establish that wood does not begin to shrink until its moisture content is reduced below the saturation point. The per cent of moisture which suffices to saturate the cell walls of wood varies between 20 and 30.

The studies now being carried on include tests of the strength of several species of wood when subjected to reversal of stress, the results of which are expected to throw light upon the question of fatigue in telephone and telegraph poles; investigation of the effect of various drying and treating processes upon the strength of wood, including treatments in which superheated steam is used, and dry-air treatments in which high temperatures and air at high pressures are used; studies of various other problems connected with the moisture content of wood; tests of small specimens of wood under dead loads, from which it is hoped to derive factors enabling the engineer to apply results obtained from tests under gradual loading to the design of structures subjected to dead loads; further tests of California eucalypts, including some important new species; and work on the shrinkage factors of Douglas fir, western hemlock, and several other western woods. The testing of western hemlock is still in progress, and tests are being continued to determine the strength of timber obtained from the National Forests.

STATISTICS.

During the early part of the fiscal year the compilation of the statistics of forest products collected during the preceding year was completed and published. On January 1, 1907, the collection of these annual statistics of forest products was transferred to the Bureau of the Census, under a cooperative plan which greatly increased the efficiency of the work. In 1906 reports were received from less than 12,000 lumber manufacturers; in 1907 from more than 21,000 manufacturers, with corresponding increases in other lines. The information concerning the annual drain upon the forests of the United States is now far more complete than ever before. The National Lumber Manufacturers' Association continued its cooperation in the statistical work, and has taken an active part in collecting the data. Preliminary circulars showing the total production of lumber, lath, and shingles, the consumption of tanbark, crossties, pulpwood, telegraph and telephone poles, and the wood used in the manufacture of tight and slack cooperage stock, veneer, and for distillation during 1906 were recently issued. The final reports are being prepared.

SPECIAL STUDIES.

A special study of dead and mature timber on the National Forests involved field investigations in the Battlement Mesa, Beaver, Gunnison, Holy Cross, Jemez, Medicine Bow, Montezuma, Pecos River, Pikes Peak, White River, and Uinta Forests.

A statistical study of the uses of wood was made by securing reports from the leading manufacturing concerns on the amount and kinds of wood used by them for various purposes. Current quotations of the market prices by grades of all the commercial kinds of

lumber in the United States were compiled at short intervals. Stumpage prices were obtained for the different commercial species throughout the United States, furnishing data especially useful to the Service in its timber sales.

Addresses were delivered before 19 meetings of lumber manufacturers, wood users, and engineers. Thirteen trade bulletins furnished short statements of the scientific and practical results of investigations, and were widely used by the trade and technical journals.

WORK OF THE ENSUING YEAR.

The section of wood chemistry will study wood preservatives, wood distillation problems, and pulpwood. There are great possibilities in the utilization of wood waste by chemical means, and the Forest Service will energetically seek their development. To secure increased efficiency in administration and operation, the chemical laboratory will be brought from New Haven and the pulp laboratory from Boston to Washington, where they will be combined under one roof. The possibility of profitably distilling fat Douglas fir will be studied on the ground, and in the South field work will seek methods of properly refining and grading yellow pine distillation products under commercial conditions. The leading yellow-pine manufacturers have offered to contribute toward this work.

Besides computing forest tables, timber tests, seasoning experiments, tree measurements, and other lines of Service work, the section of computing will gather in the field supplementary measurements on Douglas fir, sugar pine, and possibly several other Pacific Coast species.

The section of wood uses will continue to secure accurate and authoritative data upon the uses, properties, and market conditions of the commercial timbers of the country, and also to develop fields of usefulness for timber that is at present largely wasted. The mechanical and physical properties of redwood timbers and of the California tanbark oak, large quantities of which are at present being cut for the bark only, will be studied. The work upon California eucalypts will be continued.

The study of the effect of different methods of drying and treating woods will be continued and the tests of Douglas fir car sills will be completed. It is expected to begin a series of tests upon creosoted Douglas fir and yellow pine bridge stringers in cooperation with some of the leading railroad companies. Tests upon shortleaf pine from Arkansas comparable with those already made upon loblolly and longleaf pine will establish the relative values of these three important southern woods.

Field studies upon the market conditions and the uses of some of the timbers found in the National Forests will be supplemented by tests made with the special purpose of demonstrating the usefulness of species which are now regarded with little favor. Work has been started on incense cedar, amabilis fir, and western larch.

WOOD PRESERVATION.

While the field of wood preservation in the United States is broadening, the principles of the different processes are now receiving closer scrutiny. The Forest Service is looked to for reliable and

impartial information. It has been able to discourage fraudulent methods and the investment of capital in processes founded on an unsound basis, and now largely directs the trend of investigations and practice in this country. It has obtained results of practical value to the small consumer by the discovery of a simple and practical method for preserving fence posts, shingles, and other farm timbers. The entire expense of extensive investigations is borne by the cooperators.

Study of the general subject of wood preservation involves attack upon a series of subordinate problems which center in the seasoning of wood. Precise knowledge of the rate at which seasoning takes place and the effect of such modifying factors as previous water-soaking, different methods of exposure to the air, time of year when the timber was cut, and the conditions under which it was grown, is essential in order to devise the best practical methods of preserving wood. All of the experimental timber collected in connection with the projects was weighed at regular intervals. A considerable portion of it was accurately measured when freshly cut, when partially seasoned, and when air-dry—and in this way exact data on the shrinkage and the rate of seasoning were obtained. After treatment the material experimented upon was in each case put into service under conditions which will test the relative preserving power of the different processes.

WORK COMPLETED.

The following work was completed during the year:

Experiments in seasoning and treating arborvitæ telephone poles at Escanaba, Mich., in cooperation with the American Telephone and Telegraph Company, and chestnut poles at Parkton, Md., in cooperation with the same company, resulted in a practical method for treating these poles on a commercial scale.

Experiments on yellow pine cross-arms at Norfolk, Va., made it possible to devise a system for handling, grading, seasoning, and treating this and similar classes of material which will insure cheaper, stronger, and more durable timber.

Experimental treatment of hemlock and tamarack cross-ties at the plant of the Chicago and Northwestern Railway Company, under cooperation with the company, resulted in a complete series of recommendations for the handling and treatment of the ties from the time they leave the woods until they are finally placed in the track. A marked improvement in the efficiency of the plant has followed, though there has not yet been time for all the recommendations to be put into effect.

Seasoned Douglas fir, western larch, and giant arborvitæ ties, part of which had been treated, some with creosote and some with zinc chlorid, were laid in the track of the Northern Pacific Railway Company for a test of durability and of the effectiveness of different kinds of tie plates and other devices for reducing mechanical wear by the rails.

Dead lodgepole pine fence posts from the Henrys Lake National Forest were treated with creosote in an open iron tank to discover the most efficient process at the lowest cost. The work was very successful and will have practical value to the ranchers and other timber users of the region.

The study of wood paving terminated with the laying, in cooperation with the city of Minneapolis, of an experimental pavement composed of different woods laid in different ways.

WORK IN PROGRESS.

On the following projects work is in progress:

In California experiments were made in seasoning poles of eucalyptus, western yellow pine, and giant arborvitæ from Washington. Yellow pine poles were treated by the open-tank process, with excellent results. The attempt to regulate the absorption of the oil was particularly successful, and a penetration of from 2 to 4 inches was secured at will. The experiments aroused great interest among both owners and consumers of structural timber in California, and promise not only to promote a more conservative utilization of the present timber supply, but also to bring into use new species, which, untreated, are not suited for structural use.

The study of the handling, seasoning, and treatment of mine timbers, begun last year in cooperation with companies in the anthracite region of Pennsylvania, has opened a field of importance. Artificial preservation of mine timbers had previously been thought to be impracticable. The Forest Service devised a simple and inexpensive treatment, and conclusively proved its economy. Among the preservatives used were common salt, magnesium chlorid, zinc chlorid, carbolineum, and many different grades of creosote. The open-tank method of treatment proved the most satisfactory, though brush applications were found of value when more thorough impregnation is impracticable. Large and quick results in promoting economy in the use of timber and increased knowledge of how to preserve wood effectively are looked for. The cooperating company is now erecting a plant, designed by the Forest Service and erected under its supervision, for commercial treatments.

The protection of wood employed in various marine uses against borers was taken up. Creosote was found to be the best protective agent that has been used. Plans are now drawn up for cooperative study of methods of treating timber used in building barges, scows, lighters, and other craft, both fresh and salt water, and for piling.

A study of the manufacture of distillates of coal and petroleum tar oils, and of the effect on the composition of creosote of the different methods used, secured better knowledge of the grades of creosote on the market and the precautions which must be taken to avoid adulterated or inferior oils. The subject intimately concerns the success of wood preservation in the United States.

Work is under way to compile and index all extant seasoning and treating data.

Addresses were made before the annual meetings of the Wood Preservers and the American Railway Engineering and Maintenance of Way associations, and before the Philadelphia and Reading Coal and Iron Company Employees' Association.

WORK OF THE ENSUING YEAR.

The lines of work now in hand will be continued. Simple and economical methods of preserving telephone and telegraph poles, cross-ties, mine timbers, vineyard stakes, and all other timbers exposed

to rapid decay, the supplies of which are drawn from National Forests, will be sought. Success will enhance the value of the National Forests by opening up uses for dead timber and timber of inferior species. In cooperation with the agricultural departments of several Southern and Middle Western States experiments and demonstrations will be conducted in preserving for fence posts and other farm purposes such easily decaying species as loblolly pine, cottonwood, and willow, which are plentiful where the more durable woods have been exhausted or never grew. Preservation by an adaptation of the open-tank method is so simple and inexpensive as to permit every farmer to erect a tank and treat his own timber.

PUBLICATION.

The office received for review 102 manuscripts, aggregating 3,712 typewritten pages. Of these, 66 were submitted for publication, 2 were returned to the authors for revision, 3 were unavailable for publication, and 31 are in the office. There were printed 61 new publications, with a total of 2,109,000 copies, reprints of 48 circulars, 11 Yearbook extracts, 10 bulletins, 1 annual report, and 1 manual, with a total of 497,100 copies, and revisions of 4 circulars, with a total of 342,000 copies.

The office prepared 25 original articles, 16 press bulletins, with a total of 130,000 copies printed, and 14 trade bulletins, of which about 3,000 copies were printed.

Schemes for the distribution of all publications are now prepared in this office. Copies of all publications issued, except bulletins, of which the editions authorized by law were so small as to prohibit it, were sent to a special mailing list of 5,187 names. By the use of a general classified mailing list of over 693,000 names, descriptive notices of bulletins, circulars of information, and other publications of general interest were sent to those concerned in the subject-matter of the publications.

Educational work, which is in charge of the Office of Publication, was further extended through addresses made before 158 meetings in 32 States.

WORK OF THE COMING YEAR.

Besides continuing the lines of work of the past year, cooperation will be sought with school-teachers and officers of public instruction to broaden the work in education. Publications for the use of teachers will be prepared.

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Issued May 13, 1909.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 358.

A PRIMER OF FORESTRY.

PART II:
PRACTICAL FORESTRY.

BY

GIFFORD PINCHOT,
FORESTER.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., March 15, 1909.

SIR: I have the honor to transmit herewith, for publication as a Farmers' Bulletin, Part II of A Primer of Forestry, bearing the subtitle Practical Forestry. This matter was published in 1905 as Part II of Bulletin 24 of the Forest Service, for which there is a great and continuing demand. To meet this demand Part I has already been issued as Farmers' Bulletin 173, and the issuance of Part II in similar form will make the entire bulletin available for general distribution. The number of illustrations has been considerably reduced.

Respectfully,

GIFFORD PINCHOT, *Forester.*

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

A PRIMER OF FORESTRY.

PART II: PRACTICAL FORESTRY.

FOREST MANAGEMENT.

THE SERVICE OF THE FOREST.

Next to the earth itself the forest is the most useful servant of man. Not only does it sustain and regulate the streams, moderate the winds, and beautify the land, but it also supplies wood, the most widely used of all materials. Its uses are numberless, and the demands which are made upon it by mankind are numberless also. It is essential to the well-being of mankind that these demands should be met. They must be met steadily, fully, and at the right time if the forest is to give its best service. The object of practical forestry is precisely to make the forest render its best service to man in such a way as to increase rather than to diminish its usefulness in the future. Forest management and conservative lumbering are other names for practical forestry. Under whatever name it may be known, practical forestry means both the use and the preservation of the forest.

THE USES OF THE FOREST.

A forest, large or small, may render its service in many ways. It may reach its highest usefulness by standing as a safeguard against floods, winds, snow slides, moving sands, or especially against the dearth of water in the streams. A forest used in this way is called a protection forest, and is usually found in the mountains, or on bleak, open plains, or by the sea. Forests which protect the headwaters of streams used for irrigation, and many of the larger wind-breaks of the Western plains, are protection forests. The Adirondack and Catskill woodlands were regarded as protection forests by the people of the State of New York when they forbade, in the constitution of 1895, the felling, destruction, or removal of any trees from the State Forest Preserve.

A farmer living directly on the produce of his land would find his woodlot most useful to him when it supplied the largest amount of wood for his peculiar needs, or the best grazing for his cattle. A railroad holding land which it did not wish to sell would perhaps find it

most useful when it produced the greatest number of ties and bridge timbers. In both cases the forest would render its best service by producing the greatest quantity of valuable material. This is the central idea upon which the national forests of France are managed.

The greatest return in money may be the service most desired of the forest. If a farmer wished to sell the product of his woodlot instead of consuming it himself, his woodland would be useful to him just in proportion to its net yield in money. This is true also in the case of any owner of a forest who wishes to dispose of its product, but who can not, or will not, sell the forest itself. State forests, like

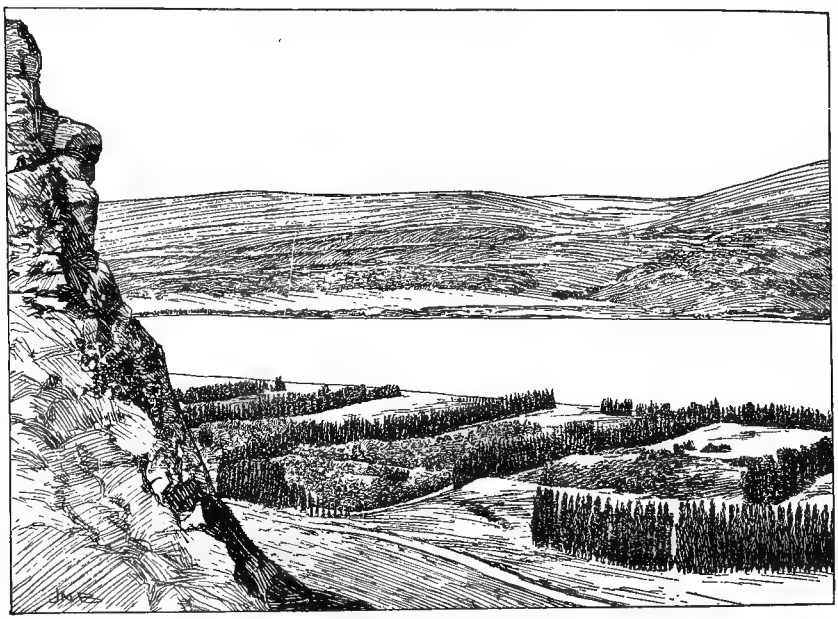

FIG. 1.—Wind-breaks of Lombardy poplar, intended to protect orchard trees against wind and moving sand, near The Dalles, Oregon.

those in the Adirondacks, often render their best service, in addition to their usefulness as protection forests, by producing the greatest net money return.

Regarded as an investment of capital, a forest is most useful when it yields the highest rate of interest. A forest whose owner could sell it if he chose, but prefers to hold it as productive capital, is useful in proportion to the interest it yields on the money invested in it. Thus, an acre of sprout land may be worth only $5, while the investment in adjoining land stocked with old trees may be $50 an acre. This is the view which controls the management of state forests in Germany. Lumbermen also regard timber land as an investment, but usually they take no care except for the yield at the moment. They disre-

gard the future yield altogether, and in consequence the forest loses its capital value, or may even be totally destroyed. Well-managed forests, on the other hand, are made to yield their service always without endangering the future yield, and usually to its great advantage. Like the plant of a successful manufacturer, a forest should increase in productiveness and value year by year.

FIG. 2.—Scene in the Sihlwald, the town forest of Zurich, Switzerland, from which its owner desires the greatest net money return.

Under various circumstances, then, a forest may yield its best return in protection, in wood, grass, or other forest products, in money, or in interest on the capital it represents. But whichever of these ways of using the forest may be chosen in any given case, the fundamental idea in forestry is that of perpetuation by wise use—that is, of making the forest yield the best service possible at the present in such a way that its usefulness in the future will not be diminished, but rather increased.

FOUR REQUIREMENTS FOR THE BEST SERVICE.

A forest well managed under the methods of practical forestry will yield a return in one of the ways just mentioned. There are, however, four things a forest must have before it can be in condition to render the best service.

The first of these is protection, especially against fire, overgrazing, and thieves, for without such protection no investment is secure and the most skillful management is of little effect.

FIG. 3.—Vigorous reproduction along the edge of a forest. Germany.

The second is strong and abundant reproduction. A forest without young growth is like a family without children. It will speedily die out.

The third requirement is a regular supply of trees ripe for the ax. This can be secured only by the right proportion of each of the smaller sizes constantly coming on in the growing forest. Thus, a farmer in need of fuel might be much inconvenienced to find no trees on his woodlot big enough for cordwood, and it would not help him to know that twenty years later he would have an oversupply. In the same way a larger forest may yield only a very irregular and unsatisfactory

product if at one time there are too many ripe trees and at another too few. For example, if 100 acres become fit to cut this year, and 200 next year, and after that none at all until 500 acres become ripe fifteen years later, it is easy to see that the yield would come at very irregular and perhaps very inconvenient times. But a forest of 10,000 acres, composed of 100 even-aged groups of trees of every age from 1 to 100 years, each group 100 acres in extent, would plainly be able to furnish every year 100 acres of 100-year-old trees ready for the ax. In such a forest the right proportion of young trees would always be coming on.

The fourth requirement is growing space enough for every tree, so that the forest as a whole may not only produce wood as fast as possible, but the most valuable sort of wood as well. If the trees stand too far apart, their trunks will be short and thickly covered with branches, the lumber cut from them will be full of knots, and its value will be small. If, on the other hand, the trees stand too closely together, although their trunks will be tall and clear of branches, they will be small in diameter, and for that reason low in value. With the right amount of growing space, trees grow both tall and of good diameter, and their trunks supply lumber of higher price because it is wide and clear.

THE YIELD OF A FOREST.

One of the central ideas of forestry is that the amount of wood taken from any healthy forest and the amount grown by it should be as nearly equal as possible. If more grows than is cut, then the forest will be filled with overmature, decaying trees; but if more wood is cut than is grown, then the supply of ripe trees will be exhausted, and the value of the forest will decline. To make the cut equal to the growth does not mean that the volume of wood grown each year on every acre should be cut from that acre, but that the total growth of all the acres, for one or for a number of years, should be cut from the forest in the corresponding period. Thus, if the growth or increase is 100 cords a year, that amount might be harvested yearly by cutting every tree on a small area, by cutting fewer trees per acre on a larger area, by distributing the cut every year over the whole surface of the forest, or by cutting 1,000 cords in any one of these ways once in ten years.

There are many different methods of finding what is the annual increase of wood in a forest. One of the simplest is to count the number of trees upon an acre and select an average tree, then to cut it down, measure its cubic contents, and find its age by counting the annual rings. That done, the yearly increase of the average tree may be found by dividing its cubic contents by the years of its age.

Finally, since we have found the yearly increase per tree and the number of trees per acre, it is easy to find the average yearly increase per acre. It is unfortunate that this simple and easy process is not always reliable, because it is hard to find either an average acre or an average tree.

The yield of a forest is the amount of wood that is taken from it in a given time. When a forest is put under conservative management, one of the most important steps is to decide how much timber can safely be taken from it; in other words, to determine the yield. There are three principal ways of doing so.

The first, and the least used, is to fix the yield at a certain number of mature trees. By this plan the yield of a certain forest might be 100 pines, 260 spruces, and 180 hemlocks, each of a given diameter, every year.

The second way is to fix the yield at a certain amount or volume of wood. Thus, the yield of a large forest might be fixed at 25,000,000 feet board measure every ten years, and that of another smaller one at 750 cords every year.

The third way is to settle upon a certain number of acres to be cut over yearly or once in a given number of years. By this method the yield of a forest of 600 acres might be fixed at 6 acres of mature timber a year, and that of another at 300 acres every twenty-five years. The time between two successive cuttings on the same area must be long enough to allow the young trees left standing to mature. That time is found by studying the rate of growth in diameter.

This method of determining the yield by area is much the most practicable of the three for the forests of the United States, and in general it is the simplest and most widely useful of all, because it does away with the difficult task of determining the yearly increase in wood.

The objects in handling forests are so various that sometimes no single one of these methods is satisfactory, and then combinations of them are of great use. Thus, by combining the method by volume and the method by area the annual yield of a forest might be established at 250 board feet per acre. This yield might be cut from the forest every year, or it might be allowed to accumulate for twenty years, and then 5,000 board feet per acre might be cut.

SILVICULTURAL SYSTEMS.

After the yield has been found it must be cut not only without injury to the future value of the forest, but in such a way as to increase its safety and usefulness. To this end certain ways of handling forests, called silvicultural systems, have grown up. They are based on the nature of the forest itself, and are chiefly imitations of what men have seen happen in the forest without their help.

From the point of view of forest management, one of the principal differences between trees is whether they spring directly from seed or are produced as sprouts from stumps or roots already in the ground. A forest composed of seedling trees is called a seed forest, or more commonly but less suitably, a seedling or high forest. One composed of sprouts is spoken of as a sprout or coppice forest, or, more often, simply as coppice, or as sprout land. Seed forests are usually composed of coniferous trees, which rarely sprout, or of broadleaf trees allowed to reach large size. Sprout forests are common wherever broadleaf trees are cut while they are still young, for

FIG. 4.—Seed forest of fir in Washington.

the sprouting power usually diminishes with age. Sprouts never reach so great a height and diameter as seedling trees, although in youth they grow much faster; and they are apt to be unsound, because the old stumps decay and infect the sprouts which spring from them.

Simple coppice.—It oftens happens, as in Pennsylvania or New Jersey, that a fire sweeps over the second-growth hardwood lands and kills all the young trees down to the ground; but the roots remain alive, and from them spring young sprouts about the bases of the burned trunks. After several years a second fire may follow and kill back the sprouts again, and other fires may continue at

intervals to burn over the land, each followed by a new crop of sprouts. When a farmer does with the ax what is often done by fire he is using the system of simple coppice. Let us suppose a farmer has a woodlot covered principally with chestnut sprouts which he wants to manage for the steady production of railroad ties. He knows that chestnut sprouts are usually large enough for ties at the age of 35 years. In order to insure a steady yield of trees fit for ties, he divides the whole woodlot into thirty-five parts of equal productive capacity, and cuts one part clean every year. All the new sprouts that spring up on the part cut in any year are of the same age. At the end of thirty-five years, when the whole woodlot has been cut over, the thirty-five parts form a series of even-aged groups of sprouts from 1 to 35 years old. Every year the sprouts on one part reach the age of 35 years and are ready for cutting.

Simple coppice is a very useful silvicultural system, and the easiest of all to apply. The chief requirements for its success are good reproduction from the stumps, proper thinning (where thinning can be made to pay), and enough young seedlings among the sprouts to replace exhausted stumps with vigorous young ones. Stumps from which the sprouts have been cut many times finally grow weak and lose their power of sprouting.

In cutting sprouts it is important not to loosen the bark on the stumps, for that impairs their sprouting power, and to make the cut as near the ground as possible. Stumps cut level with the surface sprout best of all. In simple coppice, well handled, the reproduction takes place of itself without the need of further attention from the forester.

Many thousands of acres of American woodland, especially in New England, New York, Pennsylvania, and New Jersey, and in other places where chestnut is the principal tree, are treated under a rough system of simple coppice.

Stored coppice.—Among the trees which will produce only fuel, fence posts, or railroad ties there often stand in a woodlot others which would yield much larger returns if they were allowed to reach a greater age and size than the trees about them. If there were some white oaks scattered through the chestnut coppice just described, it might be well to let them grow large enough for the production of high-priced material like quartered oak lumber. In that case it would be necessary at the time of cutting the sprouts to select and leave standing a certain number of white oaks on every acre. As many of them as survived the increased exposure to wind and sun following the sudden removal of their neighbors would remain as standards over the young sprouts. The white oak standards thus chosen would remain uncut during two, three, four, or sometimes

even five successive crops of sprouts, and would form stout trunks with little taper, clear of branches almost to the full height reached by the sprouts.

This is the silvicultural system called stored coppice, or sometimes coppice under standards. The successful management of a

FIG. 5.—Yellow poplar sprout forest in Maryland.

forest under it depends largely upon the choice of the standards. They should be seedlings, for seedlings make the best trees, or the most vigorous and healthy sprouts if seedlings can not be found, and they should be distributed as regularly as possible over the ground. The standards should be numerous enough at first to allow for

heavy loss from wind and shock when the sprouts are cut away, but they should never be allowed to suppress the lower story of growth.

Stored coppice is a very useful system where the principal demand is for small material, like fuel, ties, and fencing, but where some large timber also is required. It was developed chiefly by the French, who use it with admirable results.

Seed or high forest.—By far the most useful and important forests are, as a rule, those which spring directly from seed, such as the pine forests of the Southern States and the great hardwood forests of the Mississippi Valley. Such forests are called seed forests. The seed-forest systems are of many kinds, some of which are peculiarly adapted for the management of certain forests in the United States. Just as the sprout-forest systems are chiefly useful to produce fuel, posts, ties, and trees of small size, so the seed-forest systems are producers of sawlogs and large timbers.

Regular seed forest.—When a tract of woodland is destroyed by fire in one of the Rocky Mountain States, it often happens that the seeds of the lodgepole pine are scattered over it by the wind in prodigious numbers. The seeds germinate abundantly, seedlings spring up, and in a very few years a young even-aged forest of lodgepole pine covers the ground. As it grows older fires destroy patches of it here and there, and in time every patch is covered again with a younger generation of even age. After many years the forest which sprang up after the first fire has become broken into a number of even-aged patches without uniformity in size or regular gradations in age.

Now let us suppose that this land was taken in hand by the Government when the lodgepole pine first came in, and that the lodgepole reaches its maturity at 80 years. If the government forest officers had divided such a forest into eighty parts, and then had cut the timber from one part each year, after a time they would have had eighty divisions, each covered with even-aged forest, but differing in age among themselves from 1 to 80 years. Every year one part would reach the age of 80 years and would be cut, and evidently the other seventy-nine parts would always be stocked with trees from 1 to 79 years old.

When the trees on one of the eighty divisions just mentioned become ripe for the ax, provision must be made for a new crop. This would be a very simple matter if the forest on that division could be reproduced naturally in one year, but that is practically impossible. Such rapid reproduction can be got only by planting, which is chiefly useful in the United States for making new forests and restoring injured forests, not for renewing old ones. Reproduction from the seed of the old trees is the only kind we need consider

here. In order to bring it about a few ripe trees are first cut down, to prepare a seedbed by giving light to the soil, and to fit the seed trees to bear more abundantly by giving the crowns more room. Then, when a good crop of seed is likely to appear, a few more trees are removed to give the future seedlings light enough for healthy growth, but not enough to expose them to danger from frost, drought, or the choking of grass and weeds, for young trees just starting in life are very sensitive and easily destroyed. Finally, as the young trees grow taller and stronger, what remains of the old crop is gradually

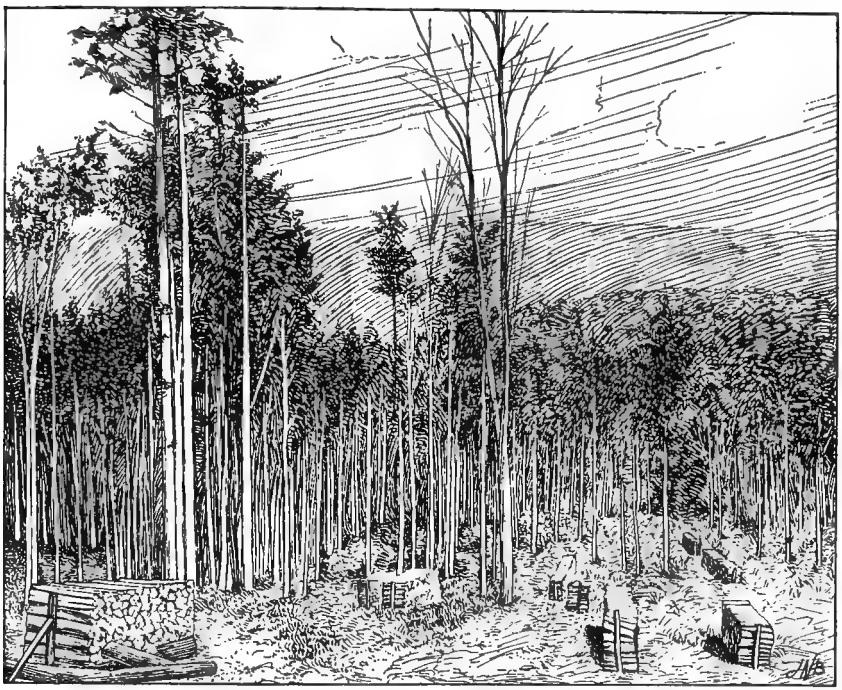

FIG. 6.—Mixed forest in process of gradual reproduction. Sihlwald, Switzerland.

cut away. When it is all gone, usually from ten to twenty years have passed since the reproduction cuttings were begun.

This is the system of regular seed forest. It is difficult to apply, and unsafe except in experienced hands. It has often been necessary to plant large areas at great expense because reproduction cuttings in regular seed forest have failed. The transportation of the timber is frequently expensive, because it must be spread over a number of years. On the other hand, when it is well applied this system produces the highest type of forest, full of tall straight trunks clear of branches, and consequently yields a high grade of timber and a large return in money.

Two-storied seed forest.—After a forest fire in Maine it frequently happens that the first tree to cover the ground is the popple, or quaking aspen. It is a slender, short-lived tree, intolerant of shade, with a light crown. After the popple has grown for some years, spruce

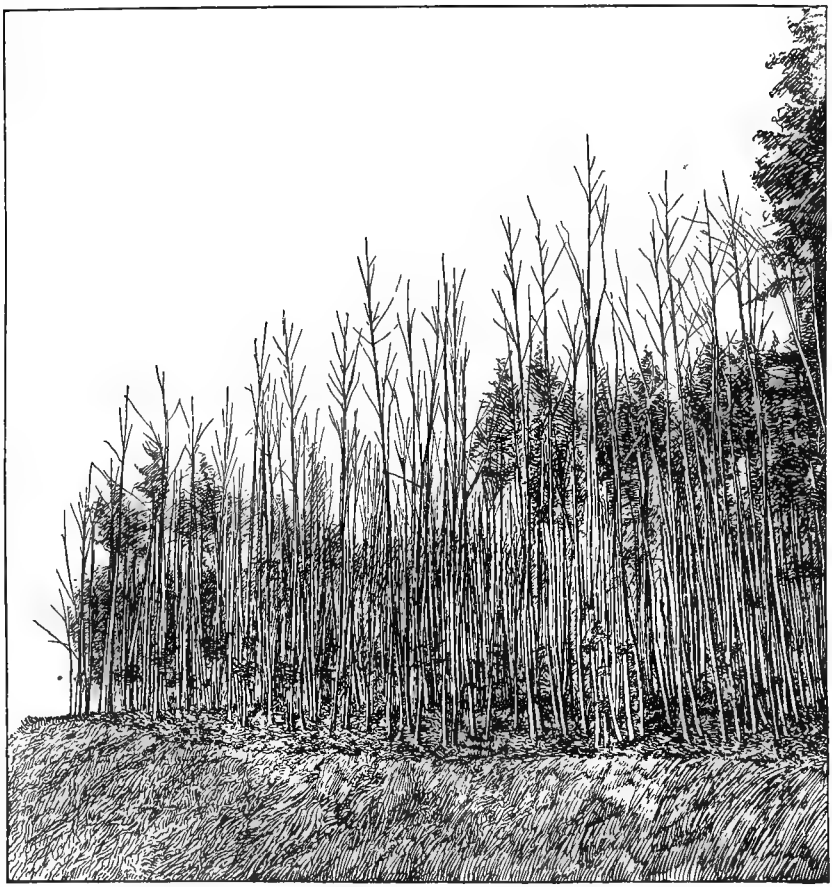

FIG. 7.—Reproduction obtained by process shown in figure 6. Sihlwald, Switzerland.

seedlings spring up under the friendly cover, and rapidly follow the popple in height. There grows up in this way a forest composed of an upper and a lower story of growth, in which, as so often happens, the lower story is of more importance.

The system of two-storied seed forest is useful when a tolerant tree like the spruce is to be grown under the shade of an intolerant tree like the aspen. In countries where forestry is well developed it is usual to plant young trees of tolerant species under older intolerant trees, to make a cover for the soil and to prevent the growth of grass

and weeds. Forests which closely resemble two-storied seed forests are common in the United States, but usually as the result of fire or careless cutting. Such are, for example, the forests of pine over oak in the southeastern United States, and of birch, beech, and maple under white pine in Michigan, Wisconsin, and Minnesota. It often happens, as in the case of the spruce and aspen, that both stories can not live on in good health together, and that the upper one must die or be cut away if the lower is to prosper.

Selection forest.—When a stand of aspen dies away from a young crop of spruce, the ground is no longer completely shaded, and there is light and room for other kinds of trees to come in. Thus, birch and maple seeds may be blown in by the wind and beechnuts carried and planted by squirrels, and eventually the pure stand of spruce is changed into a mixed forest of various ages. As the trees grow older, some of the spruce may be destroyed by beetles or thrown by the wind, and some of the broadleaf trees may die from fungous disease. Into the openings made by the death of older members of the forest fall the seeds from which younger members spring. So little by little the forest loses its even-aged character and there comes into existence what is called a natural or selection forest, in which trees of all ages are everywhere closely mixed together. Most virgin forests are selection forests.

The silvicultural system called pure selection is applied to forests of this kind. It is used chiefly for protection forests in places where it is desirable to keep the cover always unbroken; elsewhere it is out of place. Under this system the annual increase of the forest must be found before the yield can be determined. (See p. 7.) Then the fully mature trees are cut in every part of the forest every year. The cost of logging is high, for where single trees are taken here and there, roads or other means of transport must be very numerous and costly in proportion to the amount of the cut.

Localized selection.—Logging under the system just mentioned is so expensive as to prevent its application in the United States, except for woods like cherry and black walnut, which have a special and unusual value. But if, instead of taking the yield from every part of a selection forest, a comparatively small area is cut over each year, the cost of logging may be very greatly reduced. Such a method is admirably adapted to certain forest regions in the United States, as, for example, to the Adirondack Mountains of New York, where the forest is composed equally of coniferous and broadleaf trees. The conifers are the more valuable, and among them the principal lumber tree is the spruce.

The Forest Service has found by many careful measurements that if all spruce trees 12 inches and over in diameter are cut from certain

portions of the Adirondack forest, the younger spruce will grow up and replace the original stand of timber in about twenty years. But this will not happen unless the rules for cutting are faithfully observed, nor will it happen more than once unless enough old trees are left standing for seed. Such a forest may then be divided into twenty parts, and the merchantable timber about 12 inches in diam-

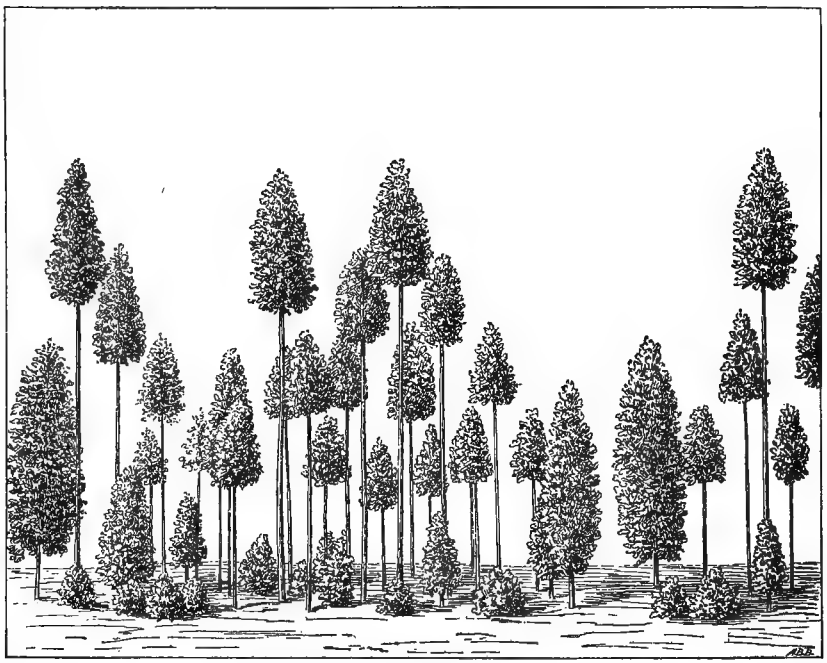

FIG. 8.—Mimic pure selection forest, showing mixture of ages.

eter may safely be cut from one division every year. By the time the last of the twenty divisions has been cut over, the first will have upon it a stand of mature spruce equal in quantity to that of twenty years before. The yield of the whole forest in spruce for a single year may be cut each year from one-twentieth of the whole area. If all the divisions were cut over five times in the life of a mature tree, then one-fifth of the standing timber would be taken from each division at each cutting. Thus, if it took one hundred years for a tree to become ripe for the ax, the cutting (at intervals of twenty years) would return five times during the life of the tree, at its twentieth, fortieth, sixtieth, eightieth, and one hundredth years.

