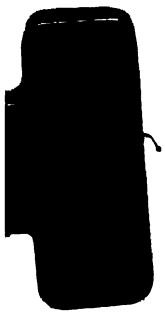
Bulletin

North Carolina Geological and Economic Survey



THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

BULLETIN No. 23

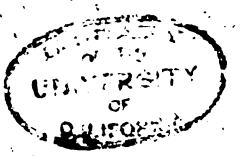
Forest Conditions in Western North Carolina

BY

J. S. HOLMES

Forester, North Carolina Geological and Economic Survey, and Forest Examiner, U. S. Forest Service

In Co-operation with the
Forest Service, United States Department of Agriculture
HENRY S. GRAVES, Forester



RALEIGH
EDWARDS & BROUGHTON PRINTING COMPANY, STATE PRINTERS
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LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., October 1, 1911.

To His Excellency, HON. W. W. KITCHIN,
Governor of North Carolina.

SIR: One of the objects of the North Carolina Geological and Economic Survey is the investigation of the forests of the State. During the past two years the Survey has made a study of forest conditions in about thirty counties of the State, and in the present report there is given the result of the investigation of the forest conditions in Western North Carolina. The study upon which this report is based was undertaken by the Survey in connection with the Forest Service of the United States Department of Agriculture, the work being done under the direction of the office of State Coöperation in the Forest Service and under the local instruction of the State Geologist. By the terms of the coöperative agreement, the Survey is authorized to publish the findings of the investigation, and I herewith submit this report for publication as Bulletin No. 23 of the reports of the North Carolina Geological and Economic Survey.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

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PREFACE.

The act of the North Carolina General Assembly of 1905 creating the North Carolina Geological and Economic Survey defines as one of the principal objects of the Survey "the examination and classification of * * * the forests * * * of the State with special reference to their bearing on the occupations of the people." This same act authorizes "the State Geologist to arrange for and accept such aid and coöperation from the several United States Government Bureaus as may assist in carrying out the provisions of this chapter."

In accordance with these provisions, in the summer of 1909 the State Geologist made arrangements with the Forest Service of the United States Department of Agriculture for a coöperative study of the forest conditions of North Carolina. The mountain region naturally called for first attention in a study of this kind, because of its large proportion of forest land and because of the tremendous present and future importance of its forests to the people of that region and to the State as a whole. The value of the forests extends also to neighboring States, through which the streams rising in these mountains flow, and even to those farther off, that depend on the Southern Appalachian region for their supply of hardwoods. A very large proportion of this area consists of absolute forest land, and, in the future, when the greater part of the more level land to the east will be cleared and used for agriculture, these mountainsides will be called upon to furnish the hardwood timber needed to supply the varied industries of the State.

The results of former investigations are embodied in various State and Federal reports*, but this one takes up a new phase of this subject,

*North Carolina Geological Survey Bulletin 6, Forests and Forest Trees of North Carolina.
Sen. Doc. 84. Message of the President of the United States Transmitting a Report of the Secretary of Agriculture in relation to the Forests, Rivers, and Mountains of the Southern Appalachian Region. Published 1902.
Professional Paper No. 37, Geological Survey. The Southern Appalachian Forests. H. B. Ayres and W. W. Ashe. Published 1905.
Professional Paper No. 72, Geological Survey. Denudation and Erosion in the Southern Appalachian Region and the Monongahela Basin. Leonidas C. Glenn. Published 1911.
Sen. Doc. 91. Report of the Secretary of Agriculture on the Southern Appalachian and White Mountain watersheds. Published 1906.
Circular 105, Forest Service. White Oak in the Southern Appalachians. W. B. Greeley and W. W. Ashe. Published July 25, 1907.
Circular 116, Forest Service. The Waning Hardwood Supply and the Appalachian Forests. William L. Hall. Published September 24, 1907.
Circular 118, Forest Service. Management of Second Growth in the Southern Appalachians. Raphael Zon. Published December 16, 1907.
Circular 135, Forest Service. Chestnut Oak in the Southern Appalachians. H. D. Foster and W. W. Ashe. Published August 31, 1908.
Circular 143, Forest Service. The relation of the Southern Appalachian Mountains to Inland Water Navigation. M. O. Leighton and A. H. Horton. Published March 7, 1908.
Circular 144, Forest Service. The Relation of the Southern Appalachian Mountains to the Development of Water Power. M. O. Leighton, M. R. Hall, and R. H. Bolster Published March 20, 1908.
Department of Agriculture Yearbook Extract 214. Practical Forestry in the Southern Appalachians. Overton W. Price. Reprint from Yearbook of 1900.

and treats of the present condition of the forest and of forest industries, with their economic relation to the people of the region and to the State as a whole. It is primarily for the owners of forest land to furnish them with information as to the proper management of their forest holdings.

The study upon which this report is based was made in the summer of 1909 by J. S. Holmes, Forester to the North Carolina Geological and Economic Survey, assisted by Messrs. W. B. Willey and A. W. Williamson, Forest Assistants in the United States Forest Service. The cost of the investigation was borne equally by the State and Federal Governments.

Further reports along the same lines will be published as the results of examinations of the forests of other portions of the State.

Acknowledgment is made to lumbermen, mill men, and others who, by their courteous answers to requests for information, assisted materially in the preparation of this report.

JOSEPH HYDE PRATT,
State Geologist.

TYPICAL HARDWOOD FOREST OF WESTERN NORTH CAROLINA. VIEW FROM HUGHES' RIDGE, SWAIN COUNTY.

FOREST CONDITIONS IN WESTERN NORTH CAROLINA.

By J. S. HOLMES.

THE REGION.

It is probable that Western North Carolina is more widely known for its fine climate, pure water, and beautiful scenery than for any others of its natural advantages. Thousands of health and pleasure seekers come each winter to this "Land of the Sky" to escape the rigors of the northern and eastern states, while tens of thousands flock each summer from the south. The entertainment of these summer and winter visitors or tourists forms a most important and promising industry, for they bring into the country each year from two and a half to three million dollars. The large part that the forests play in the tourist traffic, by increasing the purity of the streams and making the country more beautiful and interesting, is not generally realized; yet forest and stream and climate are Western North Carolina's most valuable assets. With the conservation of the forests, the improvement of the roads, and the extension of railroads, the attractiveness as well as the accessibility of the country will be tremendously enhanced, and the number of visitors will steadily increase.

Of even greater economic importance are the timber resources. The hardwoods of the Southern Appalachians are as widely known among buyers and users of wood products as the climatic advantages are by the traveling public. Oak, chestnut, poplar, cherry, walnut, and other woods are shipped to all of the eastern states, even to Canada and to Europe; and furniture made in North Carolina from wood grown in these mountains goes all over the world.

Agriculture, which in most parts of the State stands first among the important industries, takes third place in the mountains, and, if only those farm products which bring a cash return are counted, is unimportant, though considerable quantities of apples and cabbages are shipped out of the region, and corn, cattle, chickens, eggs, butter, fruit, and garden truck are sold locally.

PHYSIOGRAPHIC FEATURES.

A portion of the Blue Ridge extends across Western North Carolina in a southwesterly direction from Fisher Peak (3,609 feet) on the Virginia line to Rabun Bald (4,600 feet), just across the line in Georgia, a dis-

tance of 200 miles. Approximately parallel, to the northwest, is the Unaka Range, consisting of the Stone, Iron, Great Smoky, and Unaka mountains, forming the line between North Carolina and Tennessee. Between these two great ranges lie the sixteen mountain counties of the State: Cherokee, Clay, Graham, Swain, Macon, Jackson, Haywood, Transylvania, Henderson, Buncombe, Madison, Yancey, Mitchell, Watauga, Ashe, and Alleghany. This region, with a total length of 230 miles and a width varying from 10 to 50 miles, contains the highest mountains east of the Rockies, more than forty peaks rising to 6,000 feet or more. The topography is for the most part rugged, though there are large areas of comparatively level land in several of the counties. The elevations vary from about 1,300 feet, where two or three of the largest rivers pass out of the State along its western border, to the 6,711 feet of Mt. Mitchell; the average elevation is from 2,000 to 3,000 feet.

Almost all the drainage is toward the north and west and, with the exception of the northeast corner of the region, which is drained by New River, the streams are mainly tributary to the Tennessee. Parts of a few of the counties, however, extend over onto the southeast slopes of the Blue Ridge, and from these small areas the streams run south and east to rivers that flow into the Atlantic.

The geological formation is chiefly Pre-Cambrian, consisting of gneisses, schists, granite, diorites, and other crystalline rocks, which break down into stiff red clays. With proper care these clays make excellent agricultural soils. Two well-defined areas, however, of Cambrian formation, consisting of conglomerates, quartzites, and slates, cross the region —one quite narrow, in or near the Blue Ridge, and the other in the Unaka range, narrow at the northern end but widening out toward the southwest until it covers practically all of Swain, Graham, and Cherokee counties and parts of several others. The soil resulting from the decomposition of these rocks is sandy, with a yellowish clay subsoil, and is rather less suitable for agriculture. It seems, however, to favor a heavier growth of timber.

ACCESSIBILITY.

The accessibility of timber largely determines its value and also determines methods of forest management.

Western North Carolina is well supplied with railroads, there being no fewer than ten railroad outlets. Yet the greater part of the best timber is remote from transportation and can not be marketed profitably until new lines are built or extensions made. Since 1909, however, railroad development has been rapid, so that now only the three extreme northeastern counties are without railroads, while spurs or extensions

are under construction or are definitely planned for about half the mountain counties. The wagon roads, which are the chief feeders for the railroads, are in most cases unimproved; and though they are often fairly good in dry summer weather, many of them become almost impassable in winter. Nothing could add more to the value of timber and give proper encouragement to proper methods of forestry than the construction of good roads. This question of transportation is discussed in more detail later.

CLASSIFICATION OF LAND.

Throughout the region, agricultural land is held mostly in small areas, and a farm of more than 500 acres is exceptional. In nearly all counties, however, some forest land is held in large bodies by lumber companies, or speculators; and in some counties more than 60 per cent of the land is in tracts of more than 1000 acres in extent. But since all of this is rough, mountain woodland, unsuited to agriculture, such tenure is no drawback, but rather an advantage; for by keeping the full stand of timber, the land retains a full valuation, which is reduced as soon as the timber is taken off.

The proportion of cleared to forested land varies considerably in the different counties, depending on the transportation facilities and suitability for farming. In the region as a whole about 24 per cent of the land has at one time been cleared. While most of this land still produces agricultural crops, a good deal of it in some counties has been "thrown out," or abandoned, because it is too poor and too much washed for profitable cultivation. Such land usually produces worthless briars and bushes, or in some cases reverts to a scattered growth of oldfield pine or hardwood of little present or prospective value.

VALUATION OF LAND.

Land throughout this region is taxed according to its assessed value. The values are revised every four years by a board of assessors, and are usually from one-third to two-thirds the actual sale value. The assessment on timber land varies from $2 to $7 an acre, and is about half as much on land that has been cut over. The sale value of well timbered stands varies from $10 to $20 an acre, some areas having been sold for even higher than this; while cutover or culled woodlands sell at from less than $3 to $10 an acre, according to location. The assessed value of cleared land varies much more since it is influenced not only by quality and location, but by improvements. Cleared land is, as a rule, valued much too low when the cost of clearing and other improvements are taken into consideration.

THE FOREST.

GENERAL CONDITIONS.

The forests of this region are largely confined to absolute forest land, that is, land potentially more valuable for forest growth than for anything else. The forest may best serve for the production of timber, or it may be required mainly to prevent erosion or to protect and regulate a water supply. In the main, the mountains are so steep and the soil is so shallow that the removal of the forest cover and the cultivation of the land are followed in a comparatively few years by the washing away of the fine surface soil and the abandonment of the land for agricultural purposes. Not only have practically all of the areas suitable for agriculture been cleared—including the bottoms along the streams, gently rolling plateau land and hilltops, the lower gradual slopes, and the mountain cover—but much absolute forest land has also been cleared. It used to be that farmers cleared a "new ground" each year, and abandoned to "old fields" an equivalent of "worn out" land. This practice is now giving place to improved methods by which the cleared land is kept in good condition. Though much land has been cleared for agriculture, some of which is now reverting to forest, 76 per cent of this region is forested, or a little more than three million acres in the 16 counties.

PRESENT STAND.

The greater part of the forest has been reduced to cull stands of comparatively small and second class timber. Only two or three counties have virgin forests of any considerable extent, and these are mostly controlled by large lumber firms. Table 1 shows the relative amount of forest in each county, by areas and by species. About eleven billion feet of timber in trees 10 inches and over in diameter breasthigh remains; this is equivalent to an average stand of a little more than 3,000 board feet for every acre of forest land. The larger part of the forested area, however, has less than this, as shown on the accompanying forest map.

ANNUAL OUTPUT.

The lumber cut for the entire State, which had been gradually rising, amounted to more than 1,622 million feet in 1907, but because of business depression declined 30 per cent in 1908. In 1909 North Carolina jumped to fourth place, from thirteenth in 1908, with a cut of 2,177,715,000 board feet. The figures for 1909 given in the following tables should form a very fair and conservative estimate of the average annual output from the region. Tables 3 to 8 show the estimated output of timber by certain industries for 1909. These estimates were made by a careful mill canvass. The figures for the lumber cut for 1909, however, are those of the United States Census Bureau.

TABLE 1.—ESTIMATED AMOUNT OF STANDING TIMBER IN THOUSAND FEET BOARD MEASURE, IN TREES 10 INCHES AND OVER IN DIAMETER BREAST-HIGH, BY COUNTIES AND SPECIES.

Counties	Total Area	Area Forested	Per cent of Forest Land	Average Stand per Acre	Total	Chestnut	Red Oaks	White Oaks	Poplar	Hemlock	Chestnut Oak	Maple	Basswood
	Acres			Bd. Ft.									
Cherokee	288,640	228,473	79	1,635	373,690	88,461	120,682	32,650	32,181	5,909	16,922	5,281	4,904
Clay	118,400	99,650	84	3,804	379,027	100,733	76,742	64,370	41,325	3,221	30,780	5,940	12,762
Graham	193,280	173,763	90	6,255	1,086,937	295,793	205,459	26,114	115,741	175,334	28,426	31,105	39,609
Swain	358,400	336,850	94	4,747	1,598,927	422,726	224,257	198,708	205,081	110,159	79,982	30,371	48,439
Macon	339,840	288,234	85	2,980	858,795	196,574	320,867	46,880	61,004	118,833	37,162	9,966	8,276
Jackson	316,160	284,105	90	2,765	785,449	288,002	132,425	43,495	35,145	98,061	70,856	8,153	7,722
Haywood	346,240	287,592	83	4,960	1,426,498	351,962	246,110	102,707	97,283	116,746	70,877	45,862	54,856
Transylvania	237,440	208,573	88	1,712	357,064	92,623	116,809	31,258	47,237	11,473	15,067	3,377	7,702
Henderson	231,680	140,299	61	1,862	261,182	76,373	81,719	20,177	24,136	8,196	7,575	4,242	1,627
Buncombe	399,360	198,807	50	1,673	332,539	141,868	64,564	10,810	20,147	4,735	32,062	14,642	6,216
Madison	275,840	196,763	71	2,908	572,222	139,228	98,317	52,151	49,186	26,988	46,213	18,257	10,193
Yancey	193,280	159,660	83	4,625	738,504	195,042	140,478	65,400	56,970	23,136	44,259	22,558	17,910
Mitchell	231,680	178,479	77	3,596	641,750	242,493	121,785	56,694	35,656	27,751	31,518	28,803	17,526
Watauga	211,200	147,901	70	4,534	670,555	173,546	143,784	63,506	56,290	77,085	23,437	29,653	7,678
Ashe	255,360	145,741	57	3,594	523,848	141,780	115,535	129,313	31,631	13,098	28,720	17,051	2,168
Alleghany	142,720	53,071	37	2,030	107,728	27,237	26,914	31,443	2,056	426	5,213	347	232
Totals	4,139,520	3,127,961	76	3,425	10,714,715	2,980,461	2,236,447	975,676	911,076	821,031	574,089	275,628	247,826

TABLE 1.—ESTIMATED AMOUNT OF STANDING TIMBER IN THOUSAND FEET BOARD MEASURE, IN TREES 10 INCHES AND OVER IN DIAMETER BREAST-HIGH, BY COUNTIES AND SPECIES.—Continued.

