REPORT OF THE FORESTER.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 30, 1922.

SIR: I have the honor to transmit herewith a report of the work in the Forest Service for the fiscal year ended June 30, 1922.

WILLIAM B. GREELEY,
Forester.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

NATIONAL FORESTRY POLICY.

Every year makes the forest problem of the United States more clear. Its main features are:

1. The rising cost of timber products due primarily to heavier transportation charges from more and more distant sources of supply.
2. The unproductive condition of immense areas of land which are not adapted to agriculture.

The cut of lumber is decreasing in all the Eastern States; in practically every State west of the Great Plains it is increasing. The large sawmills of the country are in full migration westward to the last great virgin timber supply on the Pacific coast. During the past 30 years the pineries of the South have been the mainstay of the densely populated Central and Eastern States for the softwood lumber used in building, in general construction, and in many manufactures. Their cut is dwindling. Every year scores of sawmills are dismantled. The rapid increase in lumber shipments through the Panama Canal foreshadows the time, in the near future, when the principal source of softwood lumber for the entire Nation will have shifted to the west coast and the average freight cost paid by the home builder or manufacturer will have advanced to a new and higher level.

When the coniferous virgin timber of the far West is exhausted in its turn, if the principal source of supply shifts to Siberia or South America the transportation conditions which control the present lumber market will become different only in degree. Further, as the sources of supply become more restricted and more distant from the principal centers of consumption, opportunities for competition are lessened; and temporary shortages due to bad seasons, labor troubles, or congestion of transportation facilities are more probable and more severe. Thus the conditions of the trade become more favorable to monopolistic control, to violent market fluctuations, and to high prices. And we are dealing with a basic raw material, as widely used and as necessary to national existence as coal.

15485—22——1

The accessible timber of the world is inadequate to the requirements of modern civilization. We now draw one-third of our paper from Canada. The northeastern paper mills have already been seriously handicapped by the embargo against the export of pulpwood cut on crown lands, which form a large part of the Canadian forests. There is likelihood that this embargo will be extended to all forest lands in the Dominion, completely shutting off raw wood from Canada as a source of supply for the paper industry of the United States. This illustrates the hazard of becoming dependent upon foreign supplies of timber.

The problem of unproductive land left in the wake of the sawmills or abandoned by the farmer has assumed enormous proportions. Our merchantable timber is being cut at the rate of four or five million acres annually, and enormous areas of logged-off land have accumulated which are not fit for cultivation but on which little or no new timber is being grown. The extent to which these millions of acres of idle land have been swelled by the ebbing tide of cultivation in many States is not generally realized. Between the census years of 1910 and 1920 the total area of improved farm land increased 6 per cent, due to agricultural expansion in the South and West and to the stimulus of war-time demands for crop production; but in 18 of the Eastern and East Central States the improved farm land shrank at the rate of 800,000 acres a year. New England lost 32,000 farms, with a net decrease during the 10 years of over a million acres of improved land. There can be no question as to the steady contracting of cultivation in a considerable number of the oldest and most populous States and the consequent lapse of large areas of land into partial or complete idleness. What to do with unused and unproductive land is one of the most fundamental economic and social problems of the United States.

Including burned and cut-over areas and abandoned fields which once grew timber, one-third of the soil of the Union is forest land. And three-fourths of it lies in the Mississippi Valley and eastward to the Atlantic coast, in the very States having the densest population and the largest consumption of timber products. Over 40 per cent of New York and Pennsylvania is forest land. Seventy-five per cent of Maine and of New Hampshire is forest land. From 45 to 70 per cent of the area of each of the South Atlantic and Gulf States is forest land. The use of these vast areas of nontillable land for growing successive crops of timber would kill two birds with one stone. It would insure ultimately a supply of forest products adequate for all national requirements; and it would go far toward maintaining a virile rural population and stable rural communities in the regions of inferior soil and limited agriculture.

The working out of a vast economic problem of this character will necessarily require a long time and can be only partially accomplished or influenced by public action. Steady progress is being made from year to year in the protection of forest lands from fire, particularly through increased State and Federal appropriations, the encouragement given to private protective effort by public cooperation, and the enactment of better State laws for reducing the hazard caused by logging débris. Nation-wide fire protection was given a strong impetus during the past year by a threefold increase in the appropriation for Federal cooperation with the States in protecting the forested

watersheds of navigable streams. This appropriation is expendable only in States which at least match the Federal funds, and has been the cause, since its initiation in 1911, of a constantly widening circle of forest protection through public and private cooperation. But while ground is being gained and held, it must be recognized squarely that our national task of forest protection is still less than half performed and that the recurrent burning of forest lands remains the greatest handicap upon general reforestation.

Undoubtedly the second greatest drawback upon timber growing in the United States is the deterrent effect of the property tax levied year after year upon land bearing young trees. One of the outstanding needs of the situation is a system of taxing growing forests under which the principal burden will fall at the time of harvesting the matured crop but which is so adjusted as to be equitable to other classes of taxpayers and to meet the needs for public revenue. Earnest efforts to devise an adequate plan for taxing forest lands are now being made in at least a dozen States; and the Forest Service is engaged in a nation-wide study of the subject with the purpose of aiding local agencies and promoting a sound public conception of the problem.

A survey of lands, forests, waters, and wild life in northern Michigan has been undertaken by the State with a view to ascertaining the exact situation as to soil conditions, forest and game resources, denuded and unproductive land, agricultural and timber-growing possibilities, and opportunities for recreational development. This survey will afford the basis of a comprehensive State policy for dealing with its natural resources. It is an example of what should be done in every one of the 39 States which contain important areas of forest land.

There have been many other recent indications of public interest and effort in response to the clearer conception of the situation as to timber shortage and idle land. Movements are in progress to secure forestry laws in Florida, Georgia, Mississippi, and Missouri, and to extend and strengthen legislation favorable to reforestation in many other States. The creation of additional State forests is receiving a strong impetus in Texas, Minnesota, and California, while in New England the establishment of town forests is gaining noticeable headway. Meanwhile the pressure of purely economic forces is having a gradually more marked effect in stimulating the growing of timber crops, particularly in the Northern and Eastern States. The commercial planting of forest trees is increasing from year to year. Thousands of farmers and other small owners are more or less systematically reforesting their inferior lands. A considerable number of far-sighted companies engaged in the manufacture of timber products or in other industries which require wood have embarked upon the reforestation of their lands upon an extensive and well-planned scale.

These facts illustrate the many angles of the forest problem and the many factors which will contribute to its ultimate solution. We are still far short of a balance between timber use and timber growth, and the inroads upon the remaining supply of stumpage will doubtless be accelerated as building and industrial activity assume more normal proportions. Yet real progress is being made in the amount of young forest growth in the United States, which will ultimately contribute to the timber supply.

In the specific work of the Forest Service bearing upon the national situation, the most striking advances during the past year were the threefold expansion of forest protection in cooperation with the States and the enactment of a general forest exchange law. This legislation will make possible a substantial consolidation of the existing national forests and their ultimate extension through the inclusion of private cut-over lands within their exterior boundaries. A significant step was recorded in the acquisition of additional national forests under the act of 1911 through the approval of the purchase of 74,000 acres in western Pennsylvania, on the Ohio watershed, which will form a nucleus for the Allegheny National Forest. The service is continuing the nation-wide study, in cooperation with State foresters, timberland owners, and other agencies, of the barriers to reforestation which exist in each important forest region, and of the methods of cutting and fire protection which are necessary to keep the various types of forest land productive. One of the results of this investigation will be to formulate in as definite terms as practicable the measures which may equitably be enforced by public regulation in each region to keep up the productivity and usefulness of its forest lands.

During January, 1922, extended hearings were held by the Committee on Agriculture of the House of Representatives on the need for additional Federal legislation dealing with the national forestry situation. It is earnestly to be hoped that a constructive measure will be brought before Congress as the result of these hearings. It is urgent that aggressive national leadership be exerted in meeting what is steadily assuming the proportions of a grave national menace. Our national policy of forest conservation has been a matter of slow but sustained growth for over 30 years. It is not to be expected that its remaining chapters can all be written at once, and particularly that the extent and manner of exercising public control over private forest lands and industries can be settled in any final way until public sentiment shall have been more definitely and maturely formed on this subject. But there can be no question as to the wisdom or urgency of immediate legislative action on certain fundamental steps in any adequate Federal program of reforestation.

The immediate needs are:

1. The extension of Federal cooperation with States in forest protection on a scale commensurate with the national interests at stake and with a broader legislative basis adapted to the practical requirements of the situation. Such cooperation should not be restricted to the watersheds of navigable streams and should be contingent upon compliance by the cooperating States with standards established by the Secretary of Agriculture.

2. An enlarged scale of national forest purchases under the act of March 1, 1911, in order that the benefits of Federal forest ownership may be more widely applied in critical, or "key," areas.

3. The extension of forest protection and management to all lands now under national ownership or control whose greatest utility lies in the growing of timber or protection of watersheds. This should include not only the forested lands still in the unreserved public domain, but also those within military or naval reservations, recognizing the prior service of lands of the latter class for national-defense purposes.

4. Cooperation with the States in growing and distributing forest planting material, in order that this important means of reforestation may be more widely employed.

5. Provision for enlarged research in the growing and use of timber. The investigative agencies of the country are now unable to keep pace with the demands of timber growers and timber-using industries for the technical information needed to direct soundly their undertakings. The availability of accurate scientific data underlies every effort for the conservation of existing timber supplies and the growing of new timber crops.

FORESTRY IN ALASKA.

Good progress was made during the year in collecting the information essential to the practicable development of the Tongass National Forest, which occupies most of the heavily timbered panhandle of Alaska. The merchantable timber on this forest includes at least 100,000,000 cords of western hemlock and Sitka spruce. Fully 90 per cent of this timber is admirably adapted for use in the manufacture of wood pulp and paper. It is estimated that this forest alone can furnish perpetually an annual yield of print paper equal to one-third our total national consumption.

As a step toward the establishment of the industry the Tongass National Forest was last year tentatively divided into 14 zones, each embracing sufficient timber to furnish a large paper mill with a permanent supply of raw material. The lines of each zone have been so drawn as to include water powers sufficient to meet the requirements of manufacture. In the further development of this plan, the service has had two crews in the field, one estimating and appraising the timber in each zone, while the other, headed by a hydroelectric engineer, has been examining and surveying water-power resources and preparing maps and reports covering each power site in detail. The Federal Power Commission is cooperating with the Forest Service in securing the water-power data. This work is not only providing reliable information regarding the water power available for a local paper industry but also has resulted in the discovery of a number of valuable water-power sites not heretofore known to exist, notably one permitting the development of from 22,000 to 24,000 horsepower at a very low cost.

Economic conditions during the past year have not been favorable to the launching of a pulp and paper industry in Alaska. Business in the Territory has encountered the same difficulties as in the States. The drop in the market price of wood pulp last year resulted in the temporary closure of the one pulp mill in Alaska. Ocean freight rates are an important factor in marketing such a bulky product, but it appears probable that the local industry will be more successful if it includes the manufacture of pulp into paper. Evidently this belief is shared by a number of responsible concerns which have submitted applications for the purchase of pulpwood from the Alaska National Forests and applications for water-power licenses for the purpose of manufacturing both pulp and paper. As soon as they are satisfied that business conditions are stabilized, including a stable labor and money market, it is reasonable to expect the extension of this important industry to southern Alaska. Best of

all, the industry when established will be upon a permanent basis, each mill being assured a perpetual local supply of raw material at a reasonable price. The national forest contract offered is entirely acceptable to experienced paper manufacturers, who have no fault to find with the terms of sale established by the Government.

Meanwhile 86 per cent of the lumber used in Alaska is cut from the Government forests, and Sitka spruce from the Tongass National Forest is finding an outlet in the markets of the world. The sawmill at Wrangell during the past summer made a shipment of 45,000 feet board measure of Sitka spruce for the London market, and another lot of 450,000 feet board measure was shipped from Wrangell through Prince Rupert to eastern points. During the latter part of August and September a 5-masted schooner was loaded at Ketchikan, Alaska, with a cargo of approximately 1,800,000 feet of spruce for the Australian market and 3,000,000 feet more will be shipped in December from the same mill. This lumber was all cut and manufactured locally from timber purchased from the Tongass National Forest. Thus the industries developed by this great national forest are making a place for Alaska timber in the general lumber markets, furnishing labor to the residents of Alaska, and bringing outside capital into our northern ports.

The roads which are being constructed in the national forests in cooperation with the Bureau of Public Roads are proving a great factor in improving business and living conditions in southeastern Alaska. During the past a number of roads were extended out from the chief towns in the forest. The result in travel and in business and home development has been amazing. In some cases the road has been scarcely completed before every foot of frontage on each side of the highway has been taken up in suburban lots and neat and comfortable homes have been erected. Communities are being literally transformed in this way and their desirability for year-long residence greatly increased. The result is a more contented and permanent local population.

That the policies and activities of the Department of Agriculture have won the approval and support of the people living in and near the Alaska forests is becoming every day more evident. The encouragement and assistance given in building up an export lumber trade, the basic work going forward for the establishment of the pulp and paper industry, and the large expenditures which are being made on forest roads, together with a decentralized local administration, are contributing largely to the growth and prosperity of the Territory.

It is becoming evident that the solution of the Alaska problem is local self-government. The people of the Territory who come in contact with the national forests are thoroughly satisfied with the existing form of administration and control of these properties. Their criticisms of Federal red tape are not usually directed against the bureaus of this department. The counsel and assistance of our scientific bureaus are welcomed. Apparently what the people of Alaska want is not the power to run the Government's business or property in Alaska but power to run their own business. They do not object to the two national forests in Alaska being administered just as national forests are administered elsewhere, but they want to make their own laws, levy their own taxes, and spend their own public money just as do the people in the States. In short, what

Alaska wants is not that the Union should be ousted from the Territory, but that Alaska should be admitted to the Union.

It seems to be generally accepted that the Territory as a whole is not ready for statehood, but unquestionably that part lying east of the one hundred and fifty-second meridian and south of the Arctic Circle has the economic wealth and the stable, law-abiding population which according to our historic policies and precedents have always been recognized by Congress as entitling continental territory and people to self-government in the Union. From the standpoint of national-forest administration and development, no happier step could be taken than admittance of this part of the Territory to the full rights of an American Commonwealth.

THE PERSONNEL OF THE FOREST SERVICE.

The national forests comprise nearly 157,000,000 acres of land in the most rugged and isolated parts of 26 States. The forest ranger manages an average unit of 155,000 acres, and the forest supervisor an average unit of 1,060,000 acres. The type of country in which these men work varies from the flat pineries of Florida to the roughest and most inaccessible mountain ranges of Idaho or the rugged coast of southern Alaska. The nature of their duties varies from putting out fires and building trails in vast, unbroken, and undeveloped stretches of virgin forest to serving the multifarious needs of urban and industrial centers on national forests adjacent to them.

The clientele of the national forests is as varied as their resources and topography. In some ranger districts the principal concern is the selling and cutting of timber where the demand exceeds the supply and the rate and methods of cutting must be closely controlled. In others present users are chiefly stockmen and the immediate problems are the allotment and efficient use of pasturage. On still other districts the demands of the recreation-seeking public necessarily claim a large share of the forest officers' time and thought. The nine hundred-odd ranger districts in the national forests present almost every conceivable variation in the nature of the resources and the kinds of public needs.

The field officers of the Forest Service must do much of their work apart and alone. The very barriers of distance shut it off from close superintendence or "checking up." The duties of forest supervisors and rangers can not be standardized and directed like those of a group of factory employees. Their districts can not be run by rules out of a book, or through the time-worn procedure of "report and recommendations" to some desk official a hundred or a thousand miles away. They must deal with a bad forest fire or supply the wants of an isolated settler or act upon the request of a logging company or meet any one of a dozen unforeseen contingencies as responsible agents of the Government, qualified and authorized to act on the spot.

The administration of the national forests is one of the most searching tests ever undertaken in public ownership and management of natural resources. Red tape and long-range administration would be fatal. Reliance must rather be placed upon the initiative and self-directed efforts of loyal and capable men to whom specific units are entrusted for administration in accordance with general policies and who are held to responsibility for good performance by competent inspection. Local responsibility in well-trained hands

is the key to success in conserving the resources of the national forests and making them of the maximum public service.

The most important task in national-forest administration is to build up a field personnel which is qualified by the mastery of their jobs and by their training in responsibility to act with dispatch and efficiency on the ground. The demands of the public upon the national forests are constantly expanding, both in volume and variety. The capacity of the field organization of the Forest Service must keep pace with the size and scope of its job. This is partly a matter of legislation and appropriations. More largely, however, it is a matter of selecting and training field personnel and of bringing out and utilizing the best which men have in them, under the driving power of responsibility.

One of the major efforts of the service is to put into full effect a plan of personnel management which will accomplish these results. Its chief features are:

1. The careful selection and systematic training of forest guards, the temporary summer force from which qualified rangers can largely be recruited. As far as practicable the guards selected for summer work on each national forest are given at least three days of intensive training, under experienced rangers, in the technique of forest-fire detection and suppression.