This is the system of localized selection. It is simple and easy to apply, and even if mistakes occur they are not apt to have dangerous consequences. It is very elastic and has many forms, and it is well adapted to many different kinds of forest. Logging is cheap, because

the area cut over in any one year is small, and the reproduction is provided for by natural seeding in the openings of the forest

The group system.—It often happens that all the trees of a small group in the forest are killed by fire or insects at about the same time. In the opening thus made the ground is quickly covered with young growth, which extends back under the old trees as far as the light will permit. The seedlings are usually tallest, strongest, and most numerous directly under the middle of the opening, and gradu-

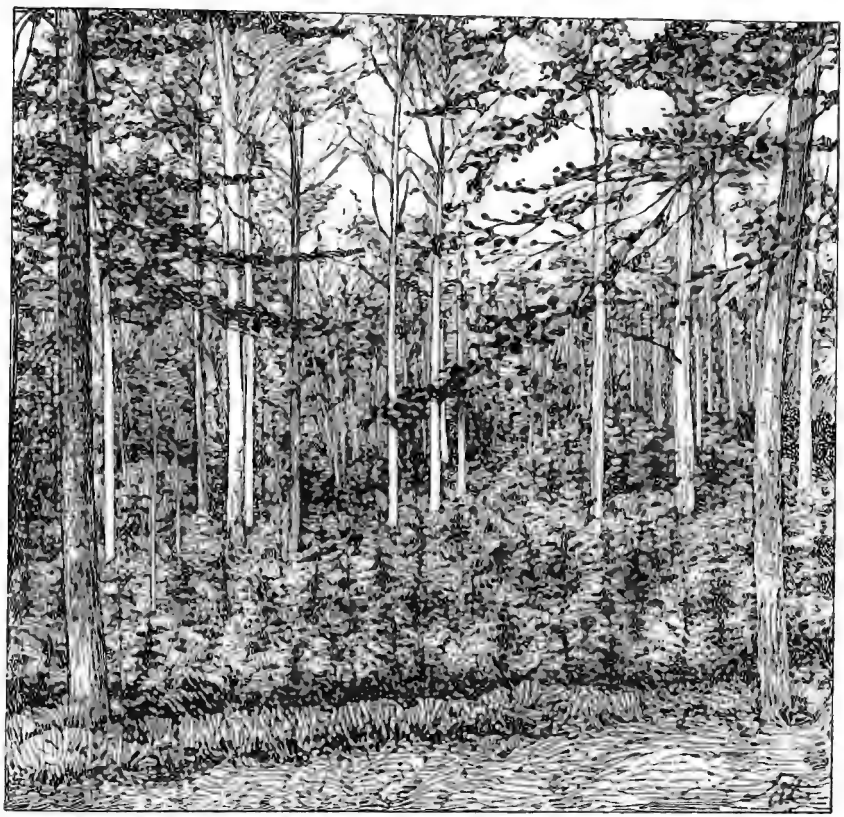

FIG. 9.—Group of spruce under beech. Germany.

ally decrease at the sides. If the wind should throw some trees at the edges of such an opening the young growth would gradually extend, and if the same thing should continue to happen in the end all the old trees would have disappeared and their places would have been taken by young growth. The group system is an imitation of this process.

Under the group system openings are made here and there in the forest by cutting away ripe trees. As the reproduction proceeds, the

old trees about the openings are gradually cut away, and the groups of young growth, spreading from the original openings like drops of oil on water, finally meet.

This is one of the simplest and most useful of all the systems, and when the openings are made small at first no other is so safe. It is especially adapted to small pieces of forest, such as woodlots, because it is simple, and because it assures the safety of the forest even with very little skill or care on the part of the owner.

The strip system.—In nearly every wooded region of the United States a tornado occasionally destroys the trees in a long and narrow belt through the forest. Fire often follows and clears the strip by

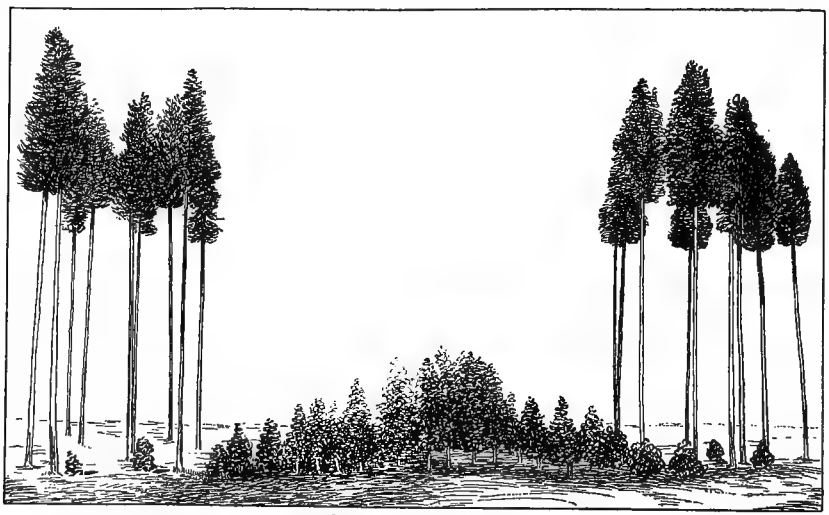

FIG. 10.—Mimic forest, showing distribution of young growth under the group system.

burning up the fallen timber. Seeds then fall in the opening, carried from the trees on either side, the seeds germinate and grow, and the reproduction of the forest takes place.

When the ax takes the place of the tornado and the timber is logged instead of being burned, the strip system is applied. Reproduction follows from trees on either side, as before. The strip system consists in cutting long narrow openings in the mature timber instead of the circular openings of the group system, to which it is similar in many ways. It is simple and effective when natural reproduction is good, and well suited for extensive operations in places where careful work is impossible. The strips are usually not over 100 yards in width. Where the soil is dry, they are run east and west to protect the young growth against the sun, and are comparatively narrow. If there is serious danger of windfall, they lie at right angles to the direction of the wind.

These are the most important of the silvicultural systems. They have many modifications, and indeed each forest may require a special form of its own, which must be devised or adapted for it by the forester. But whatever the form, the object is always to use the forest and provide for its future at the same time.

Improvement cuttings.—Very many forests in the United States, and especially many woodlots, are in poor condition and unfit for the immediate application of any silvicultural system. They need to be put in order, and for that purpose improvement cuttings are usually

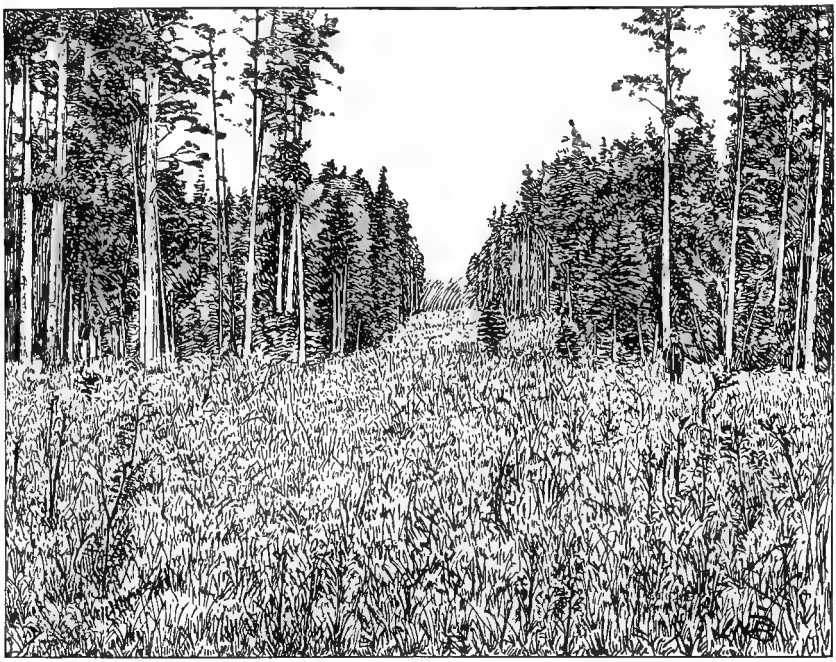

FIG. 11.—Spruce managed under the strip system. Southern Russia.

required. In the end these cuttings should remove all trees which the forest is better without, but they should be made gradually, so as not to open the cover too much and expose the soil to the wind and the sun. In general, it is unwise to cut more than 25 per cent of the poles and older trees in a dense mature forest, or to cut oftener on the same ground than once in five years. Improvement cuttings of course should never fall on trees which are to form the future crop, but they should remove spreading older trees over promising young growth; poor trees which are crowding more valuable ones; unsound trees whose places will be taken by others of greater value, or which are themselves becoming less valuable from year to year; and seed

trees of undesirable species likely to reproduce themselves, if reproduction of more useful kind is well assured. The great majority of

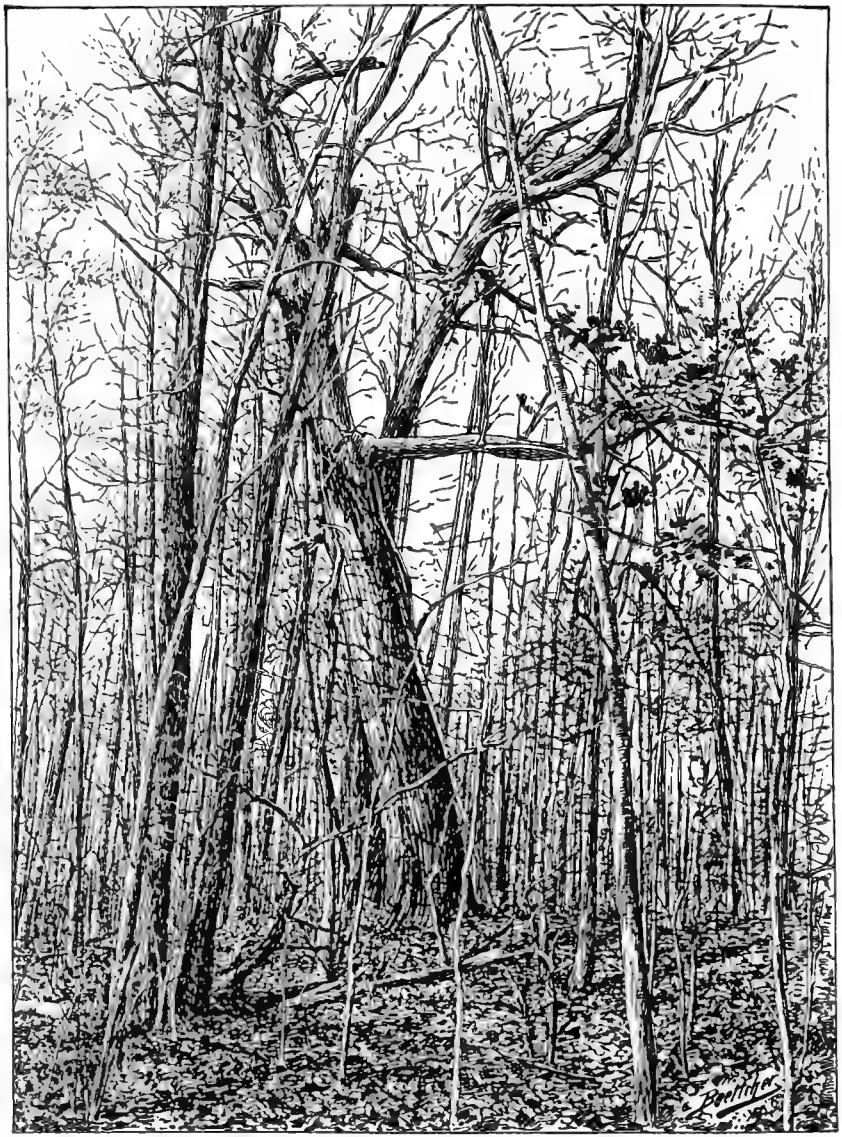

FIG. 12.—Mixed forest in need of an improvement cutting. The crooked old chestnut, in the center, in particular should be removed.

woodlots need such cutting, and when they do, whatever wood is taken from them should be cut in this way.

WORK IN THE WOODS.

The products of the forest are among the things which civilized men can not do without. Wood is needed for building, for fuel, for paper pulp, and for unnumbered other uses, and trees must be cut down to supply it. It would be both useless and mistaken to try to stop the cutting of timber, for it could not cease without great injury, not to the lumbermen only, but to all the people of the nation. The question is not of saving the trees, for every tree must inevitably die, but of saving the forest by conservative ways of cutting the trees. If the forest is to be preserved, the timber crop now ripe must be gathered in such a way as to make sure of other crops hereafter.

In general, it is true that the present methods of lumbering are unnecessarily destructive and wasteful. This is not because lumbermen are more greedy of gain or less careful of public interests than other business men, for they are not. It happens partly because in this country, compared with France and Germany and other densely populated regions, there is so much timber in proportion to the population that it does not pay the lumberman to take anything more than the better parts of the trees he fells. The lumberman can not do his work unless he does it at a profit, and he must do it, for lumber is indispensable. Consequently, although much of the waste in lumbering is not only unnecessary but actually costly to the lumberman, for the present it is impossible to avoid waste altogether. It will be easier to do so when the methods and advantages of conservative lumbering, which is forestry, are better known to the American lumbermen, and are therefore in more general use. Although rough conservative methods have often been practiced in the past, the success of the lumbermen who made the trial was generally but partial, because their knowledge of the forest was partial also. They were often deceived by underestimates of the capacity for tree growth of the lands they were handling, because accurate measurements were wanting, and they seldom made full use of the reproductive power of the forest. More recent attempts, based on better knowledge, have been successful in almost every case.

Lumbermen in America are second to none in skill and ingenuity, in the perfection of their tools, and in the effectiveness of the methods they have devised. The nations of Europe, although they have given far more attention to forestry than we, are very much behind the United States in these respects. So it is not surprising that Americans have been slow to change their methods, especially when methods and lumbermen alike have often been attacked as wrongly and intemperately as the foreign methods have been praised and recommended. German methods would be as much out of place in America as Ameri-

can methods in Germany. What American foresters should do and are doing is to combine the general principles of forestry, which are true all the world over, with American methods of lumbering. The product will be a system of forestry especially adapted to the United States. The foundations of such a system are already laid.

CONSERVATIVE LUMBERING.

Something was said in the last chapter about the systematic methods of conservative lumbering. With the gradual understanding and application of these methods by American lumbermen, already well begun, and with the work in the woods rightly carried out, there is but one reason why the great majority of the forests now standing in the United States should not in the end be lumbered steadily and systematically, or why they should fail to yield a steadily increasing return. That reason is the rapid destruction of the forests themselves. There is grave danger that the best of our forests will all be gone before their protection and perpetuation by wise use can be begun. The spread of a working knowledge of practical forestry is likely to be too slow.

Conservative lumbering and ordinary lumbering. — Conservative lumbering is distinguished from ordinary lumbering in three ways:

First. The forest is treated as a working capital whose purpose is to produce successive crops.

Second. With that purpose in view, a working plan is prepared and followed in harvesting the forest crop.

Third. The work in the woods is carried on in such a way as to leave the standing trees and the young growth as nearly unharmed by the lumbering as possible.

A forest working plan is intended to give all the information needed to decide upon and carry out the best business policy in handling and perpetuating a forest. It gives this information in the form of a written statement, which covers some or all of the following topics: It shows the present stand and condition of the forest, and gives rules for the selection and marking of trees to be cut, for making the reproduction sure, and for the protection of young and old standing trees during the logging. The working plan also predicts the future yield of the forest, basing its prediction on careful measurements which show how many standing trees of different diameters will be left per acre after the first cutting, and how fast these young trees grow. Finally, it estimates the future return in money, taking into account the taxes, interest, and other expenses on one side and the future crop on the other. In order to make this estimate entirely safe it is usually based on the present price of stumpage, although its future value will certainly be much higher.

Felling the trees.—The difference between the practical work under ordinary lumbering and under conservative lumbering is chiefly in the selection of the trees to cut, in felling them, and in the first part of their journey from the stump to the mill. Under a working plan the trees to cut are chosen in such a way that when they are gone the forest will suffer but little from their absence, because their places will be taken by others as quickly as possible. Usually the trees selected are first stamped with a marking hatchet to prevent mistakes, and then the next step is to cut them down.

FIG. 13.—Low stumps in logging.

The amount of harm done to the forest by the cutting depends considerably upon the season of the year when the work in the woods is carried on. Less damage results to the young growth and the trees left standing if the lumbering is done after the growing season is over than if it goes on in the spring and summer while the bark is loose and the leaves and twigs are tender.

A tree may be felled either with the ax or with the saw. In either case the first thing to consider is the height above the ground at which the cut is to be made. High stumps needlessly waste the best timber in a sound tree. Low stumps are slightly more difficult to cut, and therefore a little more expensive, but the additional cost is more than balanced by the gain.

The measurements made by the Forest Service have shown that the loss from cutting high stumps on a tract of 100,000 acres in the Adirondacks, yielding on an average 15 standards per acre, would be 30,000 standards, or at a stumpage value of 50 cents per standard would be $15,000.

FIG. 14.—Protection to young growth in logging. Biltmore, N. C.

The second thing to consider in felling a tree is how to get it down without breaking or splitting the trunk. On rocky, uneven ground this is often a hard thing to do, but unless it can be accomplished the tree would, as a rule, better be left untouched.

Most important of all for the perpetuation of the forest, each tree must be thrown where it will not unnecessarily injure other trees or crush in its fall the young seedlings on which the future of the forest depends. It happens very commonly in ordinary lumbering that vigorous, sound young trees are split and ruined in great numbers by old trees falling upon them, when it would be perfectly easy and almost or quite as convenient to throw the latter where they would do little or no harm.

Finally, it must cost as little as possible to fell each tree, for to be successful conservative lumbering must pay.

Swamping and sawing. — When the trees are down their lower branches are chopped off and the trunks are sawed into logs. In falling, a tree is very apt to bend and hold down beneath its trunk and branches many younger trees, which will spring up straight again if they are quickly released, but which otherwise will be killed or permanently hurt. Therefore it is very important to work up both the trunk and the top of each tree as soon as it is cut down, and so prevent it from destroying the young trees which should take its

FIG. 15.—Spruce rollway. Adirondack Mountains, New York.

place. Except when they are to be burned, even the branches of tops which can not be used should ordinarily be cut away enough to let the tops sink close to the ground, where they will rot as speedily as possible. Dry crowns propped clear of the ground by their branches rot slowly, burn fiercely, and are very dangerous in case of fire.

Skidding.—When the trunks have been sawed into logs the latter are dragged away by horses, mules, or oxen, or in some cases by a long wire rope which is wound on the drum of a donkey engine. This is called "skidding the logs." In this way they are collected in piles called "rollways," or assembled in "yards," or otherwise made ready for the next step in their progress to the mill.

Care is needed in skidding not to rub or tear the bark from valuable standing trees or to break the young growth down, for much harm is quickly done in this way. Promising young trees are often cut because it is easier to use them for corduroy or skids or for other purposes in the logging than to take others less straight or less conveniently at hand, or because they are somewhat in the way, or even from habit, when it would really be easier to let them alone. A very little care in preserving young growth makes an astonishing difference in the future value of a forest.

Transportation.—After the skidding the logs may be transported to the sawmill in many different ways. Sometimes they are loaded

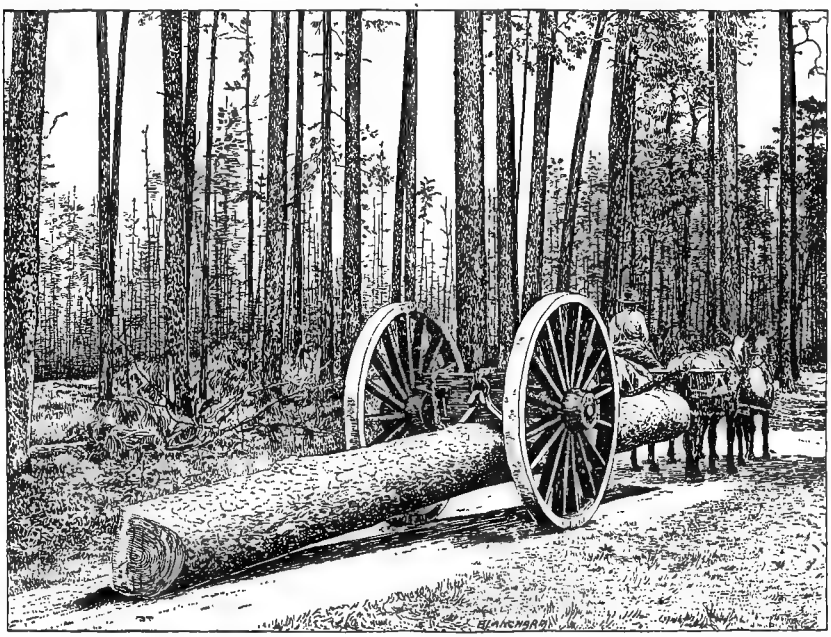

FIG. 16.—Hauling loblolly pine. South Carolina.

on sleds and drawn over carefully made ice roads to a logging railroad or to the bank of a stream. When the stream is not swift or deep enough to carry the logs of itself, splash dams are built, in which great quantities of water are held back for a time. When such a dam is opened the water is set free and great numbers of logs may be driven far down the stream by the sudden flood. In larger streams the logs are sometimes made into rafts, or they may be driven singly down the river. The log drivers who do this work learn to balance themselves on the floating, rolling logs, and walk on them almost as easily as on the solid ground. Sometimes locomotives drag the logs behind them over the ties, or they are hauled on cars which run over

poles cut in the woods instead of over metal rails; often they are rolled into slides built of other logs, and either move downhill by their own weight or are dragged along by horses, cattle, or steam. In southern swamps the logs are sometimes swung up by a wire rope suspended from the trees, and so are loaded on the great flatboat which carries them to the mill.

At the mills.—At the mills the logs are cut into lumber by various kinds of saws. Of these the circular saw is still very widely used, although the wide bite or kerf which it cuts in the log makes it very wasteful of timber. A large circular saw makes a kerf a quarter of an inch wide, so that in cutting four one-inch boards enough wood to

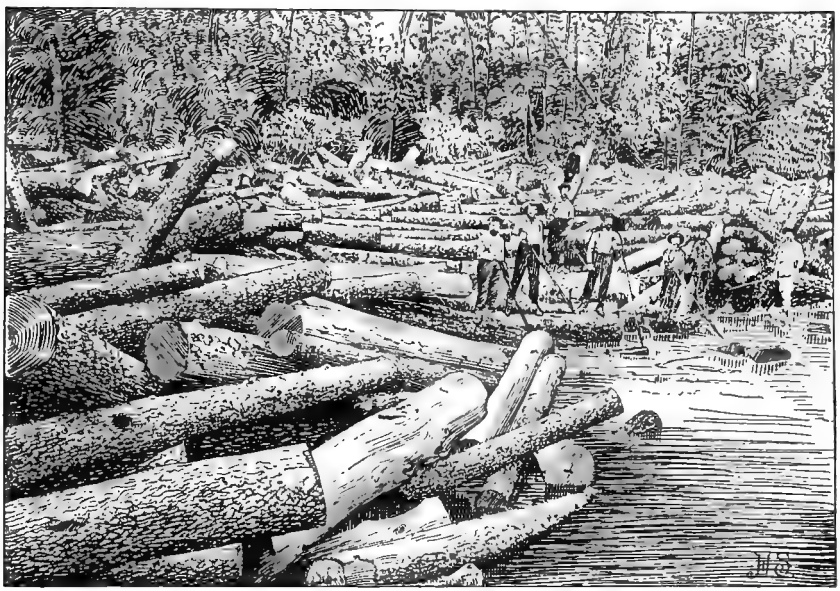

FIG. 17.—River drivers at work on a log jam. Minnesota.

make a fifth board is ripped into sawdust. Band saws are far less wasteful, for they are thinner and make a narrower kerf. Hence they are taking the place of the circular saws, although they do not work so rapidly. Many mills, in addition to their band saws or circulars, use gang saws, which cut out several boards at the same time.

Besides lumber, the best sawmills produce great quantities of lath and shingles, made either from small logs called "bolts," cut specially for that purpose, or from slabs, edgings, and other pieces of wood which might otherwise be wasted. But in spite of every effort to prevent waste in the mill by using sawdust and other refuse for fuel, and in other ways, very many thousands of tons of wood a year are thrown into great burners as the cheapest method of getting it out of the way.

When the lumber has been sawed it may be piled and seasoned in the yard or kiln-dried before it is sent to market or sold at the mill. Some sawmills on Puget Sound are built on piles over the water, so

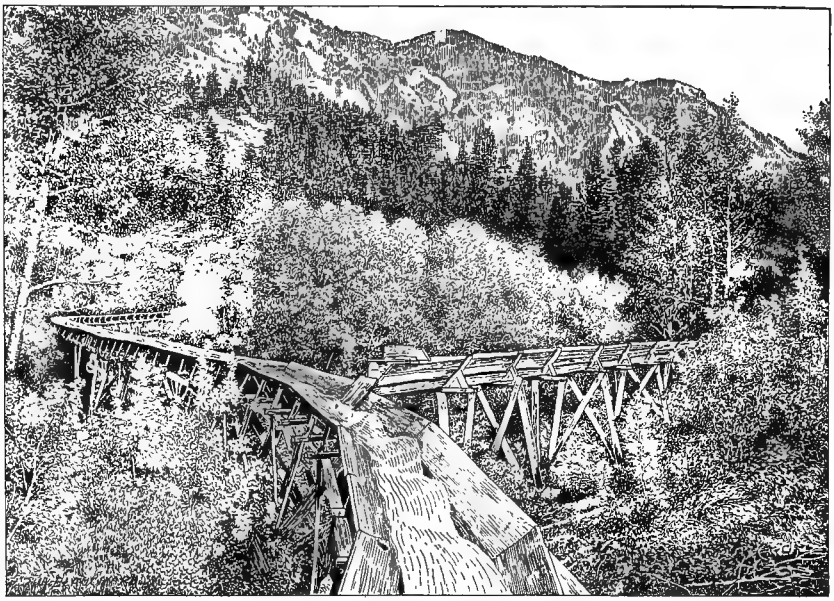

FIG. 18.—Lumber flume in the mountains. California.

that the lumber is loaded into vessels directly from the saws. Others load their product on the cars and distribute it by rail. Still others on the Pacific slope float their timber away in a narrow wooden trough called a "flume," through which flows a rapid stream of water. These flumes are sometimes over 40 miles in length, and cost almost as much to build as a railroad. Many sawmills have connected with them planing mills or woodworking factories of other kinds, so that the rough lumber from their saws is changed into the form of a finished product before it reaches the market.

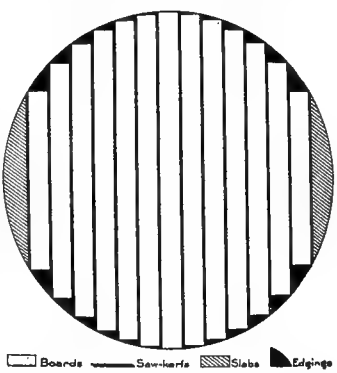

FIG. 19.—Diagram to show the sawing of a log.

Waste in lumbering.—This is very briefly the way in which a tree gets into the market at the end of its life. At every step there is some waste. Although it may be sound throughout, the lumbermen in the woods can take but a portion of it, often leaving a part of the trunk and all of the top to rot on the

ground. When each log comes to the saw there is a further loss of nearly all the slabs and edgings and all the sawdust that is not used for fuel. On the average it is doubtful whether more than half of the cubic contents of a standing tree is finally used. As prices rise and as conservative lumbering comes to be generally practiced, the greater part of this enormous loss will be avoided, but it can probably never cease altogether.

PLANTING.

It has often been proposed to plant trees in order to repair the damage done to the forests by the lumbermen. Tree planting is most useful in all the treeless or scantily wooded portions of our country where planted trees will grow, and wherever forests have been very severely injured or destroyed, but it is generally far too expensive to take the place of conservative lumbering in regions already forested. An acre of growing natural forest can be bought in nearly every forested part of our country for less than it would cost to plant, 4 feet apart, an acre of seedlings a few inches high. The true way to save the forests is not to plant new ones, but to protect and rightly use those which are standing now. The extension of the forest to regions which are without it is a most important task, but it must not be confounded with the conservative use of the forests now standing. For such use there is no substitute whatever.

THE WEATHER AND THE STREAMS.

The central point of public interest in forestry in the United States was until recently the influence of forests on climate. It is natural that the connection between the immense forests and vast plains and the wonderfully various climates of this continent should have awakened attention. It is a matter which is easily written and talked about without any thorough understanding of forestry itself, and in this it differs from other branches of the subject. In dealing with the weather one touches a thing which affects the daily life of everyone, and which, to very many, holds the balance between poverty and prosperity. It is therefore unfortunate that so much of the writing and talking upon this branch of forestry has had little definite fact or trustworthy observation behind it. The friends and the enemies of the forest have both said more than they can prove. Both have tried to establish the truth of their opinions by referring to observations of temperature and rainfall which cover too short a time to prove anything, or by hearsay and general impressions, which are not to be trusted in such matters. Such discussions make nothing clear except that the pith of the matter has not been reached by either party.

FORESTS AND CLIMATE.

The discussion of forest influence on climate began in this way. When the French revolution broke out in 1789, the old restrictions

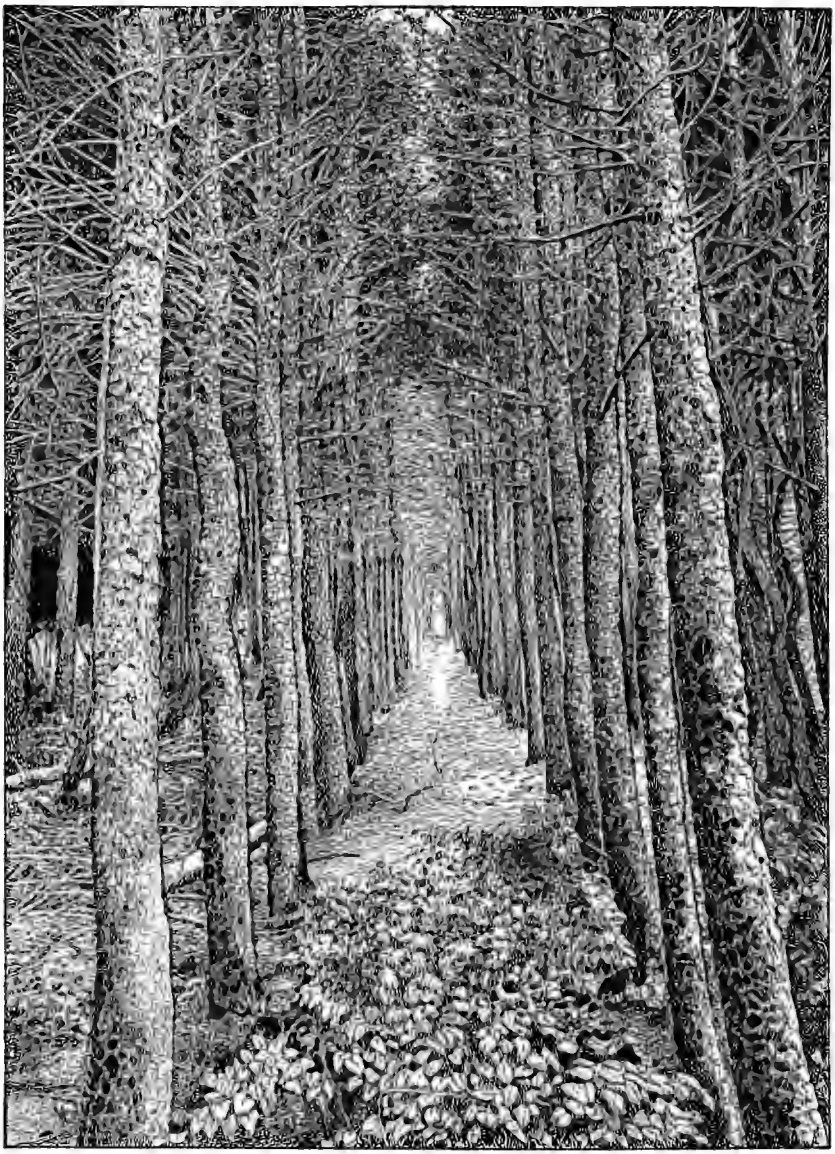

FIG. 20.—European larch grove in western Minnesota. Cost of planting per acre 17 years ago, $64.45. Present value per acre, $484.

on the management of private forests were removed. A wholesale cutting of these timberlands promptly followed, and as early as 1792

the consequences began to be observed. The question of forests and climate was then raised for the first time; but questions of this kind can not be answered without long and careful observations. Such observations were begun by Becquerel in France and Krutsch in Germany about the middle of the last century, but it was not until 1867 that a satisfactory way of making them was devised. This was the system of double stations—one within the forest, the other at a distance in the open. It was first put in operation by Professor

FIG. 21.—The forest cover. Oregon.

Ebermayer, now of the Bavarian Forest School. By this means the amount of moisture and heat in the forest may be compared with that in the open, and in the end a full and satisfactory answer will probably be reached.

In order to find how great the influence of forests on climate may be, we must first see what are the factors which make climate. Then we may ask which of these factors can be affected by the forest, and in what way.

The climate of any place on the earth's surface results from the action of the sun's heat upon it. Climate is the average condition of the weather. It depends, first of all, on the distance of a place from the equator and its elevation above the sea. Secondly, it depends on the distribution of land and water, the relief of the land, whether

flat, hilly, or mountainous, and the character of the surface covering. These are all connected with the temperature in a special manner. Lastly, it is affected by the winds and the moisture of the atmosphere. Now, it is clear that of all these factors of climate the forest can influence only the wind, the moisture, and the surface covering; but heat (with which the surface covering has so much to do), moisture, and wind are the three things which change when we say that the weather changes. These are just the points where a change due to the forest would have most effect on daily life. The influence of the forest is exerted upon them in two ways:

First. The forest cover intercepts the rain and the rays of the sun, checks the movement of the air, and reduces the radiation of heat at night.

Second. The waste from the trees and from certain plants which grow only in their shade forms the forest floor, which has much to do with the movement of water on the ground and within it. The influence of the forest cover and the forest floor appears in the temperature of the air, the evaporation of water, the rainfall, and the course of the rain water after it has reached the earth.

EFFECT OF FOREST COVER ON TEMPERATURE.

So far as the influence of the forest is concerned, the temperature of the air is affected chiefly by the forest cover. The leaves, which compose the greater part of the cover, contain from 50 to 70 per cent of water. More heat is required to raise the temperature of a pound of water one degree than for a pound of almost any other substance, and so it happens that bare soil or rock exposed to the rays of the sun becomes heated many times faster than the water in the leaves. While the heated rock or soil was warming the air about it the forest cover would still be absorbing heat and keeping the air below it cool. The leaves of the cover also tend to cool the air by transpiration, which is the evaporation of water from the leaves. This is true because heat is required to change water into water vapor, and a part of the sun's heat is taken up for this purpose. In these two ways the forest cover acts somewhat like a surface of water.

The growth of the tree itself also helps to cool the air. When the leaves take carbonic-acid gas from the air they break it up and force its carbon into new chemical compounds, which are then stored away as new material in the tree. So with water and the other substances upon which the plant feeds. But the elements are less at ease in these new compounds, and heat is required to force them to make the change. When we burn wood for fuel we are simply getting back again the heat which was used to bring about this change. So we may say roughly that the air about the tree during its lifetime has

been deprived of as much heat as would be given off if the whole tree were burned.

The effect of the cooler air of the forest is felt to some distance in the open country. During the day, in calm summer weather, when the air is warmer than the tree tops, it is gradually cooled by contact with the cooler leaves and twigs. In cooling it becomes heavier and falls toward the ground. A rising current of warmer air is formed to supply its place, and so the colder air flows off along the surface into the open country and causes local breezes. At night the air currents are reversed. The air in the forest is then warmer than the air outside, because the cover checks the radiation of heat, and so the colder air moves from the open country toward the woods. In these ways the influence of the forest is felt at a distance.

The amount of this cooling of the air has been measured in certain places. It is naturally found to be greatest in summer; while in winter and at night the air in the tree tops is a little warmer than in the open. It is important to add that the cooling effect of the forest is greater than the average in the mountains, and less in the plains.

EXTREMES OF HEAT AND COLD.

The extremes of heat and cold are moderated by the forest. Observations on this point have been made, for example, in Bavaria and Württemberg. They showed that the lowest temperature of every day in the year was higher, on an average, by nearly 2° in the forest, while the highest temperature was lower by nearly 4°. The greatest heat of the day in the summer was 7½° less in the forest than outside. Prussian observations showed that for ten years the greatest heat of the day in July was, on an average, nearly 6° lower in the forest, and the greatest cold of the night in January nearly 3° less than outside. It should not be forgotten that the latitude, the elevation, and the exposure had a powerful influence on these differences, which are also greatly affected by the kind of trees and the density of the forest.

It must be borne distinctly in mind that the figures given above are reliable only for the places in central Europe where they were observed. But the principles on which they depend are just as true in America as they are in Europe. Natural laws are the same the world over. It is safe to conclude, then, that in the United States the forest modifies the temperature of the air in certain ways and for certain reasons, both of which we have seen. Just how great this influence is in different parts of this continent it is as yet impossible to tell. But it is probably greater on the average than these observations indicate, for two reasons: First, the extremes of heat and cold, moisture and dryness, are much greater here than in central Europe, and changes are more sudden; second, in most of the double stations

mentioned above the station outside the forest was within less than a mile of it, and thus likely to be influenced by the cooler air currents flowing from it; that is, the real effect of the presence or absence of woods over large stretches of country is probably greater than these observations show.

A system introduced in Austria is expected to give a clearer idea of the distance to which the forest influence reaches. It consists of lines of stations beginning in the center of a large forest and extending step by step into the open country beyond.

MOISTURE IN FOREST AIR.

The moisture of the air is greater in the forest than outside. The absolute quantity of water vapor in a cubic foot of air is generally the same in both places, but the forest air is cooler, and therefore its relative humidity is greater. Relative humidity is the amount of vapor actually in the air, expressed as so much per cent of all it could hold at the same temperature. The amount of water that the air can hold changes when the temperature changes, but in such a way that air cooled until it is only half as warm as before can hold much less than half as much vapor. If a hot and a cold stream of air, both saturated with water vapor, meet and mix, the mixture can no longer hold as much vapor as the two streams separately, and a part is condensed, usually in the form of rain or snow. German and Swiss observations have shown that the average humidity is greater in the forest by from 3 to 10 per cent. This difference increases with the altitude above sea level and the density of the forest cover. The increase of humidity explains why dew is more frequent in the neighborhood of the forest than at a distance.

EVAPORATION.

The water which falls to the earth from the atmosphere had first to be evaporated, so that year by year the quantity of water which the air takes from the surface of the globe by evaporation is the same as that which falls upon it in the shape of rain, hail, snow, and dew. The effect of the forest on this great movement of water is to detain more of it on those portions of the earth which are sheltered by trees. It does this partly by tending to increase the rainfall, but its effect in lessening the loss of water through evaporation is probably much more important. The colder and moister air of the forest has less capacity for taking up water vapor than that of the open country. It is also quieter, which means that the winds are less active in replacing saturated air with air which can still take up more water. The forest acts powerfully in checking

the force of the winds because the elastic swaying of the twigs and branches is a very effective hindrance to the movement of the air. Strong winds, although they are often dangerous in themselves, do most harm by drying up the moisture in the soil and in the plants which grow from it. Thousands of miles of wind-breaks have been planted by farmers in the western parts of this country to protect their crops and homes against the wind. These wind-breaks serve a most useful purpose, but they are naturally far less effective in preventing evaporation than the forest itself. So great is the power of the latter that direct observations made in Bavaria and Prussia showed that evaporation from a free surface of water in the forest was only 40 per cent of that in the open.