Counties	Hickory	Yellow Pine	White Pine	Red Spruce	Beech	Ash	Buckeye	Birch	Balsam	Cucumber	Black Gum	Cherry	Miscellaneous	Total
Cherokee	11,719	35,163	3,880	.....	515	2,526	2,089	995	.....	933	4,270	1,636	2,974	373,690
Clay	16,703	773	.....	.....	1,590	4,211	3,846	969	.....	1,950	899	1,330	4,883	379,027
Graham	9,886	27,133	531	.....	10,641	20,444	26,281	27,901	.....	22,570	3,200	11,148	9,621	1,086,937
Swain	47,520	57,679	10,729	22,973	40,688	35,455	14,496	12,533	16,774	9,095	3,660	1,863	5,740	1,598,927
Macon	19,305	5,952	4,165	.....	.....	5,742	3,746	1,983	.....	7,216	5,599	.....	2,525	858,795
Jackson	18,281	5,180	13,443	27,282	2,400	2,964	7,519	6,961	11,723	561	3,352	961	925	785,449
Haywood	24,772	23,632	6,436	82,672	38,462	27,827	29,165	11,150	45,705	8,962	1,191	1,376	38,745	1,426,498
Transylvania	9,549	7,764	5,767	.....	144	963	2,129	1,394	.....	.....	2,353	937	518	357,064
Henderson	4,324	11,045	14,807	.....	300	1,205	.....	291	.....	1,173	1,770	407	1,815	261,182
Buncombe	10,423	9,490	886	286	1,317	1,377	5,799	4,437	286	1,386	1,124	.....	644	332,539
Madison	12,920	19,642	53,007	.....	16,004	3,689	7,800	5,132	.....	4,291	76	.....	10,178	572,222
Yancey	14,468	1,354	.....	42,115	25,778	14,473	13,725	7,592	27,876	4,717	.....	1,125	19,528	738,504
Mitchell	7,776	249	4,173	2,106	24,364	14,091	7,528	10,783	1,496	5,358	1,403	195	.....	641,750
Watauga	6,953	.....	39,797	.....	4,134	4,054	6,896	10,316	.....	3,539	8,217	2,472	4,169	670,555
Ashe	4,371	.....	15,086	.....	1,065	4,435	4,226	3,712	.....	3,933	4,071	1,297	2,426	523,848
Alleghany	1,008	1,234	10,594	.....	.....	440	.....	84	.....	.....	500	.....	.....	107,728
Totals	219,978	206,290	182,301	177,434	167,402	146,896	135,244	106,253	103,862	75,684	41,585	24,767	104,691	10,714,715

Table 2, which shows the total output of timber in the region during 1909, is given in cubic feet as the best common basis for comparison, much the larger part of the output being measured on this basis. The table shows a total cut for the year from the 16 mountain counties of about 32,270,000 cubic feet. This represents only that part of the total cut which was marketed. To obtain the total amount of timber cut in 1909 the amount wasted in cutting and manufacturing must be added. The waste in manufacturing lumber includes slab and kerf—about 40 per cent of each log—and the waste in the woods by tops, stumps, and culls, amounting to about one-fourth of all the timber marketed. This, with an estimated domestic consumption of 12,000,000 cubic feet for firewood, rails, and posts, makes a total cut for 1909 of about 59,000,000 cubic feet. This is equivalent to a cut of nearly 19 cubic feet per acre over all the forest land of the region.

TABLE 2.—TOTAL ESTIMATED OUTPUT OF WOOD PRODUCTS FOR 1909, BY COUNTIES.—COMPUTED IN CUBIC FEET.

Counties	Total Output	Lumber	Chestnut Tanning Extract Wood	Pulpwood	Tanbark	Ties	Poles, Pins, Shingles and Miscellaneous Products
Cherokee	2,161,250	800,083	997,500	175,750	132,750	30,000	25,167
Clay	49,167	49,167					
Graham	481,327	342,417	94,050	8,075	24,885		11,900
Swain	3,321,235	1,422,250	1,459,200	194,085	245,700		
Macon	1,271,505	725,167	268,470	36,005	108,630		133,233
Jackson	4,206,643	1,270,333	1,238,705	1,380,065	118,440	18,000	181,100
Haywood	6,078,780	1,714,250	808,450	3,428,550	82,530	21,000	24,000
Transylvania	2,578,783	260,583	1,715,700	418,000	117,000	67,500	
Henderson	1,996,708	386,833	1,281,075	142,500	110,700	60,000	15,600
Buncombe	2,452,160	1,161,000	868,490	101,175	168,525	103,000	44,970
Madison	1,314,323	1,128,750	55,290	72,200	50,670	4,800	2,613
Yancey	658,666	589,333			9,000	45,000	15,333
Mitchell	3,612,350	3,143,917	198,550	19,000	73,350	111,000	67,033
Watauga	1,389,750	1,340,750			45,000		4,000
Ashe	715,833	706,333			4,500		5,000
Alleghany	403,250	355,250			45,000		3,000
Totals	32,692,230	15,396,416	8,985,480	5,975,405	1,336,680	465,300	532,949

It is estimated that uncared for hardwood forests, such as those in Western North Carolina, are growing at the rate of from 12 to 15 cubic feet per acre per year. Assuming even that the greater figure represents the annual growth in this region, then the timber is being cut much faster than it is growing. This can not last indefinitely. Either the annual cut must be reduced to coincide with the growth, or else the growth must be made to keep pace with the demands upon it. The latter is certainly the most economical and businesslike way of dealing with the problem. By protecting these forests from fire, and by encouraging the more rapid-growing and more valuable species, the annual

yield of timber per acre can be largely increased in a comparatively short time. The large furniture and related industries in Piedmont North Carolina, which now draw the greater part of their timber supplies from the region in which they are situated, will depend more and more on the mountain forests. The demand for this material, aided by improved transportation facilities and methods of manufacture, should make it evident that the establishment of a maximum timber yield would constitute one of the most important contributions which the mountain counties could make toward the economic development of the State as a whole.

FOREST DISTRIBUTION BY TYPES.

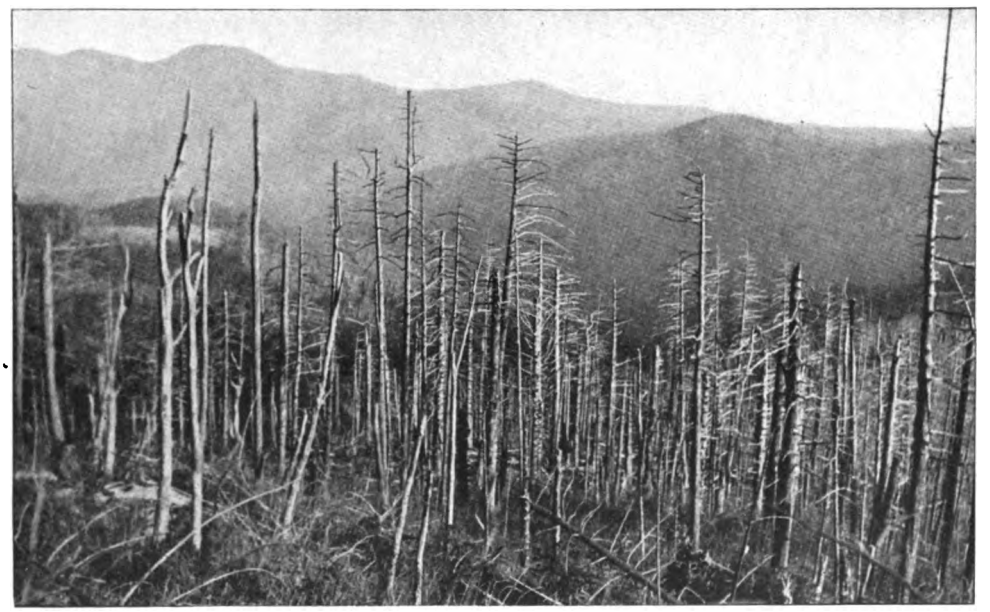
The forests of Western North Carolina are a part of the great Appalachian hardwood region, which extends from southern New England to the mountainous portions of northern Georgia and Alabama. These forests differ from those of the central hardwood region, into which they gradually merge beyond the western border of this State, in their possession of several important species which do not grow beyond the mountains, or grow in very small quantities. Such species as chestnut, red oak, hemlock, and white pine form a large proportion of the Appalachian forests, and scarcely appear in those of the central hardwood region.

There are two distinct classes of forests in this region; the spruce forest on the tops of the highest mountains, and the hardwood forest, either pure or associated with pine. On some mountain slopes hemlock grows in almost pure stands, and some old fields at the lower elevations have grown up to pure or mixed stands of pine; with these exceptions the hardwood stand covers the whole area.

SPRUCE FOREST.

The spruce forest grows only on the tops and upper slopes of the high mountains, and rarely below an average elevation of 5,500 feet. This forest is an extension of the great spruce forest of the North, which seeks increasingly higher altitudes as it extends south, and reaches its southern limit on the western shoulders of Clingman's Dome, a peak 6,600 feet high, in Swain County. The largest spruce areas in this region, as will be seen by the map, occur in Swain, Jackson, Haywood, Yancey, and Mitchell counties. The distribution of the type is dependent not only upon elevation but also upon moisture conditions and to a large extent on protection from storms by the surrounding mountain peaks. The type extends down only a short distance on the southern slopes of even the highest mountains, but along northerly ridges and slopes it sometimes descends to 4,500 feet.

A. MATURE SPRUCE FOREST SHOWING ADEQUATE REPRODUCTION.



B. MATURE SPRUCE FOREST BURNT OVER AND DESTROYED TWELVE YEARS AGO.

The soil of this forest is a cold, black loam, usually with a sandy subsoil which varies in depth from a few inches to two feet, but is usually quite shallow. It always contains a large amount of humus from the gradual decay of fallen trees, twigs, and leaves. This duff supports a growth of moss and ferns, and in the open places a turf of grass. The principal shrubs of the type are highbush huckleberry, hobble bush, and, occasionally, the handsome fetter bush. Spruce and balsam in varying proportions form the chief tree growth. Mixed with these are usually a small percentage of yellow birch and scattered specimens of mountain ash, service berry, fire cherry, and mountain maple. These hardwoods, however, are rarely of merchantable size or quality. The proportion of spruce varies greatly from as much as 80 per cent of the stand in the southwestern counties to less than 50 per cent in the more northern counties.

The stand of spruce and balsam averages from 15 to 25 thousand feet an acre over the whole area covered by this type, and many stands will cut from 40 to 50 thousand feet to the acre. Where this timber is being cut for pulp wood from 40 to 50 cords per acre is an average yield. Spruce varies in height from 40 to 50 feet on the ridges to 80 or 90 feet on the north slopes and in the heads of coves, where it attains a diameter of three feet. Balsam is smaller and is rarely more than two feet in diameter.

In the mature forest reproduction is good, owing to the very favorable moisture conditions and the freedom from fire. In dense stands there is a larger percentage of balsam, but where the forest is more open spruce reproduction is favored. On areas that have been cut over and not burnt, the young growth which had started before cutting continues to thrive, and on many areas seedlings of both species have started since cutting. Unfortunately, no very heavy cuttings could be studied, since logging for pulp wood has been carried on for only two or three years. Both spruce and balsam need moist humus for successful reproduction, and where fire recurs after cutting neither of these species will be perpetuated. The abundant rainfall, which is heavier on these mountain tops than anywhere else in the State, assisted by the dense shade of these evergreen trees, affords an efficient fire protection for spruce forests while they remain largely in their natural state. But when the trees are removed, allowing the large amount of vegetable matter on the soil and the tree tops left in logging to become dry, fires burn through the remaining timber with disastrous results. The current belief is that it is impossible to keep fires out of this type after logging, and that then these forests will disappear. If fires can not be kept out, this will certainly be the

case, and all this type, amounting to some 100,000 to 150,000 acres of splendid forest land will very rapidly become barren mountain tops. On certain areas that have already been cut and accidentally burned, grass has been sown, the owners claiming that the land will pay better in pasture than in timber. There are, however, only limited areas that are suitable for pasture, and most of the land is so steep and so rocky that once the dense forest cover is destroyed the soil will soon wash away and leave only the bare rocks. In the opinion of well-informed men, if this happens the land will eventually revert to the State for unpaid taxes.

HARDWOOD FOREST.

The hardwood forests, which occupy all but the highest peaks, vary considerably, according to soil, aspect, and elevation. They can be separated into four important types: plateau, chestnut, red oak, beech, and maple.

Plateau Type.

Along the valley of the French Broad, in Henderson, Buncombe, and Madison counties, below an elevation of approximately 2,500 feet, and in the southwestern half of Cherokee County, and on some smaller similar areas in several of the other counties, there is a type of forest very similar to that in the Piedmont section adjoining the base of the mountains. The greater part of this forest is composed of oak of several species, usually in mixture with shortleaf pine, or with pitch pine, scrub pine, and occasionally white pine. From one-half to two-thirds of the forest, however, is oak, and the principal species in order of abundance are: scarlet, black, Spanish, white, and post oak. In general, this type has been severely cut over, because of its accessibility, and, for the same reason, has often been severely burnt over. In consequence of these conditions there is little merchantable timber left. The mature oaks are fit for little besides firewood, since they are generally defective, the black and scarlet oaks are stagheaded and wormy, and the white oaks small, crooked, and knotty. The greater part of the merchantable timber in this type is shortleaf pine, which, on the dry slopes of the lower French Broad valley, may be as much as 80 per cent of the stand, and furnish a cut of three or four thousand board feet to the acre. More often, however, this tree forms only from 2 to 5 per cent of the stand. The scarcity of chestnut constitutes the principal difference between this and the other types of hardwood forest. Chestnut was probably abundant at one time, but it is now rapidly dying out. Scattering red maple, black gum, sourwood, and two or three species of hickory are present, but are rarely merchantable for anything but firewood.