2. Raising the qualifications of permanent rangers in education and experience and bettering such qualifications, after men enter the permanent ranks of the service, by every possible form of training in the duties to be performed. This includes winter correspondence courses in such subjects as forestry, range management, fire protection, and national-forest aims and policies, together with group conferences of rangers and supervisors, and training camps for the intensive instruction of limited numbers of men under the best experts in the service.

3. Increasing the force of technically trained foresters and grazing experts to the fullest extent consistent with other financial demands.

4. Requiring each ranger and forest supervisor to plan his work ahead, each year, with a view to economy in the use of time and its expenditure upon the most important tasks in sight. The annual work plan for each administrative unit can not be an inflexible or cut-and-dried affair, conforming to uniform and prescribed rules. It is a weighing and listing of the jobs to be put through each season, in the order of their urgency, by the officer immediately responsible for getting them done, with the guidance and oversight of his superior. Each work plan covers the specific tasks of a specific administrative unit and group of men. No two of them are alike. Each must be adapted to the needs of the local situation. Each must determine the standards of performance in individual duties or undertakings which may be justified in meeting the needs and putting through the work of the unit as a whole. Left largely to their own initiative and responsibility, as our field officers must be, and confronted with more to be done than can be accomplished, systematic planning of the use of time is the best guaranty that the efforts of the organization as a whole will be most fruitful.

5. Making clear to each field officer, grade by grade, the scope of his own responsibility and holding him personally accountable to his superior for making good. The stimulus of personal responsibility with its call for individual resourcefulness and pride in results must

be the driving force. Closely centralized control or routine instructions would at best yield mediocre results. Forest officers must largely direct and organize their own work. They must stand or fall on accomplishment. To the extent that the service can by its policies and traditions make the sense of personal responsibility effective throughout the ranks of the organization, its aggregate capacity will be increased.

6. Directing and "holding up" the work of field officers as far as practicable by personal contact of superior with subordinates on the ground and by personal inspection and instruction on the jobs themselves. Field inspection of the constructive sort is infinitely more effective than paper supervision from a desk; and it is one of the most telling means of training and stimulating the local officers. The organization of the service with a view to more and better inspection is a necessary feature of good personnel management.

It rests primarily with the service itself to build up the quality and capacity of its field personnel along these lines. That task has been aggressively undertaken. But at three points we are dependent in large measure upon action by Congress. The first is financial provision for the training of forest rangers in field instruction camps. The training of these officers must now be carried on by hook or by crook, through incidental means and expedients which fall far short of the mark. Provision should be made for a six or eight weeks' training camp in at least four of the field districts, where every year 30 to 40 rangers can be given expert instruction with special emphasis upon fire detection and suppression. Such training camps can not now be provided without sacrifices in the size of the protective force which are believed to be unwarranted.

A second financial need is to build up the numbers of technically trained experts in forestry and grazing. The service has been short in men of these qualifications ever since the war, whereas the volume of work requiring technical skill is constantly growing and the need of the service for new blood of this kind is greater than ever before. It is of the utmost importance that funds be provided for additional forest and grazing assistants who can be thrown directly into the expert management of timber and forage and who at the same time will develop within the organization the initiative and capacity for responsible assignments which are primary needs.

In the third place, the growth of the field organization and its adaptation to working conditions on the national forests are seriously handicapped by the arbitrary limitations of the statutory salary roll, on which a majority of the supervisors and rangers are carried. These limitations make it impossible to recognize exceptional efficiency, to allow for differences in responsibility and living costs under a wide range of assignments, and otherwise to adjust compensation to an organization of technical and executive workers. A statutory roll of salaries is wholly out of harmony with the character of the services rendered by the field officers on national forests and with the policy of Congress in dealing generally with employees of technical and administrative duties. A change from statutory to lump-sum provision in the case of all supervisors, deputy supervisors, and forest rangers would, without increasing the appropriations for the service, greatly aid our efforts to build up an organization of men capable of rendering a good account to the public.

15485—22——2

NATIONAL FOREST RECEIPTS AND EXPENDITURES.

The income-producing business on the national forests showed remarkable stability in view of the depressed or uncertain conditions in the timber and live-stock industries of the West, which afford the principal markets for national forest products. The abnormally low output of western sawmills which caused a decrease in receipts from timber sales for the preceding year continued until the last quarter of the fiscal year 1922; but for that quarter they exceeded $620,000 and for the entire year they totaled $1,780,347.24 and were almost identical with those of 1921. The receipts for the last quarter were far in excess of those for any preceding quarter in the administration of the national forests except one in 1920, and foreshadow a marked increase in the cut during the ensuing months.

Approximately 22 per cent of the cattle and 53 per cent of the sheep in the 11 Western States are grazed upon national forest ranges during part or all of the year. The grazing business of the forests consequently reflects closely the conditions in the live-stock industry of the West, which has been passing through one of the most severe financial depressions of its history. Many permittees have been forced to sacrifice portions of their breeding herds, and reductions on a few allotments were unavoidable to protect the range from deterioration. In consequence, the total number of stock grazed was about 10 per cent less than in the preceding year. The fees for this use of the national forest ranges will total, according to the best estimate now possible, $2,166,347, as against $2,415,618 for 1921.

The showing of receipts from grazing has been complicated (1) by legislation authorizing the postponement of payments for grazing permits issued during the fiscal year 1921, and (2) by the necessity, in view of the depression in the live-stock industry, of authorizing the payment of fees normally due during the fiscal year 1922 in two installments, the second of which will become payable in December of this year. The cash receipts during the fiscal year amounted to $2,933,930.07, but of this amount $1,948,925.09 represents deferred payments or collections for forage used during the preceding fiscal year. On July 1, 1922, there remained unpaid $77,997.40 in grazing fees due for the season of 1921 and approximately $100,000 due on the first installment for the season of 1922.

The actual receipts from all sources during the past year totaled $5,068,527.42. Grouping all minor uses and settlements under the major resources from which this income was derived, it may be distributed as follows:

From the use of timber	$1,828,191.64
From the use of forage	2,962,971.60
From the use of land, including water-power sites	277,364.18
Total	5,068,527.42

Disregarding dates of payment and assuming that all outstanding obligations will be met by forest users, the income-producing business of the national forests aggregated $4,271,903, as compared with $4,468,940 during the fiscal year 1921.

The expenditures of the Forest Service during the fiscal year are shown in the following table by appropriation items. These do not include expenditures from the appropriations for forest roads, the

purchase of forested lands on the watersheds of navigable streams, and cooperation with States in forest protection, which are covered elsewhere in this report.

Expenditure of Forest Service appropriations.

Protection and administration of the national forests		$5,127,382
Fighting fires which could not be suppressed by the regular protective force [1]		250,000
Classification, survey, and segregation of agricultural land, and accomplishment of authorized land exchanges		75,000
Planting 8,900 acres of nonproducing land, maintenance of nurseries, and experiments in tree planting		120,640
Permanent improvements, such as buildings, bridges, trails, telephone lines, drift fences, and water improvements [2]		400,000
Estimating the amount and fixing the minimum value of timber for sale		62,500
Examination of intensively used ranges with a view to increasing their productivity by more scientific management of stock and forage		37,500
Investigations:		
(*a*) Forest products, including the forest products laboratory at Madison, Wis	$325,000	
(*b*) Silvicultural	85,000	
(*c*) Range and forage plant	35,000	
		445,000
Recording, digesting, and disseminating the results of scientific technical work		31,280
Total		6,549,302

The total expenditures set forth above exceeded those of the preceding fiscal year by $328,480, or 5.3 per cent. Increased expenditures were made as shown below:

For the protection and administration of the national forests, chiefly the employment of additional forest guards during the fire season	$183,740
For estimates of timber and examinations of intensively used ranges	20,000
For investigations, particularly enlarged research in forest products and additional forest experiment stations	136,740
Total	340,480

Expenditures for the classification of agricultural lands and consummation of land exchanges were reduced by $12,000.

THE NATIONAL FOREST PROPERTIES.

At the close of the fiscal year the net area of national forest land was 156,837,282, acres, and the gross area (which includes interior holdings not in Government ownership) was 181,799,997 acres. The net area increased during the year 171,237 acres; the gross area decreased 20,462 acres.

Specific acts of Congress added to the forests 55,753 acres and a presidential proclamation 16,719 acres. In Michigan 11,499 acres passed from State to Federal ownership and were added to the Michigan National Forest by exchange. This was partly offset by a counter transfer to the same State of 8,320 acres, which was eliminated from the forest, and exchange agreements with other States resulted in transfers of title and eliminations totaling 43,675. Eliminations for town-site purposes (chiefly in Alaska) totaled 5,141 acres, and for

[1] An additional emergency appropriation of $341,000 was required for this purpose.
[2] Of this sum, nearly half is required for the maintenance of existing improvements used in the protection and administration of the national forests.

other reasons 21,289. The gross area was further reduced by 34,328 acres through recomputations based on more complete data and new surveys.

Exceptional opportunities were presented for extension of the eastern national forests through purchases under the Weeks law at prices much below the levels of earlier years. To the extent permitted by the available funds, full advantage of the situation was taken. Purchase agreements were approved by the National Forest Reservation Commission covering 242,169 acres at a total cost of $800,584.96. The average price of $3.30 per acre was the lowest in any single year since the initiation of purchases. Actual acquisition of the lands, however, through final transfer of title frequently does not take place until subsequent years. The acquisitions completed last year totaled 137,659.24 acres, with a cost of $839,406.91, or an average of $6.49 per acre. The location of the lands acquired is shown below:

State.	Fiscal year 1922.		Total acreage acquired to July 1, 1922.
	Acreage acquired.	Average cost per acre.	
Alabama	16,135.62	$4.62	63,262.25
Arkansas	16,673.85	4.03	40,050.61
Georgia	10,573.32	6.99	144,667.61
Maine	21.60	7.00	32,164.45
New Hampshire	21,096.66	7.88	404,207.10
North Carolina	21,405.03	9.31	323,110.82
South Carolina	0	0	18,454.26
Tennessee	31,826.33	5.15	245,250.12
Virginia	15,577.78	3.39	365,938.37
West Virginia	4,349.05	3.57	103,459.16
Total	137,659.24	6.49	1,740,564.75

The total cost of all lands purchased has been $9,329,426.80 and the average cost per acre $5.36.

The outstanding feature of the Weeks law work during the year was the formal establishment of the Allegheny purchase unit, embracing 440,000 acres on the upper headwaters of the North Fork of the Allegheny River in Pennsylvania. This unit constitutes the basis of what eventually will be another eastern national forest. Its establishment extends Federal activity in protecting the watersheds of the Ohio River drainage, and is a forward step in the promotion of reforestation and the consequent perpetuation of forest industries in northwestern Pennsylvania.

The new forest is situated at a point where problems both of watershed protection and of forest perpetuation reach a climax. Not far to the south lies Pittsburgh, whose serious flood losses have necessitated unprecedented flood-control measures, involving most elaborate and expensive engineering plans; and below Pittsburgh are other great cities whose losses of life and property due to floods have been sources of national concern. There is scarcely another region in the United States where the perpetuation of timber supplies is more important; for in a radius of 100 miles there are thousands of wood-using plants, representing investments of millions of dollars. The creation of this one 440,000-acre unit will not in it-

self materially reduce flood losses on the Ohio, nor perpetuate the enormous wood-using industries of the region, but it has exceptional importance because Federal participation in the solution of the two outstanding problems, in cooperation with the very effective work of the State itself, will eventually introduce new conditions of forest protection and management throughout the entire region.

The National Forest Reservation Commission, which controls all purchases of land under the Weeks law, has recommended that $2,000,000 be appropriated for the purchase of forest lands during the fiscal year 1924. This would be a return to the scale of expenditures established by the Weeks law itself for the first five years following its passage. With the field organization that effective work necessitates, and in view of the size of some of the forest holdings offered for purchase, $2,000,000 is the least that can be expended with complete efficiency. Its expenditure should add to the national forests 400,000 acres of forest land. Extension of the eastern national forests should not progress at any lesser rate. The original program outlined following the passage of the Weeks law is only about half completed. During the intervening 11 years the area of privately owned forest land in the United States subject to denudation, fire damage, and erosion, conditions the Weeks law was designed to remedy, has expanded enormously, despite the effective work instituted by some of the States. Outside of public domain reservations, there have been brought under public control and protection during this period, by all public agencies combined, a total of approximately 10,000,000 acres of forest land, while the total acreage cut over, and to some extent denuded by fire or damaged by erosion, has jumped from approximately 144,000,000 to 213,000,000 acres. It is essential that purchases by the Government more nearly keep pace with the progress of deforestation. A further reason for accelerating purchases is that the lands may now be bought on more favorable terms than can be expected in the future.

In last year's report special mention was made of the needs of the northern Ozark region of Missouri; the Berkshire Hills region of Massachusetts and Connecticut; the parts of Kentucky drained by the Cumberland and Kentucky Rivers; the Brown County section of Indiana; the Piedmont Plateau of Virginia, North Carolina, and South Carolina; and parts of Texas, Oklahoma, Michigan, Wisconsin, Alabama, West Virginia, Mississippi, and Maryland. The passage of another year and further studies only serve to emphasize more clearly the need for Federal ownership of key areas within such regions.

One of the most significant events in the history of the national forest movement occurred on March 20, 1922, when the President signed the bill authorizing the exchange of privately owned forest lands within any national forest for Government owned land or stumpage within any national forest in the same State. No other forest legislation passed in recent years will have so far-reaching an influence for the betterment and extension of the public forest properties. Under its terms, private owners who can not handle their holdings advantageously either independently of the national forests or under correlated use can offer them in exchange for lands or stumpage of equal value and better located for their purposes;

while the public can obtain lands suitable for permanent forestry without drain upon the Public Treasury.

There is no similarity between the forest exchange act of March 20, 1922, and the notorious lieu selection act of June 4, 1897. The latter conferred on owners of private lands within the national forest boundaries the right to surrender title to the Government and take other lands of equal area, without regard to wide discrepancies in value which almost invariably were grossly unfavorable to the public interest. Acceptance of the exchange by the Government was mandatory, not discretionary, so that there was no way to prevent lieu selections against the public interest. Because of these provisions, the act became an instrumentality of spoliation of public resources to such a degree that its repeal, on February 1, 1905, was a belated correction of a crying scandal. Under the act of March 20, 1922, the authority to make exchanges is vested jointly in the Secretary of Agriculture and the Secretary of the Interior, thus guaranteeing interdepartmental consideration of all proposals. There is absolutely no statutory obligation to approve or even consider exchanges disadvantageous to the public interest. Furthermore, all exchanges are based upon absolute, carefully determined equalities of value, area being purely of secondary consideration. Private acquisition of highly valuable public properties in exchange for lands of little or no market value thus becomes impossible.

The Forest Service, in administering the provisions of the general exchange act, has primarily in view building up the timber-growing resources of the national forests. Increased facility of administration and better protection from fire or other sources of damage are often valuable benefit but do not receive primary consideration. Under no circumstances are exchanges approved for the benefit or convenience of owners of private land, and a positive showing of clear-cut benefit to the public interest is required before any exchange is given serious consideration. The attitude of the Forest Service in approaching and in handling this exchange work has been one of great caution and conservatism. No effort has been made to inaugurate extensive exchanges under the act, but attention has been mainly given to a careful study of the situation on individual forests and to the preparation of detailed plans whereby the exchange work can be directed along the best lines.

The work of classifying the national forests under the act of March 10, 1912, has been completed except in the forests in Alaska, but areas upon which classification was suspended pending the removal of valuable timber resources or lesser areas where new developments in agriculture necessitate further consideration of the existing classification will require reexamination from time to time. A number of cases of the latter class were handled during the year, resulting in the listing and opening to entry of some additional areas of national forest land. Practically all lands of agricultural value the retention of which is not required in the public interest have been opened to entry. Further corrections in the classification will necessarily involve very small parcels of land, useful in most instances only in connection with adjoining lands in private ownership.

Almost all claims initiated under homestead laws other than the act of June 11, 1906, have now been patented or relinquished. The location of mineral claims under the mining laws continues uninter-

ruptedly but the gradual elimination of many of the speculative features of mining has tended to confine mineral entries more strictly to lands of real mineral value. The substitution of prospecting permits and leases in connection with the development of coal, oil, gas, and phosphate has also had beneficial consequences.

PROTECTION.

PROTECTION OF THE NATIONAL FORESTS.

The fires on the national forests in the calendar year 1921 compared with those during the two previous years in number, size, and cause are as follows:

Comparison of fires on national forests, calendar years 1919, 1920, and 1921.