The presence or absence of leaf mold has a powerful effect on the amount of evaporation from forest soil. The experiments of Doctor Ebermayer, a famous German forest meteorologist, showed that evaporation from forest soil without a layer of mold was 47 per cent of that from soil in the open, while with a layer of mold it was less than half as much, or 22 per cent. The greater the altitude above the sea the greater is the effect of the forest in preventing evaporation. This is a powerful reason for preserving mountain forests at the headwaters of streams, especially in the Rocky Mountain regions of the United States. Evaporation is there so active that great banks of snow lying in the full glare of the sun often disappear without melting even enough to moisten the ground on the hillsides below them. Vast quantities of water evaporate in this way without ever reaching the streams. Measurements made by the Geological Survey show that evaporation from snow may be four or five times as great as from water under like circumstances.

RAINFALL.

The causes of rain are for the most part wholly beyond the reach of influence from the forest. Such are the great currents of warm and cold water in the ocean, the direction of the prevailing winds, and the presence or absence of mountain ranges. But there are two reasons which lead us to believe that forests do affect the rainfall. These are their colder and moister air, and the resistance which they offer to the motion of the winds. A great number of observations has been made in different parts of the world to discover how much the rainfall really is affected by the forest, but for several reasons no generally accepted result has yet been reached. In the first place, accurate observations on rainfall are not easy to make. The height above the ground at which a rain gauge is placed affects it very seriously. A variation of 10 feet in height will often make more differ-

ence in the amount of rain caught than most observers claim for the whole action of the forest. The rainfall of two stations at unequal heights above sea level is sometimes wrongly compared, because the difference in rainfall may be caused by the difference in altitude. Finally, the best observations that have been made point to different conclusions. For example, measurements taken in Prussia go to show that there is an increase of rain over the forest, and that it is greater the higher the station. Thus, near the level of the sea it was only 1.25 per cent greater than over the open country, while at altitudes between 2,000 and 3,000 feet it reached 43 per cent. Observations made at Nancy, in France, which lies about 700 feet above the sea, show an average yearly increase of 16 per cent. The Bavarian observations, on the contrary, do not indicate more rain over the forest. The best evidence at hand fails to show a decrease in rainfall over the United States in the last hundred years, in spite of the immense areas of forest that have been burned and cut. But it should not be forgotten that most of those areas have grown up again, first with brush, and afterwards with trees, so that the proportion of land covered with leaves is still very large in all that part of the country which was once under forest. In India, again, a large amount of statistics has been collected which leads to the conclusion that forests do influence rainfall. The truth probably is that more rain falls over the forest than over open country similarly placed, but how much more it is impossible to say. The excess falls chiefly in the form of summer showers. One of the best authorities has estimated the difference at 10 per cent.

FALLEN RAIN.

Whatever doubt there may be about the action of the forest in producing rain, there is none about its effect on rain water after it has fallen. When rain falls over a dense forest from less than one-tenth to about one-fourth of it is caught by the trees. A small part of this water may reach the ground by running down the trunks, but the greater part of it is evaporated, and so increases the humidity of the air. That which passes through the crowns falls upon the forest floor, which sometimes has an absorbing power so great that it can hold for a while a rainfall of 5 inches. Yet this water does not remain in the porous floor, but in the end runs off into the streams, or is evaporated, or sinks into the ground. That which gets into the ground is either taken up by the roots or goes to feed the springs and water courses.

Rain which falls over a bare slope acts differently. It is not caught by the crowns nor held by the floor, nor is its flow into the streams hindered by the timber and the fallen waste from the trees. It does

not sink into the ground more than half as readily as in the forest, as experiments have shown. The result is that a great deal of water reaches the streams in a short time, which is the reason why floods occur. It is therefore true that forests tend to prevent floods. But this good influence is important only when the forest covers a large part of the drainage basin of the stream. Even then the forest may not prevent floods altogether. The forest floor, which has more to do with the fallen rain water than any other part of the forest, can affect

FIG. 22.—Beginnings of erosion in soil tramped bare by stock. Sierra Nevada Mountains, California.

its flow only so long as it has not taken up all the water it can hold. That which falls after the forest floor is saturated runs into the streams almost as fast as it would over bare ground.

An unforested drainage basin in the San Bernardino Mountains of southern California was found by the Forest Service to discharge the rain it received more than twice as rapidly as similar forested basins near by. In consequence the stream in the former went dry, while the streams in the latter were still flowing abundantly.

In these ways it happens that in mountain countries, where floods are most common and do most harm, the forests on the higher slopes are closely connected with the prosperity of the people in the valleys below.

Water in motion was nature's most powerful tool in shaping the present surface of the earth. In places where the slopes are steep, the structure of the ground loose, and the rainfall abundant, water may work very rapidly in cutting away the heights and filling the valleys. The destruction of the forest in such a region exposes the surface to the direct action of falling rain and is certain to be followed by the formation of torrents. The danger is greatest when the soil has been laid bare by the browsing and the hoofs of grazing animals, among which sheep and goats are especially destructive, or where the forest floor has been burned away.

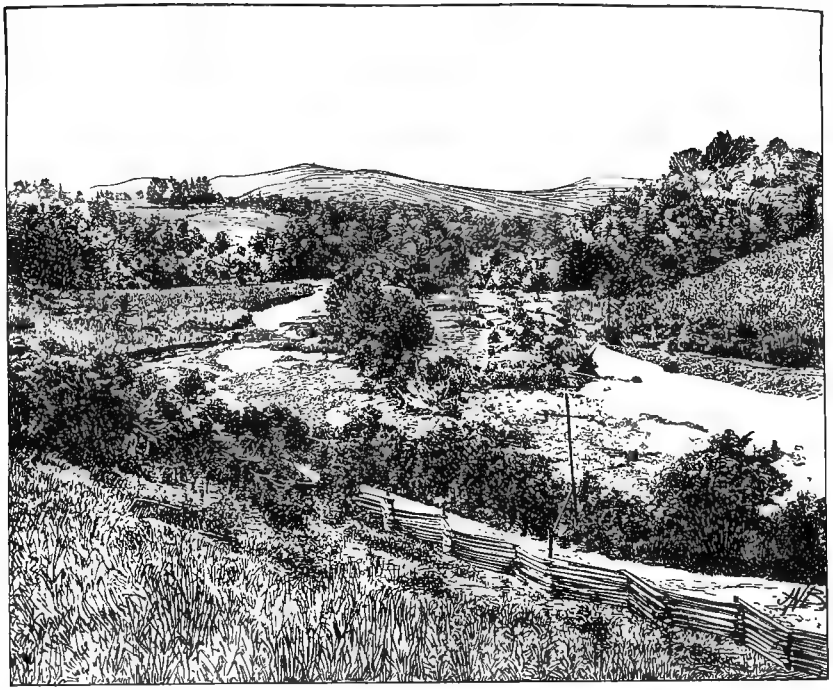

FIG. 23.—Rich bottomland washed out by floods. North Carolina.

When these conditions are both present, as in parts of the Sierra Nevada Mountains of California, of the Cascade Range in Oregon, and in many other parts of the West, the prosperity of the valleys is in serious danger. Fire and overgrazing on the mountains combine to endanger the future water supply of irrigated or irrigable areas in the valleys below. When rain falls over mountains which have so been deprived of their natural protection it is no longer caught and held back by the trees and the forest floor. The roots, which were once the strongest means of binding the soil together, now are gone and leave it without protection against the rushing water. Heavy rains or sudden

thaws swell the streams with marvelous quickness, and give them a wonderful power to cut away their banks. Where the waterway is very steep such a flood often carries with it many times its own weight of earth and stones. As it nears the valley it breaks from its bed and makes new channels, or spreads over the lowlands. The current loses its swiftness, and its load of stones and sterile earth sinks to the bottom, the heavier pieces first. Where it falls the beds of rivers are filled up and fertile lands are covered with pebbles and sand.

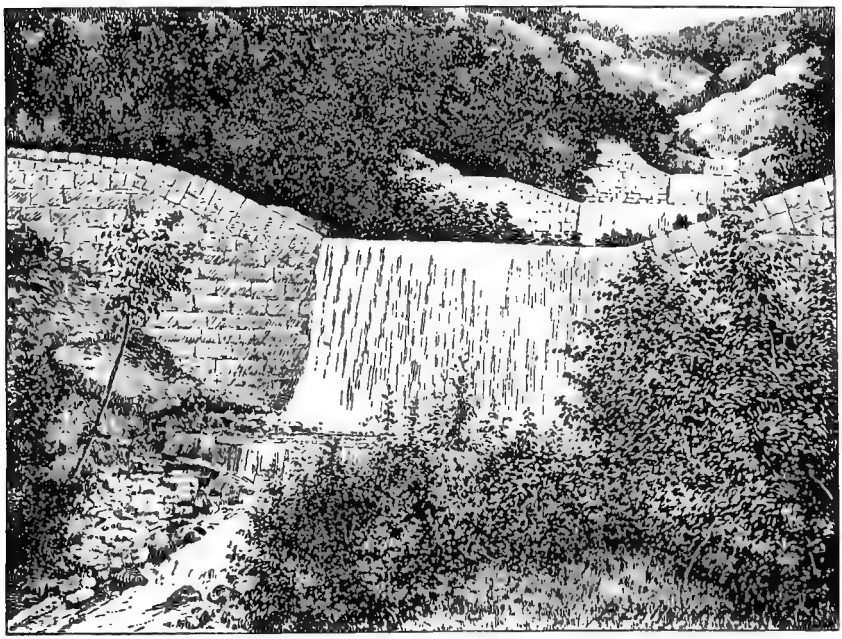

FIG. 24.—Plantation of European alder in the bed of a torrent controlled by dams. This torrent is now extinct. Alps of southern France.

For a time after such a flood the streams are usually low, because the water which should have fed them for weeks or months has run off in a few days. This may be quite as serious a matter for the farmers as the destruction of their fields, as, for example, in places like southern California, where the crops depend on irrigation with the water of streams which rise in the mountains. Torrents have begun to form there in the San Bernardino Mountains, and have already carried stones and sand into the orange groves, and even into the towns of the San Gabriel Valley. Before the water of the San Gabriel River was so largely taken out for irrigation it was rapidly cutting away the fertile land on either side of its shifting bed, and it seemed likely that serious loss of property would follow. This is the direct result of fire and grazing in the mountains.

The pasturage of sheep in the Alps of southern France was the chief cause of the destructive torrents with which the French Government has been struggling for many years. The direct loss to the French people has been enormous, and in addition the work of correction alone has cost upward of $35,000,000. Although wonderfully successful hitherto, it is still far from finished.

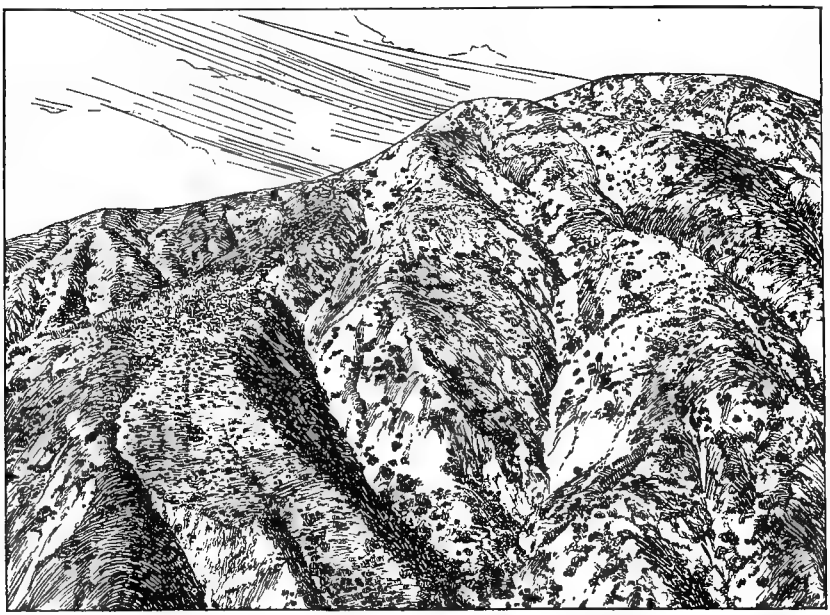

FIG. 25.—Unforested watershed in the San Bernardino Mountains. Southern California.

FORESTRY ABROAD AND AT HOME.

FORESTRY ABROAD.

Except China, all civilized nations care for the forest. Until recently the United States ranked nearly with China in this respect, and our country still remains far behind the progressive modern nations in nearly all that relates to the protection, preservation, and conservative use of the forest. Japan has a well-developed forest service and a national forest school. In Austria, Italy, and Norway and Sweden government forestry is a well-established portion of the national life. Turkey, Greece, Spain, and Portugal give attention to the forests. Russia, dealing like ourselves with vast areas of forests in thinly peopled regions, but by methods wholly different from our own, is drawing enormous revenues from the systematic care and use of the forests. In Germany the scientific treatment of

forests has reached, perhaps, its highest development. The foresters of France have perfected a most practical and effective general system of forestry and have created the difficult art of controlling the floods of mountain torrents by planting trees. The Republic of Switzerland, by the use of methods most instructive to citizens of the United States, has developed a type of government forest policy more worthy of our attention and imitation than any other in Europe. In Australia and New Zealand forestry has already made important advances. In Canada the English have made real progress in forestry. The Government sells the timber from its forests, but retains possession of the lands and employs fire guards. At the Cape of Good Hope they have an excellent forest service. In British India they have met and answered many questions which still confront the American forester, and in a little more than thirty years have created a forest service of great merit and high achievement. The United States has scarcely yet begun.

THE FOREST IN EARLY TIMES.

In very early times the forest was preserved for the game it contained. Forestry then meant the art of hunting, and had very little to do with the care of trees. Even the word "forest," which really comes from the Latin *foris*, meaning out-of-doors, was thought in England to be derived from the fact that it was a place given up to wild animals *for rest*. But gradually the forest came to be considered more than the game, and the serious study of forestry began.

MODERN FORESTRY.

Forestry as a science is of comparatively recent origin, although a work in which all the European trees are described was one of the earliest printed books. Until the end of the eighteenth century forestry was discussed chiefly by men who were either scholars or practical woodsmen, but who were not both. Then appeared Hartig and Cotta, two men who united these points of view, and their writings are at the base of the whole modern growth of the subject. Both were German. Each covered the whole field as it was then understood, and together they exerted an influence which has not been approached by any other authors since. From Germany their teaching spread to France, and early in the nineteenth century their doctrines were introduced into the French Forest School at Nancy by Lorentz, who, with his successor, Parade, was the founder of modern forestry in France.

Under the feudal system, which was finally destroyed in France by the revolution of 1789, the forest was the property of the feudal

lord. In order to make the life of his serfs, who were useful both as taxpayers and as fighting men, easier, and so increase their number, he gave them the privilege of taking from his forest the wood which they required. For similar reasons the wealthy religious houses, like that of the Grande Chartreuse, made grants of land and of rights in the forest. But after a time the number of peasants increased so much that their wants absorbed nearly the whole produce of the woodlands. Then it was found necessary to limit the prescriptive rights to forest products by restricting them to certain parts of the forest, or to make an end of them by exchanging them for the absolute ownership of smaller areas. Thus many of the communities, to which, and not to individual peasants, these rights belonged, came to possess forests of their own. But the communes, as they were called, managed their forests badly, and about three hundred years ago the Government was forced to intervene. Under the management of officers of the government forest service, the results from the communal forests have been excellent. At present these forests not only supply fuel to the villages which own them, but in some cases they produce enough to pay all the village taxes as well.

Germany.—Germany still holds the high position in forest science which began with Hartig and Cotta. The German forest schools, of which there are seven of the higher grades, are still among the very best, and the study of forestry, both in the schools and in the forest experiment stations, is eagerly pursued. The forests in Prussia, Saxony, and other German States are admirably managed, and yield important returns. The total value of the German forests, public and private, is said to be about $4,500,000,000.

France.—Forestry in France has long been associated with the names of famous men. Henry of Navarre and his friend and minister, Sully; Palissy, the great potter, who called the neglect of the forest prevalent in his time "not a mistake, but a calamity and a curse for France;" Colbert, the minister of Louis XIV; the botanist Duhamel du Monceau; Buffon, the celebrated naturalist, are among the men to whom France owes the rise and progress of her present excellent forest policy. Their peculiar service was to lay the foundation, both in law and in public opinion, upon which modern forestry in France now rests.

The forests of the French Government are admirably managed. They cover only about 2,750,000 acres, but they yield a net return each year of more than $2 per acre. Besides handling their national forests with great intelligence and success, the French foresters have done much for the general progress of forestry. They developed the art of reforesting denuded mountains, and were the first to plant trees on moving sand dunes along the seashore. More than 150,000 acres

of these dunes, which once were blown about by the wind until they overwhelmed great stretches of fertile ground, and even threatened to bury whole towns, are now covered with forests of pine, and produce great quantities of turpentine, lumber, and charcoal.

Switzerland. — In Switzerland forestry received attention from very early times. Nearly two hundred years before the discovery of America the city of Zurich began to make rules for the protection and management of the Sihlwald, a forest which it still owns, and which now yields an annual return of about $8 per acre. In the Canton of Bern a decree of the year 1592 warned the people against the wasteful use of timber and provided for the protection of the forest along various lines. It also directed that for every tree cut down a young one should be planted in its place. It is curious to find this mistaken prescription for the ills of the forest already in fashion more than three centuries ago. To save the forest every old tree must be replaced by *many* young ones.

The first general forest law of Bern was passed as early as 1725. It embodied the most important principles of wise forest legislation as we know them to-day. But this was only one of a long series of forest laws in which, from the beginning, the idea of the importance of the forest to others besides its owner became steadily stronger. The citizens of Bern have grown ever more willing to place restrictions on themselves for the benefit of the Commonwealth.

There were great floods in Switzerland in 1834, and they were the cause of a general awakening of interest in forestry. Somewhat later a federal forest commission was appointed. Since the appearance of its final report in 1861 the progress of forestry in Switzerland has been steady. In 1875 a federal forest inspector was appointed, and a year later the first Swiss forest law was passed. This law does not extend to the whole of Switzerland, but only to the Alps and the steeper foothills. In a country of steep mountains it is of first importance to guard the forests on the higher slopes. Consequently all the forests on these higher lands which serve to protect the lowlands against floods, avalanches, and other similar dangers of wind and weather are put in charge of the Swiss federal forest service.

A great saying of Landolt: "Our forest laws," said Elias Landolt, a great and simple man, whose name stands first among Swiss foresters, "are intended to work more through instruction, good example, and encouragement than by severe regulations. This method is somewhat slower than one which should involve harsher measures, but the results achieved are more useful and lasting. When forest owners do something because they are convinced of its usefulness it is done well and with an eye to the future, but what they do under compulsion is done carelessly and neglected at the

first opportunity. What they have come to learn in this way and have recognized as good will be carried out, and that better and better from year to year."

British India.—For many years after the British conquest forestry in India made very little progress. Much time was wasted in half measures, until in 1856 Doctor (now Sir Dietrich) Brandis was put in charge of the teak forests of Pegu. He acted at once upon the idea of preserving them by making them pay. At first the output of teak had to be somewhat restricted, much against the will of the timber merchants of Rangoon, who protested that the business of their city would be ruined. But after this momentary check the teak trade of Rangoon grew until it was far greater than ever before, and it is now a chief and increasing source of the prosperity of that city.

The appointment of Doctor Brandis was the beginning of the Indian forest service. In 1866 he was made inspector-general of forests, and from that time progress was rapid. The Indian forest service now has nearly 300 superior officers and over 10,000 rangers and forest guards. It has charge of about 200,000 square miles of forest, and produces a net revenue, after all expenses have been paid, of about $3,000,000 a year. In addition, the forests furnish to peasant holders of forest rights products whose value is estimated to be considerably greater than the whole cost of the forest service. About 30,000 square miles are effectively protected against fire, at an average yearly cost of less than half a cent per acre. These admirable results are especially interesting because India is like the United States in the great extent and variety of her forests and in the number and fierceness of forest fires.

FORESTRY AT HOME.

The forests of the United States cover an area of about 699,500,000 acres; or more than 35 per cent of the surface of the country. Before so large a part of them was destroyed they were perhaps the richest on the earth, and with proper care they are capable of being so again. Their power of reproduction is exceedingly good.

In the Northeastern States, and as far west as Minnesota, once stretched the great white pine forest from which, since settlement began, the greater part of our lumber has come. South of it, in a broad belt along the Atlantic and the Gulf coasts, lies the southern pine forest, whose most important tree both for lumber and naval stores is the southern yellow pine. In the Mississippi Valley lies the interior hardwood forest of oaks, hickories, ashes, gums, and other hardwood trees. It is bordered on the west by the plains, which cover the eastern slope of the continental divide until they meet the

evergreen Rocky Mountain forest, which clothes the slopes of this great range from the Canadian line to Mexico. Separated from the Rocky Mountain forest by the interior deserts, the Pacific coast forest covers the flanks of the Sierras, the Cascades, and the Coast ranges. Its largest trees are the giant sequoia and the great coast redwood, and its most important timber is the fir.

The forests of the Philippine Islands cover an area of more than 40,000,000 acres. Their timbers, almost wholly different from those of the United States, are exceedingly valuable, both as cabinet woods and as construction timber. An efficient forest service was organized in 1898, and following its reorganization in 1902 a new and excellent forest law was passed in 1904. The Philippine forest service costs but half as much as the revenue received from the forests of the islands.

The island of Porto Rico contains a national forest reserve, the site of which was once covered with valuable hardwoods; but this forest has been much abused. Porto Rico, like the Philippines, has many kinds of wood valuable for cabinetmaking.

The settler and the forest.—When the early settlers from the Old World landed on the Atlantic coast of North America they brought with them traditions of respect for the forest created by generations of forest protection at home. The country to which they came was covered, for the most part, with dense forests. There was so little open land that ground had to be cleared for the plow. It is true that the forest gave the pioneers shelter and fuel, and game for food, but it was often filled with hostile Indians, it hemmed them in on every side, and immense labor was required to win from it the soil in which to raise their necessary crops. Naturally, it seemed to them an enemy rather than a friend. Their respect for it dwindled and disappeared, and its place was taken by hate and fear.

The feeling of hostility to the forest which grew up among the early settlers continued and increased among their descendants long after all reason for it had disappeared. But even in the early days far-sighted men began to consider the safety of the forest. In 1653 the authorities of Charlestown, in Massachusetts, forbade the cutting of timber on the town lands without permission from the selectmen, and in 1689 the neighboring town of Malden fixed a penalty of 5 shillings for cutting trees less than 1 foot in diameter for fuel. An ordinance of William Penn, made in 1681, required that 1 acre of land be left covered with trees for every 5 acres cleared. But these measures were not well followed up, and the needless destruction of the forest went steadily on.

First steps in forestry.—More than a hundred years later, in 1795, a committee of the Society for the Promotion of Agriculture, Arts,

and Manufactures in New York made a report on the best way to preserve and increase the growth of timber. Four years afterwards Congress appropriated $200,000 for the purchase and preservation of timberlands to supply ship timbers for the navy, and in 1822, with the same object in view, it authorized the President to employ the army and navy to protect and preserve the live oak and red cedar timber of the Government in Florida. Since that time more and more attention has been given to the forests. In 1828 Governor De Witt Clinton, of New York, spoke of the reproduction of our woods as an object of primary importance, and in the same year the Government began an attempt to cultivate live oak in the South for the use of the navy. Three years later an act was passed which is still almost the only protection for the much-abused forests of the public domain.

In 1872 the Yellowstone National Park was established, and in 1873 Congress passed the timber-culture act, which gave Government land in the treeless regions to whoever would plant one-fourth of his claim with trees. In 1875, the American Forestry Association was formed in Chicago through the efforts of Dr. John A. Warder, who was one of the first men to agitate forest questions in the United States. In the centennial year (1876) Dr. Franklin B. Hough, perhaps the foremost pioneer of forestry in America, was appointed special agent in the Department of Agriculture. This was the beginning of educational work in forestry at Washington. Soon afterwards Congress began to make appropriations to protect the public timber, but nothing was done to introduce conservative forest management.

About this time forest associations began to be established in the different States, the most influential and effective of which has been that in Pennsylvania. The States also began to form forest boards or commissions of their own.

In 1888 the first forest bill was introduced in Congress. It failed to pass, but in 1891 an act was passed which was the first step toward a true policy for the forests of the nation. The first step toward national forestry is control of the national forests. This act, whose chief purpose was to repeal the timber-culture act, contained a clause which authorized the President to reserve timber lands on the public domain, and so prevent them from passing out of the possession of the Government.

The public domain.—In all the States and Territories west of the Mississippi except Texas, and in Ohio, Indiana, Illinois, Michigan, Wisconsin, Florida, Alabama, and Mississippi, all the land originally belonged to the Government. This was the public domain. It has gradually been sold or given away until in many of the States it has all or nearly all passed to other owners. But it still includes more

than 470,000,000 acres, or nearly one-third of the United States, not including the Territory of Alaska, which has an area of about 350,000,000 acres. A large part of the public domain has been surveyed by the Government and divided first into squares 6 miles on each side, called townships, then into squares of 1 mile, called sections, and these again into quarter sections and smaller divisions. The lines which mark these divisions are straight and at right angles to each other. When any part of the public domain is reserved or disposed of it is usually located by reference to these lines.

Federal forest reserves.—When power was given the President to make forest reserves, the public domain still contained much of the best timber in the West, but it was passing rapidly into private hands. Acting upon the wise principle that forests whose preservation is necessary for the general welfare should remain in Government control, President Harrison created the first forest reserves. President Cleveland followed his example. But there was yet no systematic plan for the making or management of the reserves, which at the time were altogether without protection by the Government. Toward the end of President Cleveland's second administration, therefore, the National Academy of Sciences was asked to appoint a commission to examine the national forest lands and report a plan for their control. The academy did so, and upon the recommendation of the National Forest Commission so appointed, President Cleveland doubled the reserve area by setting aside 13 additional forest reserves on Washington's Birthday, 1897.

The Cleveland forest reserves awakened at once great opposition, and led to a general discussion of the forest policy. But after several years of controversy widespread approval took the place of opposition, and at present the value of the forest reserves is generally recognized.

The recommendations of the National Forest Commission for the management of the forest reserves were not acted upon by Congress, but the law of June 4, 1897, gave the Secretary of the Interior authority to protect the reserves and make them useful. The passage of this law was the first step toward a national forest service. The second step was the act of Congress, approved February 1, 1905, which transferred the control of the national forest reserves from the Department of the Interior to the Department of Agriculture. This act consolidated the Government's forest work, which had been divided between the General Land Office and the Bureau of Forestry, and secured for the reserves the supervision of trained foresters.

President McKinley and after him President Roosevelt continued to make forest reserves. The latter introduced a system of examining the proposed forest reserves, so that now their boundaries are better located than ever before. Under him great progress has been made

by the Government in bringing about the practice of forestry by forest owners and in awakening the great lumber interests, as well as the people in general, to the dangers of forest destruction.

The forest reserves lie chiefly in high mountain regions. They are 62 in number, and cover an area (January 1, 1905) of 63,308,319 acres. They are useful first of all to protect the drainage basins of streams used for irrigation, and especially the watersheds of the great irrigation works which the Government is constructing under the reclamation law, which was passed in 1902. This is their most important use. Secondly, they supply grass and other forage for many thousands of grazing animals during the summer, when the lower ranges on the plains and deserts are barren and dry. Lastly, they furnish a permanent supply of wood for the use of settlers, miners, lumbermen, and other citizens. This is at present the least important use of the reserves, but it will be of greater consequence hereafter. The best way for the Government to promote each of these three great uses is to protect the forest reserves from fire.

State forestry.—Many of the States have taken great and effective interest in forestry. Among those which have made most progress are New York and Pennsylvania. New York has a state forest preserve of 1,436,686 acres, and Pennsylvania one of 700,000 acres. Michigan, Minnesota, and other States are rapidly following their example.

In 1892 the first example of systematic forestry in the United States was begun at Biltmore, in North Carolina. It is still in successful operation.

The first professional foresters in the United States were obliged to go abroad for their training, but in 1898 professional forest schools were established at Cornell University, in New York, and at Biltmore, in North Carolina, and they were followed by the Yale Forest School in 1900. Others have sprung up since. At present, thorough and efficient training in professional forestry can be had in the United States.

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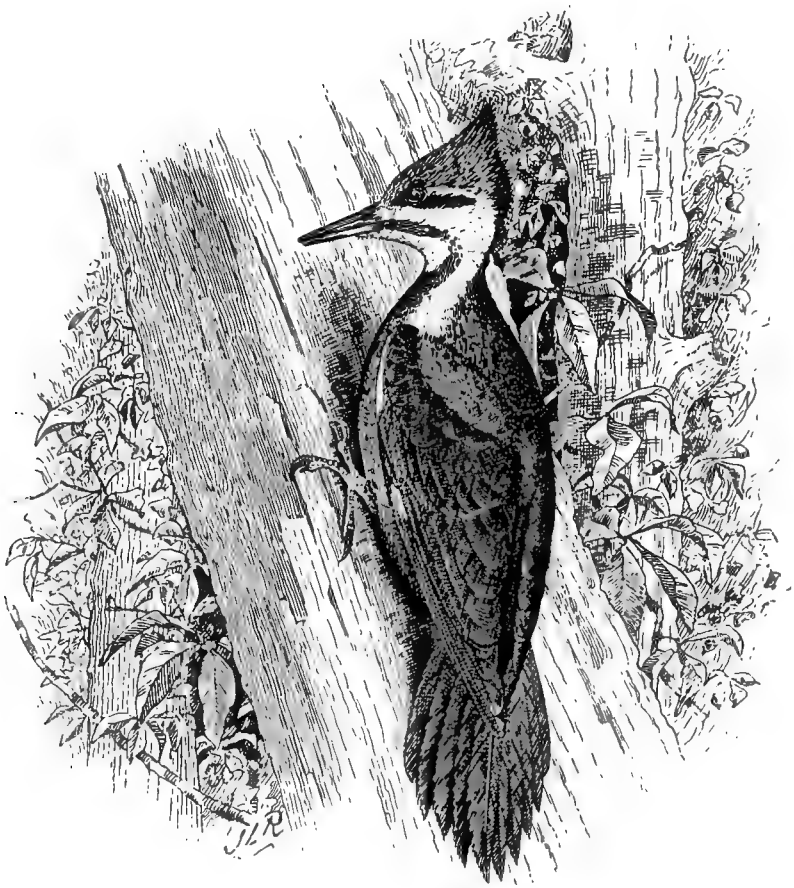

PILEATED WOODPECKER OR LOGCOCK (*Ceophlœus pileatus*).

BULLETIN No. 7

U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF ORNITHOLOGY AND MAMMALOGY

PRELIMINARY REPORT

ON THE

FOOD OF WOODPECKERS

BY

F. E. L. BEAL

ASSISTANT ORNITHOLOGIST

THE TONGUES OF WOODPECKERS

BY

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U. S. NATIONAL MUSEUM

WASHINGTON

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., May 15, 1895.

SIR: I have the honor to transmit, as Bulletin No. 7 of this division, a preliminary report on the Food of Woodpeckers, by Prof. F. E. L. Beal, Assistant Ornithologist. The report is accompanied by a short article on the 'Tongues of Woodpeckers,' prepared at my request by Mr. F. A. Lucas, Curator of the Department of Comparative Anatomy, United States National Museum.

Respectfully,

C. HART MERRIAM,
Chief of Division of Ornithology and Mammalogy.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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PRELIMINARY REPORT ON THE FOOD OF WOODPECKERS.

By F. E. L. Beal, *Assistant Ornithologist.*

GENERAL REMARKS.

With the possible exception of the crow, no birds are subject to more adverse criticism than woodpeckers. Usually no attempt is made to discriminate between the numerous species, and little account is taken of the good they do in destroying injurious insects. The name 'Sapsucker' has been applied to two or three of the smaller kinds, in the belief that they subsist to a great extent upon the juices of trees, obtained from the small holes they make in the bark. There can be little doubt that one species, the Yellow-bellied Woodpecker (*Sphyrapicus varius*), does live to a considerable extent upon this sap. Observation does not show that other species have the same habit, but it is a difficult point to decide by dissection, as fluid contents disappear quickly from the stomach.

Many observers have testified to the good work these birds do in destroying insects, while others have spoken of harm done to fruit or grain. Both are correct within certain limits.

Field observation on the food habits of birds is attended with so many difficulties as to render it a very unreliable source from which to draw general conclusions. The most conscientious and careful person is often deceived, not only as to the quantity of a particular kind of food eaten by a bird, but as to the fact that it is eaten at all. The further difficulty of keeping a number of birds, or even a single one, under constant observation makes an estimate of relative proportions of different kinds of food impossible. When much mischief is done the fact is apparent, but there is no way to find out how much good is done during the same time. For these reasons it often happens that reports on food habits, based on observations of wild birds, not only conflict with each other but also disagree with the results obtained from stomach examinations. This last method must be taken as the court of final appeal, and it is evident that a collection of stomachs covering every month in the year, and as nearly as may be all points

of the birds' range, becomes more and more trustworthy as it increases in size; in other words, the more stomachs examined the nearer correct will be the result as to the birds' annual diet.

The present paper is merely a preliminary report, based on the examination of 679 stomachs of Woodpeckers, and representing only 7 species—all from the eastern United States. These species are the Downy Woodpecker (*Dryobates pubescens*), the Hairy Woodpecker (*D. villosus*), the Flicker or Golden winged Woodpecker (*Colaptes auratus*), the Red-headed Woodpecker (*Melanerpes erythrocephalus*), the Red-bellied Woodpecker (*Melanerpes carolinus*), the Yellow-bellied Woodpecker (*Sphyrapicus varius*), and the Great Pileated Woodpecker (*Ceophlœus pileatus*). Examination of their stomachs shows that the percentage of animal food (consisting almost entirely of insects) is greatest in the Downy, and grades down through the Hairy, Flicker, Pileated, Redhead, and Yellow-bellied to the Red-bellied, which takes the smallest quantity of insects. Prof. Samuel Aughey stated that all of these species except the Pileated (which was not present) fed upon locusts or grasshoppers during the devastating incursions of these insects in Nebraska. The vegetable matter, of course, stands in inverse order. The greatest quantity of mineral matter (sand) is taken by the Flicker, somewhat less by the Redhead, very little by the Downy and Hairy, and none at all by the Yellow-bellied and Pileated.

The stomachs of all of the 7 species except the Redhead and Red-bellied contained the substance designated as 'cambium' in the accompanying list of vegetable food. This is the layer of mucilaginous material lying just inside of the bark of trees, and from which both bark and wood are formed. It is supposed by many to be the main object sought by woodpeckers. Except in the case of a single species the stomach examination does not bear out this view, since cambium, if present at all, was in such small quantities as to be of no practical importance. The Yellow-bellied Woodpecker, however, is evidently fond of this substance, for in the stomachs examined it formed 23 percent of the whole food of the year. It was found in 37 stomachs, most of which were taken in April and October. Of 18 stomachs collected in April, 16 contained cambium, and one of the remaining contained no vegetable food whatever. Moreover, as the true cambium is a soft and easily digested substance it is probable that what is usually found in the stomachs is only the outer and harder part, which therefore represents a much larger quantity. The extent of the injury done by destroying cambium must depend on the quantity taken from individual trees. It is well known that woodpeckers sometimes do serious harm by removing the outer bark from large areas on the trunks of fruit trees. The rings of punctures often seen around the trunks of apple trees are certainly the work of the Sapsucker, though sometimes attributed to the Downy and Hairy Woodpeckers. But the bird is not sufficiently numerous in most parts of the country to do much damage.

It is a difficult task to summarize the results of the investigations herein detailed, more especially if an attempt is made to decide as to the comparative merits or demerits of each particular species. The stomach examinations do not always corroborate the testimony received from observers, and many no doubt will be inclined to think they have seen more harm done by some members of this family of birds than is shown by the data here published. If birds are seen feeding repeatedly on a certain kind of food the inference is that they are particularly fond of it, but the truth may be that they are eating it because they can find nothing they like better, and that a collection of their stomachs from many localities would show only a small percentage of this particular food.

In reviewing the results of these investigations and comparing one species with another, without losing sight of the fact that comparative good is not necessarily positive good, it appears that of 7 species considered the Downy Woodpecker is the most beneficial. This is due in part to the great number of insects it eats and in part to the nature of its vegetable food, which is of little value to man. Three-fourths of its food consists of insects, and few of these are useful kinds. Of grain, it eats practically none. The greatest sin we can lay at its door is the dissemination of poison ivy.

The Hairy Woodpecker probably ranks next to the Downy in point of usefulness. It eats fewer ants, but a relatively larger percentage of beetles and caterpillars. Its grain-eating record is trifling; 2 stomachs taken in September and October contained corn. For fruit, it seeks the forests and swamps, where it finds wild cherries, grapes, and the berries of dogwood and Virginia creeper. It eats fewer seeds of the poison ivy and poison sumac than the Downy.

The Flicker eats a smaller percentage of insects than either the Downy or the Hairy Woodpecker, but if eating ants is to be considered a virtue, as we have endeavored to show, then surely this bird must be exalted, for three-fourths of all the insects it eats, comprising nearly half of its whole food, are ants. It is accused of eating corn; how little its stomach yields is shown on another page. Fruit constitutes about one-fourth of its whole fare, but the bird depends on nature and not on man to furnish the supply.

Judged by the results of the stomach examinations of the Downy and Hairy Woodpecker and Flicker it would be hard to find three other species of our common birds with fewer harmful qualities. Not one of the trio shows a questionable trait, and they should be protected and encouraged in every possible way. Fortunately, only one, the Flicker, is liable to destruction, and for this bird each farmer and landowner should pass a protective law of his own.

The Redhead makes the best showing of the seven species in the kinds of insects eaten. It consumes fewer ants and more beetles than any of the others, in this respect standing at the head, and it has a pronounced taste for beetles of very large size. Unfortunately, however, its

fondness for predaceous beetles must be reckoned against it. It also leads in the consumption of grasshoppers; these and beetles together forming 36 percent of its whole food. The stomachs yielded enough corn to show that it has a taste for that grain, though not enough to indicate that any material damage is done. It eats largely of wild fruit, and also partakes rather freely of cultivated varieties, showing some preference for the larger ones, such as apples. In certain localities, particularly in winter, it feeds extensively on beechnuts. No charge can be brought against it on the score of injuring trees by pecking.

The Red-bellied Woodpecker is more of a vegetarian than any of the others. In certain localities in Florida it does some damage to oranges, but the habit is not general. On the other hand, it eats quantities of ants and beetles.