Sprout reproduction is abundant and makes up the greater part of the undergrowth, but consists chiefly of inferior species. Where fire has been kept out for many years, white oaks are more in evidence, with occasional yellow poplar.

On many of the dry, rocky slopes above the large streams which break through the Unaka Mountains, such as the French Broad, the Doe River, Toe River, and the Nolichucky, the pines predominate, and there is an apparent gradation into an almost pure pine type. In such situations pitch pine and shortleaf are of almost equal importance, with scrub pine on the lower slopes and Table Mountain pine on the higher ridges. These slopes and ridges will never be worth anything except for growing timber, and some slopes are so rough that it is even impracticable to log them. These dry slopes have suffered greatly from fire. There are many areas, both in old fields and in cut over forest, in which white pine forms a large proportion of the stand. On all such areas it is the most valuable tree that can be grown.

Chestnut Type.

On practically all situations between 2,500 and 4,000 feet elevation and in many cases above and below these limits chestnut predominates and forms from 30 to 40 and often as much as 75 per cent of the forest. The proportion, size, and merchantable value of this species vary with the situation, which gives rise to three sub-types; ridge, slope, and cove, with several minor variations.

Ridge.—Along practically all the ridges and extending the greater part of the way down the southerly slopes chestnut forms from 25 to 50 per cent of the stand, and chestnut oak is about as abundant; and together these two species usually make up 75 per cent of the stand. Scarlet oak, black gum, shortleaf pine, and pitch pine occur in this type more than in any other, though there is rarely more than a small proportion of each. The height growth of the trees is less and the quality of the timber is inferior to that growing in the other sub-types. The trees vary from 40 to 50 feet in height and are short-boled, crooked, and fire-scarred. The open nature of the forest and the consequent exposure to the sun make it dry out readily and become an easy prey to fire. As a result, reproduction is poor, and generally confined to damaged sprouts of oaks and chestnut.

Slope.—This type comprises all forests on the northerly exposures from the east to the west slopes and, on the higher mountains, it extends around onto the south slopes. The soil is usually moist and is more fertile than that on the ridges, and the trees are consequently taller and contain more merchantable timber. Chestnut is still the most important

tree, and forms from 30 to 50 per cent of the forest. Red oak, white oak, linn, hickory, chestnut oak, buckeye, ash, and other valuable hardwoods, with a little yellow poplar in the lower part of the sub-type, form the remainder. On the upper north slopes, at the higher elevations, there is occasionally a considerable mixture of hemlock, accompanied by a dense undergrowth of laurel and doghobble. On the lower ridges, mountain ivy occasionally makes the woods almost impenetrable.

Cove.—The mountain coves have always contained the heaviest and most valuable timber. Yet many have been cleared for agriculture, and most of them have been culled of their best trees. The soil of the coves is usually rich and moist. Though chestnut is still the most abundant tree, yellow poplar is the more valuable. It is typically a cove tree, and averages from 80 to 100 feet in height with long, straight boles that produce a large proportion of high grade lumber. In estimating timber it was formerly a common practice to include only that in the coves, since it was claimed that the timber outside of these situations would scarcely more than pay for the logging. Because of the moisture, fire is much less frequent in the coves than on ridges and slopes, and reproduction is much more abundant, with a larger proportion of the more valuable species.

Red Oak Type.

Above the 4,000 foot contour and even extending up to the spruce forest, especially on the northerly slopes, red oak is likely to be the most important tree. Owing to the altitude, however, and to its exposure to high winds, the tree does not usually contain a large amount of merchantable timber, and, as such situations are very difficult to log, this forest is not now of any great value. Mixed with the red oak are chestnut, chestnut oak, sugar maple, buckeye, and linn given in the order of their importance.

Beech and Maple Type.

At the higher elevations just below and often extending up into the spruce type, as well as on mountain tops where spruce does not occur, there are areas of almost pure beech or beech mixed with sugar maple. In the southern part of the region the trees are of little commercial value, being dwarfed and crooked; but in the northern part this type contains some very good timber,—not so much of the beech and maple, but of the species that are mixed with them,—buckeye, linn, cucumber, chestnut, ash, and cherry. The ground is usually moist and covered with moss and ferns. The reproduction is chiefly seedlings of sugar maple and ash, with thrifty sprouts of linn and chestnut.

FOREST DISTRIBUTION BY SPECIES.*

Chestnut.

Chestnut is typical of the region and grows almost everywhere, forming 28 per cent of the total forest area. It is not numerically important, however, on the plateau lands of the French Broad River, and in western Cherokee County. It is the most important commercial tree, because of its rapid growth, its wide distribution, and its high market value for poles and extract wood at a comparatively early age. Much of it has been so seriously injured by fire and insects, however, that probably not more than from 25 to 40 per cent of that now standing is suitable for lumber. The recent establishment of large tanning extract plants has relieved this situation somewhat by creating a market for low grade wood, a large amount of which is now being cut wherever it is accessible.

Red Oaks.

Red Oak.—Red oak, because of its wide distribution, becomes the most valuable oak in this region, and, though it seldom occurs below 2,800 feet, it now furnishes the greater part of the oak lumber. Its favorite habitat is moist north slopes and the coves, its numerical importance increasing with the increase in altitude, till on some of the slopes and crests of the mountains above 4,000 feet, it forms 50 per cent or more of the forest over considerable areas. It is commonly known here as water oak. It attains a very large size and furnishes lumber equal in appearance, and nearly equal in price, to white oak. Its young growth is nowhere abundant, as it is easily killed by fire, and hogs help to keep it in check by devouring the acorns. It is the most rapid growing of any of the oaks, and should be encouraged in every way possible, particularly by keeping these two enemies out, when it will reproduce itself readily.

Black Oak.—Black oak, the lumber of which is often marketed as red oak, ranks second among the so-called red oaks. This tree is found throughout all of the types, but decreases in proportion in the stand as the elevation increases. In the pleateau types in Cherokee County and in the French Broad valley it is probably the most important oak and forms a considerable part of the local cut; but in these situations it is of poor quality, often wormy and rotten. It attains its best development and quality in the lower coves and richer slopes. The recent demand for tanbark from this species has increased its value. Its reproduction is good and its growth rapid, especially that of the sprouts

*The species are given in the order of their abundance in the region. See Table 1.

from the stumps of the smaller trees, and it should therefore become one of the most valuable trees, as it is already one of the most abundant, in the more favorable situations.

Scarlet Oak.—Scarlet oak is perhaps more abundant than black oak in the pleateau type but is less so in all other situations. This oak, usually called Spanish oak and occasionally spotted oak throughout the mountains, is the most abundant tree in the extreme northeastern counties of the region, often forming as much as 20 per cent of the forest and from 40 to 50 per cent of the young growth. It grows rapidly when young, and the smaller, quick-growing trees make a good quality of lumber; the old specimens, however, are likely to be wormy or otherwise defective, and it is therefore not a desirable lumber tree. Sprouts of scarlet oak are quite resistant to fire, and they can well be encouraged until more desirable species come in.

Spanish Oak.—Spanish oak, known as red oak throughout the Piedmont region, and to some extent in the mountains, is nowhere abundant. It is distributed chiefly through the plateau type, and but rarely ascends into the chestnut type. The timber is cut for lumber along with other red oaks, and among these is second only to red oak in quality. Sprouts of this tree are resistant to fire, and form a considerable part of the young growth on the dry hills and slopes in the plateau type.

Blackjack Oak.—Blackjack oak occurs on the dryest and poorest situations at lower elevations, principally in the plateau type. This tree rarely attains a size large enough for saw timber even under the most favorable conditions. The presence of blackjack is usually considered an indication of poor soil.

White Oaks.

White Oak.—White oak occurs all over the region, but is more important at the lower elevations. Throughout both the plateau type and the chestnut type up to 4,000 feet in elevation, this tree forms an important part of the forest, attaining its best development, however, in the rich coves, especially those with a more or less southerly aspect. Though forming as little as 1 per cent of the forest in the rougher parts of the more western counties, it may form as much as 35 per cent of the merchantable forest over several contiguous watersheds. In Transylvania County, in fact, as much as two-thirds of the timber is white oak and post oak combined. While the quality of the white oak timber now standing is inferior to that which for years has been cut for staves, there is still much of good quality scattered through the mountains. At present this tree is used chiefly for lumber, though recently the bark has come into the market for tanning, but owing to its

thinness and its low price, little is being peeled. Seedlings and sprouts of white oak are very sensitive to fire and unless the forests can be protected from this scourge, the black oaks will replace it in future stands. Though it is slow growing, it should be encouraged on favorable areas. Because of its special value for staves, prices will no doubt increase enough to justify growing it for this use.

Post Oak.—Post oak is common on certain areas in the plateau type, but it is nowhere important. It is used for rough saw timber and in some cases for posts, though locust is preferred. This tree grows slowly and its reproduction is nowhere good, so that only on dry, poor ridges should it be encouraged.

Yellow Poplar.

Yellow poplar grows in the coves and lower slopes all through the mountain region, though nowhere forming more than 15 per cent of the forest. It is rarely found above an altitude of 3,500 feet, at or near which elevation it attains its best development. Practically all of the stands, however, have been severely culled, so that it constitutes, on an average, not more than 8 per cent of the forest. The best timber now remaining is in the most inaccessible situations, Graham, Clay, and Swain counties probably containing the best. Seedlings of yellow poplar are very sensitive to fire, but where fire is kept out reproduction is abundant, especially where plenty of light has been let in by logging. Tree for tree, yellow poplar is more valuable than chestnut, but its distribution is more limited. It is a rapid grower when young, and finds a ready market for pulp even as a small tree. Its use for pulp should not be encouraged, if it is growing under conditions which favor its attaining saw timber size.

Hemlock.

Though forming more than 7 per cent of the entire stand of this region, hemlock is much more restricted in its distribution than the abundant hardwood species. It grows chiefly on the higher slopes and north coves of the mountains, especially above 3,500 feet, though extending in scattered trees along the streams down through the chestnut slope type. On the cold, north "benches," and in the moist coves and bottoms where it often forms from 35 to 50 per cent of the stand over considerable areas, it constitutes a distinctive sub-type. In such situations the trees grow to a large size and produce a good quality of lumber, though large old trees in situations exposed to the wind are apt to be windshaken. Stands of 10,000 or 12,000 feet to the acre are not uncommon. Because of the demand for hemlock bark for tanning pur-

poses, much of this timber was cut years ago, but since hemlock lumber brought a very low price at that time only the bark was used, the wood being left on the ground to rot. This practice is now abandoned, and even reversed, since the timber is now utilized, while the bark is often wasted. Young hemlock cannot stand fire, and comes in on only moist soil with a cover of humus, so that where the forest is burned hemlock is exterminated. Many of the areas on which hemlock now stands will be used for agriculture; others will grow more valuable trees, such as yellow poplar, linn, and ash, so that hemlock will decrease in the future mountain forest.

Chestnut Oak.

This oak, which belongs to the white oak group, is one of the most widely distributed and generally important oaks of the region. Its lumber is far inferior to that of the red oak, but its bark, which is used for tanning purposes, greatly increases the value of the stumpage. Chestnut oak forms a smaller proportion of the forest than red oak, and has a smaller individual development. It is reproduced chiefly by sprouts; its acorns are abundant enough, but are largely destroyed by hogs and by fire.

Maple.

Sugar Maple.—Sugar maple grows chiefly on the moist slopes of the higher elevations, but is nowhere important. Sometimes, on restricted areas, it forms 15 per cent of the stand; over larger areas it seldom forms more than 3 or 4 per cent of the forest, yet local saw mills occasionally cut as much as 10 per cent maple. In the northeastern counties there has been some production of maple sugar, though the industry has practically died out. Sugar maple reproduces abundantly from seed where fires are kept out, but it is of so much less value than other trees that it need not be encouraged.

Red Maple.—Red maple is scattered in very small groups or as single trees through all types, but is of such poor quality and inferior value that it is unimportant. Sprouts and seedlings are abundant, and, owing to their vitality, form a large portion of the young growth where fires kill off other trees.

Basswood.

In the coves and on northerly slopes basswood, or linn, as it is generally called, is scattered as single trees or in clumps rising from the same root. Though nowhere forming a large proportion of the forest, it is yet abundant enough to constitute more than 2 per cent of the entire stand. Two species are common, the white and the American, the latter

perhaps slightly more extended in its general range. The species are not distinguished commercially, and, as there is practically no difference in the timber or the rate of growth, they can well be classed together. The timber is usually of good quality, but forms such a small part of the cut of the local mills, that favorable prices are secured only by the larger operators and dealers. After logging linn reproduces chiefly by sprouts which grow rapidly, but are generally destroyed by cattle, which should always be excluded from areas of young growth till the shoots have grown out of their reach. Fire is not a serious menace where linn flourishes. This is a valuable and important tree in the situations to which it is best adapted.

Hickory.

Several species of hickory grow throughout the region; pignut on the higher and poorer situations; mockernut, or white hickory in the lower coves and richer slopes; bitternut, or red hickory, in the moister situations along the streams; other species are only occasional. Hickory is nowhere abundant, but sometimes forms from 5 to 10 per cent of the stand on restricted areas; taking the area as a whole, however, only 2 per cent of the forest is hickory. While more common on the lower slopes, this tree ascends all through the chestnut ridge type, but is so scattered that it has had mainly a local utilization for axe handles and firewood. Reproduction of hickory is fairly good nearly everywhere, and the insistent and increasing demand for second growth hickory justifies its encouragement in every possible way.

Yellow Pine.

Four species are included under this blanket term, though shortleaf is by far the most important and abundant.

Shortleaf Pine.—Shortleaf pine occurs at the lower elevations and through the plateau type, and along the dry ridges and south slopes of the chestnut type, where it often forms a large proportion of the forest. It comes in on abandoned fields in the plateau type, where it has its greatest value, though with proper encouragement it may form an important part of second growth forests wherever it thrives.

Pitch Pine.—Pitch pine grows on situations that favor shortleaf and is usually mixed with it, but is decidedly inferior in rate of growth and in quality, and shortleaf should always be favored.

Scrub Pine.—Scrub pine occurs only at the lower elevations and is so much inferior to shortleaf that it should not be encouraged.

Table Mountain Pine.—Table mountain pine grows only on the dry tops of the higher ridges and is of no great importance, though it is occasionally cut for lumber in the Unaka Mountains along with shortleaf and pitch pine.

White Pine.

White pine occurs chiefly along both slopes of the Blue Ridge, and along the valleys of the French Broad, Pigeon, Tennessee, and Hiawassee rivers. While it may extend to the top of the Blue Ridge it is rare above an altitude of 3,500 feet. There are pure stands in small groves, but it is usually mixed with hardwoods, and may form, over considerable areas, from 10 to 15 per cent of the stand. The mature trees are tall, and usually stand out prominently above the surrounding hardwoods. The timber is much sought after, and, except in remote places, the best trees have been culled out, and it is now being cut and transported by wagon or flume, from twenty to thirty miles to the railroad.