Classes and causes of fires.	Number of fires.			Percentage of total.		
	1919	1920	1921	1919	1920	1921
Class of fire:						
Burns less than 0.25 acre	2,839	3,122	2,947	41.75	51.37	50.37
Burns between 0.25 acre and 10 acres	2,014	1,724	1,606	29.62	28.36	27.45
Burns 10 acres and over	1,947	1,232	1,298	28.63	20.27	22.18
Total	6,800	6,078	5,851	100.00	100.00	100.00
Causes of fires:						
Railroads	701	508	643	10.31	8.36	10.99
Lightning	2,197	3,082	1,451	32.31	50.71	24.80
Incendiarism	339	245	562	4.99	4.03	9.60
Brush burning	360	248	365	5.29	4.08	6.24
Campers	1,466	1,052	1,738	21.56	17.31	29.70
Lumbering	278	211	156	4.09	3.47	2.67
Unknown	1,155	485	674	16.98	7.98	11.52
Miscellaneous	304	247	262	4.47	4.06	4.48
Total	6,800	6,078	5,851	100.00	100.00	100.00

The area burned, damage sustained, and cost of fire fighting for the three years were as follows:

Calendar year.	Total area of national forest land burned over (acres).	Total damage on national forest land burned over.	Total cost of fighting fires (exclusive of time of forest officers).
1919	2,007,034	$4,919,769	$3,039,615
1920	342,193	419,897	911,483
1921	376,208	212,182	532,811

The 1921 fire season was extremely bad in district 3 (Arizona and New Mexico) owing to drought and high winds, and in the central Rocky Mountain and Eastern States it was the most dangerous season in many years. In the other districts it was less difficult than in 1920. District 1 (Montana and northern Idaho) had 1,336 fires, a decrease from 1920 of 380; there were 862 fewer lightning fires, but 482 more man-caused fires. District 6 (Washington and Oregon) had 1,311 fires, and district 5 (California) 1,196. Districts 1, 5, and 6 together had 66 per cent of all the fires, as against 73 per cent in 1920.

The total number of man-caused fires rose from 2,996 to 4,400, and was only 4 per cent less than in 1919, as against 35 per cent less in 1920. The marked increase in fires caused by campers, brush burning, and incendiarism is disturbing. The Forest Service has made every effort possible with its available funds to reduce the number of these unnecessary man-caused fires through educational and law-enforcement work. There is urgent need for additional preventive work, without which the task of protection is in danger of becoming steadily more difficult and costly.

The further reduction of damage and cost of fire fighting from the high mark of 1919 is due partly to the favorable season and partly to the continuous effort to increase the efficiency and numerical strength of the fire-control organization. Under the appropriations for the last fiscal year it was found possible to add 86 guards to the protection organization. This added strength played a part in the reduction of damage and fire fighting costs. The failure to show a smaller area burned than in 1920 is largely due to periods of severe hazard on certain of the eastern forests, where 139,603 acres were burned as against 63,471 in 1920.

The 1922 fire season is not yet over, so that no statistics covering it can be given; and most of it does not fall within the fiscal year covered by this report. It nevertheless requires some mention. In Oregon and Washington it has been the most severe in some years. The usual May and June rains failed, and fires set to clean up slash on private lands burned on into the danger period, with resulting great losses to property and growing timber. The National Forests have not suffered as severely as outside timber lands. The second year of special protection on the area of the great timber "blow down" in and near the Olympic National Forest in Washington has been as successful as was the first, and has cost the public Treasury less because the main improvements necessary are now installed. In view of the extraordinary peril of the situation and the difficulty of the task, this is a distinct achievement.

Outside of the Pacific Northwest the season has so far been somewhat more favorable than 1921, with the exception of a late period of hot "fire weather" and unusual hazard in California. There have been comparatively few lightning fires, and this has meant absence of the "bunching" of fires which has so often proved to be more than the protective force could handle.

Appropriations for the current year made it possible to add 100 men to the fire guard force for the 1922 season. This added force, coupled with the availability of road and trail crews for fire fighting in inaccessible regions, contributed measurably to the effectiveness of the protection given for this year. Nevertheless, the guard force is still inadequate, and provision for 100 additional guards has been included in the estimates for the fiscal year 1924.

COOPERATION INCREASING.

Twenty years ago, in all but a few spots in the United States, forest fires were regarded with indifference if they did not threaten buildings or other valuable improvements; indeed, it was the custom in many regions deliberately to set fire to the woods for any of a number of reasons. The destructive effects of this attitude may be

read in the barren sand wastes of the Lake States, the desolate areas of snags and brush where fires have destroyed the magnificent fir forests of the Northwest, the thinned stands and damaged timber of the pine forests in California, or the virgin forests of the Southwest which have no understory of young timber coming on to take the place of the mature trees as they are cut.

On many of the national forests settlers burned the slash in their clearings without concern lest their fires escape to the surrounding public domain. When such fires escaped, as they often did (and still do occasionally), they were not fought if they threatened merely to devastate publicly owned timberland. Fires were set to keep the woods free of undergrowth which hindered stock grazing and afforded a refuge to marauding animals. Regular burning was believed necessary to keep down ticks and other undesirable insects. Millions of acres were burned to make it easier for hunters to see and follow game, to enable prospectors to detect rock outcrops and small metalliferous deposits more easily, and in the belief that frequent burning increased the growth of forage.

Much educational work remains to be done both in the places where burning the woods is still believed in and to establish the habit of extreme care with fire on the part of the increasing throngs, particularly of nonresidents, who traverse or use the national forests. But a contrast of conditions as they were when the national forests were established and as they are to-day shows that much ground has been gained. There are now few spots on and adjacent to the national forests where local public opinion encourages the setting of fires. The characteristic thing is for farmers, miners, and others to volunteer posthaste when they see or hear of a fire on the national forests. They usually do not need to be called by the ranger.

In Colorado cooperation by permittees and residents on and near the forests has reached the point where settlers are willing to be responsible for the handling of fires on definite areas under view from their ranches or within striking distance. It has become the common thing for ranchers to go immediately to fires and stay as long as needed even when they have to drop haying or other urgent work at their homes. So reliable has this cooperation become that it has been possible to reduce the number of guards employed locally for fire patrol.

In the Trinity National Forest, in northern California, where from Indian days down to the creation of the national forests it had been the custom to "light burn" the forests, the settlers are still fearful that the dense growth of young timber which follows effective fire protection will interfere with their stock growing and mining industries, but they nevertheless cooperate effectively with the forest officers. For a period of several years when money for fire guards was lacking, in one ranger district of 225,000 acres all fire guards were dispensed with except the lookouts and one man at a central point to receive messages from lookouts and arrange over the telephone with settlers to take charge of the fires reported.

The increased cooperation with the Forest Service in California is shown by the following significant tabulation of the number of owners of private land intermingled with national forest holdings

who have entered into cooperative agreements with the Forest Service and paid their pro rata share of the cost of fire control in the ranger districts which include their lands:

Calendar year.	Number of cooperators.
1918	440
1919	493
1920	734
1921	927

In Oregon and Washington public opinion has forced the passage of State laws which require owners of private land to maintain adequate fire control, and cooperation is therefore complete in these States. Within the last 15 years all the larger timberland owners in Oregon, Washington, Idaho, and Montana have formed associations which work in the closest relations with the national forest fire control organization. Where private and national forest lands are intermingled either the Forest Service or the association takes over the whole job of protecting the area and the cost is distributed in proportion to the acreage of each owner. Railroads give varying degrees of cooperation but no longer leave their grant lands without systematic protection, and their efforts to keep fires from starting on the rights of way are steadily becoming more effective.

Fire control on the national forests becomes every year more effective because of the various forms of cooperation obtained. The trouble is that the best cooperation now rendered is not enough. The number of fires due to human agencies must be reduced from its present preposterous size if there is to be any assurance against catastrophic losses in the extremely hazardous fire years which weather cycles are sure to bring. The only way to accomplish this is to engrave the habit of care with fire deeply on the minds of users and visitors on national forests. There is no more reason for the usual man-caused fire on the national forests than there is for the usual grade-crossing accident. It is good business to carry on an educational campaign on the need for and the methods of effective care with fire in the woods.

THE CONTROL OF INSECT INFESTATION.

The danger of serious losses by tree-killing insects and the necessity for prompt action to prevent these losses were forcibly brought out during the year by the situation in southern Oregon and northern California, briefly mentioned in last year's report. An epidemic of bark beetles in this region has caused a loss of valuable pine timber estimated at 1,500,000,000 board feet, worth at least $3,000,000, and endangered 10 times this quantity. The infestation was scattered over an area of 1,280,000 acres, of which about half is in private ownership, a small quantity in State ownership, and the rest owned or controlled by the Federal Government, partly in national forests, partly in Indian reservations, partly in the public domain, and partly in the revested Oregon and California railroad land grants. It was useless for any one owner to attempt to protect his land on account of the danger of reinfestation should the other holdings

fail to be given simultaneous treatment. In recognition of this situation, Congress made available an emergency appropriation of $150,000 for control work on lands owned or controlled by the Federal Government, with provision that it should be spent only if satisfactory cooperation were secured from the owners of other lands in the infestation unit.

The result has been gratifying cooperation between the Department of the Interior, the State of Oregon, the owners of the private land, the Bureau of Entomology, and this service. The technical methods of combating the infestation were worked out by the Bureau of Entomology, which inspected and supervised their application by all of the administrative agencies which had charge of the actual work of felling the trees and killing the insects. Climatic conditions in the spring of 1922 were unfavorable and labor proved to be unexpectedly scarce. The control work, however, covered 69,710 acres, involving felling and peeling and burning the infested bark from 7,079 trees, containing 6,672,490 board feet of timber. About 180 men were employed. The total expenditure was approximately $42,000, of which less than $25,000 is chargeable against the special appropriation. The control work was well started and economically conducted, but must be continued for two or possibly three years longer. Reappropriation of the unexpended balance of the $150,000, which is now available only until December 31, 1922, is urgently needed.

Another insect infestation which has reached large proportions is on the Kaibab National Forest and the Grand Canyon National Park, in northern Arizona. Lack of funds prevented anything being done with this infestation until the spring of 1922, when at a serious sacrifice of other work about $8,000 was expended in an attempt to stop the epidemic, using technical methods recommended by the Bureau of Entomology. In this case work could be conducted later than in southern Oregon and was continued into the fiscal year 1923 in cooperation with the National Park Service, which furnished an additional $1,000 to enable treatment to be given to the portion of the infested area in the national park.

Insect infestations, like forest fires, spread without regard to land ownership. When, as in the case of the southern Oregon infestation, both public and private timber resources are endangered, it is obvious that the Government should be prepared to do its share, since the infestation must be treated as a whole. Furthermore, like forest fires, such epidemics should be treated in their initial stages in order to prevent at the least cost serious losses of valuable timber. The lack of funds for meeting these emergencies is comparable to a lack of funds with which to put out fires while they are small. The Bureau of Entomology has studied the life history of these tree-killing insects and is prepared to furnish advice as to how to hold them in check. It would obviously be desirable to have funds available with which the Secretary, using the knowledge of these experts, could act to protect the timber on any publicly owned forest lands, in cooperation with private owners, States, or other departments of the Federal Government if other than national forest lands are involved.

COOPERATION WITH STATES IN FOREST PROTECTION.

The protection from fire of lands in State and private ownership on the forested watersheds of navigable streams, in cooperation with the States, was extended and made much more effective through the increase in the Federal appropriation from $125,000 to $400,000. The increase was used (1) to establish this cooperative work in two additional States, Ohio and Tennessee; (2) to increase the allotments to various States on the basis of the need of protection for their forests; and (3) to effect a better Federal organization, enabling more frequent and direct contact with State organizations and a closer inspection of the work.

The increased allotments made possible a much more effective organization of the work in many States, and in some instances led directly to the protection, even though often inadequate, of large areas previously without any effective fire-control organization. For example, it led to the extension of the protective activities to a forested area of 4,800,000 acres in the southern and southwestern parts of New York, and to 5,000,000 acres in Maine, which had previously received but slight protection. In Louisiana the additional Federal allotment and the increased State appropriation resulted in an enlargement of the protected area from 8,000,000 to 12,000,000 acres, and in Virginia protection was organized in four additional counties.

The steady growth of this cooperative effort and the meager proportion of the total expenditure borne by the Federal Government is indicated by the following table. It is noteworthy that the increase in Federal funds for 1922 was only about one-third of the increase in State expenditures, and that the area to which protection was extended increased 26,000,000 acres during the year.

Cooperative expenditures for protecting forested watersheds of navigable streams from fire.

Fiscal year.	Federal appropriation.	Number of States cooperating.	Area protected (thousand acres).	Federal expenditure.	State expenditure.	Total expenditure.
1911 and 1912	[1] $200,000	11	61,000	$53,287.53	[2] $350,000.00	$403,287.53
1913		12	68,000	53,247.82	[2] 380,000.00	433,247.82
1914	75,000	17	83,000	79,708.27	[2] 415,000.00	494,708.27
1915	100,000	18	95,000	69,581.75	505,924.70	575,506.45
1916	100,000	20	98,000	90,481.28	408,087.08	498,568.36
1917	100,000	21	103,000	90,580.14	435,328.11	525,908.25
1918	100,000	21	104,000	98,529.75	565,625.24	664,154.99
1919	100,000	22	110,000	99,921.38	625,445.54	725,366.92
1920	100,000	23	129,000	95,107.86	860,919.49	956,027.35
1921	125,000	24	140,000	119,529.83	1,066,027.47	1,185,557.30
1922	400,000	26	166,000	398,899.19	[3] 1,896,920.43	2,295,819.62

[1] Available during period Mar. 1, 1911, to June 30, 1915.
[2] Approximate expenditure.
[3] Includes expenditures by towns and counties.

In addition to these public expenditures, the amounts now expended by private owners for the protection of their forests total approximately $1,000,000 a year. Private outlays for this purpose have been greatly stimulated by the cooperation offered by the Federal Government, and have at least trebled since this work was initiated in 1911.

The increased appropriation made it possible to aid in meeting emergency conditions in several States which had unusually severe

fire seasons. Emergency allotments were made as follows: Maine, $17,600; Vermont, $1,000; Massachusetts, $1,100; Rhode Island, $500; Connecticut, $1,600; New York, $2,900; New Jersey, $1,400; Maryland, $200; and Washington, $1,400. The funds for these allotments were secured from unexpended balances in the allotments to States which had subnormal fire seasons during the summer of 1921, and by other economies. The total allotments to States, including these emergency allotments, were as follows:

Cooperative expenditure in fire protection under the Weeks law, fiscal year 1922.

State.	Federal.	State.	Total.
Maine	$42,150.00	$228,632.24	$270,782.24
New Hampshire	8,787.08	45,526.21	54,313.29
Vermont	4,150.00	11,933.62	16,083.62
Massachusetts	11,450.00	67,316.11	78,766.11
Rhode Island	1,055.09	6,384.59	7,439.68
Connecticut	4,750.00	17,181.11	21,931.11
New York	26,892.84	163,371.19	190,264.03
New Jersey	7,950.00	34,831.57	42,781.57
Pennsylvania	27,500.00	512,190.56	539,690.56
Maryland	3,000.00	6,722.79	9,722.79
Virginia	16,786.55	16,786.55	33,573.10
West Virginia	6,655.58	9,186.19	15,841.77
North Carolina	9,506.91	9,506.92	19,013.83
Tennessee	10,381.58	11,566.84	21,948.42
Louisiana	12,600.00	39,771.88	52,371.88
Texas	10,590.00	14,004.35	24,594.35
Ohio	143.03	679.00	822.03
Michigan	25,000.00	140,367.48	165,367.48
Wisconsin	12,650.86	17,308.23	29,959.09
Minnesota	27,300.00	233,011.47	260,311.47
South Dakota	100.00	7,724.00	7,824.00
Montana	8,746.03	15,480.00	24,226.03
Idaho, north	16,800.00	39,985.95	56,785.95
Idaho, south	3,146.16	8,784.75	11,930.91
Washington	24,900.00	69,034.03	93,934.03
Oregon	27,455.38	107,649.63	135,105.01
California	22,749.98	61,983.17	84,733.15
Administration and inspection	25,792.12		25,792.12
Total	398,899.19	1,896,920.43	2,295,819.62

Unexpended balance, $1,100.81; appropriation, $400,000.

During the last six years the Forest Service has made an attempt to secure nation-wide information on the forest-fire situation. These data indicate that the number of forest fires averaged 33,500 annually. The area of forest land burned was 7,088,000 acres annually, and the immediate property loss was $16,424,000. The number of fires in 1921 was 38,400, which is more than the average, but the area of forest land burned in that year, 4,737,000 acres, was considerably under the average for the 6-year period, though the year was very dry and the fire hazard extreme in some portions of the country. It is significant that in the southeastern group of States—North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi, of which only North Carolina is organized for forest-fire protection—the area of forest land burned in 1921 was 58 per cent of the total in the United States, and the damage to timber was 49 per cent of the total damage in the country.

About half of the forest lands of the country outside of the national forests receive some form of systematic protection. Approximately 166,000,000 acres of privately owned forest land are wholly unprotected from fire, and on many other areas the protection is incomplete and inadequate. There is organized State effort in only 26 out of the 39 States which contain extensive forest areas. A yearly ex-

penditure of $9,263,000 would fairly protect all of the privately owned forest lands in the United States. The combined efforts of the Federal Government, the States, and landowners to-day reach $3,327,000, little more than one-third of the amount needed.

With the present appropriation the Federal Government spends less than a quarter of the amount spent by the States on this fundamental phase of reforestation. It is doubtful whether any form of Federal expenditure is more valuable in assuring a future supply of forest products for the country than this cooperation, with its proven stimulus to increased efforts by States and by private owners. A material increase in the Federal appropriation for this purpose is urgently needed.

NATIONAL FOREST MANAGEMENT.

TIMBER.