The Yellow-bellied Woodpecker seems to show only one questionable trait, that of a fondness for the sap and inner bark of trees. Both field observations and the contents of the stomachs prove this charge against it, but it is not probable that forest trees are extensively injured, or that they ever will be, for aside from the fact that the bark of many trees would be unpalatable an immense number of birds would be required to do serious damage. But with fruit trees the case is different. Their number is limited, and there are no superfluous ones as in the forest. In localities where the bird is abundant considerable harm may be done to apple trees, which appear to be pleasing to its taste.

The Pileated Woodpecker is more exclusively a forest bird than any of the others, and its food consists of such elements as the woods afford, particularly the larvæ of wood-boring beetles, and wild fruits. The species is emphatically a conservator of the forests.

In describing the stomach contents of the different woodpeckers a quantity of material is classed under the term 'rubbish.' The great bulk of this stuff is rotten wood and bark, picked up in digging for insects in decayed timber, and apparently swallowed accidentally with the food. If the 6 woodpeckers which had eaten rotten wood are compared with respect to the quantity of this material contained in the stomachs it is found that the Hairy Woodpecker stands at the head with 8 percent, the Downy next with 5, the Flicker with 3, the Redhead and Yellow-bellied with 1 percent each, and the Pileated with only a trace. From this it appears that the Hairy Woodpecker is preeminently a *woodpecker*, while the Redhead and Yellow-belly do much less of this kind of work. The difference in habit is obvious to the most casual observer. The Redhead is ordinarily seen upon a fence post or telegraph pole hunting for insects that alight on these exposed surfaces, and watching for others that fly near enough to be captured in mid-air. Unlike other woodpeckers, he is seldom seen digging at a rotten branch except in spring, when he prepares a home for the family he intends to rear. The Yellow-bellied, as will be shown presently, does much wood (or bark) pecking, but of another kind.

The following tables show the food percentages of the stomachs examined:

Percentages of food of 7 species of woodpeckers.

Name of species.	No. of stomachs examined.	Percentage of stomach contents.			Percentage of different insects.						
		Animal.	Vegetable.	Mineral.	Hymenoptera (ants).	Coleoptera (beetles).	Lepidoptera (caterpillars).	Orthoptera (grasshoppers).	Hemiptera (bugs, plant lice).	Diptera (flies).	Spiders and myriapods.
Downy Woodpecker (*Dryobates pubescens*)	140	74	25	1	23	24	16	3	4	1	3
Hairy Woodpecker (*Dryobates villosus*)	82	68	31	1	17	24	21	Trace.	2	.....	4
Flicker (*Colaptes auratus*)	230	56	39	5	43	10	1	1	Trace.	Trace.	1
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	101	50	47	3	11	31	1	5	1	.....	1
Red-bellied Woodpecker (*Melanerpes carolinus*)	22	26	74	Trace.	11	10	4	Trace.	Trace.	.....	Trace.
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	81	50	50	.....	36	5	2	1	1	3	2
Pileated Woodpecker (*Ceophlœus pileatus*)	23	51	49	.....	30	15	2	Trace.	4	Trace.	Trace.

Relative proportions of larval and adult beetles (Coleoptera) in stomachs of 7 species of woodpeckers.

Name of species.	Number of stomachs examined.	Number containing adult Coleoptera.	Number containing larval Coleoptera.	Percentage of whole number.		Percentage of stomach contents.	
				Adult.	Larvæ.	Adult.	Larvæ.
Downy Woodpecker (*Dryobates pubescens*)	140	50	60	38	43	11	13
Hairy Woodpecker (*Dryobates villosus*)	82	27	46	33	56	6	18
Flicker (*Colaptes auratus*)	230	67	18	25	8	8	2
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	101	83	.....	82	.....	31	.....
Red-bellied Woodpecker (*Melanerpes carolinus*)	22	6	4	27	18	7	3
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	81	15	1	19	1	5	Trace.
Pileated Woodpecker (*Ceophlœus pileatus*)	23	4	12	17	52	2	1

DOWNY WOODPECKER.

(*Dryobates pubescens.*)

This little woodpecker is the smallest, not only of the 7 species under consideration, but of all those inhabiting the United States. He is also one of the most familiar, being no stranger to the shade trees about houses and parks, while his fondness for orchards is well known. He is so quiet and unobtrusive that the first notice one has of his presence may be a gentle tapping or scratching on the limb of a tree within two or three yards of one's head, where our diminutive friend

has discovered a decayed spot inhabited by wood-boring larvæ or a colony of ants.

One hundred and forty stomachs of the Downy Woodpecker have been examined. They were collected during every month in the year and in 21 States, the District of Columbia, Ontario, and New Brunswick. A few of the western subspecies (*Dryobates pubescens gairdneri*), from British Columbia, have been included. The stomachs contained 74 percent of insects, 25 percent of vegetable matter, and 1 percent of mineral matter or sand. The insects belong to the following orders: Ants (*Hymenoptera*), beetles (*Coleoptera*), bugs (*Hemiptera*), flies (*Diptera*), caterpillars (*Lepidoptera*), and grasshoppers (*Orthoptera*). Spiders and myriapods were also present. While all of these were eaten to some extent, they appear in widely different proportions. The ants constitute almost one-third of all the animal food, or about 23 per cent of the whole, indicating a very decided taste for this rather acid and highly flavored article of diet. Beetles stand a little higher in order of importance, amounting to about one-third of the entire insect food, or somewhat more than 24 percent of all. Many of these belong to the family of May beetles, a few were the predaceous ground beetles, but by far the greatest number were wood-boring larvæ, a fact showing that this little bird while securing his dinner is doing good work for the forest. One-fifth of the animal food, or 16 percent of the total, consists of caterpillars, many of which apparently are wood-boring species; others are kinds that live on stems and foliage. Among insects the most interesting are the bugs (*Hemiptera*), which are represented in the stomachs by several species, notably by plant lice (*Aphides*), which in several instances were found in considerable quantities, amounting to 4 percent of the whole food. From the minute size and very perishable nature of these insects it is evident that they must disappear from the stomach in a very short time, and it is fair to infer that many more were eaten than shown by the food remains. Spiders, including harvestmen or daddy longlegs, were eaten freely, and amounted to nearly one-tenth of thewhole. A few bits of snail shell were found in one stomach.

Eleven Downy Woodpeckers from Kansas collected in winter (December) deserve special notice. Eight of them had eaten the eggs of grasshoppers to an average extent of 10 percent of all their food. This, besides being in itself a good work, emphasizes the fact that this bird resorts to the ground for food in case of necessity.

Prof. Samuel Aughey examined 4 stomachs of the Downy Woodpecker in Nebraska, all of which contained grasshoppers.

The late Dr. Townend Glover, entomologist of the Department of Agriculture, states that the stomach of a Downy Woodpecker shot in February "was filled with black ants." He states further, "On one occasion a Downy Woodpecker was observed by myself making a number of small, rough-edged perforations in the bark of a young ash

tree, and upon examining the tree when the bird had flown it was found that wherever the bark had been injured the young larvæ of a wood-eating beetle had been snugly coiled underneath and had been destroyed by the bird."[1]

In the matter of vegetable diet, the taste of the Downy Woodpecker is varied, prompting him to eat a little of a good many things rather than a large quantity of any one. The following is a list of the vegetable substances that were identified:

Grain:
- Indeterminable.

Fruit:
- Dogwood berries (*Cornus florida*), (*C. alternifolia*), and (*C. asperifolia*).
- Virginia creeper berries (*Parthenocissus*[2] *quinquefolia*).
- June or service berries (*Amelanchier canadensis*).
- Strawberries (*Fragaria*).
- Pokeberries (*Phytolacca decandra*).
- Apples.
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus sp.?*).
- Mullein seeds (*Verbascum thapsus*).
- Hornbeam seeds (*Ostrya virginana*).
- Nut, unidentified.
- Flower petals and buds.
- Galls.
- Cambium.
- Seeds, unidentified.
- Rubbish.

Material believed to be fragments of grain was found in 2 stomachs but the quantity was so small that it may be dismissed without further comment. Fruit is by far the largest item of vegetable diet, forming one-tenth of the whole food. Strawberry seeds were found in only 1 stomach, apple pulp was supposed to be identified in 2, and the other varieties mentioned in the table were distributed in about the same proportion; so that no great economic interest can attach to this part of the birds' diet. The seeds and other things included under the head 'Miscellaneous' constitute about one-twelfth of the total food. Seeds of poison ivy were found in 20 stomachs and poison sumac in 1. These plants, far from being harmful to the birds, seem to form a very agreeable article of diet, and are eaten by many species. Unfortunately these seeds are protected by a hard, horny covering which successfully resists the action of the stomach, so that they pass through the alimentary canal uninjured. It is probable that we owe to birds, more than any other agency, the presence of these noxious plants beside fences, copses, and hedge rows. The remaining vegetable food, about 5 percent, was classed as rubbish, and will be discussed in connection with some of the other woodpeckers.

No beechnuts were found in any of the stomachs examined, but Dr. Merriam informs me that in northern New York they feed extensively on this nut, particularly in fall, winter, and early spring. On April 5,

[1] U. S. Agr. Rept. for 1865, 1866, p. 37–38.

[2] Commonly called *Ampelopsis*. See (List of Pteridophyta and Spermatophyta), prepared by a committee of the Botanical Club of the A. A. A. S., 1893–94, which has been followed in all questions of botanical nomenclature.

1878, Dr. Merriam "shot 4 Downy Woodpeckers all of whose gizzards were full of beechnuts and contained nothing else. The birds were often seen on moss-covered logs, and even on the ground, searching for the nuts exposed by the melting snow." Dr. Merriam states also that he has seen this woodpecker in the fall eat the red berries of the mountain ash.

HAIRY WOODPECKER.

(*Dryobates villosus.*)

This woodpecker is as common as the Downy in most parts of the United States, and to the ordinary eye can only be distinguished by its greater size, its color and markings being almost exactly the same.

FIG. 1.—Hairy Woodpecker.

The Hairy is a noiser bird, however, often making his presence known by loud calls and obtrusive behavior and by rapid flights from tree to tree. Like the Downy, he has been accused of depredations on fruit, but the stomachs examined do not show that cultivated varieties form

any considerable part of his fare. Beside the general resemblance between the two birds there is also a remarkable similarity in their food habits, as shown by the stomach contents; the greatest difference being that the Hairy eats a smaller percentage of insects than the Downy. Eighty-two stomachs have been examined, collected during every month in the year, except February; and coming from 19 States, the District of Columbia, Ontario, New Brunswick, and Nova Scotia; though most were from the northern United States. The proportion of different kinds of food is as follows: Animal, 68 percent; vegetable, 31 percent; mineral, 1 percent. The insect material was made up of ants, beetles, caterpillars, bugs, and grasshoppers. Spiders and myriapods also were present. An inspection of the percentages shows that ants are not so highly prized by the Hairy as by the Downy, since they constitute only about 17 percent of the whole food, or one-fourth of the insect portion. Beetles, both larval and adult, stand relatively higher than in the case of the Downy, comprising 24 percent of all food, or more than one-third of the insect matter. Caterpillars were eaten in greater quantities, both actually and relatively, amounting to 21 percent of the whole food, or more than one-third of all the insect material. Spiders are well represented, and aggregate nearly 6 per cent of the entire food. Among the miscellaneous insects were a few aphids or plant lice. Grasshoppers were found in only 1 stomach, but Professor Aughey found them in 4 out of 6 stomachs examined by him in Nebraska.

Mr. F. M. Webster states that he has seen a Hairy Woodpecker successfully peck a hole through the parchment-like covering of the cocoon of a Cecropia moth, devouring the contents. On examining more than 20 cocoons in a grove of boxelders he found only 2 uninjured.

The Hairy Woodpecker selects a somewhat larger variety of vegetable food than the Downy, though of the same general character. The following list of fruits and seeds found in the stomachs does not indicate that the bird visits orchards and gardens for fruit so much as swamps and thickets, where wild grapes, woodbine, and dogwood bound:

Grain:
- Corn.

Fruit:
- Dogwood berries (*Cornus florida* and *C. asperifolia*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- June or service berries (*Amelanchier canadensis*).
- Spice berries (*Benzoin benzoin*).
- Sourgum berries (*Nyssa aquatica*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Wild grapes (*Vitis cordifolia*).

Fruit—Continued:
- Blackberries or raspberries (*Rubus*).
- Pokeberries (*Phytolacca decandra*).
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus glabra*).
- Barngrass seeds (*Chamæraphis. sp?*).
- Hazelnuts.
- Seeds unidentified.
- Cambium.
- Spruce foliage (*Picea*).
- Rubbish.

The only grain discovered was corn, which was found in 2 stomachs. In one case it was green corn in the milk, but this is hardly sufficient to prove the habit of eating corn. Fruit aggregates a little more than 11 percent of the food of the species, and is fairly distributed among all the items in the above list. Since blackberries are the only kind of cultivated fruit found in the stomachs, and since they grow wild in abundance, it is evident that the Hairy Woodpecker does not at present cause any great damage by his fruit-eating habits. The substances in the miscellaneous list form about 11 percent of the whole food, and are practically of the same character as in the case of the Downy. Poison ivy seeds were eaten by 7 birds, and poison sumac by only 1, so that not so many seeds of these undesirable shrubs are distributed by the Hairy as by the Downy. The weed seeds in the stomachs were few in number, but in Iowa both the Hairy and the Downy Woodpeckers feed largely on weed seeds in winter, stomachs taken then containing little else. Rubbish amounts to about one-twelfth of all their food, which is the largest percentage shown by any species.

Dr. Merriam informs me that in northern New York the Hairy Woodpecker, like the other woodpeckers of the Adirondack region, feeds largely on beechnuts. In late fall, winter, and early spring following good yields of beechnuts the nuts form the principal food of the woodpeckers.

FLICKER.

(*Colaptes auratus.*)

This bird, one of the largest and best known of our woodpeckers, is more migratory than either the Hairy or Downy, in winter being scarce or absent from its breeding range in the Northern States, where it is very abundant in summer and early fall. The Yellow-shafted Flicker is distributed throughout the United States east of the Rocky Mountains. In the West it is replaced by the Red-shafted Flicker, which may be considered the same so far as food habits are concerned. Under one or the other of its various titles of Flicker, Golden-winged Woodpecker, High-holder, Yellow-hammer, Pigeon Woodpecker, and Hairy-wicket, it is known to every farmer and schoolboy and, unfortunately, to certain so-called sportsmen also, for this is the one woodpecker that is often seen in city markets. In most places it is a much shyer bird than either of the preceding, and while it frequents the farm and approaches buildings freely it keeps more in the tops of the trees and does not allow so near an approach of its greatest enemy, man. This is particularly true in the northeastern part of the country, where large bags of Pigeon Woodpeckers are annually made among the wild cherry trees in which the birds feed. The Flickers soon learn whom they have to fear, and such knowledge seems to be hereditary. They are very prolific, rearing from six to ten young at a brood, and so keep reasonably abundant in most parts of the country. The Flicker is the most

terrestrial of all the woodpeckers, in spite of his high-perching and high-nesting proclivities, and may often be seen walking about in the grass like a meadow lark.

In the investigation of its food habits 230 stomachs were examined, taken in every month of the year, although January and February have but 1 each. They were collected in 22 States, the District of Columbia, and the Northwest Territory, and are fairly well distributed over the region east of the Rocky Mountains. They contained 56 per cent of animal matter, 39 percent of vegetable, and 5 percent of mineral. It will be seen that the quantity of animal or insect material is less than in either of the preceding species, and the mineral matter somewhat greater. The following orders of insects were represented:

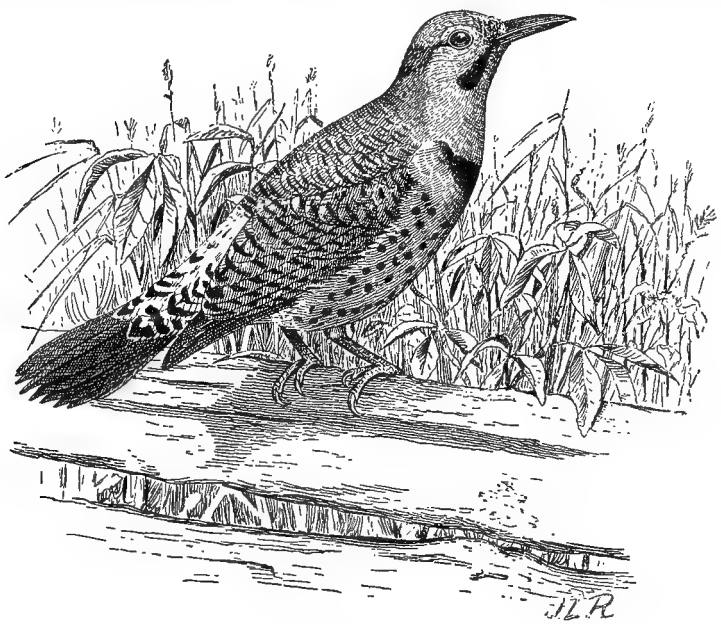

FIG. 2.—Flicker.

Ants (*Hymenoptera*), beetles (*Coleoptera*), bugs (*Hemiptera*), grasshoppers and crickets (*Orthoptera*), caterpillars (*Lepidoptera*), May flies (*Ephemerida*) and white ants (*Isoptera*). Spiders and myriapods also were present. An inspection of this insect matter shows the rather remarkable fact that more than three-fourths of it, or 43 percent of the whole food, consists of ants. If the mineral matter is thrown out as not being properly food, we find that more than 45 percent of the Flicker's food for the year consists of ants. Among the stomachs examined several contained nothing but ants. In two of these the actual number of ants present in each stomach exceeded 3,000. These were mostly small species that live in burrows in the earth, so that it is evident that when Flickers are seen upon the ground they are usually in search of

ants, although the other insects found in the stomachs account in part for this ground-feeding habit. Prof. Samuel Aughey examined 8 stomachs of Flickers in Dixon County, Nebr., in June, 1865. All of them contained grasshoppers, and the number in each stomach varied from 15 to 48.

As a large part of the food of the 7 woodpeckers studied consists of ants, the question may be asked whether the birds are doing good or harm by destroying them. There are so many different species of these insects, and they have such widely different habits, that it is difficult to make any assertion that will apply to all, but it is safe to say that many kinds are decidedly harmful, because they attend, protect, and help to spread plant, root, and bark lice of various species. These lice are among the worst enemies of plant life, and everything which tends to prevent their destruction is prejudicial to the interests of agriculture. Other species of ants destroy timber by burrowing in it; still others, in warmer climates, do much harm to fruit trees by cutting off the leaves and undermining the ground. Many species infest houses and other buildings. Apparently, then, birds do no harm in destroying ants, but on the contrary probably do much good by keeping within bounds these insect pests, whose greater abundance would be a serious injury to man. The Flicker takes the lead in this work, eating ants to the extent of nearly half of his whole food.

Next in importance to ants are beetles, which form about 10 percent of all the food, less than half the quantity eaten by the Hairy and Downy Woodpeckers. Among these were May beetles and their allies, and a few snapping beetles, but the greater number were Carabids or predaceous ground beetles. Most of these were in the adult form, but some larvæ of tiger beetles were identified. As these last live in burrows in the sand, and as Carabids live upon the ground, their presence in the stomachs again points to the terrestrial habits of the bird. The same is true of the grasshoppers and crickets. None of the other insects mentioned were eaten to any great extent, the whole aggregating only about 3 percent. Two stomachs contained each a single bedbug. Where they were obtained it is as difficult to surmise as it is to understand what motive could prompt the bird to swallow such an insect. Five stomachs contained each a few bits of snail shell.

In the matter of vegetable diet the Flicker has the most extensive list of any of the 7 woodpeckers, and many of the articles of food can only be obtained on the ground or among low bushes. Following is a list of all the vegetable substances identified in the Flicker's stomach:

Grain:
- Corn.
- Buckwheat.

Fruit:
- Dogwood berries (*Cornus florida* and *C. asperifolia*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- Hackberries (*Celtis occidentalis*).
- Black alder berries (*Ilex verticillata*).
- Sourgum berries (*Nyssa aquatica*).
- Cat or greenbrier berries (*Smilax glauca*).
- Blueberries (*Vaccinium* sp.).
- Huckleberries (*Gaylussacia* sp.).
- Pokeberries (*Phytolacca decandra*).
- June or service berries (*Amelanchier canadensis*).
- Spice berries (*Benzoin benzoin*).
- Elderberries (*Sambucus canadensis* and *S. pubens*).
- Mulberries (*Morus*).
- Wild grapes (*Vitis cordifolia*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Cultivated cherries.

Fruit—Continued.
- Blackberries (*Rubus*)
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus copallina* and *R. glabra*).
- Waxberries or bayberries (*Myrica cerifera*).
- Juniper berries (*Juniperus virginiana*).
- Knotweed or smartweed (*Polygonum convolvulus, P. persicaria, P. lapathifolium*).
- Clover seed (*Trifolium repens*).
- Grass seed (*Phleum*).
- Pigweed seed (*Chenopodium*).
- Mullein seed (*Verbascum thapsus*).
- Ragweed (*Ambrosia*).
- Magnolia seed (*Magnolia grandiflora*).
- Acorns (*Quercus*).
- Seed unidentified.
- Cambium.
- Rubbish.

Of the two kinds of grain in the above list corn was identified in 5 stomachs, buckwheat in 1. One of the stomachs containing corn was taken in March and the bird had made a full meal of it, probably because he could get nothing else. Three of the others were collected in September, and the corn was evidently 'in the milk.' The fifth was taken in October, and is of a somewhat doubtful nature.

The Department of Agriculture has received a number of reports that implicate woodpeckers in damage done to crops. The only one of any consequence is from Dr. E. S. C. Foster, of Russell County, Kans., who states that the Red-headed and Golden-winged Woodpeckers damage corn in the roasting ear by tearing open the husks. He does not say for what purpose the husks are torn open, though some observers have declared that the object is to obtain the grub which sometimes infests the ear. The testimony furnished by the stomachs does not indicate that the Golden-wing has much to do with corn stealing, for it appears that out of 98 stomachs taken in September and October, the season of harvest, only 4 contained corn at all, and these in quantities ranging from 4 to 30 percent of the stomach contents. The buckwheat was eaten in September. The Flicker has a rich and varied list of fruit, embracing at least 20 different kinds, nearly all of which are wild.

The two items of grain and fruit together constitute about 25 per cent of the whole food, the grain, however, being of little consequence. With all this fruit eating, the Flicker trespassed upon man's preserves for cherries only, and these were found in only 1 stomach. Several

observers, however, have testified that some damage is done. T. J. Parrish, of Cooke County, Tex., states that the Yellow-hammers and small woodpeckers feed on peaches, plums, grapes, and cherries.

Miscellaneous vegetable substances aggregate a little more than 10 percent of the whole food of this bird, and like the fruit list, consist of a variety of elements. Poison ivy seeds were found in 20 stomachs, poison sumac in 5, and bayberries in 14. All these seeds are coated with a white substance resembling wax, and while the quantity is small compared with the size of the seeds, it is probably rich in nutritive properties, for the seeds are a favorite article of winter diet with many birds. A number of weed seeds were found, and if eaten in considerable quantities would be a great argument in the bird's favor, but unfortunately they occurred in only one or two stomachs each, and so may be considered as merely picked up experimentally in default of something better. It is possible that a series of stomachs taken in the winter months might show a larger percentage, as has been observed in the case of other species of birds, including at least 2 woodpeckers. The mineral element of the stomach contents is larger in the Flicker than any of the others, forming 5 percent of the whole, and consisting principally of fine sand. It was noticed that the greatest quantity was present in stomachs containing ants, showing that the sand was picked up accidentally in gathering the ants from their hillocks.

RED-HEADED WOODPECKER.

(*Melanerpes erythrocephalus.*)

The handsome Redhead inhabits suitable localities throughout the United States east of the Rocky Mountains, but is only casual in New England. He is a familiar bird on telegraph poles and fence posts, and seems to prefer these rather unpicturesque objects to other apparently more fruitful hunting grounds. He feeds largely on insects found upon these bare surfaces, but the vegetable matter in his stomach shows that he forages in other pastures also.

Fifty years ago Giraud stated that on Long Island the Red-headed Woodpecker arrives early in April, and during the spring "subsists chiefly on insects. In the summer it frequents the fruit trees, ripe cherries and pears seeming to be a favorite repast. In the fall it feeds on berries and acorns, the latter at this season forming a large portion of its food."[1]

In its fondness for mast it resembles its relative, the California Woodpecker, whose habit of storing acorns is one of its most conspicuous traits. In the northern part of its range, where the oak is replaced by the beech, the Redhead makes the beechnut its principal food. Dr. C. Hart

[1] Birds of Long Island, by J. P. Giraud, jr., 1844, p. 180.

Merriam has given much testimony under this head.[1] He states that in northern New York, where it is one of the commonest woodpeckers, it subsists almost exclusively on beechnuts during the fall and winter, even picking the green nuts before they are ripe and while the trees are still covered with leaves. He has shown that these woodpeckers invariably remain throughout the winter after good nut yields and migrate whenever the nut crop fails. He says: "Gray Squirrels, Red-headed Woodpeckers, and beechnuts were numerous during the winters

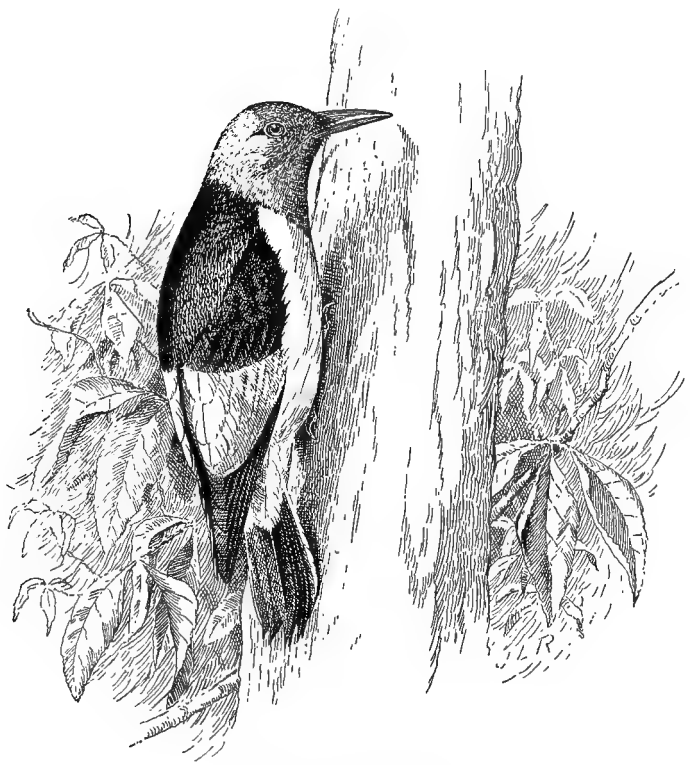

FIG. 3.—Red-headed Woodpecker.

of 1871–72, 1873–74, 1875–76, 1877–78, 1879–80, 1881–82, 1883–84, while during the alternate years the squirrels and nuts were scarce and the woodpeckers altogether absent;" and adds that in Lewis County, N. Y., "a good squirrel year is synonymous with a good year for *Melanerpes*, and vice versa." In early spring, following nut years, when the melting snow uncovers the ground, they feed on the beechnuts that were buried during winter. On April 5, 1878, at Locust Grove, N. Y., he shot 6 whose gizzards contained beechnuts and nothing else.

[1] Birds of Connecticut, 1877, p. 66; Bull. Nuttall Ornith. Club, Vol. III, 1878, p. 124; Mammals of the Adirondacks, 1884, p. 226.

In an interesting article in the Auk,[1] Mr. O. P. Hay says that in central Indiana during a good beechnut year, from the time the nuts began to ripen, the Redheads were almost constantly on the wing, passing from the beeches to some place of deposit. They hid the nuts in almost every conceivable situation. Many were placed in cavities in partly decayed trees; and the felling of an old beech was certain to provide a feast for the children. Large handfuls were taken from a single knot hole. They were often found under a patch of raised bark, and single nuts were driven into cracks in the bark. Others were thrust into cracks in gateposts; and a favorite place of deposit was behind long slivers on fence posts. In a few cases grains of corn were mixed with beechnuts. Nuts were often driven into cracks in the ends of railroad ties; and the birds were often seen on the roofs of houses pounding nuts into the crevices between the shingles. In several instances the space formed by a board springing away from a fence was nearly filled with nuts, and afterwards pieces of bark and wood were brought and driven over the nuts as if to hide them from poachers.

In summer Dr. Merriam has seen the Redheads "make frequent sallies into the air after passing insects, which were almost invariably secured." He has also seen them catch grasshoppers on the ground in a pasture.

Dr. A. K. Fisher saw several Red-headed Woodpeckers feeding on grasshoppers in the streets at Miles City, Mont., in the latter part of July, 1893. Several of the birds were seen capturing these insects near the hotel throughout the greater part of the forenoon. From a regular perch on top of a telegraph pole or cottonwood they descended on their prey, sometimes eating them on the ground, but more often returned to their former post to devour them.

The following interesting observation was made by Dr. G. S. Agersborg, of Vermillion, S. Dak.:[2]

> Last spring, in opening a good many birds of this species with the object of ascertaining their principal food, I found in their stomachs nothing but young grasshoppers. One of them, which had its headquarters near my house, was observed making frequent visits to an old oak post, and on examining it I found a large crack where the woodpecker had inserted about 100 grasshoppers of all sizes (for future use, as later observation proved), which were put in without killing them, but they were so firmly wedged in the crack that they in vain tried to get free. I told this to a couple of farmers, and found that they had also seen the same thing, and showed me posts which were used for the same purpose. Later in the season the woodpecker whose station was near my house, commenced to use his stores, and to-day (February 10), there are only a few shriveled-up grasshoppers left.

Mr. Charles Aldrich, of Webster City, Iowa, states that he saw a Redheaded Woodpecker catching grasshoppers on the prairie half a mile from timber. In Nebraska grasshoppers were found in 4 out of 6 stomachs examined by Prof. Samuel Aughey.

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[1] Auk. Vol. IV, 1887, pp. 194,195.

[2] Bull. Nuttall Ornith. Club, Vol. III, 1878, p. 97.

Besides depredations upon fruit and grain, this woodpecker has been accused of destroying the eggs of other birds and even of killing the young; and from Florida comes a report that it enters poultry houses and sucks the eggs of domestic fowls. Mr. Charles Aldrich, of Webster City, Iowa, says that a Red-headed Woodpecker was seen to kill a duckling with a single blow on the head, and then to peck out and eat the brains.[1] In view of such testimony remains of eggs and young birds were carefully looked for in the stomachs examined, but pieces of eggshell were found in only 1 stomach of the Flicker and 2 of the Redhead.

A very unusual trait has been recorded by Dr. Howard Jones, of Circleville, Ohio. Dr. Jones says he has seen the Red-headed Woodpecker steal the eggs of eave swallows, and in cases where the necks of the nests were so long that the eggs were out of reach the woodpecker made a hole in the walls of the nest and so obtained the contents. In a colony of swallows containing 'dozens' of nests not a single brood of young was raised. One of the woodpeckers also began to prey upon hens' eggs, and was finally captured in the act of robbing the nest of a sitting hen.[2]

No traces of young birds or of any other vertebrates were discovered in the stomachs of any of the 7 species under consideration, except bones of a small frog which were found in the stomach of a Red-bellied Woodpecker (*Melanerpes carolinus*) from Florida.

The Redhead has been accused of doing considerable damage to fruit and grain, and both charges are fairly well sustained. In northern New York Dr. Merriam has seen it peck into apples on the tree, and has several times seen it feed on choke cherries (*Prunus virginiana*).

Mr. August Jahn, of Pope County, Ark., writes that it has damaged his corn to the amount of $10 or $15, and Dr. J. R. Mathers, of Upshur County, W. Va., says that the same species feeds on cherries, strawberries, raspberries, and blackberries, and that its depredations are sometimes serious. According to Mr. Witmer Stone, of Germantown, Pa., Red-headed Woodpeckers have been observed to strip a blackberry patch of all of its fruit. Mr. W. B. McDaniel, of Decatur County, Ga., also reports that the Sapsucker and Redhead eat grapes and cherries, the loss being sometimes considerable. These examples show the nature of the evidence contributed by eye-witnesses, the accuracy of whose observations there is no reason to doubt. That the stomach examinations do not reveal more damaging points against the species is not surprising, for a person seeing a bird eating his choice fruit, or in some other way inflicting damage, is more impressed by it than by the sight of a hundred of the same species quietly pursuing their ordinary vocations. Thus an occasional act is taken as a characteristic habit.

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[1] Am. Nat., Vol. VI, No. 5, May, 1877, p. 308.

[2] Ornithologist and Oologist, Vol. VIII, No. 7, 1883, p. 56.

One hundred and one stomachs of the Redhead were examined from specimens collected throughout the year, although the bird is not generally abundant in the Northern States during the winter months. The specimens were taken in 20 States, the District of Columbia and Canada, and are fairly well distributed over the whole region east of the Rocky Mountains. The contents of the stomachs consisted of: Animal matter, 50 percent; vegetable matter, 47 percent; mineral matter, 3 percent. The animal and vegetable elements are nearly balanced, and the mineral element is larger than in any except the Flicker. The insects consist of ants, wasps, beetles, bugs, grasshoppers, crickets, moths, and caterpillars. Spiders and myriapods also were found. Ants amounted to about 11 percent of the whole food, which is the smallest showing of any of the 7 species under consideration, and is in harmony with the habits of the bird, which collects its food upon exposed surfaces where ants do not often occur. Beetle remains formed nearly one-third of all food, the highest record of any one of the 7 woodpeckers. The families represented were those of the common May beetle (*Lachnosterna*), which was found in several stomachs, the predaceous ground beetles, tiger beetles, weevils, and a few others. Among the May beetle family is a rather large, brilliant green beetle, known to entomologists as *Allorhina nitida*, but commonly called by the less dignified name of 'June bug.' It is very common during the early summer in the Middle and Southern States, but less so at the North. This insect was found in 11 stomachs, and 5 individuals were identified in a single stomach, which would seem an enormous meal for a bird of this size. Another large beetle eaten by this woodpecker is the fire-ground beetle (*Calosoma calidum*), a predaceous beetle of large size and vile odor. *Passalus cornutus*, one of the staghorns, a large insect, was also found, as well as a pair of mandibles belonging to *Prionus brevicornus*, one of the largest beetles in the United States. A preference for large beetles is one of the pronounced characteristics of this woodpecker. Weevils were found in 15 stomachs, and in several cases as many as 10 were present. Remains of Carabid beetles were found in 44 stomachs to an average amount of 24 percent of the contents of those that contained them, or 10 percent of all. The fact that 43 percent of all the birds taken had eaten these beetles, some of them to the extent of 16 individuals, shows a decided fondness for these insects, and taken with the fact that 5 stomachs contained Cicindelids or tiger beetles forms a rather strong indictment against the bird.

Grasshoppers and crickets formed 6 percent of the whole food, a larger percentage than in any of the other 7 species. The aggregate for all other insects is 4 percent, and the most important kinds are wasps and their allies. As this bird has often been seen capturing insects on the wing[1] it is probable that the wasps were taken in that way.

[1] See Merriam, Bull. Nuttall Ornith. Club, Vol. III, July, 1878, p. 126; also Forest and Stream, Vol. IX, January 17, 1878, p. 451.

The vegetable food of the Redhead presents considerable variety, and shows some points of difference from that of the other woodpeckers. The following is the list of substances identified:

Grain:
- Corn.

Fruit:
- Dogwood berries (*Cornus candidissima* and *C. florida*).
- Huckleberries (*Gaylussacia*).
- Strawberries (*Fragaria*).
- Blackberries or raspberries (*Rubus*).
- Mulberries (*Morus*).
- Elderberries (*Sambucus*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Cultivated cherries.
- Wild grapes (*Vitis cordifolia*).

Fruit—Continued.
- Apples.
- Pears.
- Unidentified.

Miscellaneous:
- Sumac seeds (*Rhus copallina* and *R. glabra*).
- Ragweed seeds (*Ambrosia*).
- Pigweed seeds (*Chenopodium*).
- Acorns (*Quercus*).
- Seeds unidentified.
- Galls.
- Flower anthers.
- Rubbish.

Corn was found in 17 stomachs, collected from May to September, inclusive, and amounted to more than 7 percent of all the food. While it seems to be eaten in any condition, that taken in the late summer was in the milk, and evidently picked from standing ears. This being the largest percentage of grain shown by any of the 7 species corroborates some of the testimony received, and indicates that the Redhead, if sufficiently abundant, might do considerable damage to the growing crop, particularly if other food was not at hand. While the fruit list is not so long as in the case of the Flicker, it includes more kinds that are, or may be, cultivated; and the quantity found in the stomachs, a little more than 33 percent of all the food, is greater than in any of the others. Strawberries were found in 1 stomach, blackberries or raspberries in 15, cultivated cherries in 2, apples in 4, and pears in 6. Fruit pulp was found in 33 stomachs, and it is almost certain that a large part of this was obtained from some of the larger cultivated varieties. Seeds were found in but few stomachs, and only a small number in each.

RED-BELLIED WOODPECKER.

(*Melanerpes carolinus.*)

The Red-bellied Woodpecker is a more southern species than any of the others treated in this bulletin. It is not known to breed north of the Carolinian fauna, and is abundant in Florida and the Gulf States. Curiously enough it sometimes migrates north of its breeding range to spend the winter.

Only 22 stomachs of this species have been obtained by the division. These were collected in 9 States, ranging from Florida to Michigan and from Maryland to Kansas, and in every month except April, June, and July. An examination of their stomachs shows: animal matter (insects)

26 percent and vegetable matter 74 percent. A small quantity of gravel was found in 7 stomachs, but was not reckoned as food. Ants were found in 14 stomachs, and amounted to 11 percent of the whole food. Adult beetles stand next in importance, aggregating 7 percent of all food, while larval beetles only reach 3 percent. Caterpillars had been taken by only 2 birds, but they had eaten so many that they amounted to 4 percent of the whole food. The remaining animal food is made up of small quantities of bugs (*Hemiptera*), crickets (*Orthoptera*), and spiders, with a few bones of a small tree frog found in 1 stomach taken in Florida.