White pine reproduces well in old fields and unburned woods, and in favorable situations young trees grow very rapidly, often making an annual height growth of two feet. On both sides of the Blue Ridge, and in most situations in the plateau type, this tree is of first importance. In the reforesting of cutover and waste lands, seed trees of white pine should be reserved.

Red Spruce.

Red spruce, known locally as "he balsam," is confined almost entirely to the spruce forest of the higher mountains, though a few straggling trees descend into the hardwood forest below. In the richer situations on comparatively level ridges and more gentle slopes, it attains a considerable size, and specimens 3 to 4 feet in diameter and 90 feet in height are not uncommon. On the poorer, exposed situations, however, mature trees are from 6 to 18 inches in diameter and from 30 to 60 feet in height. This tree almost always occurs mixed with balsam, the two forming 95 per cent of the stand of the spruce type, where spruce alone furnishes from 50 to 80 per cent and averages about 60 per cent. Spruce is being used chiefly for pulp wood, though lumber is cut in several places, and in one county spruce is used in a small way for the manufacture of doors and blinds.

Spruce reproduces well where moisture is abundant and where the forest is open. One area in Yancey County, where the old trees had been killed by disease, has almost perfect spruce reproduction, but unfortunately this condition is rare, and the greater part of the new growth under the old trees in the spruce forest is of balsam.

Beech.

Beech grows chiefly on cold northern slopes and coves in the higher altitudes, but occurs as scattered trees along the streams throughout the mountains. There are occasional pure stands just below the spruce forests, but there it is small and unmerchantable. It is cut to some extent from the chestnut type, where it rarely exceeds 2 or 3 per cent of the forest. In the beech and maple type, however, this tree forms 20 to 30 per cent of the stand, and is of large size and good quality; yet owing to its limited amount, its great weight, and its remoteness from transportation, it is not valued very highly. Other trees, such as linn, ash, yellow poplar, and red oak, should be encouraged to take its place in the second growth forest.

Ash.

White ash is found throughout the region, though the greater part of it has been cut, except in remote situations. The best ash is in the remote coves of Graham, Swain, Haywood, Yancey, and Mitchell counties. The tree has a range similar to that of yellow poplar, though somewhat more restricted, in coves between 3,000 and 4,500 feet elevation. The greater part of the cut is shipped out of the State. Where the woods are not burned, and seed trees are present, natural reproduction is usually abundant. Owing to its value and comparatively rapid growth it should be encouraged.

Buckeye.

Yellow or sweet buckeye occurs throughout the higher coves and north slopes of the chestnut type, and even extends up into the spruce type. It rarely constitutes more than 2 per cent of the forest where it occurs, but occasionally forms as much as 10 per cent over restricted areas. Buckeye is a soft, white wood, for which there is no great demand, though it usually forms a small portion of the cut in most of the larger mills. Buckeye grows slowly when young, and linn, red oak, poplar, and cucumber, which flourish in the same situations, should be given preference.

Birch.

Two species of birch grow in the coves and on the slopes of the higher mountains, and of these, sweet or black birch, or mountain mahogany, as it is often called, is the more valuable. This birch forms a small part of most forests above 3,000 feet, though it rarely exceeds 1 or 2 per cent of the forest except in the higher elevations. Yellow birch is confined to cold northern slopes, chiefly above 4,000 feet. On such

situations, and extending up into the spruce type these two birches are together, and often classed as one species. Here they form from 5 to 20 per cent of the forest, but are crooked and defective. They reproduce well and form from 25 to 50 per cent of the young stands on old burns or windfalls in the higher mountains. The sweet birch is a good tree for such situations and should be encouraged. Another species, the river birch, grows along streams in the plateau type. It is of little value, and is rarely used for anything except firewood.

Balsam.

Frazer's balsam or "she balsam," as it is called locally, is mixed with spruce in proportions varying from 15 to 50 per cent of the stand. Though this tree makes a somewhat more rapid growth than the spruce, when young, it does not attain as large a size, a tree 2 feet in diameter being exceptional. Balsam has been little used for lumber in North Carolina even where lumbering operations have been carried on; it is, however, now being used with spruce for pulp wood, the two being cut indiscriminately. Balsam reproduces better than spruce, and in most second growth stands young balsam predominates. Spruce is more abundant in the old stands simply because it is a longer-lived tree.

Cucumber.

Several species of magnolia are locally known as cucumber, but among lumbermen this name is generally applied to but one species, *Magnolia acuminata*. This tree grows to a large size in the rich coves and slopes of the chestnut type, though its commercial distribution is confined to the more remote parts of Graham, Swain, Macon, and Haywood counties. Over considerable areas in Graham County it forms as much as from 8 to 10 per cent of the entire stand. The value of cucumber lumber is second only to that of poplar, with which it is generally sold. Its comparative rarity prevents any general demand for it under its own name. Seedlings of this species are scarce even where seed trees occur, though where areas are protected from fire it comes in rapidly in the second growth, both as sprouts and as seedlings. One other species of magnolia grows throughout the higher mountains, the mountain magnolia or Frazer umbrella-tree. This tree rarely attains sufficient size to make merchantable lumber, though it is occasionally cut by some of the large mills.

Black Gum.

Black gum grows in scattered stands throughout the plateau type, and on the ridges and lower slopes of the chestnut type. It is so often

hollow that it has a local use for "bee gums." This tree forms a small part of the cut of some of the larger mills, but the lumber is inferior, and warps badly unless carefully handled. In burned over forests of the plateau type black gum forms a large part of the young growth, but where fires are kept out the proportion is much less, because it is supplanted by better trees.

Sweet Gum.—Sweet gum is limited to small areas in the plateau type in the western part of Cherokee County. Here it is useful to reforest abandoned fields, and should be encouraged.

Cherry.

Black cherry was at one time scattered through most of the mountain forest, but now little of it is left except in the most remote regions. This tree attains its best development in the rich coves and "benches" of the higher mountains above 3,500 feet elevation. At present the finest cherry timber is in the western part of Graham County, where near the top of the Unaka Mountains it forms as much as 2 per cent of the forest over a large area. The timber is of great value for interior finish, and is greatly sought after by lumbermen and dealers. Owing to its slow growth, to its exacting demands on soil, moisture, and situation, and to its intolerance, the reproduction of cherry is unsatisfactory. Wherever it succeeds well, it should be encouraged, though it may not pay as well as many of the faster growing and less exacting species. Another species, the *red* or *bird cherry,* is found in the higher mountains mixed with hemlock and to a limited extent with the spruce. It is small, short-lived, and of no commercial value.

Miscellaneous Hardwood Species.

Several other species are cut to fill special demands and are of considerable value both in the present and future forest, though because they grow in limited quantity they might be considered as comparatively unimportant.

Black Walnut.—Black walnut was at one time abundant, though little is now left. It prefers the Piedmont region, and the rich, deep coves, and the lower slopes of the chestnut type below 3,000 feet in elevation. Where it is still standing it has been left with the idea of profiting by its increased value. Yet its value has not appreciably increased in the past 20 years.

Butternut.—Butternut, usually called white walnut in the south, is scattered through the rich, rocky coves, at higher elevations than black walnut. Where it attains merchantable size, it is cut for lumber, and sold for much the same purposes as black walnut, but at a lower price.

Black Locust.—Black locust grows almost everywhere below 3,500 feet, but chiefly in the rich coves and slopes. Little merchantable locust is now standing, except on areas where the timber is being preserved, as this tree has been exploited for many years, first for ship building and later for insulator pins. At the present time its chief use is for fence posts. Reproduction of locust is comparatively rare through the forest, but it comes up readily in old fields on the lower slopes of the chestnut type, where it grows very rapidly.

Dogwood.—Dogwood grows all through the region, but more especially in the plateau type and the lower elevations of the chestnut type, though it is nowhere abundant. Where it could be reached readily by road or railroad, it has been cut for shuttle blocks. Dogwood is a very slow though persistent grower, and will be of little value in the future forest.

Silverbell.—Silverbell, known through the mountains as box elder, bellwood, or tisswood, is of merchantable size only on the higher slopes, mixed with hemlock, yellow birch, and sugar maple. It is cut by a few of the larger mills. It extends into the plateau type along the larger streams, but does not there attain merchantable size.

Holly.—Holly grows along the rich bottoms close to the streams in the deep valleys of the higher mountains, where it occasionally attains a size of from 1 to 1 1-2 feet in diameter. Owing to its inaccessibility and the small amount obtainable, it is seldom cut into lumber, which usually can be disposed of only by special orders.

Sycamore.—Sycamore is limited to rich bottoms and along the streams, mostly at lower elevations. In favorable soil it attains a very large size, and is cut to some extent for lumber. It is used locally and in furniture manufacture.

FOREST AND ECONOMIC CONDITIONS BY COUNTIES.

The forest and economic conditions of the various counties differ according to physiographic features and to transportation facilities. A brief description of these conditions is given so that the recommendation for proper forest management may be made more specific and definite.

CHEROKEE COUNTY.

Cherokee, the most western county, has an area of approximately 288,000 acres. All but the southernmost part is drained by the Hiawassee River, which crosses the center of the county from east to west. The topography is very rugged, the range in elevation being about 4,000 feet; and except along the valley bottoms the country is not well adapted

to agriculture. The most mountainous and inaccessible parts of the county lie along its northern and eastern borders.

The Southern Railway and the Louisville and Nashville Railroad, both terminating at Murphy, are the principal transportation lines. In addition to these a logging road runs from Andrews across the Snowbird Mountains into Graham County, and a Tennessee lumber company is planning to extend its narrow gauge logging railroad in to the virgin timber of the Tellico River region. The roads are rough, poorly graded, and poorly drained. Several miles of road running out of Andrews have been macadamized, however, and Murphy Township is macadamizing its roads.

The land is held chiefly in small holdings, and scarcely one-fourth is made up of tracts of 1,000 acres or more.

The only body of virgin timber is in the Unaka and Snowbird Mountains at the headwaters of the Tellico River, where there are nearly 10,000 acres on which the timber averages about 8,000 board feet per acre. Elsewhere the heavily culled forest averages scarcely more than 1,500 feet per acre, and consists of comparatively poor and defective timber. Below 2,500 feet considerable shortleaf pine is scattered over the area, associated chiefly with post and other oaks, and gums. Red oak and chestnut, on the other hand, are more common at the higher elevations.

Yearly fires keep the young growth down and ruin much of the old timber. Grazing is unrestricted and range burning is common. Along the western border of the county many trees have been injured or killed by the sulphur fumes from the copper smelters of Ducktown, Tenn. In the past this smoke nuisance was much worse than now, but it is being remedied.

About 20 per cent of the county has been cleared for agriculture, but much of the land proved too steep for successful farming, and has been abandoned to forest. About one-fourth of this cleared land has thus come up to young stands of yellow poplar or shortleaf pine. It is probable that still another fourth is too steep for cultivation and should be allowed to revert. This would afford needed protection from soil washing, and at the same time put the land to its best use. Though the average farm is not very fertile, there are some very rich lands along the Valley River, which range in value from $50 to $100 an acre.

Lumbering is growing less important with the diminishing supply of timber. Wagon hauls of from 15 to 25 miles are often necessary to deliver poplar at the railroad. Other forest industries are represented by a large tannery at Andrews and a furniture factory and planing mill at

Murphy. These get their material chiefly within the county. A great deal of pulp wood and chestnut extract wood is shipped out of the county.

Cherokee must, of necessity, remain chiefly a forest producing county; and the chief need of the forests is protection from fire and from indiscriminate grazing. This protection could best be attained through a paid fire warden system, together with the adoption of the stock law, which would aid in removing the principal incentive in burning the woods. With these problems solved, intensive methods of forestry, so much needed, would become possible.

CLAY COUNTY.

Clay, with an area of less than 120,000 acres, is one of the smallest counties in the State. The topography is rough and the elevations high, ranging from 1,700 to 5,300 feet. The ridges are narrow and average approximately 2,000 feet above the main valleys. The upper slopes are precipitous and boulder-strewn, with a thin and rocky soil, while lower down the slopes become less rugged, and the soil is deeper, and in the valleys there is a deep alluvial sandy or loamy clay soil.

The Hiawassee River and its tributaries, Tusquitee and Shooting Creeks, form the principal drainage system. The Nantahala River forms part of the northern border of the county; and the Tallulah, a tributary of the Savannah, rises in the mountains of the Blue Ridge and passes out of the county across its southern border.

Hayesville, the county seat, in the Hiawassee valley, is some 17 miles distant from Murphy, the nearest railroad station.

In the western portion of the county about 25 per cent of the land has been cleared, of which 10 per cent is now in pasture or reverting to forest. This is the principal agricultural section of the county; corn and hay are grown for home consumption. Hogs, goats, sheep, and cattle, are raised, but the industry is not large. In the northern and eastern portions of the county, not more than 10 per cent of the land is cleared, and the remainder is covered with the original forest growth. This part of the county is owned mostly in large tracts by lumbermen and others, more than one-third of the county being thus held.

The roads, it must be confessed, are very poor, and this fact, coupled with the long haul to a railroad, limits lumbering to four portable mills. Only the better quality of poplar, oak, and chestnut, which can be sawed into first class lumber, is cut. The long haul practically prohibits the cutting of ties, bark, acid wood, or pulp wood east of Hayesville. Some eight or ten years ago a company cut out a large

amount of poplar in the vicinity of Fires' Creek and attempted to float the logs to Murphy, but this was not a financial success.

The forests in the southwestern portion of the county have been culled several times for rails, ties, bark, and lumber; the present stand consists of over-mature, stag-headed, and defective trees scattered through a second growth of black oaks, white oaks, poplar, chestnut, ash, and hickory. Those of the northern and eastern portion of the county still retain most of the original stand, except along the streams and lower slopes, where the best timber has been removed for local use.

On the ridges, where the soil is thin and rocky, chestnut and the oaks predominate, with occasional yellow pine. In such situations the trees are scrubby and their growth is slow, but on the benches near the heads of streams, the trees are tall, with long, clear trunks. Here the chief species are chestnut, poplar, the oaks, linn, ash, and hickory, with hemlock scattered on the damp north slopes or along the streams. This type contains some of the best timber, and it is not unusual for it to run 10,000 to 15,000 feet to the acre over limited areas. The largest timber is in the vicinity of Sugar Cove and at the head of Fires' Creek. Most of the virgin stands are in bad condition, however, the trees being over-mature and fire scarred, and the ground strewn with windfalls and old logs. There is not enough grazing to injure the forest materially, except where young growth is coming in.

Throughout the northern and eastern portions of the county fires are common, and it has been estimated that 50 per cent of the land is burned over every year. Fires are set by men who believe that they will improve the range, or by nut gatherers, or even by malicious persons. The damage to mature stands is very evident on the ridges, where probably half of the trees are fire injured, especially the chestnut.