The business depression in the lumber industry, noted in last year's report, passed its low point during the fiscal year, and a sharp recovery was in progress at its close. As a result the national forest timber receipts for the year were more than in 1921, and, although the cut for the entire year was smaller than in 1920, the cut for the last quarter of the year exceeded that of the corresponding period in 1920 by 25,000,000 board feet. The broad trend of the national forest timber business in distinction from periodic fluctuations due to temporary conditions is brought out by comparing the cut under sales at 5-year intervals—68,000,000 board feet in 1905, 380,000,000 in 1910, 566,000,000 in 1915, and 806,000,000 in 1920.

This increase is being accelerated by the migration of the lumber industry to the West, which is going on quietly but steadily. Since about 1900, when the cut in the Lake State pineries began to dwindle, the South has been the chief source of lumber for the greater portion of the country. Now this source of supply is failing rapidly, and production in the West is increasing. For the four years 1913–1916 the lumber cut in the South (including the North Carolina pine region) averaged over 18,425,000,000 board feet. For the four years 1917–1920 the average was 15,345,000,000 board feet, a shrinkage of more than 15 per cent. In the West, including the Rocky Mountain region, the average cut for the same periods rose from 8,826,000,000 to 10,522,000,000 board feet, or over 19 per cent. The westward trend of the industry is illustrated by the frequent opening of new mills in the West and by the recent public statement of an officer of one of the largest lumber-producing concerns of the country that it will practically cut out its southern timber in eight years.

This change in regional lumber production means that the timber on the national forests will come into increasing demand. The amount of timber put under contract of sale in the fiscal year 1921, mostly for future cutting, was over 2,100,000,000 board feet—more than in any previous fiscal year, in spite of the business depression. Instead of being undeveloped storage areas, the forests are being opened up by railroads or motor-truck highways and the grown timber put to use. This development must be carried out with foresight to insure the permanency of the use, through permanency of the resource. The cut must be regulated on the basis not only of knowledge as to how much merchantable timber there is and where

it is, but also of knowledge as to the possible growth of timber; for on that growth depends the ability of the industries and wood users to get timber in the future. Definite plans for the control of the rate and place of cutting within logical economic and transportation units are being prepared on the national forests, in order that one of the primary purposes for their creation, "to furnish a continuous supply of timber for the use and necessities of citizens of the United States" (in the words of the basic act of June 4, 1897), may be accomplished. The plans necessitate a careful inventory of the forest and thorough study of its producing power. They are being prepared as fast as available funds will permit, taking first those forests and parts of forests where the call for timber is most pressing.

Meanwhile, applications for new large sales, involving the building of railroads and of new manufacturing plants, are creating demands which strain the resources of the service. The cruising and appraisal of the timber preparatory to sale and the administration of the sales will require more men and money at a rate commensurate with the increase in the business. It was only with great difficulty and at a sacrifice of other urgent work that, near the close of the fiscal year, a body of timber estimated to cut 890,000,000 board feet was cruised and appraised in Oregon in response to an urgent application. This timber is now being advertised, and if one or more bids are received its sale will result in building a new mill, which should be permanent, and a new railroad through an agricultural district adjacent to the forest. In another case, 235,000,000 board feet of timber was sold on the Snoqualmie National Forest in Washington. This timber, together with that on intermingled private lands, will form a 10-year supply for a new permanent mill. The largest sale made during the year was on the Lassen National Forest in California, where nearly a billion feet of timber was placed under a 30-year contract with a cooperative association of fruit growers. This sale and the plan for handling the timber on adjacent forest lands assure these fruit growers a permanent supply of lumber for boxes and other requirements.

It is not only lumber companies that secure timber from the national forests. Nearly 6,000 farmers get it each year at the cost of administering the sales under the provisions of the act of August 10, 1912; fishermen on the coast of Alaska buy fish-trap piling and timbers; the coal mining companies, and the copper producers in Montana, Wyoming, Colorado, New Mexico, and other States buy mine timbers; railroads are supplied with ties, and telephone, telegraph, and power companies with poles; pulp and paper mills get pulpwood; the turpentine distiller buys the right to tap carefully certain kinds of trees for the pitch or "gum" from which turpentine and rosin are produced. Manufacturers of furniture, excelsior, barrels, toothpicks, tennis rackets, crutches, shoe pegs, violins, tannic acid, charcoal, and many other things look to the forests as sources of raw material; even the medicine manufacturers draw on the forests, for they obtain there several thousand pounds of cascara bark a year. Only by careful, consistent management in accordance with well thought out plans can these demands continue to be met indefinitely through having timber grow as fast as it is cut.

As pointed out last year, the opportunity for developing permanent instead of short-lived wood-using industries is especially good in

Alaska, where the cruising of timber and the study of water powers, in anticipation of the certain establishment of a large pulp and paper industry, were continued. One result of this work was the discovery of new valuable water powers available to tidewater.

Timber sold, calendar year ended December 31, 1921.

State.	Board feet.			Value.		
	Commercial sales.	Cost sales.	Total.	Commercial sales.	Cost sales.	Total.
Alabama	21,000		21,000	$106		$106
Alaska	11,955,000		11,955,000	17,477		17,477
Arizona	8,519,000	647,000	9,166,000	15,524	$626	16,150
Arkansas	4,642,000	301,000	4,943,000	21,776	304	22,080
California	732,914,000	2,194,000	735,108,000	2,238,732	1,220	2,239,952
Colorado	19,904,000	1,239,000	21,143,000	54,909	1,207	56,116
Florida	1,581,000		1,581,000	5,986		5,986
Idaho	117,126,000	5,166,000	122,292,000	415,686	4,658	420,344
Michigan		12,000	12,000		9	9
Minnesota	462,000		462,000	4,485		4,485
Montana	88,190,000	5,781,000	93,971,000	299,809	5,101	304,910
Nevada	1,675,000	194,000	1,869,000	2,077	158	2,235
New Hampshire	1,919,000		1,919,000	15,176		15,176
New Mexico	11,663,000	1,387,000	13,050,000	28,726	1,054	29,780
North Carolina	1,977,000		1,977,000	5,948		5,948
Oregon	137,114,000	2,757,000	139,871,000	383,789	1,719	385,508
South Dakota	7,144,000	882,000	8,026,000	19,100	805	19,905
Tennessee	2,974,000	172,000	3,146,000	4,871	172	5,043
Utah	16,659,000	1,389,000	18,048,000	59,051	1,299	60,350
Virginia	3,045,000	10,000	3,055,000	6,789	11	6,800
Washington	49,816,000	500,000	50,316,000	81,563	278	81,841
West Virginia	318,000		318,000	1,324		1,324
Wyoming	33,961,000	781,000	34,742,000	60,559	709	61,268
Total, 1921	1,253,579,000	23,412,000	1,276,991,000	3,743,463	19,330	[1] 3,762,793
Total, fiscal year 1920	1,294,446,000	32,476,000	1,326,922,000	3,026,186	21,559	[2] 3,047,745

[1] In addition, minor products not convertible into board feet were sold, value $5,485.
[2] In addition, minor products not convertible into board feet were sold, value $25,815.

Timber cut under sales, calendar year ended December 31, 1921.

State.	Board feet.			Value.		
	Commercial sales.	Cost sales.	Total.	Commercial sales.	Cost sales.	Total.
Alabama	21,000		21,000	$106		$106
Alaska	14,316,000		14,316,000	23,152		23,152
Arizona	28,030,000	630,000	28,660,000	60,554	$552	61,106
Arkansas	6,723,000	232,000	6,955,000	35,163	230	35,393
California	123,100,000	2,049,000	125,149,000	307,248	1,091	308,339
Colorado	34,411,000	1,463,000	35,874,000	86,469	1,245	87,714
Florida	1,017,000		1,017,000	3,056		3,056
Idaho	81,685,000	3,761,000	85,446,000	262,444	3,115	265,559
Michigan	271,000	12,000	283,000	601	9	610
Minnesota	6,939,000		6,939,000	24,893		24,893
Montana	37,933,000	5,643,000	43,576,000	88,369	4,726	93,095
Nevada	1,304,000	89,000	1,393,000	1,789	76	1,865
New Hampshire	3,341,000		3,341,000	19,167		19,167
New Mexico	23,337,000	1,477,000	24,814,000	45,961	1,013	46,974
North Carolina	10,230,000		10,230,000	29,333		29,333
Oregon	133,776,000	3,278,000	137,054,000	314,350	1,888	316,238
South Dakota	19,695,000	647,000	20,342,000	52,007	432	52,439
Tennessee	8,016,000	196,000	8,212,000	18,242	185	18,427
Utah	9,558,000	1,111,000	10,669,000	24,177	1,003	25,180
Virginia	4,778,000	26,000	4,804,000	14,624	24	14,648
Washington	77,573,000	529,000	78,102,000	135,406	303	135,709
West Virginia	231,000		231,000	939		939
Wyoming	39,906,000	588,000	40,494,000	98,767	471	99,238
Total, 1921	666,191,000	21,731,000	687,922,000	1,646,817	16,363	[1] 1,663,180
Total, fiscal year 1920	783,947,000	22,184,000	806,131,000	1,754,599	15,800	[2] 1,770,399

[1] In addition, minor products not convertible into board feet were cut, value $4,511.
[2] In addition, minor products not convertible into board feet were cut, value $10,381.

Number of timber sales, classified according to amount of sale, calendar year ended December 31, 1921.

State.	$100 or under.			$101 to $500.	$501 to $1,000.	$1,001 to $5,000.	Over $5,000.	Total.
	Commercial.	Cost.	Total.					
Alabama	6	.....	6	.....	.....	.....	.....	6
Alaska	155	.....	155	1	5	2	.....	163
Arizona	747	281	1,028	3	3	3	.....	1,037
Arkansas	30	115	145	4	1	3	1	154
California	615	404	1,019	17	5	16	4	1,061
Colorado	587	278	865	8	3	8	1	885
Florida	21	.....	21	.....	4	1	.....	26
Idaho	758	1,513	2,271	8	5	11	5	2,300
Michigan	.....	3	3	.....	.....	.....	.....	3
Minnesota	8	.....	8	.....	.....	3	.....	11
Montana	683	1,572	2,255	16	7	9	2	2,289
Nebraska	14	.....	14	.....	.....	.....	.....	14
Nevada	103	58	161	.....	.....	.....	.....	161
New Hampshire	111	.....	111	1	.....	.....	1	113
New Mexico	712	575	1,287	4	2	6	.....	1,299
North Carolina	160	.....	160	2	.....	1	.....	163
Oklahoma	31	.....	31	.....	.....	.....	.....	31
Oregon	313	543	856	6	3	3	5	873
South Dakota	379	189	568	4	3	3	.....	578
Tennessee	133	61	194	1	.....	1	.....	196
Utah	440	731	1,171	3	2	1	1	1,178
Virginia	325	9	334	3	1	.....	.....	338
Washington	285	106	391	6	3	10	4	414
West Virginia	17	.....	17	.....	.....	.....	.....	17
Wyoming	187	183	370	6	1	1	2	380
Total, 1921	6,820	6,621	13,441	93	48	82	26	13,690
Total, fiscal year 1920	7,182	5,580	12,762	141	84	174	111	13,272

REFORESTATION.

The records of planting and sowing operations on the national forests are now kept by calendar years instead of by fiscal years, since when these operations are conducted at high altitudes the work is not infrequently in progress on June 30. The figures given in the following table, therefore, include some areas planted during the first six months of 1921 and reported last year with other figures for the fiscal year ending June 30, 1921:

Planting and sowing on national forests by States, calendar year 1921.

State.	Area planted.	Area sown.	Total.	State.	Area planted.	Area sown.	Total.
	Acres.	*Acres.*	*Acres.*		*Acres.*	*Acres.*	*Acres.*
Montana	2,019.40	.....	2,019.40	Wyoming	.....	135.00	135.00
Idaho	1,776.00	.....	1,776.00	Virginia	61.67	.....	61.67
Michigan	1,461.80	.....	1,461.80	Alabama	8.00	.....	8.00
Minnesota	1,332.50	.....	1,332.50	New Hampshire	3.50	.....	3.50
Colorado	853.50	.....	853.50	Arizona	2.00	.....	2.00
Nebraska	431.25	.....	431.25				
Washington	410.00	.....	410.00	Total	8,766.62	135.00	8,901.62
Oregon	407.00	.....	407.00				

The decrease in the cost of labor and the completion of the readjustments in nursery activities caused by the smaller appropriations during the war resulted in a material increase in the area reforested; but until more funds are made available the work can be conducted on only an extremely small scale in comparison with the extent of the job. The total amount of land repeatedly burned over, chiefly before the creation of the forests, which can be restored to productivity only by planting is estimated at, at least, 1,500,000 acres. At the rate at which planting work is now being conducted, it will require between 150 and 200 years to reforest these denuded areas. The work is now largely concentrated in those regions where the greatest success is obtained, such as the productive pine regions of northern Idaho, western Montana, and the Lake States. Even in these regions, however, the scale of operations is necessarily small in comparison with the denuded acreage.

RANGE.

GENERAL CONDITIONS.

Except in Arizona and New Mexico and around the Custer National Forest in Montana, national forest range conditions were exceptionally favorable throughout the West during the grazing season of 1921. Heavy snowfall in the mountains the previous winter, an early spring, and copious rains extending into the early summer months produced a most plentiful supply of forage on the ranges and an abundant hay crop on the ranches. A prolonged drought held on in Arizona and New Mexico until well into the summer, but was finally relieved by heavy rainfall, and at the close of the 1921 season these ranges also were in excellent condition. The Custer National Forest in Montana suffered one of the most severe droughts ever known, which, together with a serious grasshopper infestation, caused a shortage of the beef crop and poor condition of breeding stock to begin the winter. Elsewhere the fall conditions were favorable and most of the stock remained on the forests for the full season.

The winter of 1921–22, however, was one of almost unprecedented severity and duration. The abundant hay crop of the preceding summer was entirely consumed, and many stockmen were compelled to turn their stock on the range in the spring in advance of forage growth. This was so late in starting that in the Northwest and Rocky Mountain region ranges normally in condition to use by the first of May were at the middle of June still snow-covered in many places, and with scant vegetation where the snow had gone. There were heavy losses of breeding stock, and especially of lambs. The loss of sheep was increased by the over age of breeding ewes, a result of depressed market and financial conditions which had prevented flock masters from selling their old ewes and replacing them with younger animals.

USE OF THE RANGE.

The table on the following page shows the number of stock under permit for the calendar year 1921:

Grazing permits issued and number of stock grazed, calendar year 1921.

State.	Cattle, horses, and swine.				Sheep and goats.		
	Permits issued.	Number of stock grazed.			Permits issued.	Number of stock grazed.	
		Cattle.	Horses.	Swine.		Sheep.	Goats.
Alabama	9	190	4	.....	.....	.....	.....
Arizona	1,482	360,038	4,306	492	140	316,447	4,030
Arkansas	203	3,304	25	124	5	12	167
California	2,856	205,132	6,363	1,052	517	557,125	10,691
Colorado	4,344	344,303	8,133	27	734	909,767	1,316
Florida	43	866	3	60	3	659	21
Georgia[1]	.....	.....	.....	.....	.....	.....	.....
Idaho	3,863	162,277	11,801	.....	885	1,374,836	.....
Montana	2,871	157,468	13,599	.....	468	670,751	110
Nebraska	41	6,143	521	.....	.....	.....	.....
Nevada	499	71,807	3,490	.....	132	341,947	.....
New Hampshire	16	166	19	.....	.....	.....	.....
New Mexico	1,914	165,862	3,411	377	563	390,675	27,143
North Carolina	341	1,939	83	137	24	309	.....
Oklahoma	66	3,919	266	.....	.....	.....	.....
Oregon	2,230	154,880	8,567	21	519	727,176	96
South Dakota	781	33,712	2,596	.....	4	4,200	.....
Tennessee	111	873	24	.....	7	136	.....
Utah	6,963	161,518	8,139	162	1,725	766,337	.....
Virginia	271	2,781	6	.....	5	196	.....
Washington	918	27,470	2,396	.....	150	193,891	.....
West Virginia	8	44	.....	1	1	18	.....
Wyoming	1,197	134,988	4,363	.....	332	681,895	.....
Total	31,027	1,999,680	78,115	2,453	6,214	6,936,377	43,574

[1] Cherokee National Forest included in Tennessee.

The change from fiscal to calendar years in reporting number of stock grazed makes it impracticable to compare figures as to number of stock grazed in 1921 with figures for 1920. From such records as are available, however, the total number of stock grazed in the calendar year 1921 was less by approximately 470,000 cattle and horses and 165,000 sheep and goats than for the calendar year 1920, with about the same number of permittees, for the reason that financial considerations compelled owners to dispose of their salable stock and prevented replacement by desirable breeding stock. The demand for range, however, was as keen in 1921 as in any other year. Use of the forest ranges was less because of the necessity of relieving certain overstocked ranges and continuing the preferences of established permittees who were forced to liquidate.

MEASURES NECESSITATED BY FINANCIAL CONDITION OF STOCK INDUSTRY.

Continued deflation and liquidation characterized the year 1921. The situation of cattle producers was particularly acute. Prices remained very low; operating expenses, while somewhat reduced, were still high, and no adequate means of financing the industry was available. Stock had to be sold for whatever it would bring, and the cattlemen were unable to find funds needed for range improvement and for the purchase of bulls to better their herds or to retain young female stock. The depression also prevented the usual and desirable movement of stock from the breeding sections in the Southwest to the ranges and ranches of the Northwest, so that forest

ranges in the Southwest were materially overstocked with cattle for which no market was available, while surplus range existed in the Northwest.