Dr. B. H. Warren states that the stomachs of 3 Red-bellied Woodpeckers captured in winter in Chester and Delaware counties, Pa., contained black beetles, larvæ, fragments of acorns, and a few seeds of wild grapes. The stomachs of 8 adults from the St. Johns River, Florida, contained red seeds of 2 species of palmetto, but no insects. Two additional stomachs from the same locality contained palmetto berries, fragments of crickets (*Nemobius* and *Oracharis saltator*), a palmetto ant (*Camponotus escuriens*), and numerous joints of a myriapod, probably *Julus*.[1]

Dr. Townend Glover found in the stomach of a Red-bellied Woodpecker killed in December "pieces of acorns, seeds, and gravel, but no insects. Another, shot in December, contained wing-cases of *Buprestis*, and a species of wasp or *Polistes*, acorns, seeds, and no bark. A third, shot in May, was filled with seeds, pieces of bark, and insects, among which was an entire *Lachnosterna*, or May bug."[2]

The vegetable food of the Red-bellied Woodpecker contained in the 22 stomachs examined by the division consisted of the following seeds and fruits:

Grain:
- Corn.

Fruit:
- Mulberries (*Morus rubra*).
- Wild grapes (*Vitis cordifolia*).
- Virginia creeper (*Parthenocissus quinquefolia*).
- Elderberries (*Sambucus canadensis*).
- Rough-leaved cornel (*Cornus asperifolia*).

Fruit—Continued.
- Saw palmetto (*Sabal serrulata*).
- Holly (*Ilex opaca*).
- Wild sarsaparilla (*Aralia nudicaulis*).
- Bayberries (*Myrica cerifera*).
- Pine (*Pinus echinata*).
- Poison ivy (*Rhus radicans*).
- Ragweed (*Ambrosia* sp.).

Corn was found in only 2 stomachs. The other items were well distributed, and none of them appear to be specially preferred, unless it may be the poison ivy, which was found in 6 stomachs, and amounted to nearly 12 per cent of the whole food. Although 8 of the 22 birds were collected in Florida, no trace of the pulp of oranges was discovered, but that oranges are eaten by them is shown by the following interesting notes.

[1] Birds of Pennsylvania 2d ed., 1890, pp. 174, 175.
[2] U. S. Agric. Rept. for 1865, 1866, p. 38.

Dr. B. H. Warren states that in Florida the Red-bellied Woodpecker is commonly known as 'Orange Sapsucker' and 'Orange Borer.' Dr. Warren collected 26 of these woodpeckers in an orange grove near Volusia and found that 11 of them contained orange pulp. Three contained nothing else; the others had eaten also insects and berries.

Corroborating Dr. Warren's account, Mr. William Brewster states that at Enterprise, Fla., in February, 1889, he saw a Red-bellied Woodpecker eating the pulp of a sweet orange. Mr. Brewster states that the woodpecker attacked the orange on the ground, pecking at it in a slow and deliberate way for several minutes. On examining the orange it was found to be decayed on one side. "In the sound portion were three holes, each nearly as large as a silver dollar, with narrow strips of peel between them. The pulp had been eaten out quite to the middle of the fruit. Small pieces of rind were thickly strewn about the spot." Upon searching closely he discovered several other oranges that had been attacked in a similiar manner. All were partially decayed and were lying on the ground. He was unable to find any on the trees which showed any marks of the woodpecker's bill.[1]

Mr. Benjamin Mortimer, writing of the same bird at Sanford, Fla., says:

During February and March, 1889, while gathering fruit or pruning orange trees, I frequently found oranges that had been riddled by this woodpecker and repeatedly saw the bird at work. I never observed it feeding upon fallen oranges. It helped itself freely to sound fruit that still hung on the trees, and in some instances I have found ten or twelve oranges on one tree that had been tapped by it. Where an orange accidentally rested on a branch in such a way as to make the flower end accessible from above or from a horizontal direction the woodpecker chose that spot, as through it he could reach into all the sections of the fruit, and when this was the case there was but one hole in the orange. But usually there were many holes around it. It appeared that after having once commenced on an orange, the woodpecker returned to the same one repeatedly until he had completely consumed the pulp, and then he usually attacked another very near to it. Thus I have found certain clusters in which every orange had been bored, while all the others on the tree were untouched. An old orange grower told me that the "Sapsuckers," as he called them, never touch any but very ripe oranges, and are troublesome only to such growers as reserved their crops for the late market. He also said that it is only within a very few years that they have shown a taste for the fruit; and I myself observed that, although Red-bellies were very common in the neighborhood, only an individual, or perhaps a pair, visited any one grove.[2]

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[1] The Auk, Vol. VI, 1889, pp. 337–338.

[2] The Auk, Vol. VII, 1890, p. 340.

YELLOW-BELLIED WOODPECKER OR SAPSUCKER.

(*Sphyrapicus varius.*)

This species is probably the most migratory of all our woodpeckers, breeding only in the most northerly parts of the United States, and in some of the mountains farther south. In the fall it ranges southward, spending the winter in most of the Eastern States. It is less generally distributed than some of the other woodpeckers, being quite unknown in some sections and very abundant in others. For instance, Dr. C. Hart Merriam states that in the Adirondack region during migration it

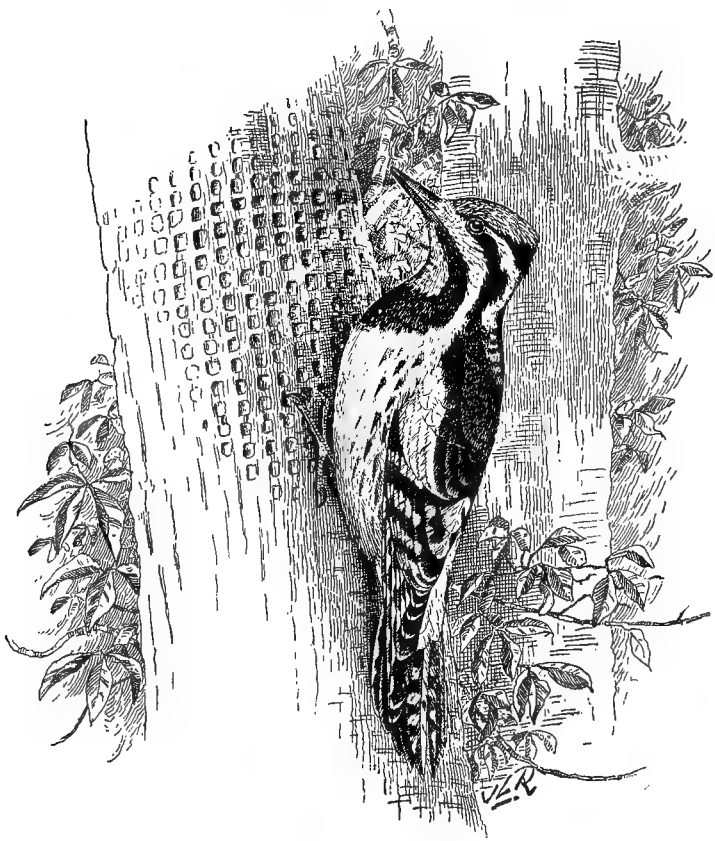

FIG. 4.—Yellow-bellied Woodpecker or Sapsucker.

outnumbers all other species of the family together, and throughout the summer is second in numbers only to the Hairy Woodpecker; and at Mount Chocorua, New Hampshire, Mr. Frank Bolles found it the most abundant species. In Minnesota also it is very common. On the other hand, near my home in Massachusetts only two or three were observed each year; and during a residence of eight years in Iowa it was noted only three or four times.

It is to this species that the term 'Sapsucker' is most often and most justly applied, for it drills holes in the bark of certain trees and drinks the sap. It feeds also on cambium, insects, and wild fruits and berries.

In writing of the habits of these woodpeckers in northern New York in 1878, Dr. Merriam states:

They really do considerable mischief by drilling holes in the bark of apple, thornapple, and mountain ash trees in such a way as to form girdles of punctures, sometimes 2 feet or more in breadth (up and down), about the trunks and branches. * * * The holes, which are sometimes merely single punctures, and sometimes squarish spaces (multiple punctures) nearly half an inch across, are placed so near together that not unfrequently they cover more of the tree than the remaining bark. Hence, more than half of the bark is sometimes removed from the girdled portions, and the balance often dries up and comes off. Therefore it is not surprising that trees which have been extensively girdled generally die, and mountain ash are much more prone to do so than either apple or thornapple trees, due, very likely, to their more slender stems. The motive which induces this species to operate thus upon young and healthy trees is, I think, but partly understood. It is unquestionably true that they feed, to a certain extent, both upon the inner bark and the fresh sap from these trees, but that the procurement of these two elements of sustenance, gratifying as they doubtless are, is their chief aim in making the punctures I am inclined to dispute. As the sap exudes from the newly-made punctures, thousands of flies, yellow jackets, and other insects congregate about the place, till the hum of their wings suggests a swarm of bees. If, now, the tree be watched, the woodpecker will soon be seen to return and alight over the part of the girdle which he has most recently punctured. Here he remains, with motionless body, and feasts upon the choicest species from the host of insects within easy reach. * * * In making each girdle they work around the trunk, and from below upwards, but they may begin a new girdle below an old one. They make but few holes each day, and after completing two or three remain over the spot for some little time, and as the clear fresh sap exudes and trickles down the bark they place their bill against the dependent drop and suck it in with evident relish—a habit which has doubtless given rise to the more appropriate than elegant term Sapsucker, by which they are commonly known in some parts of the country. I have several times watched this performance at a distance of less than 10 feet, and all the details of the process were distinctly seen, the bird looking at me, meanwhile, 'out of the corner of his eye.' When his thirst is satisfied he silently disappears, and as silently returns again, after a few hours, to feast upon the insects that have been attracted to the spot by the escaping sap. This bird, then, by a few strokes of its bill, is enabled to secure both food (animal and vegetable) and drink in abundance for an entire day; and a single tree, favorably situated, may suffice for a whole season.[1]

The late Frank Bolles has published some interesting detailed observations respecting the food habits of the Sapsucker. His conclusions are:

That the Yellow-bellied Woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap, and in some cases parts of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to any-

[1] Bull. Nuttall Ornith. Club, Vol. IV, January, 1879, pp. 3–5.

thing like the extent to which sap drinking occupies it; * * * that the forest trees attacked by them generally die, possibly in the second or third year of use; that the total damage done by them is too insignificant to justify their persecution in well-wooded regions.[1]

Mr. Bolles shot 8 Sapsuckers in July and August, 1890. Their stomachs "were well filled with insects." Some of these were examined by Mr. Samuel H. Scudder, who states:

The insects in the different stomachs are in all cases almost exclusively composed of the harder chitinous parts of ants. In a cursory examination I find little else, though one or two beetles are represented, and No. 4 must have swallowed an entire wasp of the largest size, his head and wings attesting thereto.[2]

In a subsequent article Mr. Bolles gives the result of an attempt to keep several young Sapsuckers alive on a diet of dilute maple sirup. Unfortunately for the experiment, the birds obtained and greedily devoured numerous insects attracted to the cage by the sirup. How many of the insects were eaten was not known, but all of the birds died within four months. Examination of their bodies showed fatty degeneration of the liver—a condition said to be usual in cases of starvation. Mr. Bolles states:

The most probable cause of this enlargement of the liver, which seems to have been the reason for the death of the 3 Sapsuckers, was an undue proportion of sugar in their diet. In a wild state they would have eaten insects every day and kept their stomachs well filled with the chitinous parts of acid insects. Under restraint they secured fewer and fewer insects, until, during the last few weeks of their lives, they had practically no solid food of any kind.[3]

Mr. Bolles has thus proved by experiment that concentrated sap (saturated with sugar) is not sufficient to sustain life, even with the addition of a small percentage of insects. The logical inference is that sap, while liked by the birds and consumed in large quantities, holds a subordinate place as an article of food.

The Yellow-bellied Woodpecker is represented in the collection by 81 stomachs, distributed rather irregularly through the year. None were taken in February, March, or November, and only a few in January, June, and December; the great bulk were collected in April, August, September, and October. They were obtained from 15 States, the District of Columbia, and Nova Scotia. All were from the Northern States, except a few from North Carolina, Virginia, and the District of Columbia. Unlike any of the preceding species the vegetable element of the food here exactly equals the animal part. The insect matter was made up of ants, wasps, beetles, flies, bugs, grasshoppers, crickets, and mayflies. Some spiders also were present. Of the whole food, 36 percent consisted of ants, a higher percentage than in any other woodpecker except the Flicker. Beetles amounted to 5 percent, and do not appear to be a favorite food. Flies (*Diptera*) in various forms were

[1] The Auk, Vol. VIII, July, 1891, p. 270.
[2] The Auk, Vol. VIII, July, 1891, p. 269.
[3] The Auk, Vol. IX, April, 1892, p. 119.

eaten in larger numbers than by any of the others. Among them were several long-legged crane flies (*Tipulids*). Spiders were eaten to a small extent only, and most of these were phalangers or 'daddy-longlegs,' which, taken with the crane flies, would indicate a slight preference for long-legged prey. Bugs, wasps, caterpillars, crickets, and mayflies collectively amount to about 6 percent, no one of them reaching any very important figure. Prof. Samuel Aughey examined 5 stomachs of the Yellow-bellied Woodpecker in Nebraska, all of which contained grasshoppers. The number in each stomach varied from 15 to 33.

Mr. William Brewster states that at Umbagog Lake, Maine, "After the young have hatched, the habits of the Yellow-bellied Woodpecker change. From an humble delver after worms and larvæ, it rises to the proud independence of a flycatcher, taking its prey on wing as unerringly as the best marksman of them all. From its perch on the spire of some tall stub it makes a succession of rapid sorties after its abundant victims, and then flies off to its nest with bill and mouth crammed full of insects, principally large Diptera."[1]

The vegetable food of the Sapsucker is varied. The following fruits and berries were found in the stomachs:

Fruit:
- Dogwood berries (*Cornus florida*).
- Black alder berries (*Ilex verticillata*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- Wild black cherries (*Prunus serotina*).
- Blackberries or raspberries (*Rubus*).
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Mullein seeds (*Verbascum thapsus*).
- Juniper berries (*Juniperus virginiana*).
- Buds.
- Seeds unidentified.
- Cambium.
- Rubbish.

The quantity of fruit found in the stomachs formed 26 percent of the entire food, but the only kinds identified that might possibly be cultivated were blackberries and raspberries, and these were in only 2 stomachs. Unidentifiable fruit pulp was found in 12 stomachs. Miscellaneous seeds to the amount of 5 percent complete the list of substances eaten by this species. Poison ivy seeds were found in only 1 stomach, and most of the other things were distributed in about the same proportion.

Dr. Merriam informs me that in the fall in northern New York the Sapsuckers feed on ripening beechnuts, the small branches bending low with the weight of the birds while picking the tender nuts.

[1] Bull. Nuttall Ornith. Club, Vol. I, 1876, No. 3, p. 69.

GREAT PILEATED WOODPECKER.

(*Ceophlœus pileatus.*)

Excepting the Ivory Bill this is the largest woodpecker in the United States, where it inhabits most of the heavily wooded districts. It is shy and retiring, seldom appearing outside of the forests, and difficult to approach even in its favorite haunts. Its large size, loud voice, and habit of hammering upon dead trees render it conspicuous. Its strength is marvelous, and one unacquainted with it can scarcely credit a bird with such power of destruction as is sometimes shown by a stump or dead trunk on which it has operated for ants or boring larvæ.

Only 23 stomachs of the Pileated Woodpecker have been obtained; all taken in the months of October, November, December, and January, and collected from 6 States, the District of Columbia, and Canada (including New Brunswick). Fifty-one percent of the contents of these stomachs consisted of animal matter or insects; 49 percent of vegetable matter. The insects were principally ants and beetles, with a few of some other orders. The ants were mostly of the larger species that live in decaying wood. A large proportion of the beetles were in the larval form, and all were of the wood-boring species. There were also a few caterpillars, also wood-borers, a few plant lice, several cockroaches of the species that live under the bark of dead trees, a few white ants and a few flies, with one spider.

The gizzard of a Pileated Woodpecker shot by Dr. Merriam in the Adirondacks, April 25, 1882, contained hundreds of large ants and no other food. Six stomachs, collected by Dr. B. H. Warren on the St. Johns River in Florida, contained numerous palmetto ants (*Campanotus escuriens*), and remains of other ants, several larvæ of a Prionid beetle (*Orthosoma brunnea*), numerous builder ants (*Cremastogaster lineolata*), one larva of *Xylotrechus*, and one pupa of the white ant (*Termes*). The insects were determined under Prof. C. V. Riley.[1]

Seeds and berries of the following plants were found in the stomachs examined by the division:

Sourgum (*Nyssa aquatica*).
Flowering dogwood (*Cornus florida*).
Black haw (*Viburnum prunifolium*).
Cassena (*Ilex cassine*).
Hackberry (*Celtis occidentalis*).
Persimmon (*Diospyros virginiana*).
Wild grapes (*Vitis cordifolia*).
Virginia creeper (*Parthenocissus quinquefolia*).
Greenbrier (*Smilax rotundifolia* and *S. glauca*).
Sumac (*Rhus copallina*).
Poison sumac (*Rhus vernix*).
Poison ivy (*Rhus radicans*).

[1] Birds of Pennsylvania, 2d ed., 1890, p. 177.

In addition to the 7 species of woodpeckers whose food has been already discussed, 57 stomachs have been examined, belonging to 12 species and subspecies, mostly from the southern and western parts of the United States and British Columbia, as follows:

	Stomachs.
Nuttall's Woodpecker (*Dryobates nuttalii*)	7
Red-cockaded Woodpecker (*Dryobates borealis*)	12
Baird's Woodpecker (*Dryobates scalaris bairdi*)	3
Gilded Flicker (*Colaptes chrysoides*)	3
Red-shafted Flicker (*Colaptes cafer*)	11
Northwestern Flicker (*Colaptes cafer saturatior*)	5
California Woodpecker (*Melanerpes formicivorus bairdi*)	1
Lewis's Woodpecker (*Melanerpes torquatus*)	3
Gila Woodpecker (*Melanerpes uropygialis*)	1
Red-breasted Sapsucker (*Sphyrapicus ruber*)	1
Arctic Three-toed Woodpecker (*Picoides arcticus*)	7
Alpine Three-toed Woodpecker (*Picoides americanus dorsalis*)	3

With such a small number of stomachs it is hardly worth while to discuss the food of each species. The Three-toed Woodpeckers (*Picoides*), however, deserve passing notice, since their food contains a larger percentage of wood-boring larvæ than any other woodpecker examined. As the food of the two species is practically the same they may be considered together. The contents of the 10 stomachs consists of: animal matter, 83 percent; vegetable matter, 17 percent. It is a question whether this should not all be considered as animal, for the vegetable portion consisted almost entirely of rotten wood and similar rubbish, probably taken accidentally, and is not in any proper sense food, the exception being in one case where a little cambium had been eaten by one individual of the Arctic Three-toed Woodpecker (*Picoides arcticus*) and a few skins of some small fruit by one Alpine Three-toed Woodpecker (*P. americanus dorsalis*). The animal food consisted of 63 per cent of wood-boring Coleopterous larvæ (beetles), 11 percent of Lepidopterous larvæ (caterpillars), probably also wood-borers, and 9 per cent of adult beetles, ants, and other Hymenopterous insects.

THE TONGUES OF WOODPECKERS.[1]

RELATION OF THE FORM OF THE TONGUE TO THE CHARACTER OF THE FOOD.

By FREDERIC A. LUCAS,

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Whether the tongues of birds are of value in classification, or whether the modifications of the tongue, at least the external modifications, are due to adaptation to the character of the food or the manner in which food is manipulated, is a question of much interest. Unfortunately the food and feeding habits of birds are so little known that in many cases the adaptive characters of the tongue are not recognized, since without a knowledge of the one it is difficult or impossible to explain the peculiarities of the other.

The results of the preliminary investigation of the food of North American woodpeckers, made by the Division of Ornithology and Mammalogy of the Department of Agriculture, suggested that this group would be a most excellent one to study, and the tongues of all available species have been examined.

The woodpeckers are structurally a well-marked, compact group, and any variation in the structure of a given part, if shown to be directly correlated with some peculiarity of habit, would be a good indication that the one was dependent on the other. A comparison of the structure and modifications of the tongue with the results obtained from the examination of a large series of stomachs will, it is thought, show that just such a correlation does exist between the two, and that the form of the tongue varies surprisingly according to the nature of the food.

It is of course always necessary to bear in mind that the food of a bird necessarily varies with the season—a fact well shown by the group under consideration—and consequently that the peculiarity of the tongue may be related to some special kind of food, or particular method of obtaining it, pursued during a portion of the year only. A

[1] Published by permission of Dr. G. Brown Goode, Director United States National Museum.

particular kind of food which could be best obtained by some special adaptive feature would naturally have more influence as a modifying agent, even if indulged in for only a short time, than a general diet for a long period, since the one would be positive in its effects, the other negative.

As the hyoid bone is the framework on which the tongue is built, it will be well to note some of its characteristic features in the woodpeckers before proceeding to the modifications of the tongue itself. The hyoid is so constructed as to combine the two characters of length and strength that are needed for extensile purposes. The front of the hyoid is formed by the short, fused cerato-hyals, although a groove, or in some cases a perforation, indicates the double origin of this bone. The basi-hyal is usually very long and very slender and the cerato-branchials abut upon its posterior end, the basi-branchial being absent, nor have any indications of this bone been found even in very young specimens. The cerato-branchials and epi-branchials are variable, especially the latter, which, as in the Sapsucker (*Sphyrapicus*), may be no longer than in many Passeres, or, as in the Flickers (*Colaptes*), reach the maximum length among birds. The epi-branchials curve up over the back of the skull, meet on its summit, and continue on toward the forehead. In other long-tongued birds, as in the humming bird (*Trochilus*), for example, the apposed bones reach to the base of the bill, but in the longest-tongued woodpeckers they turn to the right, pass through the right narial opening, dipping under the nostril, and thence continue quite to the tip of the bill, so that in these species the extreme possible length of tongue is reached unless some other device is resorted to.[1] The cerato-branchials lie side by side when the tongue is protruded, and even when it is withdrawn they are posteriorly but little separated. The general character of the hyoid is constant in all species examined, but, as just stated, the proportions of its component parts vary, the extremes being represented by the Sapsucker (*Sphyrapicus*) and Flicker (*Colaptes*), both of which are figured (Pl. III, figs.1, 3).

Externally the tongue consists at the tip of a horny portion more or less barbed along the edges; this is followed by a section covered with tough skin bearing on the upper surface a long patch of minute points, while the basal portion is clothed with smooth, elastic skin, which is more or less wrinkled tranversely when the tongue is retracted. The skin covering the base of the tongue is reflected, forming a sort of sheath, into which the basal part of the tongue is withdrawn when at rest. The shape of the patch of minute points, as well as the number and character of the points themselves, seems to vary in different species,

[1] It would appear that a method is already in use by which the length of the tongue can be greatly increased, and this is the curling of the free ends of the epi-branchials into a spiral. Although I have never met with a specimen in which the hyoid was so arranged, both Dr. Bryant and Mr. Wm. Palmer have recorded specimens in which the hyoid encircled the eye. Dr. Bryant's paper, entitled "Remarks on *Sphyrapicus varius*, Linn.," appeared in Proc. Bost. Soc. Nat. Hist., Vol. X, 1864–'66, pp. 91–93.

and, although these points are so small as to appear like mere granulations, they are seen under the microscope to have a perfectly definite form and to be directed backward (Pl. III, figs 8, 9.) They are smallest toward the front of the patch, and increase in size from thence backward.

The anterior, horny portion of the tongue is also subject to great variation. In most species it is armed on either side with a number of sharp, backwardly-directed spines, but these may vary in number from two or three in the Flicker (*Colaptes*, Pl. II, fig. 10), up to thirty or forty in the Redhead (*Melanerpes*, Pl. II, fig. 2). One specimen of Flicker, labeled *Colaptes hybridus*, Pl. I, fig. 1), had the tip of the tongue wholly unarmed; but this may have been an individual peculiarity, and if so, would be interesting as showing the retention in the adult of the condition found in the young. In the Sapsucker (*Sphyrapicus*) the tongue bears no spines, but two series of stiff hairs, the lower set directed outward, the upper series backward. Of course, strictly speaking, these hairs are simply very slender spines, and in the California Woodpecker (*Melanerpes formicivorous bairdi*, Pl. II, fig. 1) we find an almost intermediate stage, the spines being quite fine, and the sides of the tongue, as in a few other species, furnished with a few short hairs lying below the spines and directed outward and forward.

In very young woodpeckers the tongue is unarmed at the point, bearing neither hairs nor spines, although the patch of minute points on the upper surface is present from the first. Later on, as indicated by a fully-fledged nestling of the Downy Woodpecker (*Dryobates pubescens*, Pl. III, fig. 6), a species whose tongue, when adult, is armed with sharp barbs, the spines are represented by short, fine, reflexed hairs, like the upper series of the Sapsucker (*Sphyrapicus varius*). Thus it would seem that the lateral spines are acquired after the bird has commenced to fly, and that they must be developed very rapidly, although specimens showing the various stages in their acquisition are lacking. The growth of the hyoid must be correspondingly rapid, for in the nestling alluded to the ends of the epi-branchials reached only to the center of the skull, although the Downy is a long-tongued bird whose hyoid runs beneath the nostril into the bill. This rapid growth has been observed in the hyoid of humming birds, in which the growth of the bill is also very rapid after hatching, and it would appear that great changes take place in the tongue and beak about the time the young bird ceases to be fed and begins to feed itself.

If woodpeckers were to be classified by their tongues we would start with forms like Delattre's Woodpecker (*Ceophlœus scapularis*, Pl. II, fig. 11), and Flicker (*Colaptes auratus* or *C. chrysoides*, Pl. II, fig. 10), in which the tongue is armed with two or three points on each side; pass through the Pileated Woodpecker (*Ceophlœus pileatus*, Pl. II, fig. 9), into the White-headed Woodpecker (*Xenopicus albolarvatus*, Pl. II, fig. 8), and Downy Woodpecker (*Dryobates pubescens*, Pl. II, fig. 4),

and thence to such species as the Gila Woodpecker (*Melanerpes uropygialis*, Pl. II, fig. 6). Thence through the Three-toed Woodpecker (*Picoides*, Pl. II, fig. 5) and the Ladder-back Woodpecker (*Dryobates scalaris*, Pl. II, fig. 3), we reach the Redhead Woodpecker (*Melanerpes erythrocephalus*, Pl. II, fig. 2) and California Woodpecker (*Melanerpes formicivorus bairdi*, Pl. II, fig. 1), while between these and the short, brush-tongued Sapsucker (*Sphyrapicus*, Pl. I, fig. 12), there is a gap to be bridged over.

Considering the tongues in relation to food, we find that those of the various species of Flickers (*Colaptes*, Pl. I, fig. 3) have the fewest terminal barbs and the longest dorsal tract of fine points; they are also among the longest. The members of the genus are particularly fond of ants, and the tongue seems especially adapted for probing ant hills. The function of the fine points on the upper part of the tongue seems to be to form a rough surface to which the sticky saliva will readily adhere and to which in turn the ants will be stuck. In this genus the submaxillary salivary glands reach the maximum size in the group.

The Hairy and Downy Woodpeckers (*Dryobates villosus* and *D. pubescens*, Pl. I, fig. 4), and also the Pileated Woodpecker (*Ceophlœus pileatus*) feed more or less on the larvæ of beetles (*Coleoptera*), and these have sharply barbed tongues, well adapted for spearing grubs or for coaxing them out of their hiding places. Hence it seems extremely probable that other species similarly provided have similar food habits. In these species, and in others with sharply barbed tongues, the dorsal tracts of points vary in shape and extent as well as in the size and number of the points, but in none are they as long as in the Flicker (*Colaptes*). The same is true of the submaxillary glands, which are all smaller than in the Flicker.

The Red-headed Woodpecker (*Melanerpes erythrocephalus*, Pl. I, fig. 9), although having a peculiar tongue, has one which is less evidently specialized than those of other species, and one which suggests the fringed tongues of some finches and other passerine birds. In diet this bird appears to be the most omnivorous of the species examined, eating a large proportion of fruit, or vegetable food, the total amount for some months equaling that of the insect food. The species is evidently fond of grasshoppers, but whether or not there is any direct relation between the character of its tongue and that of its food is not evident.

The Sapsucker (*Sphyrapicus varius*, Pl. I, fig. 12) drills into the maples, birches, mountain ash, and apple trees, and feeds upon the sap as well as upon the insects which are attracted by it. The tongue may be used in two ways: either the fringe of stiff hairs may serve as a brush, to which a considerable quantity of sap would adhere, or it may serve by capillary attraction to guide the sap from the little pits in which it gathers to the front part of the tongue.

The tongue of the Sapsucker is much less extensile than that of any other woodpecker examined, and this lack of extensibility is a charac-

teristic of the tongues of insectivorous birds, such as the swifts and swallows. The spines of the upper surface of the tongue also reach their greatest size in the Sapsucker (*Sphyrapicus*), and spine-clad tongues are another characteristic of insect-eating birds. The insectivorous diet of the Sapsucker is further indicated by the fineness of the backwardly directed spiny processes at the base of the tongue and about the opening of the trachea, their use being apparently to facilitate the passage of food past the larynx.

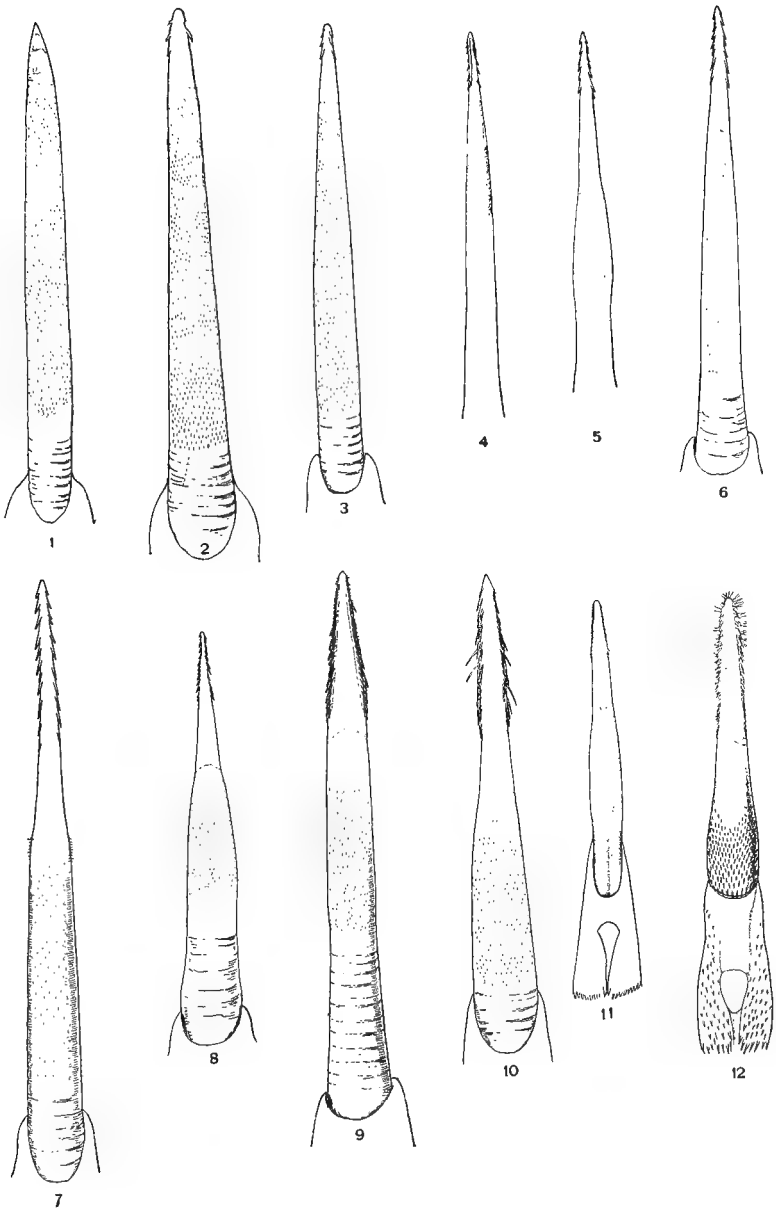
The direct relation of the modifications of the tongue to the character of the food can perhaps be best appreciated by comparing the figures of the tongue, and particularly the enlarged figures of the tongue tips, with the table giving the summary of the food. It will be seen, too, by further comparison that there is a direct relation between the form of the bill, the tongue, and the number of larvæ eaten. Those species which have bills best adapted for cutting into trees containing larvæ, and tongues most capable of extracting them from their hiding places, eat the most. Thus the Three-toed and Pileated Woodpeckers (*Picoides* and *Ceophlœus*) stand at the head of the list, closely followed by the members of the genus *Dryobates*. At the other extreme is the Sapsucker (*Sphyrapicus varius*), for this species was only once found to have eaten larvæ, and in this instance they were probably not obtained by cutting into wood. It should be noted, as showing the importance of the modifications of the tongue, that the Flicker (*Colaptes*), which has a curved bill, not well adapted to cut into trees after grubs, has, next to the Redhead (*Melanerpes*) and Sapsucker (*Sphyrapicus*), eaten the smallest percentage of larvæ of any species examined.

Altogether the evidence favors the view that modifications of the tongue are directly related to the character of the food and are not of value for classification.

Plate I.

Tongues of North American Woodpeckers (all viewed from above and enlarged 2¼ diameters).

Fig. 1. Hybrid Flicker (*Colaptes*). Fort Pierre, S. Dak.
2. Delattre's Woodpecker (*Ceophlœus scapularis*). Tabasco, Mexico.
3. Gilded Flicker (*Colaptes chrysoides*). San Jose del Cabo, Lower California.
4. Downy Woodpecker (*Dryobates pubescens*). Washington, D. C.
5. White-headed Woodpecker (*Xenopicus albolarvatus*). Clarks Fork, Columbia River, Washington.
6. Hairy Woodpecker (*Dryobates villosus*).
7. Gila Woodpecker (*Melanerpes uropygialis*). Fort Huachuca, Ariz.
8. Three-toed Woodpecker (*Picoides arcticus*). Illinois.
9. Red-headed Woodpecker (*Melanerpes erythrocephalus*). Northern Illinois.
10. California Woodpecker (*Melanerpes formicivorous bairdi*). Stockton, Cal.
11. Ladder-back Woodpecker (*Dryobates scalaris*). Matamoras, Mexico.
12. Red-naped Sapsucker (*Sphyrapicus varius nuchalis*). Fort Wingate, N. Mex.



TONGUES OF WOODPECKERS.

Plate II.

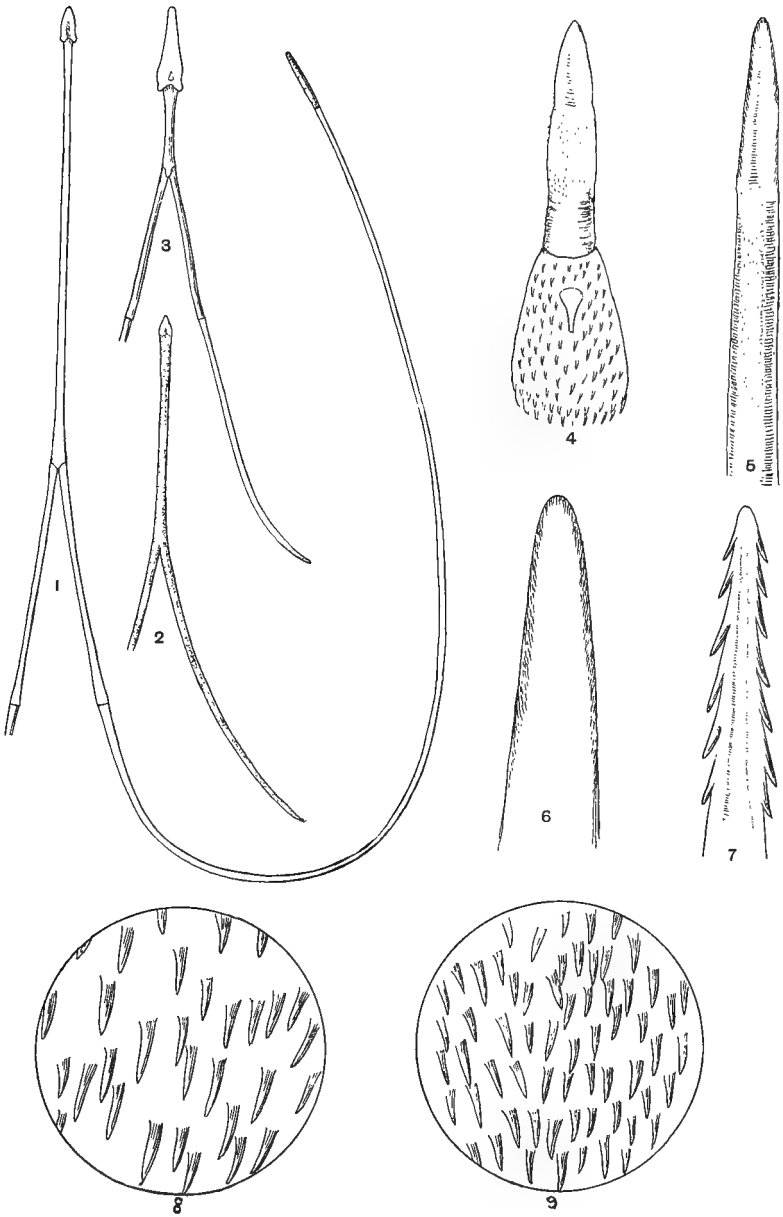
Tips of tongues of North American Woodpeckers (all save 4 viewed from above and enlarged 9⅓ diameters).

Fig. 1. California Woodpecker (*Melanerpes formicivorous bairdi*). Stockton, Cal.
2. Red-headed Woodpecker (*Melanerpes erythrocephalus*). Northern Illinois.
3. Ladder-back Woodpecker (*Dryobates scalaris*). Matamoras, Mexico.
4. Downy Woodpecker (*Dryobates pubescens*). Washington, D. C.
5. Three-toed Woodpecker (*Picoides arcticus*). Illinois.
6. Gila Woodpecker (*Melanerpes uropygialis*). Fort Huachuca, Ariz.
6*a*. Another specimen showing variation due to wear of tongue. San Jose del Cabo, Lower California.
7. Hairy Woodpecker (*Dryobates villosus*).
8. White-headed Woodpecker (*Xenopicus albolarvatus*). Clarks Fork, Columbia River, Washington.
9. Pileated Woodpecker (*Ceophlœus pileatus*). Louisiana.
10. Gilded Flicker (*Colaptes chrysoides*). San Jose del Cabo, Lower California.
11. Delattre's Woodpecker (*Ceophlœus scapularis*). Tabasco, Mexico.

TONGUES OF WOODPECKERS.

PLATE III.