The amount of reproduction, the ground cover, and the general good of the forest depend upon freedom from fire. Where fires run over an area every year reproduction is poor or lacking, and the soil is exposed to washing because the leaf cover has been destroyed. On the other hand, where fires have been kept out, dense stands of young trees are present, and the soil is deep and well protected by a thick cover of leaves and litter.

A healthy sentiment is growing throughout the county in favor of putting a stop to the wholesale firing of the forest. People are beginning to realize the damage that is done, and good results are already in evidence. One tract of some 15,000 acres in the Tusquitee Mountains has not had a fire on it for three years, and this is due not so much to the fact that the tract has been posted, but to the fact that the people in the neighborhood are opposed to fires.

GRAHAM COUNTY.

Graham County, with an approximate area of 193,000 acres, borders on the Tennessee line. It is extremely mountainous, with several peaks over 5,500 feet in elevation, and shows an altitudinal range of about 4,000 feet. The Cheoah River and a few smaller streams drain the entire county, and empty into the Little Tennessee River which forms the northern border. The soil of the narrow valley bottoms is quite fertile, though restricted in extent. The most rugged and inaccessible part of the county is the western half, occupied principally by the Snowbird and Unaka Mountains. Only 10 per cent of the county is cleared and scarcely four-fifths of this is true agricultural land.

Two-thirds of the county is owned in tracts of a thousand acres or over, principally by lumber interests, and one company alone controls about a third. The water powers of the Cheoah and Tennessee Rivers, of great potential value, are now controlled by power companies.

The western third of Graham County, of which not more than 2 per cent is cleared, contains a large amount of valuable hardwood timber, where less than 10 per cent is cut over or culled. Much of this area averages more than 10,000 feet per acre of oak, poplar, cherry, ash, chestnut, and hemlock.

A branch of the Southern Railway now skirts the northern boundary, running down the Little Tennessee River in Swain County. A branch line may be built soon to go up the Cheoah River; this will put a large area of virgin timber within reach of the markets.

Here, as elsewhere, the former practice of splashing and driving has been superseded by the use of logging railroads. Fifteen years ago an attempt was made to exploit poplar timber by splash dams on Little Snowbird, West Buffalo, and Big Santeetlah Creeks, but the loss was too heavy for even that excessively wasteful period of lumbering, and the attempt was abandoned. Along the Little Tennessee River, however, much timber has been floated out and a considerable part of the adjoining forest has been culled of much of its best floatable timber. Two narrow-gauge logging roads now enter the county, one of them crossing the county line at an elevation of between 3,200 and 3,300 feet above sea level.

Lumbering is the chief industry, with an annual cut of no less than 15,000,000 board feet. Most of the county is too remote from the railroad to make the cutting and sale of tanbark and cordwood profitable, though one company states that from 8 to 10 cords per acre of extract wood are left after heavy logging. Farming is of importance in the valleys and is usually carried on in connection with stock raising.

Stock is allowed to roam at large, and in consequence the mountain forests suffer from fires which are set with the false idea that they improve the range. There is, however, a growing sentiment against this destructive practice.

This mountainous county, largely made up of absolute forest land, must depend in great part upon its forests as a source of revenue. This being the case, fire protection and improved forest management are of vital importance, not only to the community as a whole but to the lumber companies whose timber holdings will usually be retained after being cut over. With an efficient fire warden system, toward the maintenance of which the lumber companies should contribute, the perpetuation of the forests ought to be assured.

SWAIN COUNTY.

Swain is the second largest county of the region, and contains some 358,000 acres of land, 60 per cent of which is held in large blocks by speculators and lumbermen. Its northern border extends 50 or 60 miles along the top of the main ridge of the Smoky Mountains; its southern border is formed by the Little Tennessee River, which separates this county from Graham. The general elevation of the Smoky Mountains is over 4,500 feet. The highest point in the main range is at Clingman's Dome, which has an elevation of 6,600 feet, while there are several other peaks more than 5,500 feet in height. The county is drained by many swift mountain streams, which flow into the Little Tennessee and its two main tributaries, the Tuckaseigee and Nantahala Rivers. These streams come together near Bushnell, in one of the wildest and most picturesque parts of the mountains that are penetrated by a railroad.

The topography of nearly the whole county is rough and rugged, the slopes of the ridges being steep, rocky, and often precipitous. The valleys for the most part are narrow, and contain only small areas of bottomland.

Conglomerates and gneisses are the principal soil-forming rocks. The soil of the lower valleys is a deep, alluvial loam, while on the lower slopes and in the coves a fairly deep, stiff clay soil predominates, which, when cleared, is likely to be eroded. The soil of the ridges and upper slopes is usually thin, rocky, and unproductive.

Swain cannot be said to be an agricultural county. Corn and hay are grown for local consumption in the little valleys and on the lower slopes, and stock raising is carried on in a small way in the mountains. The best farming land is found in Oconalufty and Tuckaseigee Valleys, above Bryson City, the county seat and principal shipping point, on the

Murphy branch of the Southern Railway, which runs through the central part of the county. Much lumber and cordwood, however, are shipped from Bushnell. A branch line of the same railroad extends down the north bank of the Little Tennessee River from Bushnell to Fontana, a distance of 12 miles, which line is to be continued to Knoxville, Tennessee. The Appalachian Railroad runs out from Forney eight miles to Cherokee, and is soon to be extended four miles farther up the Oconalufty River. With these extensions, transportation facilities will be materially improved.

The wagon roads in the western part of the county are rough and badly washed, so that the lumber hauling is difficult. In the central and eastern part of the county, however, the roads are in fair shape, the best roads being those on the Cherokee Indian reservation.

This reservation is located in the northeastern part of the county and contains some 18,000 acres of land. Up to a short time ago the Cherokee Indians owned several times this amount of land, but a large tract has recently been sold off to a lumber company.

Lumbering, the principal industry of the county, is carried on chiefly by means of small portable mills. One large band mill, however, is in operation at Eagle Creek, the logging being done by a narrow gauge railroad. The Whiting Lumber Company, also, runs a narrow gauge railroad from its mill in Graham County to Judson, the shipping point, where it owns a large planing mill.

Most of the lumber sawed in the county by small mills is flumed out to the railroad, because of the difficulty of transporting lumber by road, and the expense of building railroads. Within easy hauling distance of the railroads and near the flumes, where the better grades of timber have previously been removed, the land is now being cut over again for tanning extract wood, pulp wood, and tanbark, which find a ready sale delivered at all the small stations. These industries have become important factors in forest utilization. After the farm crops are harvested many persons spend the rest of the year getting out wood and bark. This thorough culling has resulted in a second growth of black oak, white oak, poplar, chestnut, ash, and hickory, which in a few years, if fires are kept out, will produce good timber.

About 94 per cent of the land is forest, of which at least one-third is virgin. The best stands are found near the heads of the streams and in the coves. The trees are tall, often with 80 feet clear length, and with diameters varying from 2 to 5 feet. The forest in such situations is made up chiefly of chestnut, poplar, hemlock, red oak, and basswood, associated with small quantities of other and sometimes even more valu-

able trees. These stands will sometimes run from 25,000 to 40,000 board feet to the acre over considerable areas, but the average yield will not exceed 7,000 feet.

About one and one-half miles north of Siler's Dome, on the Great Smoky Mountains, occurs the southwestern limit of the spruce type. The trees near the windswept summit of the mountains are rather small and scrubby, but where protected they average 2 feet in diameter and 4 to 5 logs to the tree. Some of the better forests of this type will run from 40,000 to 50,000 board feet to the acre.

Fires have been numerous in Swain as in the other mountain counties. It was estimated by some of the residents that from 30 to 50 per cent of the land has been burned over every year for a long period. Fortunately, however, conditions are changing, and most of the large companies now employ men to watch against fire, and there is a growing sentiment throughout the county against burning the woods.

MACON COUNTY.

Macon, in the southern tier of counties, is largely mountainous. It is drained by the Tennessee and Nantahala rivers, which flow north from the Blue Ridge. The Tennessee River, flowing through the center of the county, has formed a broad flood plain from one to four miles across, and this plain extends several miles along the principal tributaries. The Cowee, Blue Ridge, and Nantahala mountains rise abruptly above this fertile farming region and cover four-fifths of the county's area of 340,000 acres, of which about 15 per cent is cleared. The rock formation is chiefly granite, gneiss, and schist, decomposing principally into a micaceous red clay soil. This soil washes easily where it is cultivated on the steeper slopes, though most clearings on these slopes are kept in grass, which largely prevents erosion. The soil of the Highlands plateau is sandy and poor. Only about one-third of the county is owned in tracts of 1,000 acres or more. Most of such tracts are held for timber or speculation. Lumbering is extensive. In 1909 some 25 mills manufactured about ten million board feet of lumber, though most of this was cut by only three companies. There are some valuable mineral deposits, such as iron, mica, gold, and precious stones, but only the mica resources have been developed.

Franklin, the county seat, is the terminus of the county's only railroad, which enters from Georgia. Shippers complain of excessive freight rates, which, they say, render impossible the proper utilization of the poorer grades of lumber and of the less valuable species. The Nantahala Transportation Company operates a flume in the western part of the county, which carries, besides a great deal of hemlock, oak,

poplar, and chestnut lumber, practically all the pulp and extract wood that leaves the county. It connects with the Murphy branch of the Southern Railroad at Nantahala. Much bark is shipped from the county, though with but little profit to the farmer, who receives only $6.50 a ton loaded on the cars. This low price is a result of the high freight rate and of the roundabout railroad route to the tanneries.

Fully 80 per cent of the area of Macon County is absolute forest land, and only a little more than 3 per cent of the present forested area has soil suited to farming. These farming areas are chiefly in the center of the county. The main body of timber is in the western mountains. Here is virgin forest covering from 10 to 15 per cent of the county, and containing valuable poplar, oak, chestnut, buckeye, linn, and cherry. The forests of the eastern mountains have been more heavily culled of their valuable timber. Around Highlands are extensive areas of hemlock and some remnants of what were a few years ago valuable white pine stands, which are now nearly exhausted. The forests of the central lowland area consist chiefly of woodlots of second growth black and white oaks, none of which are larger than tie size.

The reproduction of hardwoods is good where the forests are protected from fire. White pine reproduces well on the Highlands plateau both on cleared fields and under the open defective stands of white oak, red oak, and chestnut. A little more than 3 per cent of the county is abandoned farm land, chiefly steep slopes seldom cultivated, but kept in grass. Abandoned fields generally seed up thinly to pitch pine and occasionally to fairly good stands of yellow poplar.

The object of management should be to encourage white pine on the Blue Ridge, and to remove also the inferior species when lumbering the valuable timber. Macon County will always remain primarily a forest region, though it has a good proportion of farm land.

JACKSON COUNTY.

Jackson County, with an approximate area of 316,000 acres, is rough and broken with elevations which vary from 1,875 feet near Whittier to 6,400 feet on the top of the Balsams, while the average of the southern half of the county is more than 3,000 feet. The extreme southern portion is cut off from the rest of the county by the Blue Ridge and is drained by the headwaters of the Chattooga and Whitewater rivers to the Atlantic. The northern, comprising much the greater, portion of the county, is drained by the Tuckaseegee and its tributaries. The bottoms are generally small and narrow, though there are some fairly large areas on Cullowhee Creek and Tuckaseigee River.

The northern half of the county has a red clay sub-soil, excellent for farming where the slopes are not too steep, and the soil of the bottoms is very productive; near the Blue Ridge, however, the soil is poorer and more sandy. The chief agricultural products which are shipped out of the county are apples, cattle, and sheep. From 10 to 15 per cent of the county has been cleared for cultivation, about one-sixth of which is in cultivable crops, one-half in pasture or meadow, while one-third has been abandoned. Over a large part of the county the land is either too steep or the soil too poor for the best growth of corn or small grains, but if seeded to grass within a year or two after clearing it yields good forage.

Transportation facilities are as yet inadequate. The Murphy branch of the Southern Railway crosses the northern part of the county while the Toxaway branch comes within about seven miles of the county line on the southeast. Lumber and tanbark are hauled from 20 to 25 miles to these railroads over roads that are only fair, so that only the better grades of material can be marketed at a profit. Dogwood blocks have been hauled from the south slope of the Blue Ridge, from 35 to 40 miles, to Westminster, S. C., where they are manufactured into shuttles and bobbins. Flumes are used principally in getting out cordwood, and, to some extent, lumber. Three long flumes are now in operation and two more are contemplated. Road improvement would greatly facilitate the development of the county.

More than half the forest land is held in tracts of more than 1,000 acres, and half of this is held by three owners, the Jackson Lumber Company, the Toxaway Lumber Company, and George H. Smathers. The average assessed value of timber lands is from $2 to $3 per acre, varying according to stand and location. Probably 85 per cent of the entire county is absolute forest land, and many of the clearings should never have been made.

The forests have been largely culled of the best poplar and other more valuable trees; even on the farm woodlots little merchantable poplar has been spared. White pine was at one time quite abundant over the southern half of the county, but now there is scarcely any left. Yet these are the two species which at the present time can be profitably cut and hauled long distances to the railroad. They will bring from $3 to $4 per thousand stumpage, at from 20 to 25 miles from a railroad, though together they will average less than 1,000 board feet per acre.

Chestnut and oak now form the principal part of the forest. The chestnut is, for the most part, wormy and windshaken, and is valuable chiefly for extract wood. The stand varies from 10 to more than 40 cords per acre. There is a fair proportion of pulp wood, hemlock,

poplar, linn, and pine, in addition to the chestnut, which greatly increases the desirability of such tracts as fluming propositions. Flumes are the chief means of transporting to the railroad.

Oak, on the whole, is of inferior quality except at the higher elevations and on northerly slopes, where red oak becomes important. White oak, as a rule, is small, short-boled, and often defective, and forms a comparatively small proportion of the cut. Scarlet oak is abundant on the dry flats and ridges, but makes only low grade, inferior lumber. Chestnut oak has been cut for bark within 20 miles of the railroad, except on the large holdings. Uncut stands containing chestnut oak will yield from one-fourth to one-half cord of bark per acre. Little timber of this species, however, has been utilized for lumber.

The forests south of the Blue Ridge are, on the whole, poorer than those north of it, largely because of the greater damage caused by fires on the south slopes. For these south slope forests a stand of 2,500 board feet per acre, including all merchantable timber over 10 inches in diameter, is considered good, while the average will not exceed 1,500 or 2,000 board feet. Many stands north of the Blue Ridge, however, will yield from 4,000 to 10,000 board feet, and occasionally more.

Fires are becoming less and less frequent, as the result of a distinct sentiment, particularly among the larger land owners, against the practice of burning the woods. Probably not more than 20 per cent of the forest was burnt over last year; and where the woods have escaped fire for several years reproduction is satisfactory. White pine and poplar reproduce readily along the Blue Ridge, while sprout growth of chestnut and the oaks is abundant in nearly all parts of the county. The old fields at lower elevations near the Tuckaseigee River are stocked chiefly with shortleaf, pitch and scrub pines, while white pine is a common old field tree in the southern part of the county. The stock law is in force over the middle part of the county alone, yet its extension to the entire county would unquestionably benefit both forest and cattle owners.