For the sheep industry the outlook by the close of the summer season was exceedingly hopeful. A sudden rise in the lamb market and prospects of good prices for wool turned the disheartening situation of the early part of the year to one of extreme promise. The spring of 1922 proved to be all that could be desired in the way of markets, since wool and sheep of all kinds reached prices higher than before the war.

The general financial situation was materially relieved late in 1921 by extensions of credit from newly formed loan associations and through the reestablishment of the War Finance Corporation. Relief measures were also applied by the Forest Service. In many instances more stock were allowed to remain on the forests than the permanent capacity of the range justified, to avoid forcing the sale of beef at prices which would send the producers into bankruptcy. The usual reduction in the number of stock for which permits are given new owners coming into possession of the stock of permittees through transfers and sales was in many cases waived as a stabilizing measure. Permittees temporarily unable to maintain their preferences because forced liquidation left them without stock were given time to recuperate their losses and secure other stock without forfeiture of the grazing privilege. In recognition of the necessity the stockmen were under to cut down their operating expenses, many minor infractions of the regulations due to inadequate help on the ranges were overlooked and only aggravated cases were prosecuted under the trespass procedure. The lack of efficient help on the ranges, however, increased administrative difficulties materially, caused poor distribution of stock, and in some places resulted in a seriously overgrazed condition of parts of the range.

As explained last year, Congress afforded a further measure of relief through legislation postponing the payment of grazing fees, which are required under the regulations 30 days in advance of the opening of the grazing season.

The following table shows the amount delinquent on December 1, 1921:

District No.	Number of permits, fiscal year 1921.			Delinquent.	
	Cattle and horses.	Sheep and goats.	Total.	Number of permits.	Amount.
1	2,996	539	3,535	271	$13,810.00
2	6,165	1,009	7,174	854	61,270.00
3	3,338	674	4,012	897	153,120.16
4	11,860	3,074	14,934	2,044	91,484.00
5	2,884	504	3,388	82	6,102.13
6	3,307	692	3,999	767	52,400.00
7	1,063	48	1,111	25	1,740.00
Total	31,613	6,540	38,153	4,940	379,926.29

To enable the stockmen to meet the above delinquency they were allowed to submit propositions of settlement and a note payable on or before July 1, 1922, with interest at 6 per cent. The outstanding indebtedness on July 1 was as follows:

District No.	Number of delinquents.	Total amount.	Notes.		No notes.	
			Number.	Amount.	Number.	Amount.
1	38	$3,564.31	33	$2,777.16	5	$787.15
2	102	9,643.30	51	4,118.11	51	5,525.19
3	200	40,329.10	123	33,495.72	77	6,833.38
4	316	19,803.49	206	17,173.90	110	2,629.59
5	8	730.45	2	499.80	6	230.65
6	58	3,926.75	24	2,529.26	34	1,397.49
Total	722	77,997.40	439	60,593.95	283	17,403.45

The conditions confronting the industry in 1922 had not sufficiently improved to warrant collection of the fees at the usual time. The regulations were therefore waived to allow payment to be made in two installments, one half on or before the date of entering the forest, and the other half on or before December 1, 1922.

GOVERNING PURPOSES OF RANGE ADMINISTRATION.

Range administration by the Forest Service aims (1) to bring about the largest possible yield of live-stock products, (2) to promote settlement, and (3) to stabilize the live-stock industry dependent upon use of national forest ranges, on the basis of most efficient production. Realization of these ends requires regulation of use of the range by the stockmen, range improvements, and application of the best methods of range and live-stock management.

POLICY UNDERLYING REGULATION OF USE.

Regulation of use of the range serves all three of the governing purposes. It increases the yield of live-stock products by control of the number and classes of stock allowed on the range, their distribution, and the period of use. It promotes settlement by its system of preferences, which enables the new settler to put stock on the forest ranges through reductions from time to time in the larger herds of established range users. Such reductions, however, are made gradually and will in no case go beyond the limits required for an efficient live-stock business under the specific local conditions existing. Finally, regulation of use helps stabilize the live-stock industry by lessening its hazards.

The open range live-stock industry of the West is one of extreme hazard. To secure permanence and stability of the business the ranges must have a sustained forage-producing capacity and stockmen must intrench themselves with ranch property and equipment to carry them over periods of depression or drought. Careful study has been given to the question how best to adjust the regulations to meet these needs.

FURTHER ADJUSTMENT OF REGULATIONS NEEDED.

Agricultural lands, the public domain, and the national forest ranges are so interrelated that grazing administration of the latter must of necessity take into account the conditions created by the presence of lands of the other two classes. Little difficulty is experienced in adjusting the use of the forest ranges to agricultural development, but the absence of any form of control of the public domain creates a source of embarrassment and affords a prospect of disturbance likely to prove prejudicial both to the live-stock industry and to the public welfare.

On July 1, 1921, there were approximately 189,729,492 acres of unreserved unappropriated public domain, much of which has been largely depleted of vegetation by unregulated use. Much of this range adjoins or is in the vicinity of national forests. As its capacity gradually decreases, with no resultant decrease in numbers of stock, demands on forest range increase, administration becomes more difficult in preventing trespass, operating expenses to the individuals increase, and conflicts between owners result. In a word, the competition for the use of the remaining public domain is becoming so keen that a repetition of range wars and destruction of property can be expected unless legislation is enacted by which the public grazing lands outside the forests can be effectively administered.

It has already been explained that depressed business conditions necessitated leniency in requiring the removal of stock from ranges, the use of which had become in excess of their permanent carrying capacity. The problem involved presented the greatest difficulties in regions where drought increased the demand for range on the forests, lessened the production of forage, and made it impossible for the stockmen, had they been required to cut down the number of animals grazed on the forests, to find range elsewhere. The surplus stock must be removed at the earliest opportunity. This is necessary not only to maintain the productivity of the range but also to stabilize the industry. It is vital to the live-stock industry itself in these regions to have the carrying capacity of national forests fixed with a reasonable margin of security against the frequent years of deficient rainfall, shortage of feed, and consequent heavy losses in the herds of permittees.

In connection with this readjustment of use, the time is opportune to make some changes in the regulations which will aid materially both in financial readjustments and in the stability of further use of the range resource.

The regulations call for payment of grazing fees in advance. Stockmen usually meet operating expenses by borrowing, which involves paying interest until the loans can be repaid from receipts when stock is sold. Where yearlong range is used this may involve paying interest on the amount of the grazing fees for more than a year. All State and county taxes are payable in two installments, and Federal income taxes may be paid on the installment plan. It is believed equitable and advisable to adopt as a permanent policy payment for the use of yearlong ranges in two installments.

The present system of establishing the fee to be charged for the grazing privilege is not conducive to the best interests of the industry. It has not been based on a close scientific determination of the actual

or commercial value of the forage, and stockmen have been unable to know what the fee might be year after year for a definite period. Further, the present fees do not sufficiently recognize differences in the relative value of the individual range units, due to their character and location.

As a necessary step to stabilization and permanency in the live-stock enterprises dependent upon the forests, a careful appraisal of all ranges is now under way and will be completed in 1923. This appraisal is based upon the quality and quantity of the forage; the amount and distribution of water; the character of the topography as it influences the management of stock or increases the probability of loss; the accessibility of the range to transportation, markets, and ranches or adjoining grazing land; the extent to which the range is improved with fences, corrals, pastures, roads, trails, and bridges; and the need for other improvements necessary to its fullest use. Data are also being collected and analyzed on the losses of live stock due to poisonous plants, predatory animals, straying, and other causes, and on operating expenses and the effect of national forest restrictions. All the information thus gathered with regard to conditions on the national forest ranges will be compared with similar information for private lands of known value, and the fee adjusted accordingly.

When the work is completed, and beginning with the grazing season of 1924, permits will be issued to fully qualified owners for not less than a five-year period. Such permits will authorize the grazing of not less than a stated number of live stock, which will be approximated to the number now permitted under established preferences and will be nonreducible during the period except for violation of the terms of the permit or in emergencies for the protection of the range. The primary purpose of such an arrangement is to stabilize the use of national forests by all classes of grazing permittees.

To stabilize further the use of national forest ranges and secure increased production of forage crops, permits will be predicated upon reasonable qualifications as to ownership of ranch property adequate to insure efficient live-stock production under local conditions.

NEED OF RANGE IMPROVEMENTS.

Efficient administration of the national forest ranges is seriously hampered by the lack of range improvements essential to proper, full, and permanent use. Approximately $3,500,000 has been invested on national forest ranges by stockmen. This investment has made possible larger use of the resource, and larger receipts in grazing fees. While the construction of such improvements by stockmen has produced excellent results, the system is not altogether desirable from either the stockman's or the Government's standpoint. Improvements located on Government land under special-use permits do not justify large private investments. Further, the value to the stockman of these investments is considerably diminished by the fact that he may be required to make room for small owners desiring to share the use of the range. Under existing law there is no way by which, if this happens, reimbursement to the stockman who constructed the improvements can be made. The benefits, however, both to the stockmen and to the Government secured from these

improvements prove conclusively the great importance of extending them.

The demand for range now fully equals and in many places overtaxes the capacity of the forests. To provide for increased demand, improve and protect existing ranges, and secure utilization of new areas, a large amount of improvement work must be undertaken by the Government. It is estimated that $3,500,000 will be necessary fully to improve the forest ranges. Projects have already been surveyed, on which construction can be begun immediately, involving an expenditure of over $170,000. These projects consist of boundary fences to prevent trespass, division and drift fences to control more adequately the distribution and movement of stock, water developments, and poisonous plant eradication. Such improvements as these are essential to the most effective range management and to providing for stable occupancy. The entire cost of these improvements will be returned to the Public Treasury in increased grazing receipts alone in about eight years, so that purely from a business standpoint the expenditure will be profitable—a fact which should not be overlooked.

NEED OF IMPROVED METHODS OF MANAGEMENT.

The importance of improved methods of range and live-stock management, through which are obtained both more forage and more and higher-grade live-stock products, is apparent when it is borne in mind that about 53 per cent of all the sheep and 22 per cent of all the cattle in the 11 far Western States are grazed at least a part of the year on the national forests. The need for better methods of range management, whereby the quantity of forage available is increased and its most effective utilization promoted, is heightened by the increasing dependence of the western live-stock industry on the national forests for summer range. Agricultural settlement and the steady decline in carrying capacity of the public domain are destroying the balance between summer and winter feed. To meet the demands of the future the productivity of forest ranges must be raised.

This necessitates a more scientific knowledge of the resource. One of the requirements for developing inproved methods of management is exact knowledge of the character and present condition of all the ranges. This is obtained through a careful range reconnaissance and classification. The object of this work is to obtain and apply accurate knowledge of the carrying capacity of the range, the period during which forage can be used without injury, the class of stock to which the range is best adapted, whether sheep or cattle or both can use it without injury to the vegetation and secure maximum production of meat and wool, and how stock should be handled during different seasons of the year. With this knowledge management plans are developed which provide for deferred and rotation grazing, permitting a part of each range to be reseeded with the most valuable and nutritious species at regular intervals; salting plans, which regulate the distribution of stock on the range at proper seasons; the construction of improvements; and the most beneficial methods of herding.

To carry this work forward at the rate required an enlargement of the technical grazing personnel is essential. The grazing specialist

is to grazing administration what the soil expert is to crop production, and more. He must know the species of vegetation most suitable to each locality and the class of stock which can be most economically produced on dependent range or farm lands; he must know the species of vegetation from which the greatest production of meat and wool can be derived; he must know when a forage crop can be harvested by grazing without injury to its permanency; he must develop methods of management suitable to the locality; and he must be able to work in harmony with stockmen and secure the adoption of such practices as will best meet the needs of both range and ranch property.

The results secured by the Forest Service with a limited number of these men during the past few years have fully demonstrated what can be done to meet the change in economic conditions. Many practical stockmen are beginning to employ this class of men in place of men whose sole qualification is the ability to ride a horse and rope a steer. The change, of course, is gradual, but it is placing range live-stock production on a higher level as a rationally conducted business. Western colleges have recognized the trend of the industry in the West, and are establishing courses in range management. There is urgent need on the national forests for more men trained along this line.

The need for intensive experiments and investigations to obtain additional knowledge in the light of which efficient use of the range can be still more fully brought about is discussed in the section of this report devoted to grazing studies.

RECREATION AND GAME.

Motors and good roads have combined to effect a radical change in the outdoor recreation habits of the American people. Vacation time is now a period of free movement, nomadic enjoyment of widely separated scenes, and of simple living in the open. Rich in scenic beauty and natural charm and offering the primitive attractions of the wilderness, the national forests afford an incomparable field for the indulgence of this wholesome tendency toward rational play and physical improvement. Within their limits travelers by motors, by wagon, on horseback, or on foot, campers, hunters, and fishermen, amateur photographers, mountaineers, berry pickers, naturalists, and everybody else who wishes to come have equal opportunity. Care with fire and cleanliness in camp are the only requirements imposed upon their sojourn.

The wide distribution and extent of the national forests and their proximity to thousands of cities and communities make them natural centers of summer recreation, particularly for the masses of people whose vacation must be inexpensive. Between 5,000,000 and 7,000,000 people visit the forests each year. The discouragement of recreational use of the forests would therefore be a distinct hardship, and failure to develop recreational possibilities would mean withholding a form of public service which, though intangible in value, ranks in social and indeed economic importance with the timber, forage, and water-power values of these properties. Public welfare dictates an aggressive policy of ascertaining, developing, and offering the recreational opportunities in the national forests.

The close relationship between county or municipal welfare and near-by forests is illustrated by the action of counties such as Gila County, Ariz., and Fresno and Mariposa Counties, Calif., and of cities such as Denver, Salt Lake City, Los Angeles, and Butte, whose programs of county or municipal development provide for maintaining county or municipal camps and camp grounds within the national forests. Community projects of this character are often supplemented by corporate and organizational undertakings, exemplified by the plans of copper companies in Arizona to construct summer camps for their employees at cool altitudes within the forests, and of stakes of the Mormon Church to build and maintain forest camps, such as that of the Mutual Dell Community near Salt Lake City, for the use of members of the young men's and young women's societies. And for every project of this character there are thousands of families who turn to the forests yearly to tent on a general camp ground or a secluded spot of their own choosing, or to occupy a summer home constructed under permit from the service.

This growing use means for the national forests new opportunities of service of immeasurable public value. It should be strongly encouraged. The fact that it entails obligations must, however, be recognized. The assemblage of large numbers of people at points of interest creates problems of fire protection, of sanitation, and of supervision that can not be disregarded without serious consequences to the safety of the forests and to public health. Within several States certain specific requirements are made compulsory on private lands to safeguard public health. The Federal Government should not be above such laws, nor can it throw the entire burden of their observance upon counties, municipalities, and private agencies, although a large measure of cooperation is secured from those sources. More liberal appropriations are absolutely necessary to install upon the national forests the sources of pure-water supply, fireplaces, toilets, garbage pits, and other simple facilities required for public health and comfort and reasonable security against fire. The estimate for the fiscal year 1924 of $20,000 for these purposes will amount to an expenditure of less than one-third of 1 cent for each person who uses the national forests for recreation.

The 157,000,000 acres within the national forests, of wide geographical distribution, embrace in part the natural ranges of every species of wild life known to have existed in the continental United States. Of the great wealth of game which at one time abounded in the United States only a comparatively small remnant remains. There is scarcely any species that has not been severely depleted. Any serious attempt to preserve for future generations a part of the abundant wild life with which this country was once generously endowed will depend to a substantial degree upon publicly owned lands, and particularly upon the national forests.

Settlement and intensive cultivation of nonforested lands have operated to make wild life peculiarly a product of forest land and its preservation and perpetuation a major problem of forest management. Only by a thoroughgoing correlation between the industrial uses of the forest and the food and shelter requirements of game animals and birds can the latter be saved from extinction. There is economic justification for such correlation in that game is a forest resource of material importance. Recognition of game as a forest product and

the practicability of its administration by the Federal Government are evidenced by the action of several Eastern States in ceding to the Federal Government the right to regulate the taking of game upon forest land acquired by the Government. Such action has in no way decreased the interest of these States in the game situation, but has strengthened the relationship between the State and Federal agencies.

A sustained and increasing annual yield of game may be permanently secured without impairment of the stock, and depleted areas may be restored either by distribution or by the regulation of or temporary restriction upon hunting. There are many noteworthy examples of possibilities along these lines. One is the beaver, whose introduction and protection have often led to such increases in numbers that reduction through regulated trapping frequently becomes necessary to check serious injury to property. Another is the deer, which under reasonable regulation makes marvelous gains in numbers, with a constant increase in hunting opportunities. The Federal game refuge created in 1906 within the Kaibab National Forest, in northern Arizona, and administered by the Forest Service, affords an excellent example of the capacity of deer to multiply rapidly under protection. The number of deer upon this area is not accurately known, but estimates now range from 10,000 to 30,000 head, despite yearly migrations to adjoining regions. To the motorist traversing this forest, deer are a common sight, frequently outnumbering the domestic cattle observed en route. Comparable results are obtainable with other species and in other regions. Experience conclusively demonstrates that wild life responds quickly to simple and rational forms of management and that reasonable regulation does not reduce, but in the long run markedly increases, the amount of game which may be taken annually. The significance of this is that the national forests, without any impairment of their present purposes, can be made to contribute greatly to the pleasure and profit of the public through more aggressive development of their capacity to produce game animals, birds, and fish. The promotion of healthful, vigorous types of sport would alone justify the effort required. There are also large economic possibilities of food and fur production, which systematically developed would annually contribute toward our national needs millions of dollars' worth of meat and skins.