Fig. 1. Hyoid of Flicker (*Colaptes auratus*) (adult, × 2).
2. Hyoid of Flicker (*Colaptes auratus*) (recently hatched, × 2).
3. Hyoid of Red-naped Sapsucker (*Sphyrapicus varius nuchalis*) (× 2).
4. Tongue of recently hatched Downy Woodpecker (*Dryobates pubescens*) (× 4).
5. Tongue of fully-fledged nestling of Downy Woodpecker (*Dryobates pubescens*) (× 3½).
6. Tip of tongue of fully-fledged nestling of Downy Woodpecker (*Dryobates pubescens*) (× 6).
7. Tip of tongue of adult Downy Woodpecker (*Dryobates pubescens*) (× 6¾).
8. Spines from dorsal tract of tongue of Red-headed Woodpecker (*Melanerpes erythrocephalus*) (greatly enlarged).
9. Spines from dorsal tract of tongue of Ladder-back Woodpecker (*Dryobates scalaris*) (greatly enlarged).



TONGUES OF WOODPECKERS.

[*Reprinted from* SCIENCE, *N. S., Vol. XIX., No. 492, Pages 867–868, June 3, 1904.*]

ALBINO BROOK TROUT.

AMONG the brook trout hatched at the Adirondack Hatchery, Saranac Inn, N. Y., in March, 1902, there appeared to be some distinct albinos. There were about fifty of these fry out of an entire hatching of 800,000 ordinary brook trout eggs, taken from both wild and confined trout. These albinos were put by themselves, and four reached maturity.

Two of them are typical albinos. They are the same in outline as the ordinary brook trout. The skin is white, mottled with an ochraceous yellow, colored with the typical red and yellow spots. The fins are white, with the red band and yellow mottling. Eyes red. The general appearance of the fish is delicate, and the bones are apparently visible through the seemingly transparent skin. As these fish were reared in captivity they have been confined to the ordinary fish races, and fed on ground liver. One is a male, the other a female. The former now measures seven inches in length; the latter, nine inches.

The other two fish are a grayish white, with dark fins and black eyes.

On November 10, 1903, when the two albinos were twenty months old, they were stripped for eggs and fertilization. At this time their combined weight was approximately one half pound, the female being much the larger. Mr. G. E. Winchester, foreman of the Fish Hatchery, made the following experiments in fertilization: viz., first cross, 527 eggs from female albino $\times$ albino male; second cross, 103 eggs from female albino $\times$ natural male; third cross, 424 eggs from natural female $\times$ albino male.

The eggs, after fertilization, were placed in the hatchery races the same as all brook trout eggs. The hatching began March 1, 1904, and continued until the thirteenth of the month, the period of incubation being the same as that of the ordinary brook trout egg.

The result of the hatching was as follows: From the first cross 32 hatched, or approximately 6 per cent.; from the second cross 43 hatched, or approximately 42 per cent.; from the third cross 416 hatched, or approximately 98 per cent.

At the present time—one month after all the fish were hatched—the following number is living: from the first cross 20, or 62 per cent.; from the second cross none; from the third cross all, or 100 per cent.

The weakness of the pure albinos is indicated by the fact that only 6 per cent. of the eggs proved fertile, and several of these are not perfect fish. Yet they have the characteristics of the albino parents.

Of the fry from the second cross 42 per cent. hatched; but none were alive at the end of one month. Some of them were imperfect in form, and were colored more like the natural male parent, but not entirely so.

From the third cross all the eggs were fertile except eight—a loss of but two per cent.—and all are living at the end of thirty days. There are practically no cripples, and the coloring is typical of the natural female parent.

The silver gray albinos did not spawn. They have the appearance of barren fish.

These fish were exhibited by this department at the New York state fair last fall and attracted much attention.

C. R. Pettis.

Forest, Fish and Game Commission,
Albany, N. Y..

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 228.

FOREST PLANTING AND FARM MANAGEMENT.

BY

GEORGE L. CLOTHIER,
ASSISTANT FOREST INSPECTOR, FOREST SERVICE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Forest Service,
Washington, D. C., August 8, 1905.

Sir: A paper on Forest Planting and Farm Management, prepared under my direction by Mr. George L. Clothier, of the Forest Service, and published in the Yearbook of the Department for 1904, is herewith submitted, with a few slight alterations, for republication as a Farmers' Bulletin.

Respectfully,

Gifford Pinchot,
Forester.

Hon. James Wilson,
Secretary of Agriculture.

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FORESTRY AND FARM DESIGNING.

Although agriculture stands first among American industries and our production of farm products is greater than that of any other country, the possibilities of the art of agriculture have hardly begun to be understood. That scientific farming will vastly increase the productive power of the land in the United States is beyond doubt. With the advance of knowledge through the discovery of new truths and the advance in practice through the better application of what science has already found out, improved utilization of the country's resources will make room for a future rapid growth in population and wealth, as expansion in territory has made room in the past. Making the same land twice as productive as before is as good as doubling the amount of land, if not better, and we have as yet scarcely scratched the surface of the agricultural resources of the country as a whole. One of the ways in which present methods of farm management may be greatly improved is by better recognition of what may be called farm engineering, or farm designing; and this in turn must give an important place to the consideration of farm forestry.

The farm designer, or farm architect as he might be called, can do much to improve the efficiency of farm operation. Economical management may be attained by a scientific adjustment of the parts of a farm, just as the utility of a great building may be increased by the careful planning of a qualified architect. Several agricultural colleges and experiment stations have recognized this fact, and have given a distinct place to this as a part of the great problem of how to get the most out of the soil. The best opportunities to apply these principles are found in those parts of the West where new farms are being taken up. Generally it is also in these regions that forestry can do most for the farmer, for in the treeless regions, especially, the full development of the country depends in no small degree on the establishment of forest plantations.

From the fact that trees take so much time to grow, the forester who seeks to advise a farmer how he can make trees contribute most

largely to his prosperity is compelled to take a long look ahead and to consider the whole problem of farm arrangement. In well-settled regions the possibilities of farm designing are apt to be severely limited by what has been done in the past. The location of the buildings, the division into fields, and in many cases the situation of the timber, are now fixed facts. Nevertheless, even here a decided improvement may often be made, as will be illustrated later. What needs to be emphasized now is that even in the older parts of the country a farm should be run according to a definite and carefully considered plan, designed to secure economy of operation and the best use of every part; that tree planting for farm purposes ought always to take into account this plan; and that even where standing timber is already present it may be in the interest of the best use of all parts of the farm to cut this down and plant elsewhere.

THE NEED OF FOREST PLANTING.

Forests are indispensable to the highest material development of any country. We have learned that, besides furnishing the useful timber products resulting from the growth of trees, they conserve moisture, ameliorate climatic extremes, and purify the atmosphere. Where they are not found naturally, or where they have been thoughtlessly removed from wide stretches of country, it becomes desirable in behalf of the public welfare to plant trees in great number. Obviously the benefits of such plantations will be most widely felt if the planting is well distributed over the region. Further, it is a work the benefits of which are shared by all, and which all should join in performing.

The plantations in a definite region should be made after one general plan, in order to allot to each farm its proportionate amount of forest. The method of planting and the position of the planting sites should evidently be made with reference to a system of farm management, since a forest is the most permanent thing that can be planted on a farm. An example of such a plan and such a system is shown in fig. 1.

MISTAKES OF THE PAST.

It is unfortunate that a large percentage of the plantations made by farmers have been disappointing. Yet some commercial plantations, such as that of Mr. L. W. Yaggy, at Hutchinson, Kans., have been financially successful.

Farm forest planting has been practiced in some of our prairie States for more than half a century, and great good has resulted from many of the plantations, but the measurable increase in the wealth of the country attributable to forest planting has been small, owing to

the choice of poor sites and the use of unsuitable species. The artificial forests of Illinois would have been worth many times what they are at present if longer-lived and more valuable species had been used in the plantations instead of silver maple or other trees of as little worth. Species of the greatest value have often been ignored because of their slow growth, and others, deserving to be classed as "weed trees," have been used in their place. Successful plantations of black walnut, hickory, elm, oak, and other valuable trees are common enough to prove that the slower-growing woods ordinarily pay best. Silver maple, boxelder, and the like are valuable chiefly for firewood, and it is easily possible to overstock the market for cordwood in any locality. Lumber woods, on the other hand, can always be disposed of in any quantity.

In order to illustrate the relative values of the two classes, let a comparison be made between the returns from a 64-year-old stand of black walnut in Morgan County, Ill., and a 35-year-old stand of silver maple in Sangamon County. These were the best groves of each species found in the State during an extended survey made in the summer of 1904. The figures relating to the two tracts may be best contrasted in the following table:

Value of planted forests of black walnut and silver maple on the prairies of Illinois.

Species.	Location.	Age.	Area.	Number of trees on area.	Average diameter breast-high.		
					Dominant trees.	Intermediate trees.	Suppressed trees.
		Years.	*Acres.*		*Inches.*	*Inches.*	*Inches.*
Black walnut	Morgan County, Ill.	64	0.6	119	19.0	13.3	9.4
Silver maple	Sangamon County, Ill.	35	5.6	1,478	10.6	.....	.....

Species.	Location.	Number of trees per acre.	Yield per acre.			Total value per acre.[b]	Annual value per acre.[c]
			Lumber.[a]	Fence posts.	Firewood.		
			Board ft.		*Cords.*		
Black walnut	Morgan County, Ill.	198	42,000	1,800	15	$1,050	$5.58
Silver maple	Sangamon County, Ill.	264	.....	.....	65	130	2.15

[a] From trees 11 inches and over in diameter breasthigh.

[b] Lumber at $20 per 1,000 board feet, fence posts at 10 cents each, and firewood at $2 per cord.

[c] Interest compounded annually at 3 per cent.

It would be quite as easy to show that the returns from hickory, elm, or some other wood which can be used when no older than the maple would amount to more than those from the latter, but the comparison of walnut with maple serves also to emphasize the greater

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value of a wood which must be kept until the trees attain a good size. The figures in the last column represent the annual returns from the two plantations irrespective of their age, and are therefore directly comparable.

It is a well-known fact that the great majority of the forest plantations made in accordance with the timber-culture act were failures. Here, again, the unfavorable results were due to poor sites and ill-adapted species, combined with a lack of care on the part of planters and the dishonesty of entrymen, who regarded this law merely as a means of obtaining title to public land without paying for it.

Plantations made by specialists and designed for a special purpose do not usually require very elaborate planting plans. It is the small woodlot plantation that is to serve many purposes in the economy of the farm which calls for the most careful planning.

PREPARATION OF A PLANTING PLAN.

As a machine of production, a farm should have a plan which provides for the best use of its every part. The woodlot or forest plantation should be in a position to contribute to the successful operation of this plan, for the trees may affect the atmospheric drainage, the wind currents, and the humidity of the air about the home. At the same time a planting plan must provide for sites which will produce the best possible growth. The arrangement of the fields and the location of the fences, private lanes, drainage systems, buildings, and farmstead should all be considered before any forest planting is undertaken.

Very rarely indeed have farmers deliberately planned the location and make-up of their forest plantations with reference to the needs, convenience and economy of their farms, and the relative value and adaptability of the trees to be planted. Woodlots have sometimes been so poorly located as to do actual damage to farms. Cases have been observed in the northern half of the Middle West where windbreaks planted too close to the buildings caused the drifting snow of severe winters to bury the houses 15 or 20 feet deep. In the winter of 1899 a farmhouse in the Red River Valley, North Dakota, was buried in a snowdrift for three months because a cottonwood grove had been planted too near it. In other cases trees have been planted near tile drains, which the roots clog.

It is probable that not one-tenth of American farms are being operated under any permanent system of management. Before forest planting is undertaken some such system must be adopted, however, in order to make the future existence of the forest plantations possible, for more than half the planting plans made since July 1, 1899,

by the Forest Service, fundamentally affect the future management of the farms. As very few farmers are accustomed to formulating farm plans, the agent of the Forest Service, besides being called upon to give advice in matters pertaining to technical forestry, is usually drafted into this service as well. After consultation with the landholder and consideration of all the matters affected by the policy of management, he is able to bring out an orderly arrangement which will permit on the same farm the practice of both scientific agriculture and scientific forestry.

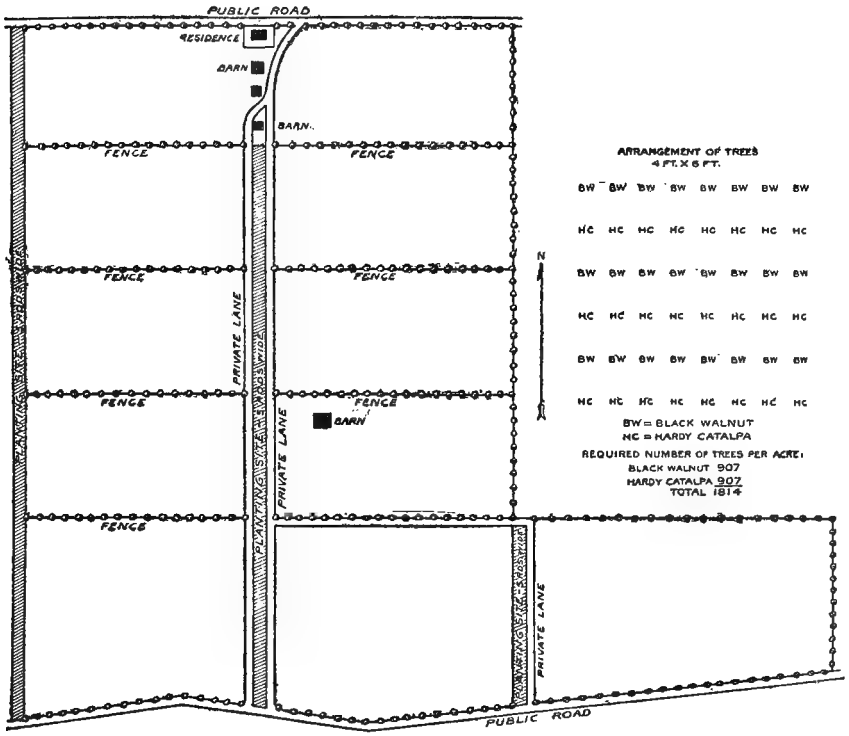

FIG. 1.—Arrangement of forest plantations on a farm in central Ohio to facilitate scientific farm management.

A CONCRETE EXAMPLE.

The planting plan shown in fig. 1 was made for a farm in central Ohio, and illustrates graphically the bearing that forest planting may have on the management of a farm. This farm in Ohio contains 375 acres, and that part of it which is devoted to agriculture is capable of earning interest on a capitalization of $100 per acre; not a foot of it is unsuited to tillage. That part which was originally heavily timbered has all been cleared, except a blue-grass pasture of 30 or 40

acres which is occupied by the remains of the original forest, consisting of a scattered stand of declining sugar maple and beech trees. This timberland embraces the most fertile part of the farm, and interferes most seriously with the convenient and economical division of the farm into fields. If the Forest Service had advised the owner to attempt to rejuvenate the dying trees and to underplant them with expensive nursery stock, the instructions would have been implicitly followed, but such advice would have wrought a positive injury to the landholder. Instead, the planting plan advises that the forest area of the farm be reduced by clearing the only natural timber left standing, and that, instead of retaining the scattered growth now cumbering the pasture, trees sufficient to occupy about half the present forest acreage be planted in such positions as to protect the farm from the severe westerly winds prevailing in the region.

The owner was therefore advised as follows:

(1) The major part of this farm is too valuable for agricultural purposes to be devoted to forestry. The native timber now scattered over the pasture is rapidly declining, and is reduced by every hard storm. No natural reproduction is taking place, and while the land is grazed none can be secured. The location of the scattered trees in the middle of the farm would require expensive fencing in order to protect them from live stock. Thus, it is believed that the rejuvenation of the old forest on this farm is impracticable. Instead, this land, as soon as the old trees have all disappeared or been removed, should be laid out into permanent fields. As every well-regulated farm, however, should possess some timber land to supply it with fence posts and to furnish shade and shelter for live stock, new plantations are recommended. The trees will take up as little room as possible, while the arrangement of the fields in rectangular blocks will greatly facilitate the use of modern machinery.

(2) The chief plantations should occupy strips 5 rods wide, running from north to south. One of these strips should be planted on the western border of the farm and another crossing its center due south of the residence. A third should cut off the block extending east from the southeast corner of the main rectangular tract. In addition to these strips, it is advised that single rows of trees be planted on the division lines between the fields, so that they may be used as live posts upon which to fasten wire to form fences. (See fig. 1.)

(3) Black walnut and hardy catalpa should be used in equal proportions for the belts, and should be planted every 4 feet in alternating rows, which should be 6 feet apart. The walnut seed should be planted two years prior to the introduction of the catalpa seedlings, in order to allow the slow-growing walnut to get a start before being

crowded by the catalpa. The nuts of the walnut should be collected as soon as ripe in the fall, and should either be stratified [a] in moist sand or planted immediately in their permanent site. These nuts should never be allowed to dry out after ripening. They are most easily planted while plowing, by dropping them in a furrow and covering them with the next furrow slice. If walnuts are thus planted, the squirrels are not likely to find them. The ground between the rows during the following two years should be planted with corn, and should receive good tillage. This can best be done by use of the lister. After the catalpa seedlings are introduced no more corn should be planted, but the ground should be cultivated as long as a single-horse cultivator can be run between the rows. Catalpa seedlings 12 to 16 inches tall and one year old should be used. They can be obtained from dealers for $1.50 to $5 per thousand. The labor of planting these seedlings may be performed chiefly by horsepower. Both walnut and catalpa should be planted in accordance with the diagram shown at the right in fig. 1.

By consulting the illustration the reader will see that the planting plan subdivides this farm into eleven fields—eight rectangular ones of equal area and similar dimensions, and three of nearly equal area but of unlike dimensions. This division will permit the application of scientific crop rotations, the eight rectangular fields being suited to two systems of four-year rotations and the three irregular fields to one three-year rotation. The convenient shape, ease of cultivation, and wonderful fertility of this farm present an excellent opportunity for the arrangement of such rotations of suitable crops.

Trees planted on the lines which separate the fields will serve as windbreaks as well as living fence posts. A method adopted by some is to plant Osage orange hedges between the fields, and every 20 feet to allow one of the trees to grow to its natural height. The remaining trees should be pruned to a height of 5 feet and kept within proper limits for a hedge. Then, if this growth proves inefficient as a fence, it can be reenforced by fencing wire stapled to the large trees. If the Osage orange is undesirable or a hedge is not wanted, chestnut should prove a desirable tree for the fence lines. The young trees should be planted about 20 feet apart, and when they begin to crowd each other every alternate tree should be cut out. Round-headed and with sturdy trunks, these trees will form very effective windbreaks for the intervening fields. Their nuts will bring a satisfactory return for the land they occupy, and the trees which are cut out will furnish excellent fence posts. The substitution of straight woven-wire fences for the old zigzag ones of rails transforms the fence lines from breed-

[a] Stratification is a method of storing forest seeds to prevent them from drying out. The seeds are stored in alternating layers between layers of moist sand.

ing places for noxious weeds into productive land upon which the living fence posts grow into a merchantable product.

Such a plan as this fixes the boundaries of the fields, locates the private lanes, and, in fact, forms the skeleton of any future system of farm management that may be applied to this farm.

A MODEL PRAIRIE FARM PLAN.

In order to illustrate a model prairie farm plan made in accordance with sound principles of forestry, fig. 2 has been prepared. This

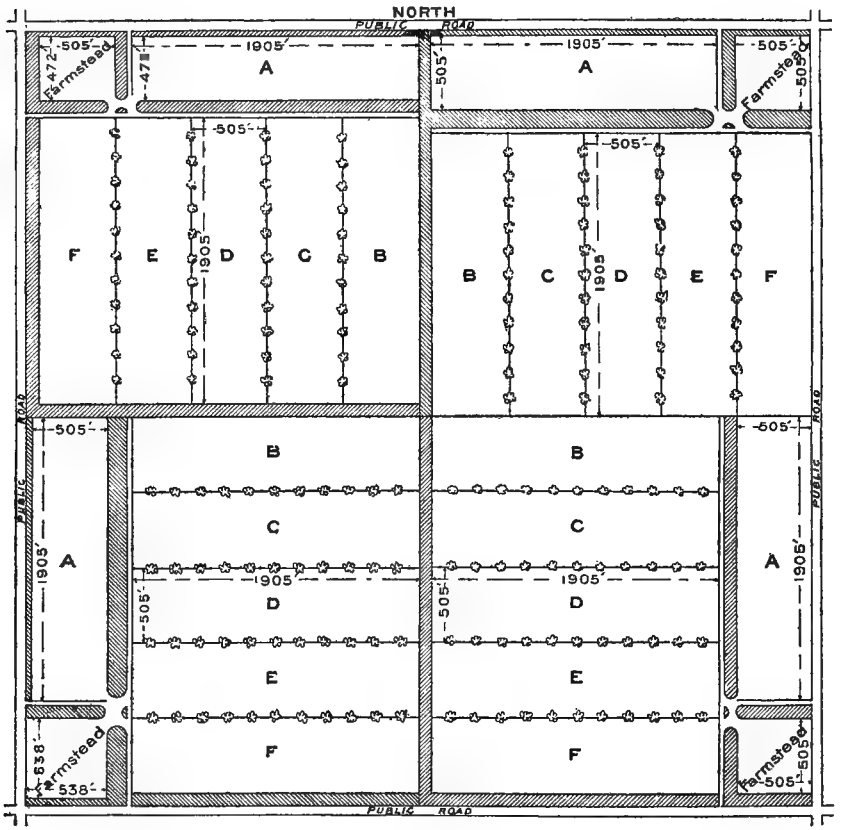

FIG. 2.—Ideal plan of the four quarters of a section with location of forest and windbreak plantations—suited to the prairies of Kansas and Oklahoma.

farm plan is applicable to a large region in the prairies of the Middle West, where windbreaks are necessary to the full development of the country. It assumes that the land is of uniform condition of soil, and has been surveyed by the rectangular system adopted by the Government. The public roads are supposed to be located on the section lines. The application of this model to a country with its

surface broken by creeks or lakes would, of course, necessitate a modification to fit local conditions. The plan is intended merely to illustrate principles.

Four farms of 160 acres each are shown, illustrating an arrangement suitable to each of the four quarters of a section. The farmstead, or that portion of a farm which is occupied by the residence, barn, orchards, gardens, lawn, and feedlots, is here shown as placed at the section corner of each farm. While in a large proportion of cases the location of the farmstead will be determined by the particular conditions, as water supply, topography, etc., an arrangement, where practicable, by which the houses stand on the section corners will be worth considering.

The fields on each quarter section have been laid out to permit the planting of windbreaks to protect the crops from the hot southwesterly winds of summer and the cold northwesterly winds of winter. The farmsteads are also provided with protection from winds. East winds have not been considered, because of their infrequent occurrence, but a general adoption of this plan on all the farms of a region would afford protection from all points of the compass.

The fields, with one exception, are all of the same shape and size, there being on each quarter section six fields, each 22.1 acres in area. This method of dividing the farm into fields will afford an opportunity for the application of a scientific system of crop rotation, and the fields, being six in number, will permit the application of a compound rotation embracing the use of a perennial crop like alfalfa in combination with five annual crops, where this is desired. If the use of a perennial is not desirable, the six fields will permit the running of two parallel three-crop rotations.

TREES AND METHODS RECOMMENDED.

The plan provides that the forest trees shall be planted in belts varying from 2 to 8 rods in width, except along fence lines, where they are in single rows. The best results, purely from the standpoint of forestry, will be obtained in the widest belts, since trees are social in their habits. Still better tree growth would be secured by planting in compact blocks. But as agriculture is the fundamental industry in the region to which this plan applies, the tree planting is designed only to supplement the production of field crops. Eleven or 12 per cent of each quarter section is to be devoted to forest. This is exclusive of the space occupied by the single lines of trees in the fence rows.

The species that may be recommended for this purpose vary for each particular locality with conditions of climate, rainfall, and soil. Considering the Middle Western States together, however, the fol-

lowing trees, when placed on hospitable soil fulfilling the requirements of each individual species, may, in the northern half of the region, be successfully grown as windbreaks:

Arborvitæ.	White elm.	Laurel-leafed willow.
Green ash.	European larch.	Russian golden willow.
Boxelder.	Russian wild olive.	White willow.
Cottonwood.	Western yellow pine.	
Cork elm.	Black Hills spruce.	

In the southern half of the Middle West, also the green ash, cottonwood, white elm, Russian wild olive, and western yellow pine may be successfully grown, and in addition the following species:

Chinese arborvitæ.	Honey locust.	Osage orange.
Wild China.	Mesquite.	Persimmon.
Black locust.	Russian mulberry.	Shittimwood.

These lists do not include all of the best timber trees that might be grown in the Middle West, for many valuable timber trees will not endure such severe exposure as a windbreak is subject to.

In the establishment of a windbreak wisdom is required in the placing of the different species. A windbreak composed of more than one species is usually the most effective. An excellent method of arrangement is to place the shortest trees in the outside row (toward the prevailing wind), to plant a somewhat taller species next to them, and to place the tallest trees in a third row on the side adjacent to the buildings or the area which is to be protected. This causes the wind to strike the trees as it would strike the face of a steep hill, deflecting its course upward. If the tallest trees of the third row consist of a flexible species, such as cottonwood, European larch, white willow, or honey locust, they will bend before the wind, and act as a cushion to deflect it upward and over the object to be protected. A satisfactory windbreak 5 rods in width, for the protection of the north and west sides of a farmstead (see fig. 2) and adapted to Minnesota and the Dakotas, is as follows: Plant 13 rows of trees, parallel to one another and 6 feet 10 inches apart. The first two rows on the north and west edges of the belts should consist of Russian wild olive, the third and fourth rows of arborvitæ, the fifth and sixth rows of boxelder, the seventh and eighth rows of white elm, the ninth and tenth rows of white willow, and the remaining three rows of common cottonwood. Such a plantation, when mature, will appear like a wall with a sloping top, the highest side being where the cottonwoods are planted.

Carrying out this same principle for Oklahoma and Texas, with a change in the position of the plantations to afford protection from southwest winds (see fig. 2), the following method is advised: The

first two rows on the south and west edges of the belts should consist of Russian mulberry or Osage orange, the third and fourth rows of Chinese arborvitæ, the fifth and sixth rows of black locust, the seventh and eighth rows of green ash, the ninth and tenth rows of white elm, and the remaining three rows of honey locust or common cottonwood.

In southern California, where the damaging winds come from opposite points of the compass (from both the southwest and northeast), a good plan for a windbreak is one in which the tallest, most flexible trees will be in the center rows, so that the species on either side will slope downward toward the outside edges of the belt. For such a windbreak 2½ rods wide and consisting of 7 rows of trees, the following arrangement may be suggested: The three rows in the middle of the belt should be of blue gum (*Eucalyptus globulus*), the next row toward the outside on each side should be of Monterey pine (*Pinus radiata*), and the two rows occupying the two edges of the belt should be of Monterey cypress (*Cupressus macrocarpa*). This same arrangement may be used on a belt 5 rods wide by doubling the number of rows of pine and cypress and increasing the gum to five rows. In order to construct a windbreak in California that will be perfectly effective, the belts should be placed on all four sides of the area which is to be protected. This is illustrated by the farmstead on the northwest quarter of the section shown in fig. 2.

The belts advised in the model plan are of sufficient width to produce all the timber that will be needed on a farm of 160 acres, while the fields are sufficiently narrow to be protected from winds by the single lines of trees occupying the fence rows. Experiments have demonstrated that a windbreak, on level land, will be effective for a distance of at least ten times its height. For perfect protection on the model farms herein described, the trees in the windbreak must reach a height of at least 50 feet.

An objection to growing trees along fence lines has been made by farmers on the ground that such trees steal the soil nourishment from the crops which are on the edges of the fields. It is true that healthy, vigorous trees make great demands on the soil moisture in their immediate vicinity, but wherever their influence is felt as windbreaks they conserve enough moisture, by preventing rapid evaporation, to more than pay for all that they use. By planting a deep-rooted crop like alfalfa under the shade of the fence-line trees, good returns from the land may be secured in spite of the fact that the trees absorb a part of its moisture. It is a great mistake to begrudge a useful tree the space it occupies, and particularly so in the naturally treeless prairies of the Middle West.

SPECIAL FEATURES OF FOREST PLANTING ABOUT THE FARMSTEAD.

On rare occasions it is found to be impracticable to concentrate the different elements of the farmstead in one place. (See fig. 3.) In the great majority of cases, however, it is both practicable and economical to have a farmstead, and the choice of its site is of the first importance to the landowner.

If the farmsteads of several adjoining sections were laid out in accordance with the plan herein suggested, four farmhouses would be grouped at each crossroads corner, bringing neighbors together in a little settlement. The position at the crossroads is also likely to facilitate the reaching of church, school, and town. An argument against such an arrangement is the possibility of its leading to neighborhood quarrels.

In many cases, however, uniformity of soil does not exist. The farmstead must then be located with reference to the adaptability of the soil to the forest growth, since a farmstead without trees for shade and shelter is not worthy of the name. The forest planter, therefore, is often the one to determine the location of a permanent site for the farmhouse, and he may also lay out at least the plan of the farmstead itself.

Fig. 3, representing the farmstead located on the southeast quarter of the section sketched in fig. 2, has been prepared to show how forest planting may be made to help every one of the different parts that go to make up the farmstead. Windbreak belts, 5 rods wide, are located on the north, west, and south sides of the farmstead. Open spaces varying from 72 to 96 feet in width have been provided to the north and west of the buildings and orchards, to act as snow traps to catch the drifts during winter storms. Every farmer is familiar with the fact that a hedge or belt of trees on the north side of an east-and-west road will cause the road to be filled with snow during winter, when the wind comes from the north. So the open space on the farmstead will in the same way trap the snow, and will consequently prevent any drifts from forming near the barn or residence or in the orchards. These open spaces may be utilized for garden vegetables, sugar beets, and other annual feed crops, the accumulation of winter snows serving as an annual irrigation to store up large quantities of soil moisture for the garden, and making the land particularly well adapted to this purpose. The trees on the edges of these spaces will, for the same reason, grow very vigorously.

In this plan the convenience, health, and comfort of the tenants of the farmhouse have all been considered in the location of both barn and residence. The grouping of the trees in the background of the

lawn has been made with reference to adornment, but without an attempt to enter into the details of landscape gardening. The plan leaves the lawn in such a shape, however, that the landscape gardener may have full scope for the display of his talents. A plan including, as this one does, complete protection from the hot winds of summer and the cold storms of winter will add greatly to the intrinsic

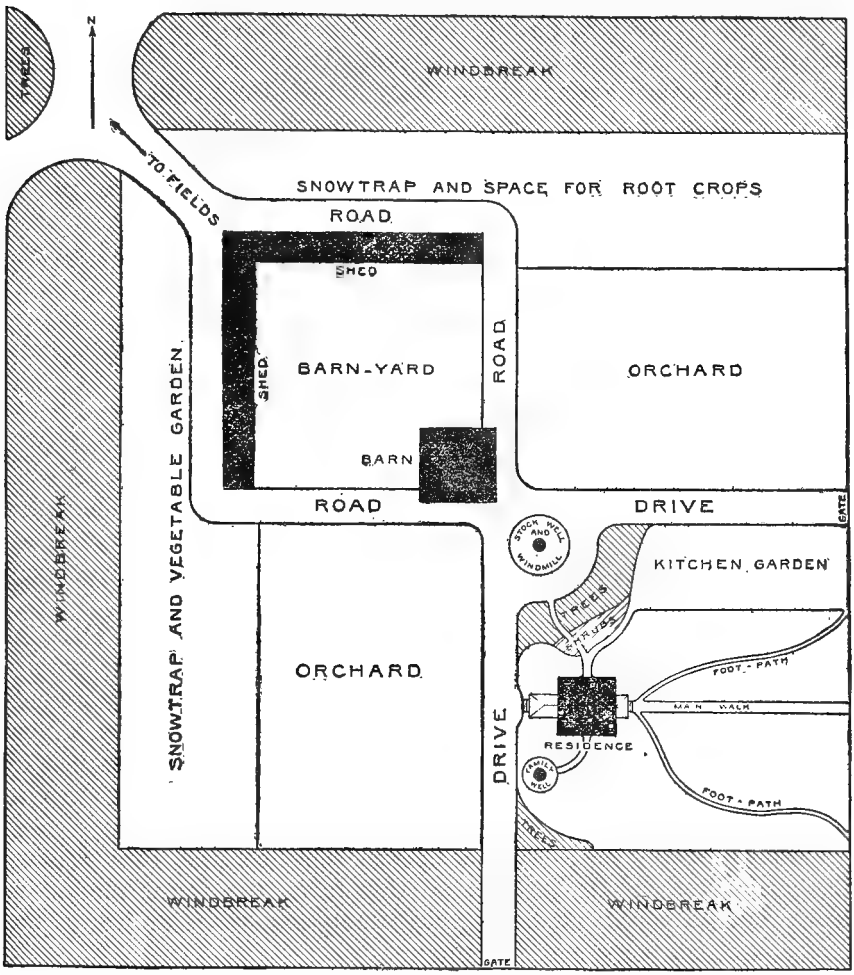

FIG. 3.—Plan of a farmstead, situated at the southeast corner of a prairie farm, arranged to afford windbreak protection.

worth of any farm located in the prairie States. If the farmer is engaged in the production of beef and pork, the protection of the barnyard and feedlots will economize the feed consumed by the fattening animals, for it takes more grain to produce a pound of flesh

upon animals exposed to the cold north winds of winter than upon stock that is protected from blizzards. Thus a windbreak takes the place of grain in maintaining the heat of the animal during cold weather. On the other hand, it will add to the farmer's bank account during the summer, for it will afford shade and protection to fattening animals, which lose flesh in very hot weather.

Windbreak belts in connection with a farmstead form an asset that is none the less real because the actual money value may not easily be determined. The protection to an orchard afforded by forest trees is valuable, since late frosts are not likely to blight the fruit blossoms of a protected orchard. Forest belts on the south and west sides of the farmstead give ample protection against the parching blasts from the southwest—the hot winds of summer, which are destructive to fruit in many parts of the country. It is to be understood, however, that the forest plantations herein recommended are also to be utilized for the production of the needed timber supplies on the farm. By judiciously thinning the plantations, 20 acres of planted forest will furnish all the fuel needed on a farm of 160 acres, besides producing lumber for the renewal of the farm buildings. Many Kansas and Nebraska farmers have in twenty years grown cottonwood trees large enough for sawlogs. Mr. W. D. Rippey, of Severance, Kans., cut 200,000 feet of cottonwood lumber a few years ago from trees of his own planting. Mr. Rippey's plantations were on uplands where the soil is not particularly well adapted to the growth of cottonwood, and, when lumbered, were but little more than a quarter of a century old.

On the farm of Mr. T. F. Eastgate, near Larimore, N. Dak., in the Red River Valley, a belt of planted cottonwood trees, supplemented by a dense undergrowth of wild plum bushes, acts as a windbreak and snow catcher, causing a snowdrift to form in winter over the open field, which is devoted to alfalfa. In the summer of 1904 Mr. Eastgate harvested alfalfa hay from this field at the rate of more than 5 tons per acre.

Besides serving as a windbreak and snow catcher, thus making the growth of alfalfa possible on this farm, the forest plantation has produced cordwood during its twenty-one years of life at the rate of 4.74 cords per acre per annum.

The successful growth of alfalfa on 10 per cent of the area of this region would double the earning power of every acre of land in the Red River Valley; and, since the thermometer here sometimes falls as low as 50° below zero, it is possible to grow this extremely valuable forage only by utilizing some contrivance like Mr. Eastgate's windbreak, to catch the snowdrifts and form during the winter a protecting blanket over the plants.

CONCLUSION.

Forestry is but a branch of the great industry of agriculture, but it can give important aid to the farmer in getting sustenance for the human race from the soil. It has been shown that where forest planting is desirable, the planting plan is of fundamental importance to the management of the farm which is concerned. The location and cultivation of these forests may either make them peculiarly advantageous or cause them to become a detriment to the economical management of the farm.

The planting plans which have been set forth in the preceding pages are not regarded as perfect, but are given as suggestions of what may be done to make farm forest planting serviceable. They are based on considerable practical experience, and it is believed that they demonstrate beyond a doubt how far superior is a well-considered, systematic method of handling the problems of farm forestry to the haphazard, careless methods so often practiced in the past.

Farmers are now receiving instructions from the Department of Agriculture both for the establishment of forest plantations and for the inauguration of cropping systems, but it seldom happens that the same farmer receives instruction in both matters at the same time. The intimate relations existing between farm management and forest planting are so patent and their importance is so great that the two should go hand in hand. It is to be hoped that as the practice of scientific agriculture spreads, model farms may be laid out in all parts of the United States, on which practicable plans for forest planting may be demonstrated and the best methods of planning the various parts of a farm so as to make provision for an economical and practicable system of crop rotation may be illustrated. Farmers, in order to get the services of Government experts in planning both forest plantations and systems of farm management, should make application for instructions both to the Bureau of Plant Industry and to the Forest Service.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number and title of each. Copies will be sent to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C.