HAYWOOD COUNTY.

Haywood County covers approximately 346,000 acres, with an average assessed valuation of about $5 per acre. Much over half the land is held in large tracts by lumbermen or speculators.

The general topography of Haywood is very rough and the elevations high. The highest point, Richland Balsam, has an elevation of 6,540 feet, and several other peaks are 6,000 feet or over. The main ridges, along the county line to the west and south, average higher than 5,000 feet.

The county comprises the entire Pigeon River watershed in North Carolina. This river has its source on the north slope of the Pisgah ridge, and flows north throughout the central portion of the county, being joined by several large tributaries, all rising within the county. Above Ferguson, the river flows through a comparatively broad valley, the principal agricultural region.

The soil in the valleys varies from a sandy clay loam to a stiff, heavy red clay, while on the slopes the soil is clay. On the ridges the soil is a very thin sandy clay except on the high Balsam Mountains, where there is a deep black loam, rich in humus, that is easily destroyed by fires and by washing.

Waynesville, the county seat, with an elevation of about 2,700 feet, is one of the principal summer resorts in Western North Carolina.

The Southern Railroad runs through the central southern or best agricultural portion of the county, through the Pigeon River and Richland Creek valleys, and affords good transportation facilities. A narnow gauge railroad, used by the Champion Fiber Company to get pulp wood to their plant, runs up Allen Creek a distance of about eight miles. This company has graded a railroad from Clyde to Sunburst, and expects to put it in operation soon. About 50 miles of macadam roads have been built in different directions from Waynesville. The dirt roads in the valleys are in good shape, but the rougher mountain roads are in bad shape.

Practically 17 per cent of the county has been cleared for agriculture, and the farmers specialize on stock raising, Haywood's cattle and mules being known all over the region. Little of this, however, is grazed on forest range, since the greater part of the county is now under stock law. At least half of the cleared land on the lower slopes and broad ridges is used for grazing. Unfortunately, much of the land which has been cleared for grazing is very steep and has washed so badly that it has become almost worthless.

Haywood probably leads the mountain counties in the manufacture of forest products. The Champion Fiber Company, at Canton, is the largest mill of its kind in the South. It employs from 600 to 800 hands, and furnishes a steady market for a large amount of timber, much of which would otherwise have little value. There are several wood-working factories at Waynesville and Hazelwood, and a tannery at the latter place.

Lumbering is carried on mainly by small, portable sawmills, the lumber being hauled to the railroad on wagons. Flumes are being used to great advantage on three large operations to float cordwood and lumber to the railroad.

The best timber is in the coves and towards the heads of the streams in the western and southern portions. Here virgin stands of the principal species still remain, and some large watersheds average more than 7,000 board feet per acre. Large quantities of chestnut, poplar, red oak, linn, and hemlock are still standing, and much of it is over-mature. At least one-third of the county is covered with original forest growth. On the lower slopes and ridges, the forests have been culled several times and now support a second growth of oaks, chestnut, hickory, and maple. Where fires have been kept out these stands are growing fairly well, but the forest would be greatly improved if the over-mature trees were removed. In the old washed fields of the western and central portions yellow pine has come up, and if left will hold the soil and put it to profitable use. The largest continuous area of spruce and balsam in the State is on the high mountains of the southern part of Haywood and extending over into Jackson and Transylvania counties. In this area red spruce constitutes about 80 per cent of the stand, balsam 18 per cent, and birch, beech, and buckeye the remainder. The trees grow in dense stands, with diameters up to 3 feet. The best timbered areas will cut 50,000 board feet to the acre, but the whole type will not average more than 8,000 because of the small timber on the tops of the ridges. The Champion Fiber Company is now logging in this forest near Richland Balsam.

The general sentiment of the people throughout the county is against fires, yet from carelessness and other sources fires burn over 20 per cent of the forests annually. Land-owners fail to insist on fire prevention when they sell standing timber, and the purchaser is indifferent, so long as he sustains no loss.

TRANSYLVANIA COUNTY.

Transylvania County has an approximate area of 237,000 acres. The comparatively small portion of agricultural land lies chiefly in the valley of the French Broad which rises in the southwest and flows northeast through the middle of the county, draining nearly the whole area. Its two principal tributaries, Davidson and Little rivers, drain, respectively, the rugged northern and southeastern sections. South of the Blue Ridge a small section drains into the Horsepasture River, which flows into South Carolina. The most rugged mountains are in the northwestern part, reaching an altitude in the Pisgah ridge of 6,440 feet. The lowest elevation in the county is on Toxaway River, 1,100 feet above sea level.

The rock formation is largely granitic, with some schist and limestone. The soil generally is loamy, but along the Blue Ridge, in the

southern part of the county, sand predominates. Most of the county is absolute forest land, yet the forest is in poor condition, the repeated burnings having hastened the death of mature timber and largely prevented its replacement by young growth. Near the railroad the woods have been culled of their best timber during the past ten years, and the poorer species are gaining ground.

A tract of 50,000 acres in this county, belonging to the G. W. Vanderbilt estate, has had fire patrol for several years. In spite of some wilfull setting of fires the reproduction is remarkably good over more than half of this protected area.

This county contains several large holdings, aggregating nearly 100,000 acres, or 42 per cent of the total area. Most of this land lies in a solid body which could readily be placed under a system of fire patrol, which could be maintained at a cost of only a few cents per acre. The stock law is in force over probably a third of the county, but not in the more mountainous parts.

One of the chief sources of income is the summer tourist trade, and some 12,000 acres are owned by summer hotels in solid holdings. This is one of the best known summer resort regions in the Appalachian Mountains, the celebrated "Sapphire Country" lying in this and Jackson County. For this reason, the forests should have special consideration here, because of their great æsthetic as well as economic value.

Aside from the summer resort business, the great industry is the marketing of chestnut extract wood and tanbark, and the old overmature chestnut is being cut and disposed of for extract wood, of which there is still probably 30 cords to the acre on the forested area of the county. There is a large extract plant and a large tannery, both centrally located. A very small proportion of this chestnut wood is fit for saw-timber. Much pulp wood from hemlock, poplar, linn, and pine, is shipped out of the county.

The lumber trade is not active at this time, and no large mills are in operation, though one is being erected in the Cathey's Creek region, which will cut 1,000,000 feet a year. The reasons for the present small annual cut are: the poor stand on much of the area; the inaccessibility of some of the better timber; and, most of all, the control of large bodies of timber by companies which do not wish to have them logged.

The county has good railroad facilities, since the Transylvania branch of the Southern Railroad extends almost across the county, making good connections at Hendersonville and Asheville for the north and south. The roads of the county are good in the larger valleys, but much of the county is still somewhat inaccessible, even by trail. Though there is con-

siderable undeveloped agricultural land in the large holdings, this is typically a mountain county which will remain largely dependent on its forests for its revenue and prosperity.

HENDERSON COUNTY.

Henderson County, with an area of nearly 232,000 acres, has a larger proportion of comparatively level land than most of the mountain counties. The Blue Ridge crosses the eastern part of the county and the Pisgah range borders it on the west. Between these two is a large plateau drained by the French Broad and its principal tributaries, Mills River and Mud Creek. The south slope of the Blue Ridge is drained by Green and Broad rivers, both flowing eastward.

The rock formation is mostly granitic. The soil is sandy, underlaid by deep red clay, except in the southern part where clay comes to the surface. Though not the best agricultural land, the soil is productive when properly farmed and fertilized.

The county is well provided with railroad facilities, the Toxaway and Spartanburg branches of the Southern Railway connecting it with all important markets. The public roads form a complete network over the greater part of the county and are kept in condition by the county chain-gang. A few areas along the more distant borders, however, are still somewhat inaccessible. On Big Hungry River, about the headwaters of Green River and in the extreme northwestern part of the county are large areas, several thousand acres in extent, that are too far removed from the railroad to be properly opened up for lumbering or settlement.

These three localities, together with the Broad River drainage basin in the northeastern part of the county, include all of the best timber, though the larger and better poplar is mostly culled out. Whip sawing has been extensively practiced in lumbering poplar, and is still employed. Some logging was done in the extreme northwest, chiefly on the Vanderbilt estate, and the timber splashed down Mills River from 12 to 15 years ago. Elsewhere in the county most of the merchantable timber has been cut.

Since there are so few extensive tracts of valuable timber in the county there are few large mills, but 25 or more small mills are scattered over the county; none of them cut much more than half a million feet annually. Many of them have little else than small black oak and poor quality pitch and shortleaf pine to work on. Among these mills are at least three old-fashioned sash-saw water mills; their presence indicates the exhaustion of the supply of accessible timber, since the owners say it would not pay to install modern circular saws. Several

small shingle mills are operated in connection with the saw mills, and this enables them to utilize small and poor timber. One mill was cutting laths from pine logs that were as small as 5 inches in diameter at the top. The only shingle mill of importance cuts 500,000 shingles annually.

The pulp and extract wood business is carried on very extensively with no immediate sign of lessening. Probably about four-fifths of the exported wood is chestnut, about one-tenth poplar, and one-tenth pine and miscellaneous pulp wood, together with a considerable amount of fuel wood which is shipped to Asheville. Tanbark is nearly exhausted, though several carloads are shipped annually from most of the railroad stations. A considerable number of ties are cut and delivered along the railroad right of way. Other minor wood industries in the county are a handle factory, a planing mill, and a furniture factory. Henderson is one of the most densely settled counties, and will always make a considerable demand upon its forests. Its location with reference to markets, and its population, make possible a complete utilization of the timber resources. It will remain primarily a farming and stock-raising county, though it contains large areas of absolute forest land. The people are progressive, and are aware of the damage by forest fires. There is a county stock law and a live public sentiment which help to keep most forest fires in control.

Forest reproduction is good, except in remote mountain districts where fires still occur. White pine, while not abundant commercially except in the southwest, comes in remarkably well on old fields where there are nearby seed trees. Its height growth will average fully 2 feet a year, and this makes it one of the best species for planting. Chestnut is not reproducing well, which is possibly partly due to the fact that it is culled out so that the stumps are too much shaded by other species for successful coppice growth. Its poor sprout growth may also be due to the fact that the trees are cut at the season of the year which least favors sprouting. Poplar also comes in poorly except along the edge of clearings and waste areas. The chief reproduction in the forest here, as elsewhere, is oak, especially scarlet oak. On many old clearings, poplar and locust come in well, and on clear cuttings the oaks and chestnut flourish. White pine is seeding abundantly under the rather open woodlot forests of black and white oaks, where there are seed trees. In many places, especially south of Hendersonville, it would be wise to cut out the overhead oaks for fuel, leaving a good stand of young white pine which is already on the ground.

This county is widely known for its advantages as a summer resort. Large areas about Hendersonville, Flat Rock, and the several artificial

lakes in the region are kept in forest and protected from fire for the beautifying of summer homes and estates.

Henderson County has special reason to protect and perpetuate its forests on the absolute forest land, because their benefits are needed for the large and growing population on the extensive farm areas.

BUNCOMBE COUNTY.

Buncombe, with an approximate area of 400,000 acres, is the largest county west of the Blue Ridge. The topography is on the whole more open and level than that of any other county of the region, though several peaks rise to over 6,000 feet in the northeast corner of the county, and in the southwest also the mountains attain considerable heights; all the central part, however, is a rolling plateau, varying from 2,000 to 2,500 feet in elevation. This condition, together with the favorable markets, makes Buncombe one of the best agricultural counties of the region.

The French Broad River, which flows through the center of the county, with its tributaries, Swannanoa River, Hominy, Cane, Sandy Mush, Big Ivy, and other smaller creeks, drains the entire county.

Owing to the comparatively slight fall in most of the streams, there are large areas of bottom land, which produce excellent crops. Altogether 50 per cent of the county has been cleared for cultivation, but probably 10 per cent of this is now abandoned. There is much forest land left, however, that can be cleared. Five-sixths is held in farms and small areas under 1,000 acres in extent, so that much the greater part of the forest land should be considered as farm woodlots. Of the remaining one-sixth, nearly one-half belongs to the famous Biltmore estate, which, besides forest, includes much rich and well-tilled agricultural land.

Rough forest land has an assessed valuation of from $2 to $5 per acre, varying according to location and the amount of standing timber.

Railroad facilities in Buncombe County are excellent. Four lines of the Southern Railway radiate from Asheville, the center of the county, to the north, south, east, and west; besides which there is an electric road which is being extended from Asheville to the northeast corner of the county. There are 700 miles of wagon roads in the county, 60 miles of which are macadamized.

Buncombe is essentially an agricultural county. There are a few small woodworking plants in and around Asheville, a tanning extract plant, and one of the largest plants in the South for the manufacture of coffins and caskets is now being built at Asheville. Asheville is headquarters for a large hardwood business, but the dealers draw their sup-

plies chiefly from outlying counties. There are many portable mills which cut small amounts of timber here and there over the county, though only one or two large logging operations have been attempted.

The forests have been so closely and so frequently cut over that there is little virgin timber left. Practically the only good timber is on the high, steep mountains in the northeast and even here most of the larger poplar was culled out years ago. There still remains some smaller poplar and considerable chestnut, red and chestnut oaks, and a little maple. The best timbered stands are variously estimated at from 2,000 to 7,000 board feet of merchantable timber per acre, with 3,000 feet of saw timber as a fair average. Throughout the remaining forested portions of the county there is little salable saw timber left. Second growth, especially of the different species of pine, has come in abundantly on the more severely cut over woods of the rolling uplands as well as on the old fields. Pine does not seem to flourish above 2,500 feet in elevation. Reproduction of the hardwoods, such as chestnut, poplar, and the oaks, is abundant on the steeper and higher slopes, while locust is found principally on the abandoned cleared lands. In the flat woods, a gravelly area in the southeastern part of the county, young chestnut is almost entirely absent, and even the old trees which were once common have nearly all died.

There is a strong sentiment against burning the woods and much of the woodland has not been burnt for many years. Carelessness on the part of farmers in cleaning up land for cultivation in the spring has, however, been the cause of several very destructive fires.

The forests of Buncombe have their chief value to the people in furnishing fuel, posts, and other timber for local uses, and in preventing erosion. While the mountainous regions in the outskirts of the county will continue to produce timber of the more valuable kinds, the forests of the central part will be required chiefly to supply the local needs. By keeping fire out absolutely, and by cutting for fuel all the slow growing, inferior species, the productiveness and value of these forests should continuously increase.

MADISON COUNTY.