As a first step in determining the requirements of wild life on the national forests, an effort has been made to secure reliable data on the number and species of game animals. Estimates so far submitted on the more important big-game species indicate that the national forests contain nearly half a million deer of several species, reported as existing on 86 forests. Elk formerly occurred in nearly every State, but the larger number are now confined to national forests and national parks in 14 States. Of a total of 72,000 elk reported in existence in the United States several years ago, a majority find range on the national forests some time during the year. The once large herds of antelope found in all Western States have been almost annihilated, but the 2,400 head now existing on the national forests in 10 States constitute the nucleus of future herds. A total of 13,000 mountain sheep in 11 States, and 10,000 mountain goats in 4 States are reported. A few representatives of many other big game species are still found in widely scattered sections of the national for-

ests, while fur-bearing animals under protection show a remarkable increase in most localities.

As a second step in the development of game management plans, 97 State game refuges, involving approximately 11,000,000 acres, have been established. Supplementing these are 4 Federal refuges, containing approximately 773,925 acres, within the boundaries of the national forests. In addition to these State and Federal refuges, there is an almost equal acreage upon which the grazing of domestic stock has been restricted so as to provide an ample supply of forage for game. All State and Federal game refuges are natural breeding grounds, and since all hunting on them is forbidden by State or Federal law, adjacent territory is being restocked by the overflow from these refuges.

To promote better cooperation and organization in game protection, informal agreements have been entered into with State game officers in most of the national forest States. These agreements provide for the appointment of qualified forest officers as deputy State game wardens. They also provide for the presentation of annual reports to the governor or the State game commission wherein information regarding game conditions is presented in detail, with specific recommendations for changes in game laws or on other matters relating to the welfare of the game. Under this arrangement there is a strict enforcement of the game laws by forest officers, who, in 1921, made 170 arrests for violation of the game laws, with 94 convictions resulting, and who reported to State officials 28 violations, with 13 convictions resulting. The findings and recommendations contained in the annual reports have frequently been used by State officials in recommending or shaping new legislation.

Through the cooperation of the National Park Service, the Biological Survey, and the Montana Fish and Game Commission, the Yellowstone herds of elk were given excellent protection, which, coupled with rather favorable winter conditions, reduced the usual loss to almost a minimum. However, the situation confronting these herds during severe winters continues to be critical and can only be ameliorated by the acquisition of winter-range lands as indicated in the report for 1921.

The many State and local fish and game protective associations are most valuable agencies in the protection and development of the game resources and are the media through which favorable public sentiment toward adequate game protection is most effectively promoted. Their membership includes the naturalist, the game enthusiast, the stockman, and men engaged in business enterprises of all kinds. Many conflicting interests may be effectively reconciled through such organizations. Their extension into all localities can not be too strongly encouraged. As these many small organizations become more closely affiliated with those of national importance the effectiveness of their cooperation greatly increases.

No greater stimulus for recreation can be found than a stream or lake well stocked with game fish; but through increased use many streams once plentifully stocked are becoming depleted. To meet rapidly increasing use and maintain fish production, carefully prepared plans for securing, transporting, and planting fry or fingerlings must be executed. These plans show the species inhabiting the

stream, the quantity and kinds of fish food, the species to which the stream is best adapted, and the number of fry required yearly. Because of the loss usually occurring in transplanting small fry, it is sometimes necessary to establish rearing ponds where the young fry may be fed until they are large enough to be released into mountain streams. These rearing ponds with their thousands of small fish may be seen on many of our national forests. In this connection the periodic closure or alternation in the use of streams frequently is necessary, and is secured through orders by the State game officials.

During the year each national forest district completed plans for the stocking of streams on one or more national forests, and in cooperation with the Bureau of Fisheries and the several State hatcheries real progress was made in stocking streams and lakes in which no fish have hitherto been found, and in replenishing the supply in favorable or accessible streams and lakes frequented by many campers and sportsmen. In Colorado the Forest Service received 4,173,000 trout fry from State hatcheries and 776,000 trout fry from Federal hatcheries, which were successfully planted in streams and lakes within the national forests, the normal loss in transporting being cut by over 25 per cent.

Fish and game management plans are being developed on all forests as fast as funds and personnel will permit. Their objective are: The preservation of adequate spawning and breeding stocks; control of environmental factors inimical to productiveness; and promotion of public sentiment, laws, and organizations necessary to the proper protection and development of wild life. These plans call for a high degree of expert knowledge and study in order that conflicting interests may be properly reconciled. The advice and assistance received from the Biological Survey has contributed materially to their development. The views of the game enthusiast must be harmonized with those of the sportsman, stockman, and lumberman. Each must recognize the problems of the other, and through cooperation assist in the proper management of the resource.

WATER POWER.

During the second year of operation under the Federal water power act of June 10, 1920, 45 applications were received for use of land within or partly within the national forests. The number for the preceding year was 124. The passage of a new law naturally stimulates action to take advantage of it, so that more applications are to be expected the first year than subsequently. Moreover, previous laws offered insufficient tenure to attract investments in water power and therefore tended to retard development, especially where the applicant company had no established market. Construction under earlier laws was restricted in a very considerable measure to extensions of systems already operating. The Federal water power act greatly encouraged new water power development, and a large proportion of the applications received are from new companies.

The tabulation following contains data concerning water power permits or easements granted by the Department of Agriculture under former legislation and in effect on June 30, 1922.

Water-power development and transmission-line rights of way under permit or easement fiscal year 1922.

Class of permits or easements.	Transmission lines only.			Power projects (reservoirs), conduits, and power houses.		
	Number of permits or easements.	Within national forest boundaries.	On national forest land.	Number of permits or easements.	Estimated average output (in horsepower) at minimum discharge.	Total number permits or easements.
		Miles.	*Miles.*			
Permits or easements in force at close of fiscal year:						
Rental—						
Preliminary				1	772	1
Final	151	1,158.60	872.30	87	658,829	238
Free permits or easements	24	156.21	128.64	95	27,338	119
Total	175	1,314.81	1,000.94	183	686,939	358
Construction completed at close of fiscal year:						
Rental permits or easements	151	1,158.60	872.30	74	308,990	225
Free permits or easements	24	156.21	128.64	81	9,934	105
Total	175	1,314.81	1,000.94	155	318,924	330
Construction incomplete at close of fiscal year:						
Rental permits or easements				12	346,210	12
Free permits or easements				13	17,389	13
Total				25	363,599	25
Construction not started at close of fiscal year:						
Rental permits or easements				2	4,401	2
Free permits or easements				1	15	1
Total				3	4,416	3

In the report of last year mention was made of the burden placed upon the Forest Service by the requirement of the Federal water power act that the work of the Federal Power Commission shall be performed largely by the Departments of War, Interior, and Agriculture. Although the volume of work handled by the Forest Service for the Federal Power Commission is far greater than its own water-power business before the commission was created, no provision for meeting the increased cost has been made, and it has been necessary to draw on funds needed for other work. During two years under the Federal water power act 105 applications have been referred to the Forest Service for engineering investigation and report, and at the request of the commission it is supervising and inspecting the operations of 52 permittees or licensees. Although every effort has been made to expedite the work of the Federal Power Commission and nearly every engineer in the Forest Service qualified for water-power examinations has spent a large portion of his time thereon, there were, on June 30, 40 applications upon which report had not been made. During the year 48 cases were reported upon and 36 cases were referred to the Forest Service for engineering examination.

ROADS AND TRAILS.

Road and trail work in the national forests was actively prosecuted and a material advance made toward the transportation system necessary for public travel and for the administration and protection of

the forests. While an immense amount of construction remains to be done and many years will elapse before the system is completed, during the calendar year 1921, 1,104 miles of road and 2,959 miles of trail were constructed or improved, and 3,007 miles of road and 4,294 miles of trail were maintained. These mileages include not only the more important and costly work performed under the supervision of the Bureau of Public Roads, but also the comparatively simple and inexpensive work done directly by the Forest Service. The figures on accomplishments and expenditures follow:

Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds by States.

State.	Calendar year 1921.		Total to Dec. 31, 1921.			Expenditures to Dec. 30, 1921.		
	Roads constructed.	Trails constructed.	Roads constructed.	Trails constructed.	Roads and trails maintained.	Federal.	Cooperative.	Total funds.
	Miles.	*Miles.*	*Miles.*	*Miles.*	*Miles.*			
Alabama					10.0	$733.50		$733.50
Alaska	22.4	17.2	62.6	57.3	37.5	485,096.81	$164,806.16	649,902.97
Arizona	85.2	268.5	295.3	481.1	209.0	845,736.87	648,892.93	1,494,629.80
Arkansas	9.7	28.7	78.9	46.1	227.7	237,129.13	24,184.93	261,314.06
California	79.8	221.5	333.8	619.2	4,030.0	2,298,906.26	679,900.58	2,978,806.84
Colorado	77.9	228.3	331.2	467.6	137.8	1,400,792.50	433,452.81	1,834,245.31
Florida	.2		45.2		42.0	70,291.41	56,600.00	126,891.41
Georgia	7.5	19.8	8.5	32.8	80.0	116,610.95		116,610.95
Idaho	139.6	428.9	711.2	1,010.9	338.9	2,134,207.01	874,705.35	3,008,912.36
Kansas			3.4			2,111.51		2,111.51
Maine				39.0	35.0	6,169.42		6,169.42
Michigan	7.1		40.4			3,263.26	186.95	3,450.21
Minnesota	22.0	29.0	30.4	29.0	78.7	90,778.53	90,905.11	181,703.64
Montana	29.6	29.6	230.7	202.9	316.1	1,312,502.75	362,122.50	1,674,625.25
Nebraska	15.0		23.8		7.0	8,637.32		8,637.32
Nevada	46.8	79.5	217.6	170.0	92.2	177,378.53	93,773.75	271,152.28
New Hampshire	2.0	23.0	5.0	235.0	246.0	19,285.69	220.25	19,505.94
New Mexico	53.8	147.2	229.2	464.7	145.8	820,185.75	179,095.32	999,281.07
North Carolina	14.4	14.5	51.7	45.5	350.6	177,787.71	31,951.17	209,738.88
North Dakota			1.0			65.75		65.75
Oklahoma					20.0	6,230.81	925.00	7,155.81
Oregon	155.5	180.2	734.1	524.0	685.0	1,790,199.16	1,383,813.77	3,174,012.93
Porto Rico				20.0	20.0	3,356.11		3,356.11
South Carolina	5.3		5.3		5.3	47,310.43	11,000.00	58,310.43
South Dakota	23.3	17.6	66.1	20.6	26.9	168,691.53	90,638.93	259,330.46
Tennessee	8.0	13.0	11.7	28.5	211.0	76,258.57	64,559.38	140,817.95
Utah	155.0	106.5	709.5	595.2	173.3	856,841.75	533,001.06	1,389,842.81
Virginia			4.0	50.5	322.0	31,382.73	2,409.91	33,792.64
Washington	58.7	40.0	270.5	314.0	588.0	1,426,246.31	835,696.29	2,261,942.60
West Virginia					141.0	1,319.54		1,319.54
Wyoming	85.6	1,066.0	284.6	1,265.8	167.5	899,302.61	229,051.32	1,038,353.93
Total	1,104.4	2,959.0	4,785.7	6,710.7	8,744.3	15,424,830.21	6,791,893.47	22,216,723.68

Congress has now passed four measures appropriating money for road and trail construction in the national forests. The first of these was contained in the agricultural appropriation act of March 4, 1912, which appropriated 10 per cent of the receipts from the national forests in any State for road and trail construction within the national forests of that State. The provisions of this legislation were well adapted to national forest transportation needs, except that it is frequently necessary to improve roads and trails which are not entirely within the forest boundaries; but it soon became evident that the amount annually made available was far too small to meet the requirements both of the forests and of the local public.

The act of July 11, 1916, therefore, appropriated $10,000,000, at the rate of $1,000,000 annually, for roads and trails within or partly

within the national forests when necessary for the use and development of resources upon which communities within or adjacent to the forests are dependent. The act provided that the expenditures in any forest constitute a liability against 10 per cent of the future receipts from that forest, and it limited the expenditures to 10 per cent of the value of national forest timber and forage within the county or counties where the road is located. Application for aid must be filed by the properly constituted State or county authorities, and cooperation in an equitable amount is a requisite before Federal money can be spent upon a project.

While this fund may legally be used for roads developing forest as well as other resources, there was a great need for roads and trails required primarily for the administration and protection of the national forests. On February 28, 1919, $9,000,000 was appropriated, to be expended in cooperation with the local authorities for roads and trails necessary for the national forests or which were of national importance.

In the meantime the interest in the construction of better roads throughout the Nation had become widespread, and there was a general demand for Federal aid on roads traversing the national forests, which form links in State and county highway systems. The forest road legislation previously enacted did not specify the proportion of the total appropriations which should be expended upon roads constructed primarily for the use of the public. Since the need for these roads was very evident, and since it was found almost impossible to get local cooperation on the roads and trails primarily required for the protection of the forests themselves, a large portion of the total appropriations was expended on the roads of primary importance to public travel and the development of the administrative and utilization road system did not advance as fast as the conditions required.

The action taken by Congress in the Federal highway act of November 1, 1921, meets the requirements of national forest road construction very satisfactorily, and the present legislation will probably answer the needs for many years to come. The outstanding feature of this legislation is a recognition that forest-road funds are required (1) for the administration, protection, and development of the Government's own properties in order that they may not only be safeguarded but also made of maximum service to the public; (2) for aid to the States and counties in the construction of roads which are essential links in the public-highway system. Separate appropriations were made by Congress for these two classes of roads, and while the Secretary of Agriculture is permitted to accept cooperation, financial assistance is not required.

By section 23 of the Federal highway act, $5,000,000 was made immediately available for Forest roads and trails and $10,000,000 was made available on July 1, 1922. The act provides that $2,500,000 of the first appropriation and $3,000,000 of the second, or in other words a total of $5,500,000, shall be used for roads and trails of primary importance for the protection, administration, and utilization of the national forests, or, when necessary, for the use and development of the resources upon which communities within or adjacent to the national forests are dependent. This appropriation has been designated as the forest-development fund. In

accordance with the provisions of the act, it has been apportioned to the several States, Alaska, and Porto Rico according to the relative needs of the various national forests, taking into consideration the existing transportation facilities, value of timber and other resources served, relative fire danger, and comparative difficulties of road and trail construction. Congress designated that the remainder of the total appropriation, $9,500,000, should be used for forest roads of primary importance to the States, counties, or communities within, adjoining, or adjacent to the national forests, and stipulated that it be apportioned to the States and Territories according to the area and value of the national forest land. This appropriation has been designated as the forest-highway fund. The condition of the five respective forest-road appropriations on January 1, 1922, was as follows:

Condition of road appropriations.

Fund.	Total appropriations to December 31, 1921.	Total expenditures.	Unexpended balance.
10 per cent	$3,042,248.40	$2,678,226.43	$364,021.97
Section 8	6,000,000.00	4,515,539.80	1,484,460.20
Federal forest road construction	9,000,000.00	7,611,429.74	1,388,570.26
Forest highway	2,500,000.00		2,500,000.00
Forest development	2,500,000.00		2,500,000.00
Total	23,042,248.40	14,805,195.97	8,237,052.43

The distribution among States of the appropriations available for expenditure prior to July 1, 1922, and of the appropriations which on that date were made available for expenditure is shown in the following tabulation:

Distribution among the States of the total appropriations and of the appropriation for the fiscal year 1923.

State.	10 per cent fund.		Section 8 fund.		Federal forest road construction fund total.
	Fiscal year 1923.	Total.	Fiscal year 1923.	Total.	
Alabama	$70.58	$272.52	[1]	$60.00	$712.37
Alaska	4,574.34	73,958.73	$42,092	327,318.43	189,125.23
Arizona	27,819.50	362,035.78	57,293	420,785.60	455,304.40
Arkansas	3,122.62	50,153.52	10,243	99,942.16	141,288.55
California	62,876.54	480,299.33	127,714	1,029,680.11	1,132,744.01
Colorado	30,344.24	344,552.20	69,894	522,575.07	762,500.61
Florida	2,409.37	16,365.61	[2]	69,092.67	25,247.49
Georgia	629.15	2,667.59	[1]	303.17	119,893.01
Idaho	39,096.47	407,422.36	117,097	814,934.67	1,366,208.87
Kansas		1,977.32			
Maine	112.23	761.62	[1]	169.01	3,604.79
Michigan	21.95	741.34	[2]	15.00	3,000.00
Minnesota	260.47	13,482.12	[2]	613.65	108,136.76
Montana	23,040.05	358,151.52	67,608	530,048.89	748,000.60
Nebraska	404.41	10,080.20	[2]	26.98	
Nevada	5,676.53	89,050.21	18,002	139,440.55	105,250.57
New Hampshire	1,421.00	9,845.80	[1]	181.10	10,681.46
New Mexico	17,990.25	222,075.84	39,055	301,261.61	513,159.72
North Carolina	3,023.58	12,930.46	[1]	59,755.99	185,315.32
North Dakota		156.79		15.00	
Oklahoma	158.87	4,641.60	[2]	49.45	2,570.39
Oregon	44,006.09	375,651.22	122,967	937,315.60	994,458.32
Porto Rico		3.70	[2]	15.00	3,336.11
South Carolina	48.56	304.46	[1]	60.00	47,296.13

[1] Group II. [2] Group I.