No. 22. The Feeding of Farm Animals. No. 24. Hog Cholera and Swine Plague. No. 25. Peanuts Culture and Uses. No. 27. Flax for Seed and Fiber. No. 28. Weeds: And How to Kill Them. No. 29 Souring and Other Changes in Milk. No. 30. Grape Diseases on the Pacific Coast. No. 31. Alfalfa or Lucerne. No. 32. Silos and Silage. No. 33. Peach Growing for Market. No. 34. Meats: Composition and Cooking. No. 35. Potato Culture. No. 36. Cotton Seed and Its Products. No. 37. Kafir Corn: Culture and Uses. No. 38. Spraying for Fruit Diseases. No. 39. Onion Culture. No. 41. Fowls: Care and Feeding. No. 42. Facts About Milk. No. 43. Sewage Disposal on the Farm. No. 44. Commercial Fertilizers. No. 45. Insects Injurious to Stored Grain. No. 46. Irrigation in Humid Climates. No. 47. Insects Affecting the Cotton Plant. No. 48. The Manuring of Cotton. No. 49. Sheep Feeding. No. 50. Sorghum as a Forage Crop. No. 51. Standard Varieties of Chickens. No. 52. The Sugar Beet. No. 54. Some Common Birds. No. 55. The Dairy Herd. No. 56. Experiment Station Work—I. No. 57. Butter Making on the Farm. No. 58. The Soy Bean as a Forage Crop. No. 59. Bee Keeping. No. 60. Methods of Curing Tobacco. No. 61. Asparagus Culture. No. 62. Marketing Farm Produce. No. 63. Care of Milk on the Farm. No. 64. Ducks and Geese. No 65. Experiment Station Work—II. No. 66. Meadows and Pastures. No. 68. The Black Rot of the Cabbage. No. 69. Experiment Station Work—III. No. 70. Insect Enemies of the Grape. No. 71. Essentials in Beef Production. No. 72. Cattle Ranges of the Southwest. No. 73. Experiment Station Work—IV. No. 74. Milk as Food. No. 75. The Grain Smuts. No. 77. The Liming of Soils. No. 78. Experiment Station Work—V. No. 79. Experiment Station Work—VI. No. 80. The Peach Twig-borer. No. 81. Corn Culture in the South. No. 82. The Culture of Tobacco. No. 83. Tobacco Soils. No. 84. Experiment Station Work—VII. No. 85. Fish as Food. No. 86. Thirty Poisonous Plants. No. 87. Experiment Station Work—VIII. No. 88. Alkali Lands. No. 89. Cowpeas. No. 91. Potato Diseases and Treatment. No. 92. Experiment Station Work—IX. No. 93. Sugar as Food. No. 94. The Vegetable Garden. No. 95. Good Roads for Farmers. No. 96. Raising Sheep for Mutton. No. 97. Experiment Station Work—X. No. 98. Suggestions to Southern Farmers. No. 99. Insect Enemies of Shade Trees. No. 100. Hog Raising in the South. No. 101. Millets. No. 102. Southern Forage Plants. No. 103. Experiment Station Work—XI. No. 104. Notes on Frost. No. 105. Experiment Station Work—XII. No. 106. Breeds of Dairy Cattle. No. 107. Experiment Station Work—XIII. No. 108. Saltbushes. No. 109. Farmers' Reading Courses. No. 110. Rice Culture in the United States. No. 111. Farmers' Interest in Good Seed. No. 112. Bread and Bread Making. No. 113. The Apple and How to Grow It. No. 114. Experiment Station Work—XIV. No. 115. Hop Culture in California. No. 116. Irrigation in Fruit Growing. No. 118. Grape Growing in the South. No. 119. Experiment Station Work—XV. No. 120. Insects Affecting Tobacco. No. 121. Beans, Peas, and other Legumes as Food. No. 122. Experiment Station Work—XVI. No. 123. Red Clover Seed: Information for Purchasers. No. 124. Experiment Station Work—XVII. No. 125. Protection of Food Products from Injurious Temperatures. No. 126. Practical Suggestions for Farm Buildings. No. 127. Important Insecticides. No. 128. Eggs and Their Uses as Food. No. 129. Sweet Potatoes. No. 131. Household Tests for Detection of Oleomargarine and Renovated Butter. No. 132. Insect Enemies of Growing Wheat. No. 133. Experiment Station Work—XVIII. No. 134. Tree Planting in Rural School Grounds. No. 135. Sorghum Sirup Manufacture. No. 136. Earth Roads. No. 137. The Angora Goat. No. 138. Irrigation in Field and Garden. No. 139. Emmer: A Grain for the Semiarid Regions. No. 140. Pineapple Growing. No. 141. Poultry Raising on the Farm. No. 142. Principles of Nutrition and Nutritive Value of Food. No. 143. Conformation of Beef and Dairy Cattle. No. 144. 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Cream Separator on Western Farms. No. 202. Experiment Station Work—XXVI. No. 203. Canned Fruits, Preserves, and Jellies. No. 204. The Cultivation of Mushrooms. No. 205. Pig Management. No. 206. Milk Fever and its Treatment. No. 207. Game Laws for 1904. No. 208. Varieties of Fruits Recommended for Planting. No. 209. Controlling the Boll Weevil in Cotton Seed and at Ginneries. No. 210. Experiment Station Work—XXVII. No. 211. The Use of Paris Green in Controlling the Cotton Boll Weevil. No. 212. The Cotton Bollworm—1904. No. 213. Raspberries. No. 214. Beneficial Bacteria for Leguminous Crops. No. 215. Alfalfa in the Eastern States. No. 216. Control of the Cotton Boll Weevil. No. 217. Essential Steps in Securing an Early Crop of Cotton. No. 218 The School Garden. No. 219. Lessons taught by the Grain-Rust Epidemic of 1904. No. 221. Fungous Diseases of the Cranberry. No. 222. Experiment Station Work—XXVIII. No. 223. Miscellaneous Cotton Insects in Texas. No. 224. Canadian Field Peas. No. 225. Experiment Station Work—XXIX. No. 226. Relation of Coyotes to Stock Raising in the West. No. 227. Experiment Station Work—XXX.

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U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF PUBLICATIONS—BULLETIN No. 9.
GEO. WM. HILL, EDITOR.

INDEX TO THE YEARBOOKS

OF THE

UNITED STATES DEPARTMENT OF AGRICULTURE

1901-1905.

PREPARED BY

CHARLES H. GREATHOUSE,
In Charge of Indexing, Division of Publications.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

[CHAPTER 23, Stat. L., 1895.]

AN ACT Providing for the public printing and binding and the distribution of public documents.

* * * * * * *

Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be especially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Publications,
Washington, D. C., August 27, 1908.

Sir: I have the honor to transmit herewith the manuscript of the Index to the Yearbooks of the United States Department of Agriculture, 1901–1905, prepared by Mr. Charles H. Greathouse, assistant in charge of indexing in this Division, and to recommend the publication of the same as Bulletin No. 9 of the Division of Publications. Indexes of the Annual Reports of the Secretary of Agriculture, 1837–1893, and the Yearbooks, 1894–1900, have already been published as Bulletins Nos. 1 and 8, and the present index is a continuation of those bulletins. It gives me pleasure to concur in Mr. Greathouse's request that due credit be given to Mrs. Laura B. Lawson and Mrs. Mary A. E. Smith, of the Index Section, for skilled assistance in making the index now offered.

It is the purpose to publish a supplementary general index every five or every ten years, as may prove advisable.

Very respectfully,

Geo. Wm. Hill.

Hon. James Wilson,
Secretary of Agriculture.

INDEX TO YEARBOOKS OF THE U. S. DEPARTMENT OF AGRICULTURE, 1901-1905.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS—Circular No. 23 (Revised).
A. C. TRUE, DIRECTOR.

KEY TO SUBJECT INDEX OF EXPERIMENT STATION LITERATURE.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

REVISED APRIL 25, 1902.

Key to Subject Index of Experiment Station Literature.

1 GENERAL SCIENCES

(Includes only such general subjects as can not conveniently be indexed under the categories relating directly to agricultural and economic investigations)

.1 Physics

.2 Chemistry

.01 Physical
.02 Inorganic
.03 Organic
.04 Physiological
.05 Technical
.06 Analytical
.001 Methods and apparatus
.002 Analyses

.3 Mineralogy. Geology

.4 Botany

.01 Systematic
.02 Morphological and physiological
.03 Variations in plants
.001 Crossing (including hybridization)
.002 Acclimatization

.5 Fermentation. Bacteriology

.6 Animal physiology

.7 Zoology

.8 Meteorology. Climatology

2. AIR AND WATER

.1 Physics

.2 Chemistry

(For methods of analysis, see CHEMISTRY, analytical)

.3 Methods of investigation

3. SOILS

.1 History and classification

.2 Physics

.3 Chemistry

(For methods of analysis, see CHEMISTRY, analytical)

.4 Tillage

.5 Reclamation and renovation

.6 Methods of investigation

4. FERTILIZERS

.1 History, nature, uses

.2 Farm manures

(Animal and green manures, composts, marls, muck, etc.)

.3 Commercial fertilizers

.4 Experiments

(Deals with the fertilizers rather than the crops grown. For fertilizers for special crops, see FIELD CROPS, manuring, and HORTICULTURE.)

.5 Inspection (laws, methods, and general results)

(For methods of analysis, see CHEMISTRY, analytical)

5. PLANTS

.1 Field crops

.01 History and uses
.02 Species and varieties (especially descriptions and comparative tests)
.03 Composition
.04 Culture (adaptability to localities, planting, irrigation, cultivation, harvesting, etc.)
.05 Manuring (see also Fertilizers, experiments)
.06 Curing and storage
.07 Rotation

.2 Horticulture

.01 Vegetables
.02 Orchard fruits
.03 Small fruits
.04 Grapes
.05 Nuts
.06 Ornamental horticulture

.3 Forestry

.4 Seeds

.5 Weeds

.6 Diseases of plants

.01 Parasitic
.001 Diseases due to vegetable organisms (fungi, bacteria)
.002 Diseases due to animal organisms
(For diseases due to insects, see ENTOMOLOGY)
.02 Non-parasitic
.03 Remedies — Fungicides, fungicide appliances, etc

6. FOODS

(Includes foods for man and domestic animals. For the feeding of animals, see ANIMAL PRODUCTION)

.1 Composition and valuation

.2 Nutritive values

(Includes digestibility and potential energy)

.3 Preparation and use

.4 Food accessories, condiments

.5 Beverages

.6 Adulteration and inspection

(For methods of analysis, see CHEMISTRY, analytical)

.7 Preservation

7. ANIMALS

.1 History and general principles

.2 Breeds and breeding

.3 Animal production

.01 Cattle raising
.02 Dairy farming
.03 Sheep husbandry
.04 Swine husbandry
.05 Horse and mule husbandry
.06 Aviculture
.07 Fish culture, oyster culture, etc.

.4 Diseases. Veterinary science

8. ENTOMOLOGY

.1 Beneficial insects

.01 Apiculture
.02 Sericulture

.2 Injurious insects

.01 Insects affecting animals
.02 Insects affecting plants
.03 Repression—Insecticides, insecticide appliances, etc.

.3 Insect parasites and diseases

9. DAIRYING

(Deals with milk after it is drawn from the animal. For feeding and care of animals, see ANIMAL PRODUCTION, dairy farming)

.1 History and general principles

9. DAIRYING—*Continued*

.2 Composition and properties of milk and its products

.3 Changes in milk

.01 Fermentative changes
.02 Creaming of milk

.4 Handling of milk (milk supply)

.5 Inspection (laws, methods)

(For methods of analysis, see also CHEMISTRY, analytical)

.6 Butter making, creameries

.7 Cheese making, cheese factories

10. TECHNOLOGY

.1 Milling
.2 Starch and sugars
.3 Liquors
.4 Fats, oils
.5 Dyes and tanning
.6 Textiles

11. AGRICULTURAL ENGINEERING

.1 Properties of materials

.2 Drainage

.3 Irrigation

(For the irrigation of special crops, see FIELD CROPS, culture, and HORTICULTURE)

.4 Farm implements
.5 Roads and bridges
.6 Fences
.7 Farm buildings

12. STATISTICS OF THE STATIONS

.1 History, organization, and lines of work

.2 Legislation

.3 Equipment

.01 Apparatus
.02 Buildings
.03 Farms
.04 Implements
.05 Live stock

.4 Finances

.5 Bibliography

13. MISCELLANEOUS

.1 Rural economy

.2 Agricultural statistics

N. B.—The index is arranged on a decimal system, the number on the card before the decimal point representing one of the grand divisions of the index and the numbers after the decimal point representing subdivisions of the several grades. Thus on a card numbered 12.34; 12 = Statistics, .3 = Equipment, .04 = Implements. A card numbered 3.3 belongs under chemistry of soils; 5.22, orchard fruits; 9.32, creaming of milk.

SUGGESTIONS FOR DISTRIBUTING AND FILING INDEX CARDS ACCORDING TO THE FOREGOING KEY.

The utility of the index depends in a large measure upon a prompt and systematic method of distributing and filing the cards. The plan as carried out in this Office is as follows:

1. *Distribution.*—As soon as a package of 200 cards is received, it is opened and the cards distributed on a table or desk into 13 stacks as determined by the figure preceding the decimal point of the number in the upper right-hand corner of each card. Thus cards with such index numbers as 5.14, 7.32, 9.31, and 13.34 would be placed respectively on stacks 5, 7, 9, and 13. By this method every card is first brought under the main divisions of the index as shown by the Key.

Each stack is then taken separately and the same plan carried out with regard to the first index numbers following the decimal point. Thus cards in stack 5 are arranged under 5.1, 5.2, 5.3, 5.4, 5.5, or 5.6, as the case may be. In like manner cards under each of these subdivisions are arranged under the second and last decimal point, as 5.11, 5.12, 5.13, etc.

The next step is to take each subdivision, as 5.13, and arrange the cards topically in alphabetical order. This work can all be done on a desk or table in a short space of time.

2. *Filing.*—The index is intended to be used *topically* and the topics are selected with the object of keeping the index within reasonable limits consistent with intelligent and practical indexing of the literature. Cards should then be filed—

(1) Alphabetically by topics;
(2) Alphabetically by stations;
(3) Chronologically under stations.

The advantage of this method is that any person interested in a particular subject, as, for example, the "culture of corn," by any station or all the stations, finds the cards relating to this subject grouped (1) under "Corn, Culture," (2) under "Alabama College" (or other station in alphabetical order), and (3) arranged in each case in chronological order from the beginning of the work to the last entry. The stations being arranged alphabetically, the work on "Corn, Culture" is thus brought together, and one may consider as he desires a single experiment, the work of a station, or the results of the stations' experiments as a whole. In like manner with the "test of varieties of crops," "feeding experiments with live stock," "dairy herd records," "injurious insects," etc., the data on these lines are topically, alphabetically, and chronologically grouped.

If this general plan be followed it does not require much time to distribute and file the index, and its general usefulness is thereby greatly enhanced.

Issued December 5, 1908.

United States Department of Agriculture,

OFFICE OF EXPERIMENT STATIONS—Circular 47 (Rev.).

A. C. TRUE, Director.

THE CARD INDEX OF EXPERIMENT STATION LITERATURE.

It is the purpose of this circular to outline briefly the general plan of the subject index of experiment station literature regularly issued in card form by this Office, and to state the conditions governing the distribution and sale of the index.

The index at the present time covers only the publications of the agricultural experiment stations in the United States, Alaska, Hawaii, and Porto Rico. Of these publications the index includes all regular, special, and technical bulletins and the reports, but not such publications as circulars and press bulletins, except as these are reprinted in the other publications mentioned. Publications of this Department and of State boards or departments of agriculture are therefore not included. The index begins with the publications of the stations for the year 1888, and is kept as nearly up to date as is practicable.

The index comprises thirteen primary divisions, as follows: (1) General sciences, (2) air and water, (3) soils, (4) fertilizers, (5) plants, (6) foods, (7) animals, (8) entomology, (9) dairying, (10) technology, (11) agricultural engineering, (12) statistics, and (13) miscellaneous. These subjects have been divided and subdivided only so far as seemed necessary to facilitate reference to the individual entries of the index. Under general sciences are placed only such entries as relate to the general principles of the various sciences which lie at the foundation of experimental investigations in agriculture. Under statistics are included the entries relating to the organization, equipment, and general operations of the stations. The other primary divisions provide for the articles relating more directly to the agricultural and economic investigations. The plan of the index permits the addition of references to any literature relating to agriculture, and also affords a wide opportunity for the extension of the index by individual students for their own special purposes.

Each of the divisions, as a rule, contains entries for all the important articles on the subject. In some cases, however, an article, especially of a popular nature, may deal with several subjects and be indexed only under the most important phase of the work. As an illustration of this point, an article dealing with the use of fertilizers for field crops on certain soils may appear only under one of the headings—Fertilizers, Field Crops, or Soils. This has been necessary in order to keep the

number of cards within reasonable limits. Where the index, however, is used in its entirety, as planned, cross references lessen the difficulty from this source.

The divisions and subdivisions are arranged on a decimal system and are plainly indicated by the use of division cards of different colors.

The index is printed on cards 2 by 5 inches in size. Each index card contains an appropriate title, the author of the article, a reference to the publication in which it appeared and to the Experiment Station Record in which an abstract of the article may be found, and a condensed statement of its contents. At the upper right-hand corner of the card is a number indicating under what heading the card should be placed in the index. The order in which the cards are printed is indicated at the lower left-hand corner. It is designed that the cards should be arranged in alphabetical and chronological order under the final subdivisions of the index.

One copy of the index is sent without charge to each of the agricultural colleges and experiment stations and to several of the State boards and commissioners of agriculture. Besides this free distribution, the Office is prepared, under authority of the law, to furnish a limited number of sets of the index at a price only sufficient to cover additional cost of printing. This is estimated at $2 per thousand cards. For the division cards an additional charge of $1.25 is made.

A few sets of the index have been broken, and separate divisions may be obtained at the same rate per thousand cards.

A key to the index, containing the system of classification, is sent with the first installment of cards and also on application.

Sets of division cards and 29,500 index cards, bringing the index up, approximately, to September 1, 1908, are available, and one of these sets will be sent to any address upon receipt of $60.25. Subscribers are also informed when each successive lot of 1,000 cards is ready for distribution. About 1,000 cards are required for the station publications issued each year. Only 300 copies of the index are printed.

Payments should be made by United States money order in favor of A. Zappone, Disbursing Officer, but, like all other communications relating to the index, should be forwarded in envelopes addressed to the Director of the Office of Experiment Stations.

Respectfully submitted.

A. C. TRUE,
Director.

Approved:

JAMES WILSON
Secretary of Agriculture.

WASHINGTON, D. C., *November 25, 1908.*

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SMITHSONIAN INSTITUTION.

UNITED STATES NATIONAL MUSEUM.

BULLETIN

OF THE

UNITED STATES NATIONAL MUSEUM.

No. 51.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1902.

ADVERTISEMENT.

This work (Bulletin No. 51) is one of a series of papers intended to illustrate the collections belonging to or placed under the charge of the Smithsonian Institution and deposited in the United States National Museum.

The publications of the National Museum consist of two series—the *Bulletin* and the *Proceedings*.

The *Bulletin*, publication of which was commenced in 1875, is a series of elaborate papers issued separately and based for the most part upon collections in the National Museum. They are monographic in scope and are devoted principally to the discussion of large zoological groups, bibliographies of eminent naturalists, reports of expeditions, etc. The bulletins, issued only as volumes with one exception, are of octavo size, although a quarto form, known as the Special Bulletin, has been adopted in a few instances in which a larger page was deemed indispensable.

The *Proceedings* (octavo), the first volume of which was issued in 1878, are intended primarily as a medium of publication for newly acquired facts in biology, anthropology, and geology, descriptions of new forms of animals and plants, discussions of nomenclature, etc. A volume of about 1,000 pages is issued annually for distribution to libraries, while a limited edition of each paper in the volume is printed and distributed in pamphlet form in advance.

In addition, there are printed each year in the second volume of the Smithsonian Report (known as the Report of the National Museum) papers, chiefly of an ethnological character, describing collections in the National Museum.

Papers intended for publication by the National Museum are usually referred to an advisory committee, composed as follows: Frederick W. True (chairman), William H. Holmes, George P. Merrill, James E. Benedict, Otis T. Mason, Leonhard Stejneger, Lester F. Ward, and Marcus Benjamin (editor).

S. P. Langley,
Secretary of the Smithsonian Institution.

Washington, U. S. A., *April 4, 1902.*

A LIST

OF

THE PUBLICATIONS

OF THE

UNITED STATES NATIONAL MUSEUM

(1875-1900)

INCLUDING THE ANNUAL REPORTS, PROCEEDINGS, BULLETINS, SPECIAL BULLETINS, AND CIRCULARS,

WITH INDEX TO TITLES.

BY

RANDOLPH I. GEARE,
Chief, Division of Correspondence and Documents.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

PREFACE.

The purpose of this bulletin is to present a list, with index to titles, of the publications of the U. S. National Museum, which consist of an annual Report, an annual volume of Proceedings, Bulletins, Special Bulletins, and Circulars.

The Report constitutes the second volume of the Smithsonian Report, and the first one thus issued is for the year 1884. A certain number of these volumes is assigned to the Museum for distribution to libraries, to correspondents, and to contributors to the collections, while a considerable part of the edition is distributed by members of Congress. The special papers in these volumes, for the most part describing ethnological collections in the National Museum, are furnished free to those interested.

The series of Proceedings of the National Museum began in 1878, and 23 volumes, containing 1,240 separate papers, have been published. These papers, which are technical, describe, or are based wholly or in part upon, material in the Museum. The volumes are sent only to libraries, while the separate papers are furnished without charge to specialists and others engaged in scientific work.

The first number of the Bulletin was issued in 1875. Of the latest in the series, No. 50 (The Birds of North and Middle America), only the first volume, relating to the Fringillidæ, has been issued. The bulletins are intended principally for libraries, but are also given to known specialists working on the groups to which they relate.

Special Bulletins, in quarto, have been issued at irregular intervals, but this form has been used only where a size larger than octavo was deemed especially desirable. The last one published (No. IV) is the first volume of a monograph of the American Hydroids, and relates to the group Plumularidæ.

The primary object of the issuance of the series of Circulars was to bring to immediate notice urgent wants of the Museum, or to promulgate special information with the least possible delay. The first circular was published in 1881, and at the time when the present list was sent to the Printing Office this series contained fifty numbers.

None of the above-mentioned publications are sold by the Museum, but when the Museum can not supply them, persons desiring to purchase are advised to write to the Superintendent of Documents, Union Building, Washington, D. C.

Occasionally the Museum exchanges its publications for desirable specimens.

TABLE OF CONTENTS.

A LIST OF THE PUBLICATIONS OF THE U. S. NATIONAL MUSEUM.

I.—REPORTS.

1881-1900.

510— | Report | of the | Assistant Director | of the | U. S. National Museum, | G. Brown Goode, | for the year 1881. | —— | From the Smithsonian Report for 1881. | —— | Washington: | Government Printing Office. | 1883.

8vo., pp. 1-79.

Report of Assistant Director ..... pp. 1–30.
List of officers ..... p. 31.
Bibliography ..... pp. 31–50.
List of contributors ..... pp. 51–79.

This was the first report on the operations of the National Museum printed under a separate cover. The reports of the Museum for 1881, 1882, and 1883, were first printed in the reports of the Institution for those years, and were afterwards issued in pamphlet form.

The Museum Report for 1884 was the first one to occupy a separate volume of the Smithsonian Report, and to be accompanied by papers based upon the collections.

524— | Report | of the | Assistant Director | of the | U. S. National Museum, | G. Brown Goode, | for the year 1882. | —— | From the Smithsonian Report, 1882. | —— | Washington: | Government Printing Office. | 1883.

8vo., pp. 1-145.

Report of Assistant Director ..... pp. 1–48.
List of officers ..... p. 49.
Bibliography ..... pp. 49–76.
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List of contributors ..... pp. 113–145.

587— | Report | of the | Assistant Director | and of | the Curators | of the | U. S. National Museum | for | the year 1883. | ——— | From the Smithsonian Report for 1883. | ——— | Washington: | Government Printing Office. | 1885.

8vo., pp. 1-200.

Report of the Assistant Director ..... pp. 1–30.
Reports of curators ..... pp. 30–114.
Materia Medica. By J. M. Flint. pp. 30–35.
Foods and Textile Industries. By Romyn Hitchcock. pp. 36–38.
Antiquities. By Charles Rau. pp. 38–47.
Mammals. By Frederick W. True. pp. 48–60.
Birds. By Robert Ridgway. pp. 60–65.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the year 1884. | ——— | Part II. | ——— | Washington: | Government Printing Office. | 1885.

8vo., pp. ix, 1–458, 105 pls.

Beginning with this year and continuing until 1892, the reports consist of Part I, Report of the Assistant Director [after 1885 this title was changed to Assistant Secretary]; Part II, Reports of the Curators and Acting Curators; Part III, Papers based on collections in the National Museum; Part IV, Bibliography; Part V, List of accessions to the Museum.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | to July, 1885.[1] | ——— | Part II. | ——— | Washington: | Government Printing Office. | 1886.

8vo., pp. xi, 1–264; vii, 1–939, 144 pls.

Report of Assistant Director ..... pp. 1–54.
Reports of curators ..... pp. 55–147.
Materia Medica. By H. G. Beyer. pp. 57–58.
Textile Industries. By Romyn Hitchcock. pp. 59–60.
Foods. By Romyn Hitchcock. p. 61.
Enthnology. By Otis T. Mason. pp. 63–67.
American Prehistoric Pottery. By W. H. Holmes. p. 69.
Antiquities. By Charles Rau. pp. 71–78.
Mammals. By Frederick W. True. pp. 79–84.
Birds. By Robert Ridgway. pp. 85–91.
Reptiles and Batrachians. By H. C. Yarrow. pp. 93–94.
Fishes. By Tarleton H. Bean. pp. 95–98.
Comparative Anatomy. By Frederick W. True. pp. 99–102.
Mollusks. By William Healey Dall. pp. 103–111.
Insects. By C. V. Riley. pp. 113–116.
Marine Invertebrates. By Richard Rathbun. pp. 117–127.
Invertebrate Fossils (Paleozoic). By C. D. Walcott. pp. 129–132.
Invertebrate Fossils (Meso-Cenozoic). By Charles A. White. p. 133.
Plants. By Lester F. Ward. pp. 135–136.
Minerals. By F. W. Clarke. pp. 137–138.
Lithology and Physical Geology. By George P. Merrill. pp. 139–142.
Metallurgy and Economic Geology. By F. P. Dewey. pp. 143–147.
Bibliography ..... pp. 149–174.
List of accessions ..... pp. 175–243.
Paper on the George Catlin Indian Gallery ..... pp. 1–939.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1886, | —— | Part II. | —— | Washington: | Government Printing Office. | 1889.

8vo., pp. xi, 1–842, 16 pls., 23 figs.

Report of Assistant Secretary ..... pp. 1–83.
Reports of curators ..... pp. 85–252.
Ethnology. By Otis T. Mason. pp. 87–96.
American Aboriginal Pottery. By W. H. Holmes. pp. 97–100.
Archæology. By Charles Rau. pp. 101–112; 4 pls., 20 figs.
Foods and Textiles. By Romyn Hitchcock. pp. 113–118.
Steam Transportation. By J. Elfreth Watkins. pp. 119–141; 5 pls., 9 figs.
Materia Medica. By H. G. Beyer. pp. 143–145.
Mammals. By Frederick W. True. pp. 147–152.
Birds. By Robert Ridgway. pp. 153–162.
Birds' Eggs. By Charles Bendire. pp. 163–164.
Reptiles and Batrachians. By H. C. Yarrow. pp. 165–166.
Fishes. By Tarleton H. Bean. pp. 167–172.
Mollusks (including Cenozoic Fossils). By Wm. H. Dall. pp. 173–179.
Insects. By C. V. Riley. pp. 181–197; 1 pl., 5 figs.

[1] It having been decided to issue future reports by the fiscal year instead of by the calendar year, this volume covers only the first six months of the year 1885.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1887. | —— | Part II, | ——— | Washington: | Government Printing Office. | 1889.

8vo., pp. xviii, 1–771, 32 pls., 125 figs.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1888. | —— | Report of the U. S. National Museum. | —— | Washington: | Government Printing Office. | 1890.

8vo., pp. xxii, 1–876, 108 pls., 2 charts, 174 figs., 4 diagrams, 1 map.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1889. | —— | Report | of the | National Museum. | —— | Washington: | Government Printing Office. | 1891.

pp. xvii, 1–883, Appendix E, pp. 1–50; 107 pls., 137 figs., 7 maps.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1890. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1891.

pp. xviii, 1–811, 163 pls., 99 figs.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1891. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1892.

8vo., pp. xvii, 1–869, 84 pls., 151 figs., 3 diagrams.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1892. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1893.

8vo., pp. xv, 1–620, 103 pls., 5 figs.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the year ending June 30, 1893. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1895.

8vo., pp. xxi, 1–794, 188 pls., 116 figs.

This and the subsequent reports consist of only two parts: I, Report of the Assistant Secretary, with appendices; II, Papers describing and illustrating collections in the National Museum.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1894. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1896.

8vo., pp. xxvi, 1–1030, 57 pls., 851 figs., 1 chart, 1 map.

V. The work of the mechanics and laborers. pp. 106–107.
VI. List of accessions. pp. 108–166.
VII. Specimens sent for examination and report. pp. 167–179.
VIII. Bibliography, with supplementary lists of new genera and species. pp. 180–227.
IX. List of papers in the Annual Report and Proceedings of the National Museum, published in separate form during the year ending June 30, 1894. pp. 228–231.
X. Lectures and meetings of societies. pp. 232–233.
Papers illustrating the collections ..... pp. 235–1011.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1895. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1897.

8vo., pp. xx, 1–1080, 154 pls., 382 figs.

Report of Assistant Secretary ..... pp. 1–102.
Appendices. pp. 103–308.
I. The scientific and administrative staffs. pp. 103–104.
II. List of accessions. pp. 105–162.
III. List of accessions to the Museum library received by gift and exchange during the fiscal year ending June 30, 1895, exclusive of publications retained from the Smithsonian library. pp. 163–205.
IV. Bibliography, with supplementary lists of new genera and species. pp. 207–250.
V. List of papers in the Proceedings of the National Museum, published in separate form during the year ending June 30, 1895. pp. 251–253.
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VII. Lectures and meetings of societies. pp. 267–270.
VIII. Finance, property, supplies, and accounts. pp. 271–274.
IX. List of duplicate specimens prepared for distribution to educational establishments since 1890. pp. 275–298.
X. Statement of the distribution of specimens during the year ending June 30, 1895. pp. 299–305.
XI. The work of the mechanics and laborers. pp. 307–308.
Papers illustrating the collections..... pp. 309–1045.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1896. | —— | Report | of the | U. S. National Museum. | —— | Washington: | Government Printing Office. | 1898.

8vo., pp. xxiv, 1–1107, 199 pls., 555 figs.

Report of Assistant Secretary ..... pp. 1–106.
Appendices. pp. 107–284.
I. The scientific and administrative staff. pp. 107–108.
II. List of accessions. pp. 109–164.
III. List of accessions to the Museum library by gift and exchange during the fiscal year ending June 30, 1896. pp. 165–194.
IV. Bibliography, with supplementary lists of new genera and species. pp. 195–250.

V. Papers published in separate form during the year ending June 30, 1896. pp. 251–253.
VI. Specimens sent to the Museum for examination and report. pp. 254–267.
VII. Lectures and meetings of societies. pp. 268–270.
VIII. Finance, property, supplies, and accounts. pp. 271–272.
IX. Statement of the distribution of specimens during the year ending June 30, 1896. pp. 273–280.
X. The work of the mechanics and laborers. pp. 281–284.
Papers illustrating the collections ..... pp. 285–1057.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the operations, expenditures, and condition | of the Institution | for the | year ending June 30, 1897. | —— | Report | of the | U. S. National Museum. | Part I. | —— | Washington: | Government Printing Office. | 1899.

8vo., pp. xxvii, 1–1021, 150 pls., 457 figs.

Report of the Assistant Secretary ..... pp. 1–88.
Appendices. pp. 89–245.
I. The scientific and administrative staff. pp. 89–90.
II. List of accessions. pp. 91–151.
III. List of accessions to the Museum library by gift and exchange during the fiscal year ending June 30, 1897. pp. 153–191.
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pp. xii, 1–515, 110 pls.

This volume constitutes a memorial to Dr. G. Brown Goode.

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The beginnings of natural history in America. pp. 355–406.
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Report on the Department of Geology. By George P. Merrill. pp. 45–50.

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8 vo., pp. i–xvii, 1–738, 113 pls., 126 figs.

II.—PAPERS PRINTED IN THE ANNUAL REPORTS OF THE U. S. NATIONAL MUSEUM.

(NOS. 1-122.)

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R. 1. Throwing-sticks in the National Museum. By Otis T. Mason.
pp. 279–289, 17 pls.

R. 2. Basket-work of the North American aborigines. By Otis T. Mason.
. pp. 291–306, 64 pls.

R. 3. A study of the Eskimo bows in the U. S. National Museum. By John Murdoch.
pp. 307–316, 12 pls.

R. 4. On a Spotted dolphin apparently identical with the *Prodelphinus doris* of Gray. By Frederick W. True.
pp. 317–324, 6 pls.

R. 5. The Florida muskrat (*Neofiber alleni* True). By Frederick W. True.
pp. 325–330, 3 pls.

R. 6. On the West Indian seal (*Monachus tropicalis* Gray). By Frederick W. True and F. A. Lucas.
pp. 331–335, 3 pls.

1885.

R. 7. Sketch of the exhibit made by the Smithsonian Institution at the New Orleans Exposition. (Part of the Report of the Assistant Director.)
pp. 35–37.

R. 8. The George Catlin Indian Gallery in the U. S. National Museum, with memoirs and statistics. By Thomas Donaldson.
pp. vii, 1–939, 144 pls.

1886.

R. 9. Report upon the exhibit made by the Smithsonian Institution at the New Orleans Exposition (including Louisville and Cincinnati). By R. Edward Earll. (Part of the Report of the Assistant Secretary.)
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R. 10. The meteorite collection in the U. S. National Museum: A catalogue of meteorites represented November 1, 1886. By F. W. Clarke.
pp. 255–265, 1 plate.

R. 11. Gem collection of the U. S. National Museum. By George F. Kunz.
pp. 267–275.

R. 12. The collection of building and ornamental stones in the U. S. National Museum: A handbook and catalogue. By George P. Merrill.
pp. 277–648, 9 pls., 14 figs.

R. 13. List of specimens of textile fibers and fabrics in the reference series of the section of textile industries of the U. S. National Museum, June 30, 1886. By Romyn Hitchcock.
pp. 649–655.

R. 14. Preparation of microscopical mounts of vegetable textile fibers. By Romyn Hitchcock.
pp. 657–658.

R. 15. How to collect mammal skins for purposes of study and for mounting. By William T. Hornaday.
pp. 659–670, 9 figs.

1887.

R. 16. Cradles of the American aborigines. By Otis T. Mason.
pp. 161–212; 45 figs.

R. 17. Notes on the artificial deformation of children among savages and civilized peoples. By J. H. Porter.
pp. 213–235.

R. 18. The human beast of burden. By Otis T. Mason.
pp. 237–295, 54 figs.

R. 19. Ethno-conchology: A study of primitive money. By Robert E. C. Stearns.
pp. 297–334, 9 pls., 22 figs.

R. 20. A preliminary catalogue of the Eskimo collection in the U. S. National Museum, arranged geographically and by uses. By T. Dix Bolles.
pp. 335–365.

R. 21. The extermination of the American bison, with a sketch of its discovery and life history. By William T. Hornaday.
pp. 367–548, 22 pls.

R. 22. The preservation of museum specimens from insects and the effect of dampness. By Walter Hough.
pp. 549–558, 4 figs.

1888.

R. 23. Report upon the participation of the Smithsonian Institution in the Industrial Exposition at Minneapolis, 1887. By William V. Cox. (Part of the Report of the Assistant Secretary.)
pp. 82–84.

R. 24. The coast Indians of southern Alaska and northern British Columbia. By Albert P. Niblack, U. S. N.
pp. 225–386, 70 pls., 48 figs., 2 charts.

R. 25. A catalogue of the Hippisley collection of Chinese porcelains; with a sketch of the history of ceramic art in China. By Alfred E. Hippisley.
pp. 387–491.

R. 26. The expedition to Funk Island, with observations upon the history and anatomy of the Great Auk. By Frederic A. Lucas.
pp. 493–529, 3 pls., 4 diagrams.

R. 27. Fire-making apparatus in the U. S. National Museum. By Walter Hough.
pp. 531–587, 6 pls., 49 figs.

R. 28. The collection of Korean mortuary pottery in the U. S. National Museum. By Pierre Louis Jouy.
pp. 589–596, 5 pls., 1 map.

R. 29. A study of prehistoric anthropology: Handbook for beginners. By Thomas Wilson.
pp. 597–671, 20 pls., 43 figs.

R. 30. Ancient Indian matting, from Petit Anse Island, Louisiana. By Thomas Wilson.
pp. 673–675, 1 plate.

R. 31. Results of an inquiry as to the existence of man in North America during the paleolithic period of the Stone Age. By Thomas Wilson.
pp. 677–702, 14 figs.

1889.

R. 32. Museum catalogues. By Randolph I. Geare. (Part of the Report of the Assistant Secretary.)
pp. 8–21.

R. 33. Report upon the participation of the Smithsonian Institution and the National Museum in the expositions held at Cincinnati and Mariettta in 1888. (Part of the Report of the Assistant Secretary.)
pp. 149–186, 4 pls.

This report consists of a letter addressed to the Secretary of the Smithsonian Institution and inclosing Appendix A: Report upon the exhibit of the Smithsonian Institution, including the U. S. National Museum, at the Centennial Exposition of the Ohio Valley and Central States, held at Cincinnati, Ohio, in 1888. By R. Edward Earll. Appendix B: Report upon the exhibit of the Smithsonian Institution, including the U. S. National Museum, at the Centennial Exposition, Marietta, Ohio, July 16 to 21, 1888. By William V. Cox.

R. 34. Biographical notice of James Stevenson (Appendix C). (Part of the Report of the Assistant Secretary.)
pp. 187–190.

R. 35. Lists of institutions and foreign and domestic libraries to which it is desired to send future publications of the National Museum (Appendix D). (Part of the Report of the Assistant Secretary.)
pp. 191–277.

R. 36. The museums of the future.[1] By G. Brown Goode.
pp. 427–445.

R. 37. Te Pito Te Henua, or Easter Island. By W. J. Thomson, U. S. N.
pp. 447–552, 49 pls., 20 figs.

R. 38. Aboriginal skin-dressing: A study based on material in the U. S. National Museum. By Otis T. Mason.
pp. 553–589, 33 pls.

R. 39. The Puma, or American lion: *Felis concolor* of Linnæus. By Frederick W. True.
pp. 591–608, 1 plate.

R. 40. Animals recently extinct or threatened with extermination, as represented in the collections of the U. S. National Museum. By Frederic A. Lucas.
pp. 609–649, 11 pls., 2 figs., 7 maps.

R. 41. The development of the American rail and track, as illustrated by the collection in the U. S. National Museum. By J. Elfreth Watkins.
pp. 651–708, 116 figs.

R. 42. Explorations in Newfoundland and Labrador in 1887, made in connection with the cruise of the U. S. Fish Commission schooner *Grampus*. By Frederic A. Lucas.
pp. 709–728, 1 plate.

R. 43. On a bronze Buddha in the U. S. National Museum. By Charles De Kay.
pp. 729–735, 1 plate.

R. 44. Preliminary handbook of the Department of Geology in the U. S. National Museum. By George P. Merrill. (Appendix E.)
pp. 1–50.

1890.

R. 45. The Humming birds. By Robert Ridgway.
pp. 253–383, 46 pls., 47 figs.

R. 46. White-line engraving or relief-printing in the fifteenth and sixteenth centuries. By S. R. Koehler.
pp. 385–394, 4 pls., 3 figs.

R. 47. The methods of fire-making. By Walter Hough.
pp. 395–409, 1 pl., 13 figs.

R. 48. Ulu, or Woman's knife, of the Eskimo. By Otis T. Mason
pp. 411–416, 21 pls.

R. 49. The ancient Pit-dwellers of Yezo. By Romyn Hitchcock.
pp. 417–427, 8 pls., 4 figs.

[1] A lecture delivered before the Brooklyn Institute, February 28, 1889.