Madison County contains approximately 270,000 acres. About 35 per cent of the land is held in large holdings of 1,000 acres or more in extent, which are situated for the most part in the northern and western portions of the county, where the land is valued chiefly for its timber. The topography, like that throughout the western part of the State, is rough. The highest point is Sandy Mush Bald, in the extreme southwestern corner, which reaches an elevation of 5,168 feet, while the lowest

altitude, 1,300 feet, is in the valley of the French Broad at the Tennessee line. This river, which falls about 227 feet in its northwestward course through the center of the county, together with its tributaries, the largest of which are Spring and Laurel creeks, makes a very complete drainage system. The valleys of the streams that flow into the French Broad are generally narrow, with steep, rocky slopes near their mouths, generally becoming broader with more gentle slopes near the headwaters. The ridges are low and broad in the eastern portion of the county, while in the west they are not uncommonly rocky and precipitous. The principal rocks are conglomerates, quartz, and sandstone.

In general, the soil may be described as a loamy clay. On the lower slopes and in the valleys it is deep and alluvial in character, becoming poorer and thinner in the upper slopes, until on the higher ridges it occurs only in thin patches or between the crevices of the rocks.

The principal agricultural crops, corn, hay, rye, and wheat, are raised for home consumption; recently Burley tobacco has been tried in the western portion of the county; stock raising is extensive.

Marshall, the county seat, is built on a small area of flat land in the French Broad Gorge, and is enclosed on either side by steep hills rising some 200 feet above the stream. A cotton mill utilizes the water-power at this point.

The chief shipping points are all located along the French Broad on the Southern Railway, of which Barnard, Stackhouse, Hot Springs, and Paint Rock are the most important. Barnard has a hickory handle factory.

Transportation facilities are poor. The roads on the high ground are washed and rocky, and many of the valley roads have been relegated to the creek beds. These conditions, together with the rough topography, prevent the close utilization of timber at present market prices, except near the railroad; as a result thousands of feet of dead and down timber, which might be utilized for ties or cordwood, are going to waste.

Approximately 29 per cent of the land is cleared. The agricultural sections are along the valleys, the lower slopes, and the broad hilltops of the eastern, southern, and central portions. Here the woods have been cut over several times for lumber, so that the present forest is made up of second growth oak, chestnut, hickory, maple, and poplar, mixed with over-mature, stag-headed trees, chiefly of chestnut and oaks. These stands would be greatly improved if the mature trees were removed. Yellow and white pine have come in on the old fields of the eastern portions of the county, forming dense stands that should be cared for and protected from fire.

The northern and western portions of the county still retain a large part of the original growth of chestnut, poplar, and red and white oaks. Along the main streams and in the more accessible places, however, portable mills have taken out much of the better grades of oak and poplar. Several years ago a company splashed logs down Big Laurel to its mouth, but the operation was unprofitable.

West of Shelton Laurel, white pine grows in mixture with the hardwoods, and is the chief tree in the stand. Over considerable areas it still forms as much as one-quarter of the merchantable standing timber. In rocky cliffs along the French Broad River the three common species of pine—scrub, shortleaf, and pitch—often mixed with a few white pines, form almost pure coniferous stands. Their growth is slow and the trees are small, averaging from 6 to 12 inches in diameter. The soil is thin and susceptible to erosion, so that in cutting this type, enough trees should be left to protect the soil and to furnish seed for a second crop. These pines are prolific seed bearers, and if fire is kept out reproduction can readily be obtained.

Fire scalds, or old burns, are very numerous on the southern slopes in the western part of the county, and much damage has been done by forest fires elsewhere. It is estimated that at least 25 per cent of the forests throughout the county are burned over annually. The present sentiment of the people, however, is against fires, but nut gatherers and campers still do enormous damage with fire each year. In the more thickly settled regions the woods are injured by cattle which run at large in the northern half of the county, where in many places reproduction from this cause is almost wholly lacking.

YANCEY COUNTY.

Yancey has an approximate area of 193,000 acres, with an average assessed value of $2.60 per acre. Over 40 per cent of the land is held in large tracts of 1,000 acres or more in extent. These holdings are valued chiefly for their timber and are held principally as investments.

The topography is generally rough and the average elevation high. The Black Mountain Range in the southern portion of the county contains many peaks more than 6,000 feet high, and Mount Mitchell, the highest peak east of the Rockies, rises to an elevation of 6,711 feet above sea level. In the northern and western sections of the county the ridges have an average elevation of about 4,000 feet above sea level, Bald Mountain rising to 5,500 feet.

Four considerable streams, South Toe and Caney rivers, and Jacks and Crabtree creeks, rise within the county, and flowing in a northerly direction empty into Toe River, which forms the northern boundary of the county.

The rocky and often precipitous slopes and narrow ridges of the higher mountains give place below the 4,000 foot contour to broader ridges with more gentle slopes, these, in turn, gradually descending into comparatively level, though narrow, valleys, where most of the land has been cleared and is devoted to agriculture.

The principal rocks are sandstones, conglomerates, and quartzites. Micaceous rocks occur throughout the county, but are most abundant in the eastern portion, where mica mines are being operated. The soil on the higher ridges is very thin, except in the spruce formation, where, on the slopes, there is a deep, black sandy loam which washes away when the forest is cleared off. The lower ridges and slopes are covered with a sandy clay of varying depth, which is well adapted to the production of grass, and of fruits, especially apples. The principal crops are corn, hay, and potatoes, all of which are used locally. Stock raising is extensive, and though cattle, sheep, and hogs still roam the woods in the roughest districts, large areas have been cleared on the ridges for grazing purposes. Good grass land is valued at from $10 to $15 per acre, while farm land in the valley ranges from $20 to $50 per acre.

Lumbering is carried on for the most part by small portable mills. Some seven years ago a lumber company put in a band-mill near Bald Mountain, built 18 miles of narrow gauge railroad down Caney River to Huntdale, and failed after taking out some 15,000,000 feet of timber. Lumber that is shipped out has to be hauled over rough roads, which in winter and spring are almost impassable. Besides this the railroad points are on the north side of the Toe River in Mitchell County, and there are no bridges. Since the larger streams can not be forded after heavy rains, the building of roads and bridges would enormously increase the value of property in Yancey County.

Burnsville, the county seat, has all the advantages of an ideal summer resort, except accessibility.

Of the 85 per cent of forest land, considerably more than half has been cut over; virgin stands still remain in the southern and western portions of the county. The Murchison boundary of 13,000 acres, located on the headwaters of Caney Creek, is the largest single tract of virgin timber.

In the northern, central, and eastern portions, a large amount of the land has at one time or another been cleared for agriculture, but much of it has been abandoned and now generally supports a thrifty second growth. Here the forests have been culled several times, and the better grades of oak, poplar, and pine removed, leaving the poorer species. As a result most of the woodland is second growth, with scattered old chestnuts, red oaks, poplars, and white oaks, many of which are stag-headed,

decayed at the butt, and over-mature. These are in many cases hindering the development of the younger trees, so that the forest would be benefited by their removal. Where the cuttings have been comparatively recent and severe, an even-aged second growth of oaks, chestnut, poplar, hickory, and maple is common. Where fires have not burned the stands are thrifty and in good condition.

In the forests which have not been culled heavily, chestnut and the oaks make up at least 60 per cent of the stand; poplar, hickory, and maple are also important. Over-mature and defective trees of all species, but especially of chestnut, are present. Chestnut and the oaks are reproducing prolifically from sprouts, while seedlings of poplar and hickory are common. At present, there is very little market for the large defective chestnut trees, and this must continue to be the case until means of transportation are improved,* so that this wood can be got out at a profit.

Several areas of the beech and maple type occur in Yancey, as well as in the counties to the east. Beech, birch, sugar maple, and linn make up about 70 per cent of this type. Unfortunately, under present market conditions, the beech, birch, and maple have little value, so that only the linn, ash, cucumber, and buckeye are cut. This gives the inferior species such a great advantage in reseeding the woods that the second growth forest can not help going backward, because it will contain a smaller proportion of the better species than the present one.

A considerable area of spruce forest occurs on the Black Mountains. Red spruce and balsam each make up about half of the stand, the two together running from 20 to 50 cords an acre. Owing to the inaccessibility of this timber it has little commercial value at present, but as transportation facilities improve it will no doubt come into the market for pulp wood and lumber.

The spruce forest has suffered severely from fire. On the east slope of the Black Mountains at least 10 per cent of this type has been totally destroyed. After burning, the soil has been washed away, leaving only bare rocks. The fires are said to be set by hunters. Some 15 to 25 per cent of the county is still burned over each year. The people, however, are becoming convinced that burning the woods is a most destructive practice, and fires are decreasing.

MITCHELL COUNTY.

Mitchell County contains approximately 231,000 acres, with an average assessed value of about $4.50 per acre. Except the northeast corner,

*A railroad is now being built from the Carolina, Clinchfield and Ohio Railway to Burnsville.

which is drained by Linville River, flowing south, and Elk Creek, flowing north, the county lies within the drainage basin of the North Toe River, which, with Crabtree Creek, forms its western boundary. The streams, generally speaking, flow through comparatively narrow valleys with high mountains on either side. The topography is rough and the altitudes high. Grandfather Mountain attains an altitude of nearly 6,000 feet, while several other peaks exceed 5,000 feet in height. The average elevation of the county may be said to be approximatly 3,000 feet above sea level. The ridges of the higher mountains are narrow, with rocky, precipitous slopes and thin soil, while the lower ridges are often broader. These slopes have a sandy clay soil of varying depths, which, if not too steep, will produce an abundance of grass when cleared. The broad ridges, especially in the southern part of the county, which have been cleared for farming purposes, are usually covered with a deep, loamy clay soil. In the valleys the soil varies from a sandy loam to a stiff red clay. These valley and lower soils are well adapted to agriculture.

A few valley roads are in fair condition, but like its neighbor, Yancey, this county should have improved travel facilities in roads and bridges. It would seem that some arrangement could be entered into between these two counties for the joint construction of two or three bridges across Toe River, which would result in enormous benefit to both. Mitchell has built one steel bridge across North Toe at Spruce Pine, where the stream is entirely within the county.

The Carolina, Clinchfield and Ohio Railway runs down the Mitchell side of the North Toe River, so that all points in the southern portion of the county are within a fairly short haul from the railroad. A narrow gauge railroad, which runs from Pineola to Johnson City, Tenn., has opened up the northeastern section of the county to summer visitors, and has made an outlet for timber products. The greater part of the lumber shipped from the county has been carried over this road.

Bakersville, the county seat, is in the heart of the mountains on Cane River, some three miles from the nearest railroad station. Better travel facilities would make it a very attractive summer resort.

Farming is carried on chiefly along the valleys and lower slopes and hills. Corn and hay, the chief crops, are used locally. At least 50 per cent of the cleared land is used for grazing, though stock are still allowed to range the forests over a large part of the county.

Mica, kaolin, and iron are mined to a limited extent. Sheet mica is associated with feldspar in the central and southern portions of the county, and considerable high grade commercial mica has been shipped. There are two kaolin mines on Bear Creek. At Cranberry, iron has

been mined for from 30 to 40 years. The ore was formerly smelted here, but now it is taken in the rough state to Johnson City, Tenn. Before the Civil War, iron ore was mined and smelted near Magnetic City.

Lumbering, which is carried on chiefly by small portable mills, is the principal industry. Some 52 sawmills are at present operating in the county, of which a dozen or more are small water-mills, run in connection with grist mills. All lumber is hauled to the railroad by wagons. This is an expensive process, for though the distances are not great, the hauls are made most difficult by the poor condition of the roads, which in the winter and spring months are almost impassable for a loaded wagon. Three of the larger lumber companies have built tram roads from their logging yards to their mills and the railroad, in order to do away with the difficulties of wagon hauling.

Forests still cover 77 per cent of the county. The best grades of timber are in the northern and southeastern portions, where there are virgin stands. Probably the largest single tract of virgin timber, consisting of some 9,200 acres situated in the Linville River drainage basin, is held by the Linville Improvement Company. Around Magnetic City and Cranberry, where the forest was cut over some 25 or 30 years ago for smelter wood, thrifty second growth stands of young oak, chestnut, poplar, and sugar maple occur. These young stands will develop into valuable forests if protected from fire.

In the less severely culled woods, which constitute the greater part of the forests, chestnut and the oaks are the most important species. In the coves and near the heads of streams, chestnut is the most characteristic tree, probably making up 40 per cent of the stand. The trees are generally large, and the timber for the most part over-mature and poor. Most of it has little value, except for extract wood. In the bottoms hemlock is in poor condition. It is estimated that at least 30 per cent of the trees are shaky or otherwise defective. This bottomland type of hemlock growth which is most common in the Linville Valley and near Montezuma generally occupies deep, loamy clay soils that are well suited to agriculture. These will eventually be cleared up and the land converted into farms. Spruce and balsam occupy the tops and upper slopes of Grandfather, Roan, and Unaka mountains. The trees are generally small and scrubby, and the stand will not average over 20 cords to the acre. Red spruce makes up about 60 per cent of this forest and balsam 35 per cent, while birch, buckeye, and hemlock constitute the remainder.

Fires are most frequent in the vicinity of the railroads, and until recent years there has been little attempt to prevent them. Probably from 20 to 25 per cent of the forest is still burned over annually.

WATAUGA COUNTY.

Watauga, with an area of 211,200 acres, is an upland county of rather rugged topography. The range of elevation is from 2,000 feet near the foot of the Blue Ridge to 5,964 on the top of Grandfather Mountain, while the greater part of the county has an elevation of more than 3,000 feet. The crest of the Blue Ridge runs along the south boundary or a few miles within it. North of this the county is again divided by the Rich Mountain Ridge, which runs north and south through the middle of the county, shedding the western drainage into Watauga River and the eastern into the North Fork of the New River.

The rock of the county is principally freestone, ranging from a fine-grained granite to mica and chlorite schists. The soil is a gray sandy loam almost free from the red clay which is usually prevalent in the mountain counties, and is fairly deep even on the mountains, and does not easily erode.

Watauga has no railroad within its border, the nearest station being Elk Park, five miles outside. Yet the public road system is good, and the roads are for the most part well graded and well kept.

Lumbering is prominent and the lumber can be profitably hauled long distances, even more than 30 miles. The chief shipping points are Elk Park and Pineola, in Mitchell County, Lenoir in Caldwell County, and Shouns and Butler in Tennessee. One large company with a band mill at Butler, Tenn., is operating a tram road in the western end of the county. Of the remaining 20-odd mills, none cuts as much as a million feet, and most are small portable or water mills with a cut of less than 250,000 feet per year. These mills are pretty evenly distributed through the county.

No pulp or extract wood is cut, though in the vicinity of Beech Mountain considerable hemlock bark is gathered and taken to Elk Park and Butler. Probably a thousand cords were taken out in 1909.

Farming is the chief occupation in Watauga. It is famous for its grass, and for its sheep and cattle. There are good farms in all parts of the county except on the rocky slopes of the Blue Ridge in the southeastern corner. Even a large part of the present forest occupies good agricultural land, but this can well be kept so as to furnish fuel and lumber for the farms. Probably 20 per cent of the forest is in farm woodlots. Most of the cleared land used for farming is, strangely enough, on steep mountain sides. Such slopes in a clay county would wash badly, but here, owing to the deeper and more porous soils, and to efficient farm management, there is no serious erosion.