Distribution among the States of the total appropriations and of the appropriation for the fiscal year 1923—Continued.

State.	10 per cent fund.		Section 8 fund.		Federal forest road construction fund total.
	Fiscal year 1923.	Total.	Fiscal year 1923.	Total.	
South Dakota	$5,938.43	$67,929.92	$7,819	$58,709.24	$76,910.09
Tennessee	1,373.58	7,231.56	(1)	57,207.39	27,949.75
Utah	15,903.14	215,904.51	39,223	314,259.78	471,583.37
Virginia	2,296.11	11,950.72	(1)	41,120.38	71,844.26
Washington	27,721.45	212,148.76	86,550	674,728.32	707,629.15
West Virginia	242.64	1,478.41	(1)	128.64	2,149.80
Wyoming	17,994.81	187,895.97	47,006	315,370.12	540,026.37
Group I			13,981	13,981.00	
Group II			33,456	33,456.00	
Special fund			100,000	217,379.42	
Equipment and administration expense					184,162.50
Total	338,576.96	[3] 3,542,061.69	1,000,000	7,000,000.00	9,000,000.00

State.	Forest highway fund.		Forest development fund.		Grand total.
	Fiscal year 1923.	Total.	Fiscal year 1923.	Total.	
Alabama	$3,590	$4,880	$3,163	$5,799	$11,723.89
Alaska	711,998	970,271	27,394	50,222	1,610,895.39
Arizona	444,049	598,189	153,121	280,722	2,117,036.78
Arkansas	51,729	70,365	39,585	72,573	434,322.23
California	1,065,108	1,460,871	383,903	703,822	4,807,416.45
Colorado	536,519	717,058	183,469	336,360	2,683,045.88
Florida	18,470	25,118	4,762	8,730	144,493.77
Georgia	9,814	13,355	11,098	20,347	156,565.77
Idaho	818,950	1,097,894	593,812	1,088,656	4,775,115.90
Kansas					1,977.32
Maine	2,029	2,760	2,593	4,754	12,049.42
Michigan	2,695	3,638	3,393	6,220	13,614.34
Minnesota	45,152	60,929	35,793	65,621	248,782.53
Montana	644,792	878,886	313,426	574,615	3,089,702.01
Nebraska	8,141	11,065	6,086	11,159	32,331.18
Nevada	152,632	207,984	30,205	55,377	597,102.33
New Hampshire	25,951	35,294	13,241	24,276	80,278.36
New Mexico	338,619	458,258	119,810	219,652	1,714,407.17
North Carolina	20,486	27,856	25,627	46,984	332,841.77
North Dakota					171.79
Oklahoma	4,150	5,645	4,791	8,764	21,670.44
Oregon	846,360	1,157,109	391,939	718,555	4,203,089.14
Porto Rico	1,069	1,454	2,911	5,344	10,152.81
South Carolina	1,156	1,572	4,747	8,704	57,846.59
South Dakota	57,042	77,553	34,985	64,139	345,241.25
Tennessee	15,136	20,896	12,678	23,243	136,527.70
Utah	273,247	371,776	89,595	164,258	1,537,781.66
Virginia	19,199	26,140	25,369	46,512	197,567.36
Washington	518,263	708,133	328,848	602,889	2,905,528.23
West Virginia	4,453	6,051	7,965	14,602	24,409.85
Wyoming	359,201	479,000	145,691	267,101	1,789,393.46
Group I					13,981.00
Group II					33,456.00
Special fund					217,379.42
Equipment and administration expense					184,162.50
Total	7,000,000	9,500,000	3,000,000	5,500,000	34,542,061.69

[1] Group II.

[3] Includes $161,236.33 deferred grazing fees for fiscal year 1922.

The selection of projects for current construction and the development of the entire forest road system are handled in close cooperation with the Bureau of Public Roads and the highway commissions of the States concerned. All road projects of high standards, requiring technical highway engineering, are surveyed and built under the direction of the Bureau of Public Roads. The trails and inexpensive

low-grade roads are built by the Forest Service, utilizing its field organization of forest supervisors and rangers.

To carry on highway work most efficiently it is necessary that the program be determined at least one year, and preferably two years, prior to the beginning of construction. The program for the 1924 construction season is now under consideration but can not be definitely determined upon until the appropriations for the year are known. Congress has recognized the adaptability of the legislation contained in section 23 of the Federal highway act and has authorized an annual appropriation of $6,500,000 for expenditure under the provisions of that section for the fiscal years 1924 and 1925.

A comprehensive study is now being made of the road needs of the national forests under the two classes of forest roads specified in the Federal highway act. The figures available indicate that to complete the necessary system of forest development roads and trails, 13,560 miles of roads and 37,114 miles of trails must be constructed, at an estimated expenditure of $64,693,000. For the system of forest highways of primary importance to the States, counties, and communities, the rough survey indicates that $107,658,000 must be expended for construction or improvement. If the present current appropriations are continued, it appears possible to complete the development of an adequate road system within the national forests, covering all requirements, in from 20 to 26 years.

MAPS AND SURVEYS.

Accurate maps of the national forests are essential to every activity conducted by the service. For the successful direction of forest-fire detection and suppression it is vitally important that topographic features and improvements such as ranches, telephone lines, roads, trails, and other means of communication and transportation be accurately delineated. Topographic maps are also needed in connection with timber sales and the management of grazing business. The increasing use of the forests for recreation has greatly multiplied the demand for maps by the public.

The foundation essentials for accurate maps are precise, detailed topographic surveys. These surveys are executed by the United States Geological Survey after the Coast and Geodetic Survey has extended the necessary judiciary control. Small fragmentary sections of the forests have from time to time been mapped by the Forest Service in connection with timber sales or other activities which require immediate data. The service cooperates with and assists the Geological Survey in every possible way, including financial aid whenever available, in surveying and mapping the national forests.

At present, of the 181,799,997 acres included within the forest boundaries, 20 per cent is accurately mapped, and 56 per cent has been covered by rough reconnaissance, leaving about 24 per cent upon which no work has been done. This means that surveys are needed upon 80 per cent of the national-forest areas to permit the compilation of accurate and reliable maps.

Ordinarily, maps are printed upon three scales—one-quarter, one-half, and one inch to the mile, depending upon the available and desired detail. All Forest Service men on field work carefully check up errors which appear upon the maps, note corrections which

come to their attention, recommend to the United States Geographic Board names for unnamed topographic features, and currently gather new and more detailed data for inclusion upon the maps. After sufficient information has been secured to warrant a revision, new maps are prepared and published.

RESEARCH.

Forest research is revealing more clearly each year the gigantic outline of our forest problems, and has begun in a small way to unravel the myriad technical puzzles that confront us in the revolution from timber mining to timber growing. Its broad aim is to obtain the knowledge necessary for the best use of our forest land and of what it can be made to grow. This calls for both technical and economic research. The two are complementary. We must know what we shall need to produce; and what we shall need depends on how we utilize the products of our forests. It is impossible to deal with production independently of utilization. Forestry, like agriculture (of which it is a subdivision), must concern itself not merely with the technique of production, but with the business of land management and crop marketing, and the economic requirements and industrial practices that integrally shape that business.

Neither the purpose of the research work of the Forest Service nor its practical importance and necessary scope can be understood without recognition of these facts. A sound national policy of forestry can not reach full fruition until far more is known about how to grow timber under widely varying conditions, what our economic and industrial requirements are, and by what methods of use these requirements can most satisfactorily and with least waste be met. In the course of about 75 years most of our enormous natural wealth in virgin timber has been consumed or converted into other forms of capital. With industrial progress our per capita consumption of timber increased until, a few years ago, advancing prices and depletion of supplies turned the tide. We are still living mainly on our forest capital; and to meet our current needs we are not merely draining the insufficient reservoir of remaining mature timber, but also drawing heavily on growing stock that has not reached sawtimber size. The accident of a sudden crisis less than three years ago sent lumber prices temporarily skyward so fast that public attention was sharply drawn to the situation and an inquiry ordered. The crisis passed, but the inquiry made clear that the Nation had experienced a brief preliminary symptom of the economic stringency which must come as the full consequences of our past and present course work out. The availability of accurate information is essential to every effort in the whole slow process of restoring the balance between timber use and timber growth.

SILVICAL INVESTIGATIONS.

Nowhere is there a greater need for knowledge of timber growing than in the eastern United States, where the relatively dense population, the enormous industrial demands for timber, and the large areas of land best fitted for forests all unite to urge timber production on a large scale. Here, where its results are most certain to be immediately and widely applied, Federal forest research has but

made a beginning. The Southern and the Appalachian Forest Experiment Stations have now been in operation a little more than a year, have organized their staffs, have taken a rapid survey of their fields, and have concentrated their efforts on the problems that are most urgent—such as the amount of loss from forest fires, simple methods of cutting to assure natural reproduction, and studies of the growth and yield of timber, the effects of grazing on forest reproduction, and improved methods of turpentining. These investigations will help in the management of the national forests in the Southeast, but their outstanding significance will be in relation to the vastly larger areas of timberlands in private ownership.

These two stations cover only part of the eastern forests; two other great forest regions, New England and the Lake States, are equally in need of forest experiment stations, and there is a rapidly growing public recognition of this need in both regions. It is the aim of the Forest Service to establish them as soon as the necessary appropriations can be secured.

There has been much discussion in recent years of public regulation of all forest lands. There is urgent need for more exact knowledge than we now have as to what public regulation might fairly and reasonably require and what it might accomplish in growing timber. The Forest Service has undertaken to answer these questions in the main forest types of the country. Going further, this investigation also seeks to establish what might be termed "desirable forestry practice"—that is, the things that must be done not merely to keep forest lands reasonably productive, but to produce good qualities and higher yields of timber. These two projects, nation-wide in scope, aim to deal in a broad way with the immediate questions arising in the reforestation of the 83 per cent of our forest lands in private ownership.

Side by side with this extension of research into new regions and broad problems has come the fruition of intensive investigations in regional forestry problems of great importance. In the Southwest and the Pacific Northwest, for example, 10 years of patient study at the Fort Valley and Wind River Forest Experiment Stations has thrown a flood of light upon the best methods of securing natural reproduction of western yellow pine and Douglas fir. These problems are difficult because of the dry climate and frequent droughts in the Southwest and logging slash conditions in the Northwest, and even their partial solution gives the key to scientific management of these important forest types. Such solutions, reached only through prolonged observations, experiments, and studies demonstrate the importance of permament forest experiment stations.

There is no use in growing timber to be burned; and the Forest Service is paying more and more attention to studying forest fires as well as fighting them. This study is proceeding along a variety of approaches. Where do the most fires occur? How are they caused? What are the weak spots in the prevention organizations? Such studies make possible an increased efficiency in the expenditure of fire-protection funds, public or private, and in the reduction of current fire losses.

Another promising lead is the relation between forest fires and weather. Forest Service investigators are finding a very close relation between the relative humidity of the atmosphere and the fierce-

ness with which forest fires burn. Low humidity means danger, but abundant moisture in the air acts on a fire like a wet blanket. Tests made this season on forest fires in the Pacific Northwest have predicted with surprising accuracy the rising or falling violence of the fires and have made possible increased efficiency of attack. A great difficulty in large-scale fire fighting has come from our inability to recognize dangerous conditions until they have actually arrived and oftentimes brought disaster. The prediction of these oncoming emergencies, even a few hours ahead, will permit more effective mobilizing to meet them.

FOREST PRODUCTS.

If it is folly to grow timber merely to be burnt, it is equal folly to grow it to be wasted by ignorance or indifference. Nowhere in American life is waste more conspicuous than in our forests and forest products. In all the stages of manufacture—the woods, the sawmill, the wood-using factories, the building trades, wherever wood is used—there is waste, appalling in its aggregate. American business has begun to see the vital importance of better methods of manufacturing and using wood; it recognizes that wood saved is equivalent to wood grown; it perceives that high prices and growing scarcity must soon make economy imperative; and it desires to be shown how waste may be curtailed. The work of the Forest Products Laboratory is accomplishing this. In a word, its task is to do by saving what silviculture does by timber-growing.

The year was one of the most successful in the history of the Forest Products Laboratory. The scope of the fundamental research was enlarged, its application increased, cooperative work with industrial agencies extended, and new methods of disseminating results developed. This involved a larger personnel than for any previous year save during the war crisis.

The annual production of lumber and structural timbers for general building purposes reaches a value of nearly a billion dollars, and its most efficient production and utilization present many problems, the study of which goes on year after year. The study of the strength of timbers is a case in point. The object sought is to reduce waste by developing more accurate knowledge of the limits and causes of strength variability, so that less allowance need be made to insure the necessary margin of safety. A series of studies completed during the year show how, with proper selection, higher working stresses and hence smaller timbers of Douglas fir, western yellow pine, and hemlock can be used than in the current practice. An exhaustive piece of research which will extend over four years is under way on large columns of southern pine and Douglas fir; it has already indicated that pieces with more knots than have been allowed can be used and that grading rules for their selection can be improved.

The laboratory is dealing on a comprehensive scale, yet with elaboration and painstaking accuracy, with the whole field of use of wood. Nor is its work confined to finding out how wood can be saved, or better used. A large part of its effort is given to bringing to pass the industrial application of results. Representatives of the laboratory have taken an active part in the movement for standardizing

lumber grades. This reform is a very large task, but if rightly accomplished its value to the country can hardly be overstated.

A few examples will serve to illustrate to what extent the work of the laboratory bears upon the standardization of lumber and other forest products. During the year standard methods of mechanical tests of woods, developed through many years of work, were adopted by a committee representing the American Society for Testing Materials—the first step to its final ratification by the society and ultimately by the American Engineering Standards Committee. A committee appointed by the Secretary of Commerce to develop a general national building code also adopted the laboratory's recommendations having to do with the use of wood in buildings. A safety code for ladders, as developed by the American Engineering Standards Committee, included the laboratory's recommendations for the selection of side rails. Uniform specifications for railroad ties, formulated under the direction of two sponsors appointed by the American Engineering Standards Committee, one being the Forest Service, were tentatively adopted by a committee representing 13 national organizations.

The year marks also the conclusion of an exhaustive research initiated early in the war to determine the kinds of woods and manufacturing conditions necessary to insure efficient airplane propellers. The work has conclusively proved that aside from wearing properties, practically all commercial American woods, whether quarter or slash sawed, can, under proper manufacturing conditions, be satisfactorily used. This knowledge at the time of the war would have saved enormous expenditures for mahogany and walnut. Other results of value in connection not merely with propellers, but with all high-grade glued-wood products, were secured concerning the conditions necessary for the most effective gluing, the methods that afford best results, water-resistant glues, protection coatings to increase the resistance of glues to moisture, and the best methods of joining and splicing laminations. It was found that with proper gluing, forms of joint, and joint construction, a joint strength equal to that of the wood can be secured. All of these matters make for the more economical use of wood.

Continued attention was given to the study of boxes, crates, and fiber containers—a subject of great importance and many ramifications. Its purpose is to enable the commerce of the country to be carried with a minimum of wood consumption and a maximum of service. Approximately 16 per cent of our lumber goes into crates and boxes, while the use of fiber containers is increasing very rapidly. The failure of containers in shipment results in enormous annual losses. The general character of this study and some of its results have been outlined in previous reports. New and valuable information on the causes of weakness and how the requisite strength can be secured with more economical use of material was obtained.

Similarly, the practicability of eliminating waste in wood-using industries due to sawing full-length lumber into pieces of the size and kind desired for manufacture, instead of purchasing such pieces as "dimension stock" from the sawmill, where its production would result in a marked economy of material as well as in lower freight costs, was given much attention and found to promise enormous savings. New and important results were obtained in the study of

kiln-drying methods, and a broad study of air-seasoning methods was initiated.

Microscopic studies indicated that "brashness," at least in spruce and ash, is due to incipient decay rather than to any structural characteristics, and this, if established, may lead to practical methods for its determination and elimination. Improved and cheaper methods of preservative treatment, particularly of Rocky Mountain Douglas fir ties treated with zinc chloride, were sought with success. Studies designed to prolong the life of the naval stores industry in the South through improved methods of turpentining were continued.

Substantial improvement in the chemical products and by-products of wood cellulose are dependent upon a much more exhaustive knowledge of its chemistry than now exists. Research during the year established significant facts which have a direct bearing upon the most effective selection of material for chemical by-products. The possible increase in yields under chemical pulp processes from the 40 to 45 per cent now obtained to the theoretically possible yield of 60 per cent without decided loss in the quality of the pulp depends upon a much more exhaustive knowledge of cellulose chemistry.