R. 50. The Ainos of Yezo, Japan. By Romyn Hitchcock.
pp. 429–502, 37 pls., 21 figs.

R. 51. Handbook for the Department of Geology in the U. S. National Museum. Part I. Geognosy. The materials of the earth's crust. By George P. Merrill.
pp. 503–591, 12 pls., 10 figs.

R. 52. The Catlin collection of Indian paintings.[1] By Washington Matthews, U. S. A.
pp. 593–610, 21 pls.

R. 53. The log of the *Savannah*. By J. Elfreth Watkins.
pp. 611–639, 6 pls.

R. 54. Anthropology at the Paris Exposition in 1889. By Thomas Wilson.
pp. 641–680, 7 pls., 1 fig.

1891.

R. 55. The genesis of the National Museum. By G. Brown Goode.
pp. 273–380.

R. 56. Ethnological collections in the U. S. National Museum from Kilima-Njaro, East Africa. By W. L. Abbott.
pp. 381–428, 24 figs.

R. 57. The Bernadou, Allen, and Jouy Korean collections in the U. S. National Museum. By Walter Hough.
pp. 429–488, 31 pls.

R. 58. Shinto, or the mythology of the Japanese. By Romyn Hitchcock.
pp. 489–509.

R. 59. The ancient burial mounds of Japan. By Romyn Hitchcock.
pp. 511–523, 31 pls.

R. 60. Some ancient relics in Japan. By Romyn Hitchcock.
pp. 525–526, 4 pls.

R. 61. Prehistoric naval architecture of the north of Europe. By George H. Boehmer.
pp. 527–647, 17 pls., 126 figs.

R. 62. First draft of a system of classification for the World's Columbian Exposition. By G. Brown Goode.
pp. 649–735.

1892.

R. 63. Japanese wood-cutting and wood-cut printing. By T. Tokuno.
pp. 221–244, 10 pls., 5 figs.

R. 64. The relation of biology to geological investigation. By Charles A. White.
pp. 245–368, 1 plate.

R. 65. Scientific taxidermy for museums. (Based on a study of the United States Government collections.) By R. W. Shufeldt.
pp. 369–436, 84 pls.

[1] Reprint of a lecture delivered in the National Museum on April 13, 1889.

R. 66. The shofar—its use and origin. By Cyrus Adler.
pp. 437–450, 4 pls.

R. 67. The Crump burial cave. (Blount County, Alabama.) By Frank Burns.
pp. 451–454, 1 plate.

R. 68. Minute stone implements from India. By Thomas Wilson.
pp. 455–460, 2 pls.

R. 69. Comparative oölogy of North American birds. By R. W. Shufeldt.
pp. 461–493.

1893.

R. 70. Recent advances in museum methods. (Part of the Report of the Assistant Secretary.)
pp. 21–58, 55 pls.

R. 71. Columbian Historical Exposition in Madrid. (Part of the Report of the Assistant Secretary.)
pp. 86–108; also Appendix X, pp. 324–334.

R. 72. The World's Columbian Exposition. (Part of the Report of the Assistant Secretary.)
pp. 108–114, 1 plate; also Appendix IX, pp. 316–321.

R. 73. The poisonous snakes of North America. By Leonhard Stejneger.
pp. 345–487, 19 pls., 70 figs.

R. 74. Chinese games with dice and dominoes. By Stewart Culin.
pp. 489–537, 12 pls., 33 figs.

R. 75. The onyx marbles; their origin, composition, and uses, both ancient and modern. By George P. Merrill.
pp. 539–585, 18 pls.

R. 76. The cowbirds. By Charles Bendire.
pp. 587–624, 3 pls.

R. 77. Primitive American armor. By Walter Hough.
pp. 625–651.

R. 78. The weapons and wings of birds. By Frederic A. Lucas.
pp. 653–663, 1 plate, 8 figs.

R. 79. Notes on the ethnology of Tibet. By William Woodville Rockhill.
pp. 665–747, 52 pls.

R. 80. Two Persepolitan casts in the U. S. National Museum. By Cyrus Adler.
pp. 749–753, 2 pls.

R. 81. Museum collections to illustrate religious history and ceremonials. By Cyrus Adler.
pp. 755–768.

R. 82. If public libraries, why not public museums?[1] By Edward S. Morse.
pp. 769–780.

[1] Reprinted from The Atlantic Monthly, July, 1893, pp. 112–119.

1894.

R. 83. Primitive travel and transportation. By Otis Tufton Mason.
pp. 237–593, 25 pls., 260 figs.

R. 84. Mancala, the national game of Africa. By Stewart Culin.
pp. 595–607, 5 pls., 15 figs.

R. 85. The golden patera of Rennes. By Thomas Wilson.
pp. 609–617, 1 plate, 1 fig.

R. 86. The wooden statue of Baron Ii Kamon-no-Kami Naosuké, pioneer diplomat of Japan. (Translation by Mr. H. Satoh of the label accompanying the statue.)
pp. 619–622, 1 plate.

R. 87. A study of the primitive methods of drilling. By J. D. McGuire.
pp. 623–756, 201 figs.

R. 88. The swastika, the earliest known symbol, and its migrations; with observations on the migration of certain industries in prehistoric times. By Thomas Wilson.
pp. 757–1011, 25 pls., 374 figs., 1 map, 1 chart.

1895.

R. 89. The social organization and the secret societies of the Kwakiutl Indians. By Franz Boas.
pp. 311–738, 51 pls., 215 figs.

R. 90. The graphic art of the Eskimos. By Walter James offman.
pp. 739–968, 82 pls., 154 figs.

R. 91. Notes on the geology and natural history of the peninsula of Lower California. By George P. Merrill.
pp. 969–994, 10 pls.

R. 92. The mineralogical collections in the U. S. National Museum. By Wirt Tassin.
pp. 995–1000, 1 plate.

R. 93. The tongues of birds. By Frederic A. Lucas.
pp. 1001–1020, 2 pls., 13 figs.

R. 94. The Ontonagon copper bowlder in the U. S. National Museum. By Charles Moore.
pp. 1021–1030, 2 pls.

R. 95. Taxidermical methods in the Leyden Museum, Holland. By R. W. Shufeldt.
pp. 1031–1037, 6 pls.

R. 96. The antiquity of the red race in America. By Thomas Wilson.
pp. 1039–1045.

1896.

R. 97. An account of the U. S National Museum. By Frederick W. True.
pp. 287–324.

R. 98. Prehistoric art; or, the origin of art as manifested in the works of prehistoric man. By Thomas Wilson.
pp. 325–664, 75 pls., 325 figs.

R. 99. Chess and playing cards: catalogue of games and implements for divination exhibited by the United States National Museum in connection with the Department of Archæology and Paleontology of the University of Pennsylvania at the Cotton States and International Exposition, Atlanta, Georgia, 1895. By Stewart Culin.
pp. 665–942, 50 pls., 226 figs.

R. 100. Biblical antiquities: A description of the exhibit at the Cotton States International Exposition at Atlanta, 1895. By Cyrus Adler and I. M. Casanowicz.
pp. 943–1023, 46 pls.

R. 101. The lamp of the Eskimo. By Walter Hough.
pp. 1025–1057, 24 pls., 4 figs.

1897.

R. 102. Recent foraminifera: A descriptive catalogue of specimens dredged by the U. S. Fish Commission steamer *Albatross*. By James M. Flint, U. S. N.
pp. 249–349, 80 pls.

R. 103. Pipes and smoking customs of the American aborigines, based on material in the U. S. National Museum. By Joseph D. McGuire.
pp. 351–645, 5 pls., 239 figs.

R. 104. Catalogue of the series illustrating the properties of minerals. By Wirt Tassin.
pp. 647–688.

R. 105. Te Pito Te Henua, known as "Rapa Nui;" commonly called Easter Island, South Pacific Ocean. By George H. Cooke, U. S. N.
pp. 689–723.

R. 106. The man's knife among the North American Indians: A study in the collections of the U. S. National Museum. By Otis Tufton Mason.
pp. 725–745, 17 figs.

R. 107. Classification of the mineral collections in the U. S. National Museum. By Wirt Tassin.
pp. 747–810.

R. 108. Arrowpoints, spearheads, and knives of prehistoric times. By Thomas Wilson.
pp. 811–988, 65 pls., 201 figs.

1898.

R. 109. Future development of the National Museum. (Part of the Report of the Acting Assistant Secretary.)
pp. 13–16.

R. 110. The crocodilians, lizards, and snakes of North America. By Edward Drinker Cope.
pp. 153–1270, 36 pls., 347 figs.

1899.

R. 111. Guide to the study of the collections in the section of applied geology: The non-metallic minerals. By George P. Merrill.
pp. 155–483, 30 pls., 13 figs.

R. 112. A primitive frame for weaving narrow fabrics. By Otis Tufton Mason.
pp. 485–510, 9 pls., 19 figs.

R. 113. An early West Virginia pottery. By Walter Hough.
pp. 511–521, 18 pls.

R. 114. Pointed bark canoes of the Kutenai and Amur. By Otis Tufton Mason. (With notes on the Kutenai canoe by Meriden S. Hill.)
pp. 523–537, 5 pls., 6 figs.

R. 115. Descriptive catalogue of a collection of objects of Jewish ceremonial deposited in the U. S. National Museum by Hadji Ephraim Benguiat. By Cyrus Adler and I. M. Casanowicz.
pp. 539–561, 36 pls.

1900.

R. 116. Anthropological studies in California. By W. H. Holmes.
pp. 155–187, 50 pls.

R. 117. Aboriginal American harpoons: A study in ethnic distribution and invention. By Otis T. Mason.
pp. 189–304, frontispiece, 19 pls., 92 figs.

R. 118. A sketch of the history of the ceramic art in China, with a catalogue of the Hippisley collection of Chinese porcelains. By Alfred E. Hippisley.
pp. 305–416, 21 pls.

R. 119. Contributions to the history of musical scales. By Charles K. Wead.
pp. 417–462, 10 pls., 8 figs.

R. 120. A collection of Hopi ceremonial pigments. By Walter Hough.
pp. 463–471.

R. 121. Descriptive catalogue of the collections of gems in the U. S. National Museum. By Wirt Tassin.
pp. 473–670, 9 pls., 26 figs.

R. 122. Descriptive catalogue of the meteorite collection in the U. S. National Museum. By Wirt Tassin.
pp. 671–698, 4 pls.

III.—PROCEEDINGS OF THE U. S. NATIONAL MUSEUM.[1]

[VOLUMES I–XXIII.]

VOLUME I, CONTAINING PAPERS 1–61.

Department of the Interior: | U. S. National Museum. | —— 17 —— | Proceedings | of the | United States National Museum. | Vol. 1. | 1878. | —— | Published under the direction of the Smithsonian Institution. | —— | Washington: | Government Printing Office. | 1879.

8vo., pp. iv, 1–520, 8 pls., 7 figs.

P. 1. Descriptions of new forms of mollusks from Alaska contained in the collections of the National Museum. By William H. Dall.
pp. 1–3.

P. 2. Postpliocene fossils in the coast range of California. By William H. Dall.
p. 3.

P. 3. Notes on the American species of the genus *Cybium*. By Felipe Poey.
pp. 3–5.

P. 4. The *Clupea tyrannus* of Latrobe. By G. Brown Goode.
pp. 5–6.

P. 5. The occurrence of *Belone latimanus* in Buzzard's Bay, Massachusetts. By G. Brown Goode.
pp. 6–7.

P. 6. The voices of crustaceans. By G. Brown Goode.
pp. 7–8.

P. 7. On a new humming bird (*Atthis ellioti*) from Guatemala. By Robert Ridgway.
pp. 8–10.

P. 8. Fossil mollusks from later tertiaries of California. By William H. Dall.
pp. 10–16.

P. 9. The manufacture of porpoise oil. By Caleb Cook.
pp. 16–18.

P. 10. The craig flounder of Europe, *Glyptocephalus cynoglossus*, on the coast of North America. By G. Brown Goode and Tarleton H. Bean.
pp. 19–23.

[1] Vols. I–X were issued as publications of the Department of the Interior.

P. 11. Note on shells from Costa Rica kitchenmidden, collected by Drs. Flint and Bransford. By William H. Dall.
pp. 23–24.

P. 12. Arsenic acid for protecting anatomical preparations from insects. By J. B. S. Jackson.
p. 24.

P. 13. The oceanic bonito on the coast of the United States. By G. Brown Goode and Tarleton H. Bean.
pp. 24–26.

P. 14. Distribution of Californian tertiary fossils. By William H. Dall.
pp. 26–30.

P. 15. A revision of the American species of the genus *Brevoortia*, with a description of a new species from the Gulf of Mexico. By G. Brown Goode.
pp. 30–42.

P. 16. Description of *Caulolatilus microps*, a new species of fish from the coast of Florida. By G. Brown Goode and Tarleton H. Bean.
pp. 42–45.

P. 17. The occurrence of *Hippocampus antiquorum*, or an allied form, on Saint George's Banks. By G. Brown Goode.
pp. 45–46.

P. 18. Descriptions of new species of shells from California in the collections of the National Museum. By William H. Dall.
pp. 46–47.

P. 19. Catalogue of the birds of Dominica from collections made for the Smithsonian Institution by Frederick A. Ober, together with his notes and observations. By George N. Lawrence.
pp. 48–69.

P. 20. Notes on a collection of fishes from Clackamas River, Oregon. By David S. Jordan.
pp. 69–85.

P. 21. A review of the American species of the genus *Scops*, Savigny. By Robert Ridgway.
pp. 85–117.

P. 22. Notes on the ornithology of southern Texas, being a list of birds observed in the vicinity of Fort Brown, Texas, from February, 1876, to June, 1878. By James C. Merrill.
pp. 118–173, 3 pls.

P. 23. On a serranoid fish, *Epinephelus drummond-hayi*, from the Bermudas and Florida. By G. Brown Goode and Tarleton H. Bean.
pp. 173–175.

P. 24. Descriptions of two new species of fishes, *Lutjanus blackfordii* and *Lutjanus stearnsii*, from the coast of Florida. By G. Brown Goode and Tarleton H. Bean.
pp. 176–181.

P. 25. A note on the Gulf menhaden, *Brevoortia patronus* Goode. By Silas Stearns.
pp. 181–182.

P. 26. A note upon the black grouper, *Epinephelus nigritus* (Holbrook) Gill, of the southern coast. By G. Brown Goode and Tarleton H. Bean.
pp. 182–184.

P. 27. Catalogue of the birds of Saint Vincent, from collections made by Mr. Fred. A. Ober, under the directions of the Smithsonian Institution, with his notes thereon. By George N. Lawrence.
pp. 185–198.

P. 28. Description of a new sparoid fish, *Sargus holbrookii*, from Savannah Bank. By Tarleton H. Bean.
pp. 198–200.

P. 29. Catalogue of casts taken by Clark Mills, esq., of the heads of sixty-four Indian prisoners of various western tribes, and held at Fort Marion, Saint Augustine, Florida, in charge of Capt. R. H. Pratt, U. S. A. By R. H. Pratt.
pp. 201–214.

P. 30. Synopsis of the pediculate fishes of the eastern coast of extratropical North America. By Theodore Gill.
pp. 215–221.

P. 31. Note on the Antennariidæ. By Theodore Gill.
pp. 221–222.

P. 32. On the proper specific name of the common pelagic Antennariid *Pterophryne*. By Theodore Gill.
pp. 223–226.

P. 33. Note on the Ceratiidæ. By Theodore Gill.
pp. 227–231.

P. 34. Note on the Maltheidæ. By Theodore Gill.
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P. 35. Catalogue of the birds of Antigua and Barbuda, from collections made for the Smithsonian Institution by Mr. Fred. A. Ober, with his observations. By George N. Lawrence.
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Smithsonian Institution. | United States National Museum. | —— | Proceedings | of the | United States National Museum. | —— | Volume XIX. | —— | Published under the direction of the Smithsonian Institution. | —— | Washington: | Government Printing Office. | 1897.
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Part VI.—Reptiles. By Samuel Garman (pp. 285–303).
Part VII.—Annelids. By Prof. H. E. Webster (pp. 305–327, 6 pls.).

B. 26. Avifauna Columbiana: being a list of birds ascertained to inhabit the District of Columbia, with the times of arrival and departure of such as are non-residents, and brief notices of habits, etc. The second edition, revised to date, and entirely rewritten. By Elliott Coues, M. D., Ph. D., professor of anatomy in the National Medical College, etc., and D. Webster Prentiss, A. M., M. D., professor of materia medica and therapeutics in the National Medical College, etc.

8vo., 1883, pp. 1–133, 2 pls., 100 figs.

B. 27. Great International Fisheries Exhibition, London, 1883. Descriptive catalogues of the collections sent from the United States to the International Fisheries Exhibition, London, 1883, constituting a report upon the American section. Prepared under the direction of G. Brown Goode, U. S. commissioner, and a staff of associates.

8vo., 1884, pp. liv, 1–1279.

Great international fisheries exhibition. London, 1883. United States of America. A. Preliminary catalogue and synopsis of the collections exhibited by the United States Fish Commission and by special exhibitors. With a concordance to the official classification of the exhibition. 8vo., 1883, pp. 1–105.

Great international fisheries exhibition. London, 1883. United States of America. B. Collection of economic crustaceans, worms, echinoderms, and sponges. By Richard Rathbun, curator of the department of marine invertebrates in the United States National Museum. 8vo., 1883, pp. 107–137.

Great international fisheries exhibition. London, 1883. United States of America. C. Catalogue of the aquatic and fish-eating birds exhibited by the United States National Museum. By Robert Ridgway, curator, department of birds, U. S. National Museum. 8vo., 1883, pp. 139–184.

Great international fisheries exhibition. London, 1883. United States of America. D. Catalogue of the economic mollusca and the apparatus and appliances used in their capture and preparation for market, exhibited by the United States National Museum. By Lieut. Francis Winslow, U. S. Navy. 8vo., 1883, pp. 185–270.

Great international fisheries exhibition. London, 1883. United States of America. E. The whale fishery and its appliances. By James Temple Brown, assistant in the department of art and industry, U. S. National Museum. 8vo., 1883, pp. 271–386.

Great international fisheries exhibition. London, 1883. United States of America. F. Catalogue of the collections of fishes exhibited by the United States National Museum. By Tarleton H. Bean, curator of the department of fishes in the United States National Museum. 8vo., 1883, pp. 387–510.

Great international fisheries exhibition. London, 1883. United States of America. G. Descriptive catalogue of the collection illustrating the scientific investigation of the sea and fresh waters. By Richard Rathbun, curator of the department of marine invertebrates in the United States National Museum. 8vo., 1883, pp. 511–621.

Great international fisheries exhibition. London, 1883. United States of America. H. Catalogue of the aquatic mammals exhibited by the United States National Museum. By Frederick W. True, curator of the department of mammals, United States National Museum. 8vo., 1884, pp. 623–644.

Great international fisheries exhibition. London, 1883. United States of America. I. Catalogue of the collection illustrating the fishing vessels and boats, and their equipment; the economic condition of fishermen; anglers' outfits, etc. By Capt. J. W. Collins, assistant, U. S. Fish Commission. 8vo., 1884, pp. 645–823.

Great international fisheries exhibition. London, 1883. United States of America. J. Catalogue of the apparatus for the capture of fish exhibited by the United States National Museum. By R. Edward Earll, curator of the fisheries collections, U. S. National Museum, and assistant U. S. Fish Commission. 8vo., 1884, pp. 825–1030.

Great international fisheries exhibition. London, 1883. United States of America. K. Catalogue of fishery products, and of the apparatus used in their preparation. By A. Howard Clark, assistant in the department of art and industry, United States National Museum. 8vo., 1884, pp. 1031–1154.

Great international fisheries exhibition. London, 1883. United States of America. L. Catalogue of the fish-cultural exhibit of the United States Fish Commission. By R. Edward Earll, curator of the fisheries collections, U. S. National Museum, and assistant, U. S. Fish Commission. 8vo., 1884, pp. 1155–1249.

B. 28. A manual of American land shells. By W. G. Binney.
8vo., 1885, pp. 1–528, 516 figs.

B. 29. Results of ornithological explorations in the Commander Islands and in Kamtschatka. By Leonhard Stejneger.
8vo., 1885, pp. 1–382, 8 pls., 7 figs., 1 map.

B. 30. Bibliographies of American naturalists. III. Bibliography of publications relating to the collection of fossil invertebrates in the United States National Museum, including complete lists of the writings of Fielding B. Meek, Charles A. White,[1] and Charles D. Walcott. By John Belknap Marcou.
8vo., 1885, pp. 1–333.

B. 31. Bulletin of the United States National Museum. No. 31. Synopsis of the North American Syrphidæ. By Samuel W. Williston, M. D., Ph. D.
8vo., 1886, pp. xxx, 1–335, 12 pls.

B. 32. Catalogue of batrachians and reptiles of Central America and Mexico. By E. D. Cope.
8vo., 1887, pp. 1–98.

B. 33. Catalogue of minerals and synonyms. By T. Egleston, Ph. D.
8vo., 1887, pp. 1–198.

B. 34. The batrachia of North America. By E. D. Cope.
8vo., 1889, pp. 1–525, 86 pls., 119 figs.

[1] For supplementary list, see P. 1135.

B. 35. Bibliographical catalogue of the described transformations of North American lepidoptera. By Henry Edwards.
8vo., 1889, pp. 1–147.

B. 36. Contributions to the natural history of the cetaceans. A review of the family Delphinidæ. By Frederick W. True, curator of the department of mammals, United States National Museum.
8vo., 1889, pp. 1–191, 47 pls.

B. 37. A preliminary catalogue of the shell-bearing marine mollusks and brachiopods of the south-eastern coast of the United States, with illustrations of many of the species. By William Healey Dall, A. M., honorary curator, department of mollusks, U. S. National Museum.
8vo., 1889, pp. 1–221, 74 pls.

B. 38. Contribution toward a monograph of the insects of the lepidopterous family Noctuidæ of temperate North America. Revision of the species of the genus *Agrotis*. By John B. Smith, professor of entomology, Rutgers College, New Jersey.
8vo., 1890, pp. iv, 1–237, 5 pls.

B. 39. [Directions for collecting and preserving specimens.]

Part A.—Directions for collecting birds. By Robert Ridgway. 8vo., 1891, pp. 1–27, 9 figs.

Part B.—Directions for collecting recent and fossil plants. By F. H. Knowlton (with notes on collecting and preserving fresh-water algæ, by Frank S. Collins). 8vo., 1891, pp. 1–46, 10 figs.

Part C.—Notes on the preparation of rough skeletons. By Frederic A. Lucas. 8vo., 1891, pp. 1–11, 12 figs.

Part D.—Directions for collecting, preparing, and preserving birds' eggs and nests. By Charles Bendire. 8vo., 1891, pp. 1–10, 7 figs.

Part E.—Directions for collecting reptiles and batrachians (with supplementary note giving directions for preserving small herpetological specimens in formalin). By Leonhard Stejneger. 8vo., 1891, pp. 1–13, 5 figs.

Part F.—Directions for collecting and preserving insects. By C. V. Riley, M. A., Ph. D. 8vo., 1892, pp. 1–147, 1 plate, 139 figs.

Part G.—Instructions for collecting mollusks, and other useful hints for the conchologist. By William H. Dall. 8vo., 1892, pp. 1–56, 8 figs.

Part H.—Directions for collecting minerals. By Wirt Tassin. 8vo., 1895, pp. 1–6, 8 figs.

Part I.—Directions for collecting rocks and for the preparation of thin sections. By George P. Merrill. 8vo., 1895, pp. 1–15, 17 figs.

Part J.—Directions for collecting specimens and information illustrating the aboriginal uses of plants. By Frederick V. Coville. 8vo., 1895, pp. 1–8.

Part K.—Directions for collecting and preparing fossils. By Charles Schuchert. 8vo., 1895, pp. 1–31, 13 figs.

Part L.—Directions for collecting and preserving scale insects (Coccidæ). By T. D. A. Cockerell. 8vo., 1897, pp. 1–9.

Part M.—The methods employed at the Naples Zoological Station for the preservation of marine animals. By Dr. Salvatore Lo Bianco. Translated from the original Italian by Edmund Otis Hovey. 8vo., 1899, pp. 1–42, frontispiece.

Part N.—Directions for preparing study specimens of small mammals. By Gerrit S. Miller, jr. 8vo., 1899, pp. 1–10, 1 fig.

Part N.—Second edition, revised, with abstracts in German, French, and Spanish. 8vo., 1901, pp. 1–25, 3 figs.

Part O.—Directions for collecting and rearing dragonflies, stoneflies, and mayflies. By James G. Needham, Ph. D. 8vo., 1899, pp. 1–9, 4 figs.

B. 40. Bibliographies of American naturalists. IV. The published writings of George Newbold Lawrence, 1844–1891. By L. S. Foster.

8vo., 1892, pp. xi, 1–124, frontispiece.

B. 41. Bibliographies of American naturalists. V. The published writings of Dr. Charles Girard. By George Brown Goode.

8vo., 1891, pp. vi, 1–141, frontispiece.

B. 42. A preliminary descriptive catalogue of the systematic collections in economic geology and metallurgy in the United States National Museum. By Frederic P. Dewey.

8vo., 1891, pp. xviii, 1–256, 34 pls., 10 figs.

B. 43. A monograph of the bats of North America. By Harrison Allen, M. D.

8vo., 1893, pp. ix, 1–198, 38 pls., 1 diagram.

B. 44. A catalogue, bibliographical and synonymical, of the species of moths of the lepidopterous superfamily Noctuidæ, found in boreal America, with critical notes. By John B. Smith, Sc. D.

8vo., 1893, pp. 1–424.

B. 45. A monograph of the North American Proctotrypidæ. By William H. Ashmead.

8vo., 1893, pp. 1–472, 18 pls., 2 figs.

B. 46. The myriapoda of North America. By Charles Harvey Bollman. Edited by L. M. Underwood.

8vo., 1893, pp. 1–210.

B. 47. The fishes of North and Middle America: A descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, north of the Isthmus of Panama. By David Starr Jordan, Ph. D., president of the Leland Stanford Junior University, and Barton Warren Evermann, Ph. D., ichthyologist of the United States Fish Commission.

8vo., 4 vols., pp. 1–3313, 392 pls.

Part I.—1896, pp. lx, 1–1240.
Part II.—1898, pp. xxx, 1241–2183.
Part III.—1898, pp. xxiv, 2183*a*–3136.
Part IV.—1900, pp. ci, 3137–3313; 392 pls.

B. 48. Contributions toward a monograph of the insects of the lepidopterous family Noctuidæ of boreal North America. A revision of the deltoid moths. By John B. Smith, Sc. D., professor of entomology in Rutgers College.

8vo., 1895, pp. i–vi, 1–129, 14 pls.

B. 49. The published writings of Philip Lutley Sclater, 1844–1896. Prepared under the direction of G. Brown Goode.
8vo., 1896, pp. xix, 1–135, frontispiece.

B. 50. The birds of North and Middle America: A descriptive catalogue of the higher groups, genera, species, and subspecies of birds known to occur in North America, from the Arctic lands to the Isthmus of Panama, the West Indies and other islands of the Caribbean Sea, and the Galapagos Archipelago. By Robert Ridgway, curator, division of birds. Part I. Family Fringillidæ—The Finches.
8vo., 1901, pp. i–xxx, 1–715, 20 pls. (Additional parts in preparation.)

V. SPECIAL BULLETINS OF THE U. S. NATIONAL MUSEUM.

(NOS. I–IV.)

I. Smithsonian Institution. | United States National Museum. | Special Bulletin No. 1. | —— | Life histories | of | North American birds | with special reference to | their breeding habits and eggs, | with | twelve lithographic plates. | By | Charles Bendire, captain, U. S. Army (retired), | Honorary Curator of the Department of Oölogy, U. S. National Museum, | member of the American Ornithologists' Union. | —— | Washington: | Government Printing Office | 1892.

4to., pp. viii, 1–446, 12 pls.

II. Smithsonian Institution. | United States National Museum. | —— | Special Bulletin. | —— | Oceanic Ichthyology, | a treatise on the | deep-sea and pelagic fishes of the world, based chiefly upon | the collections made by the steamers Blake, Albatross, | and Fish Hawk in the Northwestern Atlantic, | with | an atlas containing 417 figures, | By | George Brown Goode, Ph. D., LL. D., | Assistant Secretary, Smithsonian Institution, in charge of U. S. National Museum, | and | Tarleton H. Bean, M. D., M. S., | Director of the New York Aquarium. | —— | Washington: | Government Printing Office. | 1895.

4to., Vol. I, pp. xxxv, 1–553, 24 figs., 1 diagram; Vol. II, pp. xxiii, 1–26, 123 pls.

III. Smithsonian Institution. | United States National Museum. | Special Bulletin. | —— | Life histories | of | North American birds, | from the parrots to the grackles, | with special reference to | their breeding habits and eggs, | By | Charles Bendire, captain and brevet major, U. S. A. (retired), | Honorary Curator of the Department of Oölogy, U. S. National Museum | member of the American Ornithologists' Union. | with | seven lithographic plates. | —— | Washington: | Government Printing Office. | 1895.

4to., pp. ix, 1–518, 7 pls.

IV. Smithsonian Institution. | United States National Museum. | —— | Special Bulletin. | —— | American Hydroids. | —— | Part I. | The Plumularidæ, | with thirty-four plates. | By | Charles Cleveland Nutting, | Professor of Zoology, University of Iowa. | —— | Washington: | Government Printing Office. | 1900.

4to., pp. ii, 1–285, 34 pls., 124 figs.

VI. CIRCULARS OF THE U. S. NATIONAL MUSEUM.[1]

(NOS. 1–50.)

C. 1. Organization of the U. S. National Museum. By G. Brown Goode.
8vo., 1881, pp. 1–58.

C. 2. Circular addressed to friends of the Museum. By Spencer F. Baird.
8vo., 1881, pp. 1–2.

C. 3. Circular in reference to petroleum collections. By Spencer F. Baird.
8vo., 1881, pp. 1–2.

C. 4. Circular concerning the department of insects. By Spencer F. Baird.
8vo., 1881, 1 page.

C. 5. Establishment and officers.
8vo., 1881, pp. 1–2.

C. 6. Classification and arrangement of the materia medica collection. By James M. Flint, U. S. N.
8vo., 1881, pp. 1–2.

C. 7. A classification of the forms in which drugs and medicines appear and are administered. By James M. Flint, U. S. N.
8vo., 1881, pp. 1–7.

C. 8. Memoranda for collectors of drugs for the materia medica section of the National Museum. By James M. Flint, U. S. N.
8vo., 1881, pp. 1–2.

C. 9. Circular in reference to the building-stone collection. By Spencer F. Baird.
8vo., 1881, pp. 1–6.

C. 10. Two letters on the work of the National Museum. By Barnet Phillips.
8vo., 1881, pp. 1–10.

C. 11. A provisional classification of the food collections. By G. Brown Goode.
8vo., 1881, pp. 1–22.

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[1] Circulars 1–18 reprinted in Proceedings U. S. National Museum, Volume IV.
Circulars 19–23 reprinted in Proceedings U. S. National Museum, Volume VI.
Circulars 24–31 reprinted in Proceedings U. S. National Museum, Volume VII.
Circulars 32 33 reprinted in Proceedings U. S. National Museum, Volume VIII.
Circular 35 reprinted in Report U. S. National Museum, 1886, p. 25.
Circular 37 reprinted in Proceedings U. S. National Museum, Volume X.

C. 12. Classification of the collection to illustrate the art of taxidermy. By William T. Hornaday.
8vo., 1881, pp. 1–2.

C. 13. Outline of a scheme of museum classification. By G. Brown Goode.
8vo., 1881, pp. 1–4.

C. 14. Circular requesting material for the library. By Spencer F. Baird.
8vo., 1881, pp. 1–3.

C. 15. The organization and objects of the National Museum.
8vo., 1881, pp. 1–4.

C. 16. Plans for the installation of collections.
8vo., 1881, pp. 1–2.

C. 17. Contributions and their acknowledgment.
8vo., 1881, 1 page.

C. 18. List of publications of the United States National Museum.
8vo., 1881, pp. 1–12.

C. 19. Classification of the materia medica collection of the U. S. National Museum, and catalogue of specimens. By James M. Flint, U. S. N.
8vo., 1883, pp. 1–45.

C. 20. Request for specimens of drugs and information concerning them. By Spencer F. Baird.
8vo., 1883, 1 page.

C. 21. Circular relative to contributions of aboriginal antiquities to the U. S. National Museum. By Charles Rau.
8vo., 1883, 5 pp.

C. 22. Brief directions for removing and preserving the skins of mammals. By William T. Hornaday.
8vo., 1883, 7 pp., 4 figs.

C. 23. Instructions for taking paper molds of inscriptions in stone, wood, bronze, etc. Prepared by A. P. Niblack, U. S. N.
8vo., 1883, 5 pp.

C. 24. Plan of a collection to illustrate the textile industries of the United States, to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–85, at New Orleans. By Romyn Hitchcock.
8vo., 1884, pp. 1–16.

C. 25. Preliminary plan for a collection of the building and ornamental stones and rocks of the United States, to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–85, at New Orleans. By George P. Merrill.
8vo., 1884, pp. 1–2.

C. 26. Plan for a collection of gems and precious stones, to be exhibited at the Cincinnati Industrial Exposition and the World's Industrial and Cotton Centennial Exposition of 1884–85, at New Orleans. By F. W. Clarke.
8vo., 1884, pp. 1–2.

C. 27. Directions for collecting, preserving, and transporting tortricids and other small moths. By C. H. Fernald.
8vo., 1884, pp. 1–3.

C. 28. Directions for mound exploration. By Cyrus Thomas.
8vo., 1884, pp. 1–3.

C. 29. Provisional plan for a collection of mammals to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–85, at New Orleans. By Frederick W. True.
8vo., 1884, pp. 1–27.

C. 30. A list of birds the eggs of which are wanted to complete the series in the National Museum, with instructions for collecting eggs. By Charles E. Bendire, U. S. A.
8vo., 1884, 4 pp.

C. 31. Plan to illustrate the mineral resources of the United States and their utilization, at the World's Industrial and Cotton Centennial Exposition of 1884–85, at New Orleans. By Fred. P. Dewey.
8vo., 1884, 8 pp.

C. 32. Classification of the materia medica collection of the U. S. National Museum, and catalogue of specimens. By James M. Flint, U. S. N. (Revised and extended by Dr. Henry G. Beyer, U. S. N.)
8vo., 1885, pp. 1–39.

C. 33. Notes on the preparation of rough skeletons. By Frederic A. Lucas.
8vo , 1885, pp. 1–8, 12 figs.

C. 34. Circular for the guidance of persons desiring to make exchanges of birds or birds' eggs with the National Museum.
8vo., 1886, 1 page.

C. 35. Concerning the lending of type specimens. By Spencer F. Baird.
8vo., 1886, 1 page.

C. 36. Circular concerning the department of antiquities. By S. P. Langley.
8vo., 1887, 6 pp., 17 figs.

C. 37. Catalogue of the contributions of the section of graphic arts to the Ohio Valley Centennial Exposition, Cincinnati, Ohio, 1888. By S. R. Koehler.
8vo., 1887, 31 pp.

C. 38. Contributions of the department of transportation and engineering to the Ohio Valley Centennial Exposition, 1888. By J. Elfreth Watkins.
8vo., 1888, pp. 1–18.

C. 39. The contribution of the section of oriental antiquities to the Ohio Valley Centenial Exposition. By Cyrus Adler.
8vo., 1888, pp. 1–7.

C. 40. Description of exhibit made by the department of prehistoric anthropology in the National Museum at the Ohio Valley and Central States Exposition in Cincinnati, Ohio, 1888. By Thomas Wilson.
8vo., 1888, pp. 1–33, 50 figs.

C. 41. Guide to a collection illustrating the families of mammals, exhibited in the Ohio Valley Centennial Exposition in 1888 by the U. S. National Museum. By Frederick W. True.
8vo., 1888, pp. 1–26.

C. 42. Circular relating to prehistoric anthropology. By Thomas Wilson.
8vo., 1888, pp. 1–16, 4 figs.

C. 43. To the correspondents of the U. S. National Museum. By G. Brown Goode. [With a view to securing accessions for the library.]
8vo., 1894, 1 page.

C. 44. To the correspondents of the U. S. National Museum. By G. Brown Goode. [With a view to securing publications for the library in exchange.]
8vo., 1894, pp. 1–8.

C. 45. To the correspondents of the U. S. National Museum. By G. Brown Goode. [With a view to securing authors' separates and reprints for the library.]
8vo., 1894, 1 page.

C. 46. [Regarding the proposed revision of Bulletin 22, relating to the flora of the District of Columbia.] By G. Brown Goode.
8vo., 1895, 2 pp.

C. 47. Circular in regard to the identification of specimens of mollusks by the National Museum. By G. Brown Goode.
8vo., 1895, 2 pp.

C. 48. Circular in regard to bones and teeth of the mastodon and mammoth. By Frederic A. Lucas.
8vo., 1897, pp. 1–4, 2 figs.

C. 49. [Circular relating to the North American Violaceæ.] By Frederick W. True.
8vo., 1899, 1 page.

C. 50. [Circular transmitting questions relating to birds and birds' eggs.] By Richard Rathbun.
8vo., 1901, 3 pp.

VII.—INDEX TO TITLES IN PRECEDING LIST.

[In the references the following abbreviations are used: R.=paper printed in the Reports; P.=paper printed in the Proceedings; B.=Bulletin; Sp. B.=Special Bulletin; C.=Circular. The references under certain special headings, such as U. S. Fish Commission, etc., are necessarily incomplete, as this is only an index of *titles*. References to persons whose names occur in the titles, but who are not themselves the authors of the papers, are placed in brackets.]

[1] For a complete list of papers relating to the work of the "Albatross" see "Dredging and other records of the 'Albatross,' with bibliography relative to the work of the vessel," compiled by C. H. Townsend and published in the Report of the U. S. Fish Commission for 1900.

[2] In addition to the above-numbered series the following papers, printed in the Proceedings subsequent to Volume XVIII, are based wholly or in part on "Albatross" collections: Nos. 1114, 1115, 1161, 1162, 1213, 1236, 1239, 1241, 1244, 1259, 1261.

[1] Under this heading will be found references to all papers on ethnology, archæology, and technology.

B.

C.

D.

E.

[1] See also under Rosa Smith.

F.

G.

[1] Also reprinted in Museum Report for 1897, Vol. II.

H.

[1] In addition to the papers here indicated several others relating to museum history and administration, and also to American science and scientific institutions, were reprinted in the Musuem Report for 1897, Vol. II.

I.

J.

K.

L.

M.

N.

[1] Also reprinted in Museum Report for 1897, Vol. II.

O.

P.

[1] See also under Directions for Collecting, and Taxidermy.

R.

S.

T.

U.

[1] See also under Directions for collecting, Preservation, and Preparation.

V.

W.

X.

Y.

Z.

O