Investigations to improve the sulphite process developed a method of analyzing cooking liquor which permits an accurate control of the cooking time and pressure and thereby makes possible the accurate regulation of the cook and the quality of pulp desired. This method is now being tested commercially and should permit a marked improvement in the cooking of sulphite pulp. It has also shown the desirability of using water-saturated chips in the sulphite process—a radical change from the present commercial practice of using air-dried or even kiln-dried chips. Other important progress in pulp and paper investigations includes the completion of comparative pulping tests on approximately 100 commercial American woods; the development of methods for the successful grinding of jack pine for container board, which if commercially applicable will have a wide bearing on the value and future utilization of the enormous quantities of Lake States jack pine; and further work on a method for deinking of news and magazine stock, which has been partially and will be completely tested on a commercial basis.

Investigations in the production of sugar and ethyl alcohol from mill waste and sawdust showed that the yield of convertible sugars should be increased 25 per cent by stronger sulphuric acid, without appreciable increase in expense. Chemical studies of the sugars and cellulose also showed the production of mannose during the hydrolysis of wood cellulose and thereby established a marked chemical difference between cellulose from cotton and from wood, a fact heretofore denied by many authorities. The development of cattle food from hydrolyzed sawdust has progressed satisfactorily, final tests completed during the year with University of Wisconsin experts having shown that this material can be fed dairy cattle with good results to the extent of one-third of the normal concentrated food. Continued research for a higher yield of wood alcohol in the destructive distillation of hardwoods disclosed that sodium carbonate is by far the most effective of over 30 catalyzers, and gives a largely increased product. Efforts will be made during the coming year to determine its commercial applicability.

With the increasing volume of valuable information from research particular attention was directed during the year to its more effective dissemination and application. The short instructional courses in kiln drying, boxing, and crating given to industrial representatives were expanded. In order to place kiln drying results more effectively before western lumber manufacturers several members of the staff devoted over five months to kiln courses in the West. The success which marked this work indicates the desirability of further expansion of extension activities along these lines.

The publication of results is the most important means of dissemination and one which is being expanded. Never during any month of the past year did articles on the laboratory work appear in less, and in some months many more, than 100 technical, trade, and popular magazines. Each of a number of brief articles summarizing the most widely usable facts obtained from research received a wide circulation through the press at large.

FOREST ECONOMICS.

The pressure of population on natural resources is perennial. As never before the world is taking stock of what it has and what it needs. Not the least indispensable of these things is wood, and to take stock of how much wood we have and what we shall need is an important step in determining our future attitude toward our forests.

As a background to this broad inquiry, Forest Service investigators have recently completed a unique and exhaustive compilation of the forest resources of the world. Not the least startling of its revelations is that so far as our great structural and all-purpose woods—the softwoods—are concerned, we must become self-sufficient or go without. There is an immense reservoir of hardwoods in the Tropics, hardwoods which can be used for limited and special purposes and secured at mahogany prices. But the struggle for the world's supply of softwoods will become more and more intense, and those nations will fare best that prudently use their suitable waste lands for growing coniferous woods. This study rudely shatters the dream of those who rely on importing the timber we need when our own is gone.

Nor is the situation hopeful when we turn to our own forests. There has been a marked and fairly steady decline in our national output of lumber from about 46,000,000,000 board feet in 1906 to less than 34,000,000,000 board feet in 1920. This downward trend, which seems unlikely to turn permanently upward again at any time that can now be foreseen has taken place in spite of a large increase in population, with its increasing demand for housing, furniture, and wood in many other forms. The decline in the production of lumber and the increase in population have resulted in a striking drop in the per capita consumption of lumber—from over 500 board feet per person in 1906 to about 320 board feet in 1920.

Unquestionably among a people who have largely depended on wood for so many of the essentials of industry and daily living, as well as for the comforts and luxuries of an expanding civilization, this decline in the consumption of wood means a decline in the standards of living. Of this declining standard the shortage of housing is an impressive example.

The shortage of lumber, with its corollary of high prices, has followed the westward sweep of lumbering, while the bulk of our population and the greatest demands for lumber remain in the Central and Eastern States. The Nation's lumber shipment in 1920, a recent Forest Service study shows, was no less than 2,070,000 carloads; and the average haul for each carload was 485 miles. According to the best estimate the Forest Service is able to make, the freight bill on lumber for that year was $275,000,000. This gigantic sum merely gives one measure of the cost of treating our forests as mines instead of timber farms. A fraction of this sum wisely invested each year in forest protection and rehabilitation would grow timber where it is needed, reduce the Nation's freight bill, cheapen lumber, and release vast amounts of railroad equipment and labor for unavoidable transport. Coal and iron can not be grown, but timber can be.

These are some of the broad-scale effects of forest depletion. To trace its effects more minutely in one typical region, the branch of research is conducting a study of the economic effects of forest devastation in one State. What does forest destruction do to population, to agriculture, to labor, to the lumbering industry, to the wood-using industries, to the general economic and social life of the community? Here, in one cross section of American life, answers to these questions will be sought in order to strike a balance sheet between forest devastation and forest conservation.

On a nation-wide scale also, though less intensively, the research corps is tracing out the effects of timber mining as opposed to timber growing. This study will attempt not merely to set forth the historical, economic, and social consequences of timber mining, but to make a census of our total progress in forestry up to the present time. This, it is hoped, will be a useful contribution to the general study of the use of land now being made by the Department of Agriculture. In its larger aspects forestry is not merely a land problem, but an agricultural problem. Not only should lands best suited to forests be used for forests, but these forests should be intensively managed as farms are intensively managed. For a stable and prosperous agriculture in many older regions of the East, the forested hills and the cultivated valleys must be handled with equal skill; they are indispensable one to the other. Luckless attempts to convert good forests into poor farms are fortunately on the wane.

Unfortunately financial limitations do not permit a stock-taking of our forests on an adequate scale. Yet these studies point the way and show the urgency of a nation-wide timber survey, a project the Forest Service has strongly urged in recent years and again repeats.

GRAZING STUDIES.

Efficient use of range land is dependent upon intensive investigations. The results so far secured in the administration of national forest ranges are partially attributable to the investigations conducted at the Great Basin Experiment Station in Utah and at the Jornada and Santa Rita range reserves in New Mexico and Arizona. As these experiments are extended and perfected, the need for more knowledge of the effect of grazing on the life of valuable forage plants becomes

apparent. While in the nature of the case a long interval must elapse before the results of investigations are fully available for use, they are applicable to both private and Government land, and are becoming an essential part of the everyday grazing practice.

Intensive reconnaissance or stock taking by grazing specialists during the year covered a total of 1,024,921 acres on the Beaverhead, Montezuma, Carson, Santa Fe, Fillmore, and Wasatch National Forests. In addition, 573,101 acres were covered by local forest officers. Reconnaissance of national forest ranges is now progressing at the rate of less than 2,000,000 acres a year. It should be largely expanded, since it is the essential basis, the inventory of forest resources, upon which all betterments in grazing management depend.

The trained grazing experts in the Forest Service have proved invaluable not only in conducting range reconnaissance and preparing grazing management plans for national forests, but particularly in bringing the current use of the range into line with the new requirements. A much larger number of technically trained grazing men is needed to get the improved methods of range management developed by research into effect on the national forest ranges.

Artificial reseeding was studied principally at the Great Basin station and the Jornada Range Reserve. At the Great Basin station it was found that introduced species, such as timothy and redtop, do not produce viable seed at 8,000 feet elevation or above, so that the planted stands disappear and reseeding becomes necessary at intervals of five to seven years. The sod-forming grasses, such as Hungarian brome, Canadian blue grass, and others, spreading as they do by underground shoots, will increase naturally from an original seeding. The evidence points to the undesirability of using seed-dependent plants as against the true sod formers in artificial reseeding of the range. Artificial reseeding has in no way shown itself as a substitute for range management that will secure natural revegetation except on especially suitable sites where there is little hope for the restoration of native vegetation in the near future.

Natural revegetation studies were continued at the Great Basin station and at the two range reserves. On several forests in each of the districts areas protected by inclosures have been established to enable administrative officers and stockmen to see by comparison how use of the range as currently practiced is affecting the vegetation. These plots are of material importance in determining the need for improving the forage production and in convincing stockmen of the necessity for methods of management that will permit revegetation.

Critical studies of the effect of time and frequency of cropping upon vegetation were continued at the Great Basin Experiment Station. The results so far obtained indicate that too early grazing is the leading factor responsible for the present run-down condition of many ranges, but that if grazing is deferred until the main forage plants have reached a height of 6 inches, there will be little or no injury from this source if the land is not too heavily grazed. Observations were made on many forests to determine where grazing of the various parts of the range should begin, and management methods were devised to control the movement of cattle to conform with the various seasonal and altitudinal zones, by proper salting, herding, and fencing. Postponed opening of the season compels range users to hold stock on the winter

range or feed them longer; but the evident benefit to the forest ranges of postponement has made stockmen willing for the most part to make the adjustments necessary.

The collection of range plants and the study of their distribution, forage value, and life history was given considerable impetus by the general range appraisal which has been undertaken. Original identifications were made of 2,801 specimens by the Bureau of Plant Industry in 1921. The collection now contains about 43,500 specimens, of 5,168 species and 110 varieties, belonging to over 1,000 genera.

The study of the effect of grazing on erosion on alpine lands emphasized the necessity for preventing any grazing practice which causes destruction of cover, or the retarding of a permanent, dense vegetation. Where erosion has already begun, the planting of sweet sage, violet wheat grass, and mountain and smooth brome grasses has been found a promising measure for checking it, but the treatment necessary is justified only on watersheds of special importance for furnishing water for municipal or similar purposes.

The study to determine the effect of burning dense brush areas in California on their value for grazing was concluded. It has shown that after a temporary increase in the carrying capacity of the range, due to an increase in herbaceous vegetation and in tender browse sprouts, the brush crowds out the herbaceous plants and the sprouts become too woody to be browsed. The danger of fire spreading from brush areas to valuable timber stands, the cost of burning, and the short duration of its good effect argue against this practice.

Drought conditions in the Southwest, coupled with the difficult financial situation, handicapped the investigation of methods of handling stock on the Jornada Range Reserve. Nevertheless, the methods being tried out showed their superiority over those commonly used in the Southwest. On both the Jornada and the Santa Rita Range Reserves losses last year were much less and calf crops larger than on adjoining similar range. To make the Jornada investigations fully effective in securing results of great importance to stock growers in dry regions, provision should be made for the purchase of a herd of cattle sufficient in size to meet the need of the experiment. Such a purchase would permit cooperation between the Forest Service and the Bureau of Animal Industry in determining in connection with the use of range land the breeds and methods of management best fitted to the requirements of the most important breeding section of the West, the age at which stock can most profitably be disposed of, and many kindred problems essential to the betterment of the industry. A salting study under way in New Mexico and Arizona will determine whether cattle can be salted advantageously away from water in a dry climate.

Determination of grazing capacity is one of the most important and complicated problems in range management. It involves more or less study of each individual range because of differences in the natural forage cover, factors affecting its use, and climate. The recurring droughts in the Southwest emphasize the need for taking the factor of drought into consideration in determining the carrying capacity of ranges.

The practicability of eradicating tall larkspur by grubbing has been fully established, and all that remains is to prosecute this work on larkspur-infested ranges wherever funds can be secured. No

Government funds were available for this purpose, but stockmen did considerable grubbing of forest ranges at their own expense. The Government should undertake a large number of projects, in the interest of increased grazing receipts and decreased fire hazard, on areas now ungrazed. Eradication of water hemlock by grubbing was tried out on several areas in the Northwest with fair success and saving of live stock. Grubbing of loco in the Southwest gave only indifferent results. The original stand was usually eradicated, but the plants are prolific seeders and seeds appear to lie dormant for one or more years, so that reinfestations occur with the recurrence of favorable growing conditions.

Valuable data were collected on watering places on various ranges in the Southwest. The object was to obtain a basis for a water-development policy. Efficient watering is one of the major problems of range use in the desert regions. This was especially manifest during the drought in the Southwest the past year, when many stock died because of the long distances they had to travel to water when they were in poor condition and feed was short. Severe depletion of the range around watering places also took place.

Studies were started on the Tonto Forest in Arizona and on the Dixie-Sevier Forest in Utah to work out the proper management for browse range. The studies have shown that the degree of grazing necessary to secure full use of the browse is detrimental to the herbaceous vegetation and increases erosion.

A study to determine the best grazing management for the vast areas of logged-over lands west of the Cascades in the Northwest was started. Its object is to formulate a grazing practice which will insure for logged-over lands in that region adequate reforestation, reduction of fire hazard, and profitable returns from grazing. It is believed that another stand of timber and a reduction of the fire hazard can be obtained, together with cash returns to help pay carrying charges, provided use for grazing and for timber production are properly harmonized.

INFORMATIONAL AND EDUCATIONAL ACTIVITIES.

Increased attention was given by forest officers to methods of securing the cooperation of the public in fire control, and particularly in fire prevention through the exercise of habitual care in the woods. The reduction of fire loss and expenditures for protection is a problem affecting human conduct. Passive approval by the public of the idea of protecting forests against fire is far from being enough. Carelessness with fire is primarily a matter of personal habits, and to change the habits of a large number of people so that they will not merely agree that fires are undesirable, but actually govern their conduct in accordance with a conviction of a public duty in the matter is not an easy or simple task. In the language of the street, it is the task of "selling" forest protection to the American public.

In so far as the local public in and about the national forests is concerned, to a very large measure this task has already been accomplished. The extent to which a sense of personal responsibility in the use of fire in the open has taken hold of communities in these regions is really surprising. It is partly the result of appreciation of the actual benefits of the forests as contributors to individual and local

welfare. It is, of course, also partly the educational effect on public sentiment of the mere organization of protective activities by the Government—of the fact that fires are fought—not allowed to run their course as though they were a part of the natural order of things. But it is also, and in large measure, the result of conscientious educational effort directed at the evil of man-caused fires and seeking to strike at the root of that evil by, first, making men unwilling to cause fires, and, secondly, showing them what they should do or not do in order to avoid causing fires.

There is still much more that needs to be done even among the residents within and near the forests. Community education to the habitual and thorough-going practice of fire prevention requires constant reiteration of the lesson to be inculcated, and constant study of new ways to bring it home. This is being sought. Forest officers are encouraged and expected to give thought and time to it as a part of their official duty. Not only through personal influence exerted in their daily contact with forest users and their fellow citizens but through public talks, when occasion offers, before civic bodies, commercial organizations, social clubs, schools, and similar gatherings, through the press, through participation in and encouragement of forest-protection week, through effective use of posters and other educational material furnished them for distribution, and through ingenuity in devising new methods of arousing the interest of the public in the subject of fire prevention and what it requires of the individual, they are actively spreading the gospel of forest protection.

But there is urgent need for a much broader work of public education against forest fires. As facilities for travel into and through the forests are multiplied and as resort to the forests for recreational purposes increases by leaps and bounds, it is necessary to find ways of inculcating habits of care and a realization of the importance of preserving the forests on a very broad scale. A large part of the danger to the national forests from man-caused fires is due to the seasonal influx of tourists, campers, hunters, and fishermen, and other visitors from the cities and from distant parts of the country. A national campaign of public education on the subject of forest fires is demanded if the task of protection of the vast area of the national forests, from Maine and Florida to California and Washington, is to be successfully performed.

There is a greater reason for conducting such a campaign with vigor and effectiveness. The interests of the public in forestry are not confined to the perpetuation of forest growth and the saving from fire of the present growth of timber on the national forests. All forest lands, whether publicly or privately owned, must be protected if the needs of the Nation are to be met. They can not effectively be protected without the general cooperation of the public to prevent fires as well as specific provision for detecting and suppressing fires as an organized activity.

Even this is not all. The people of the United States are becoming alive to the need for forestry, but they are far from realizing what it actually calls for. Forestry is with us largely a governmental activity alone, an educational development working downward from the top, not a common possession of the rural population. It needs to become ingrained in the lives and habits and modes of thinking

of the people—to become, as it is with the French people, almost instinctive. It needs to become a part of our farm lore, on the same footing as the growing of corn or potatoes or wheat or the care of orchards and live stock. We are so far from this that in many parts of the country intelligent people still regard forestry as synonymous with tree planting, and suppose that the way to go about it is by requiring that whenever a tree is cut down another should be put in its place. Under such conditions the right use of forests generally is hopeless.

To promote the diffusion of knowledge of forestry generally, as well as to secure the best results in the efforts of all parts of the Forest Service to bring about better protection of the national forests, the branch of public relations was created a little more than two years ago. Its work includes informational and educational activities in the Washington office, including the preparation of news material, exhibit and motion-picture plans, and cooperation with educational agencies of many kinds. It includes also the conduct of similar activities in all the district offices and by forest officers on the national forests. While it has obtained important results it has not begun to take full advantage of the numberless opportunities to advance forestry throughout the country through the work of public education. It is not engaged in propaganda to build up support for the Forest Service as an organization or for specific policies or measures concerning the advisability of which there may be question, but exists for the diffusion of knowledge without which enlightened action is impossible. Its work should be largely extended.

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