In but few places is the forest in large, unbroken areas, as in certain tracts on Beech, Grandfather, and Rich mountains, and on the south slope of the Blue Ridge. While showing much variation in different parts of the county, the forests are nevertheless characterized by certain species. Hemlock is very abundant throughout, and cuts high grade local building material. Oak and chestnut still predominate in some parts, though they are not much more common than the sugar maple. Cherry and walnut were once common, but together with most of the poplar were cut years ago. White ash is becoming scarce, but white oak is more abundant than in most other counties of this region. Balsam and spruce grow above 5,500 feet on Grandfather Mountain, on Beech Mountain, and in the Elk Mountains.

Practically all of the county is owned in small holdings of less than 500 acres, only about 10 per cent being in the hands of lumber interests or in large estates of over 1,000 acres.

Watauga, remote as it is from large markets, is a progressive county, and is well settled. The land is natural farmland, and except along the southern slopes of the Blue Ridge, there are no very extensive areas of absolute forest land.

ASHE COUNTY.

Ashe, embracing an area of 255,000 acres, is, like Watauga, a farming county; it is perhaps more rugged, though lower in general elevation. The crest of the Blue Ridge forms much of its southeast boundary, while the Elk Mountains occur in the southwest. Other ranges from 4,000 to 5,000 feet high are scattered irregularly over the county.

The county is drained by the North and South Forks of New River. These streams rise in Watauga County and flow in a northeasterly direction. In Ashe County both are capable of floating logs. The chief rock formation of Ashe County is a black banded gneiss grading into shales, slates, and schists, which decompose into a red clay soil containing small mica particles. Along the Blue Ridge the usual gray mica and chlorite schists and granites occur, decomposing into a gray sandy soil.

Like Watauga and Alleghany, Ashe County is remote from railroads. Wilkesboro, in Wilkes County, North Carolina, and Shouns, Tennessee, are its nearest railroad points. Most of the lumber and produce taken out and the supplies brought in have to be hauled from 15 to 40 miles, but the public roads are for the most part well kept. Like all clay roads, however, they are heavy in wet weather.

Ashe County has copper, iron, and mica deposits, some of which have been partially developed. The chief occupation, however, is farming, and this is likely to be the case for some time to come. Cattle and

sheep grazing is extensive. The cleared land on the steep slopes washes considerably, even when in grass, and it is estimated that about 5 per cent of such land is so badly eroded as to warrant its abandonment to forest growth.

A large part of the land has been cleared, since the county has been long settled, and for this reason the forested area has a low average stand to the acre compared with Watauga County. There are no large timbered tracts except in the southwestern part of the county on Paddy, Nigger, Bluff, Elk, Three Top, and other mountains. There are many sawmills, though none has an annual cut of more than 500,000 board feet. Many of these mills cut shingles as well as lumber. Chestnut and white and red oaks form the bulk of the cut, except in the southeastern quarter of the county, where white pine leads. The supply of this timber, however, is nearing exhaustion. Locust does well all over the county, though often attacked by the borer. Probably some hundred thousand locust posts are annually cut for local use.

The forest trees are about the same as those in Watauga. Hemlock is not so abundant, because more of the hemlock lands have been cleared up for cultivation. White oak is the commonest oak, and is much more plentiful than in Watauga County, though much of it is defective.

Ashe will always be chiefly important as a farming county, and its forest's greatest value will be for the production of firewood, small timbers for farm use and for a local lumber supply. While some of the mountain areas in the western part are largely composed of absolute forest land, and can most profitably be kept in forest growth, yet taking the county as a whole, there are no extended areas that are pre-eminently suited for a large State or National forest reserve.

ALLEGHANY COUNTY.

Alleghany, comprising about 140,000 acres, is similar to both Ashe and Watauga counties in its topography and soil, though somewhat less rough than either. It lies largely northwest of the Blue Ridge, and all but a small area south of this divide drains into New River in Virginia, principally through Little River and its tributaries. The county ranges in elevation from about 2,400 to 4,100 feet.

The characteristic rocks are the granites, gneisses, and schists of the Blue Ridge, which decompose into a sandy soil. In the northern third of the county the soil contains clay admixture and yields good crops. In this clay soil are evidences of deep erosion even on gentle slopes, but most of the farms are kept in grass, and this tends to hold the soil in place. The greater part of the county, however, has a lighter, more porous soil, which resists erosion, and where this is the case, even the

steeper mountain sides have a fairly deep soil and are successfully farmed and grazed. A few thousand acres lying south of the Blue Ridge, unlike the rest of the county, is rocky and precipitous, with shallow soil, which is generally unsuited to farming.

Alleghany does not have adequate market facilities, since its roads are not as good as they should be, and the nearest railroad stations are beyond its boundaries. The middle of the county is 25 miles from Galax, Va., 35 from Wilkesboro, N. C., and nearly 30 from Elkin, N. C., the three chief markets. There are no streams large enough for the transportation of timber, though Little River might possibly be drivable in flood seasons. As a result of its isolation Alleghany has not been able to develop its resources. About a thousand cords of tanbark are hauled to market each year, over distances 20 miles or more; but this would scarcely be a paying proposition, were it not for the fact that supplies must be brought in, and a load is thus secured both ways.

Lumbering is on a small scale, with some two dozen portable and water mills. As in Ashe and Watauga counties, there is no great incentive to cut lumber for shipment, since the long haul not only necessitates careful culling, but tends to take away all profit, even on the valuable species. Three or four mills manufacture chestnut shingles, while two or three mills do finishing work, either in connection with the sawmill or as a separate business.

Farming is the chief occupation. The section around and north of Peach Bottom Mountain is fertile and produces two tons of hay to the acre. Sheep and cattle are raised, while the chief field crops are hay, cabbage, buckwheat, and corn.

The mineral resources are undeveloped; soapstone occurs in some places and other minerals have been found along the Blue Ridge.

Most of the forest of the county was cut off years ago when the land was being cleared for farming. At present 63 per cent of the county is cleared. Even in the uncleared areas, the timber may be negligible in quantity and quality because of fires which were set to "improve" the range for cattle. Most of the old timber that has survived is defective chestnut. Young white pine has started up in places, since the cessation of fires. Young scarlet oak grows all over the county. The forest generally is characterized by the predominance of white oak and an abundance of scarlet oak pole stands. Red oak, known locally as water oak, is common on the better sites and in the mountains, and furnishes a large part of the better grades of lumber.

White pine could be planted to advantage on the sandier soils. On the better soils red oak should do well. Scarlet oak managed as coppice, will furnish fuel.

Alleghany will always be a farming county and can utilize locally most of the timber that can be grown there. The county is now under the stock law, and forest fires, which formerly did so much damage, are now rare.

TIMBER INDUSTRIES.

LUMBER.

Practically all of the timber cut in Western North Carolina is sawed or otherwise manufactured in that part of the State; little is shipped out in the log. Two-fifths of all the timber cut for sale is manufactured into lumber; but the greater part of this is shipped out of the region.

Except for agriculture, almost all of the products of which are consumed locally, lumbering is by far the most important industry. In 1909 about 185,000,000 feet of lumber brought a money return of nearly $3,000,000. Table 3, p. 61, shows the total output of lumber for 1909 by counties and species, as obtained by the United States Census Bureau.

Three different classes of sawmills are in operation: (1) large stationary mills, equipped generally with bandsaws, but occasionally with double circular saws; (2) small portable circular sawmills, usually run by steam; (3) small stationary circular sawmills run by water-power.

BAND MILLS.

There were only seven large stationary sawmills in operation during 1908 and 1909, and only four of these ran anywhere near full time. There are several other mills of this class, but they have been shut down for some time, owing to the recent financial depression, or to other causes, while there are two or three similar mills now in process of construction. This class of mills manufactured about 16 per cent of the total amount of lumber cut in this region during 1909, or an average of about 5,000,000 feet per mill. Though this was an enormous increase over the cut of 1908, it did not nearly come up to the full capacity of these mills.

The successful operation of such large stationary mills must depend on the control of a large supply of timber, either through timber rights over a large area, or, more commonly in this region, by possession of both land and timber. Five operators in Western North Carolina together own more than 170,000 acres of forest land in four different counties, and their holdings contain a stand of at least 120,000,000 feet.

The band mills have several advantages over the smaller circular mills. In the first place, there is considerably less waste in manufacture; the kerf cut by a band saw is about one-half of that by a circular saw; large logs can be much more profitably handled because full width

A. LOGGING WHITE PINE AND HEMLOCK, MITCHELL COUNTY.

B. BINDING POPLAR BOARDS FOR EXPORT, SWAIN COUNTY.

TABLE 3.—TOTAL OUTPUT OF LUMBER IN THOUSAND FEET BOARD MEASURE, BY COUNTIES AND KINDS OF WOOD: 1909.

County	Number of Mills Reporting	Total	Oak	Chestnut	Hemlock	Yellow Pine	Poplar	White Pine	Basswood	Ash	Maple	Buckeye	Hickory	Birch	Miscellaneous*
Cherokee	17	9,601	3,433	1,970	141	1,870	1,500	275	170	30	7	55	30	----	120
Clay	3	590	87	28	----	420	50	----	----	3	----	----	1	----	1
Graham	4	4,109	850	750	600	165	1,085	20	225	77	225	30	2	50	30
Swain	21	17,067	4,002	5,143	1,674	2,414	2,473	389	422	83	197	92	35	66	77
Macon	10	8,702	3,312	1,862	177	406	2,573	31	176	59	15	51	35	----	5
Jackson	14	15,244	4,075	3,225	225	3,930	1,822	200	735	312	465	140	25	20	70
Haywood	22	20,571	3,639	4,112	7,753	1,412	1,783	20	572	130	251	356	84	99	360
Transylvania	11	3,127	960	210	125	383	1,336	53	23	2	10	8	11	----	6
Henderson	22	4,642	2,473	376	71	1,065	352	34	10	----	87	5	33	2	134
Buncombe	34	13,932	5,478	2,110	175	3,025	1,708	35	510	280	191	163	48	55	154
Madison	33	13,545	2,727	2,052	130	2,164	2,113	3,307	592	80	53	14	211	5	97
Yancey	22	7,072	2,723	2,159	110	505	847	108	402	60	38	56	15	----	49
Mitchell	55	37,727	8,423	3,774	17,273	2,509	1,836	978	892	886	351	346	30	91	338
Watauga	59	16,039	3,718	2,524	2,408	1,981	1,258	2,790	448	432	306	98	12	64	51
Ashe	47	8,476	3,076	1,629	316	168	1,103	950	553	328	239	81	12	----	21
Alleghany	14	4,263	1,807	900	10	626	565	340	----	----	5	----	----	10	----
Totals	388	184,757	50,783	32,824	31,188	23,043	22,404	9,530	5,730	2,762	2,439	1,495	584	462	1,513

*Includes beech, cherry, walnut, locust, spruce, butternut, sycamore, elm, cottonwood and shittimwood.

boards can be taken out of even the largest logs; lumber is usually less damaged and is, therefore, more salable. Lumbermen claim that an average saving of 10 per cent of the timber is affected by using a band mill. Moreover, because these mills are on railroad lines or on private spurs connected with the railroad, the lower grades of lumber, which with the portable mills are either wasted or sold at a low price for local use, can be readily disposed of. Yet the large stationery mill has one disadvantage as compared with the smaller mills, a probable higher cost of logging, because of a longer haul to mill which necessitates a costly logging railroad. The cost of such roads must be charged against every thousand feet of lumber. To reduce the cost per thousand some operators use material that is too small or too defective to be manufactured with profit. Hence, immature trees, especially of the more valuable species, such as poplar, ash, and linn, are cut and manufactured, though they have less value than they would have as standing trees with the chance to develop to good merchantable size, not counting at all their protective value to steep easily-eroded hillsides.

PORTABLE MILLS.

Rather more than 78 per cent of the lumber is sawed by small portable mills. There are about 300 such mills in the 16 western counties, with an average annual production for each mill of about 350,000 feet. These mills are usually owned and operated by men who own no timber land and either buy enough for a short run or else cut the timber for the owner, charging $3 or $4 per thousand for sawing. In some cases, however, one man owns several of these small mills, and cuts wherever timber can be purchased. These have made more uniform profits than other lumbermen in the region. The average cost to mills is from $3 to $5 a thousand for cutting and logging, and from $3 to $4 for sawing.

The cost of hauling lumber to the railroad varies according to distances, road conditions, and kind of lumber, but averages about 40 cents per mile per thousand feet. Except for hauling, lumber can be sawed cheaper than by the large stationary mills, but the difference is somewhat balanced by the fact that the large mills generally load their stuff directly on the cars.

A combination of the band and the portable mills will probably be found to work to greater advantage, both to the operator and the forest, than either of them does alone. In many parts of the country portable band mills are being used to great advantage, the value of the lumber being increased while the cost of logging is decreased. The profitable use of portable mills requires good roads. The construction and main-

tenance of good roads by either the State or counties would not only favor the use of portable mills, but would increase the value of all property, farm as well as forest, by cheapening the transportation of the products.

WATER MILLS.

Scattered all over the region, but mostly in the better settled communities, are small water-power sawmills, cutting from 30,000 to 40,000 feet of lumber a year. Most of these are connected with grist mills and are operated only occasionally, cutting chiefly for local custom, though a few have a fairly large cut and ship the best of their lumber. Though there are from 100 to 150 water mills in these mountains, they produce only about 5 per cent of the total output of lumber, and most of this is consumed in the neighborhood where it is cut. A water-power mill is of great advantage because no man is needed to fire an engine, and two men can run it. But the power is too uncertain for commercial operations of large size, and will not be generally used so long as there is sufficient waste to provide fuel for the engine. In these mountains there are still to be found a few water mills fitted up with the old fashioned sash saws (up and down saws). Some men prefer them to the circular saw because they have such simple gear that there is little loss in power transmission.

Whip sawing, or, as it used to be called, pit sawing, is still practiced in a few counties, and some of the best quality poplar and linn squares that are shipped out are cut in this way, and hauled 20 or 25 miles to the railroad.

TANNING EXTRACT.

It was not until ten years ago that chestnut wood, which for thirty or forty years had been used in France in the dyeing of silk and the manufacture of leather, was used to any extent in this country. Then plants were established for the manufacture of tannic acid extract from chestnut all through the Eastern States. Several factories were put up in Western North Carolina, chiefly in connection with tanneries. One plant near the Tennessee line in Cherokee County closed out because of bad location and poor management, but four other factories are now operating at Andrews, Canton, Pisgah Forest, and Asheville; and another at Old Fort, just outside, uses material from this region.

Practically all of the 94,500 cords of chestnut wood cut in this region in 1909 was consumed by these five factories. According to the United States Census Bureau, the tanneries in North Carolina used eighteen million pounds of tanning extract made from chestnut wood; the remainder of the output, amounting to probably three-fourths of the total,

was shipped outside of the State. When this industry started, chestnut wood could be bought for $2 a cord delivered at the railroad, and for two or three years it did not bring more than $2.50 a cord; the price has, however, gradually increased until now $4 is paid.

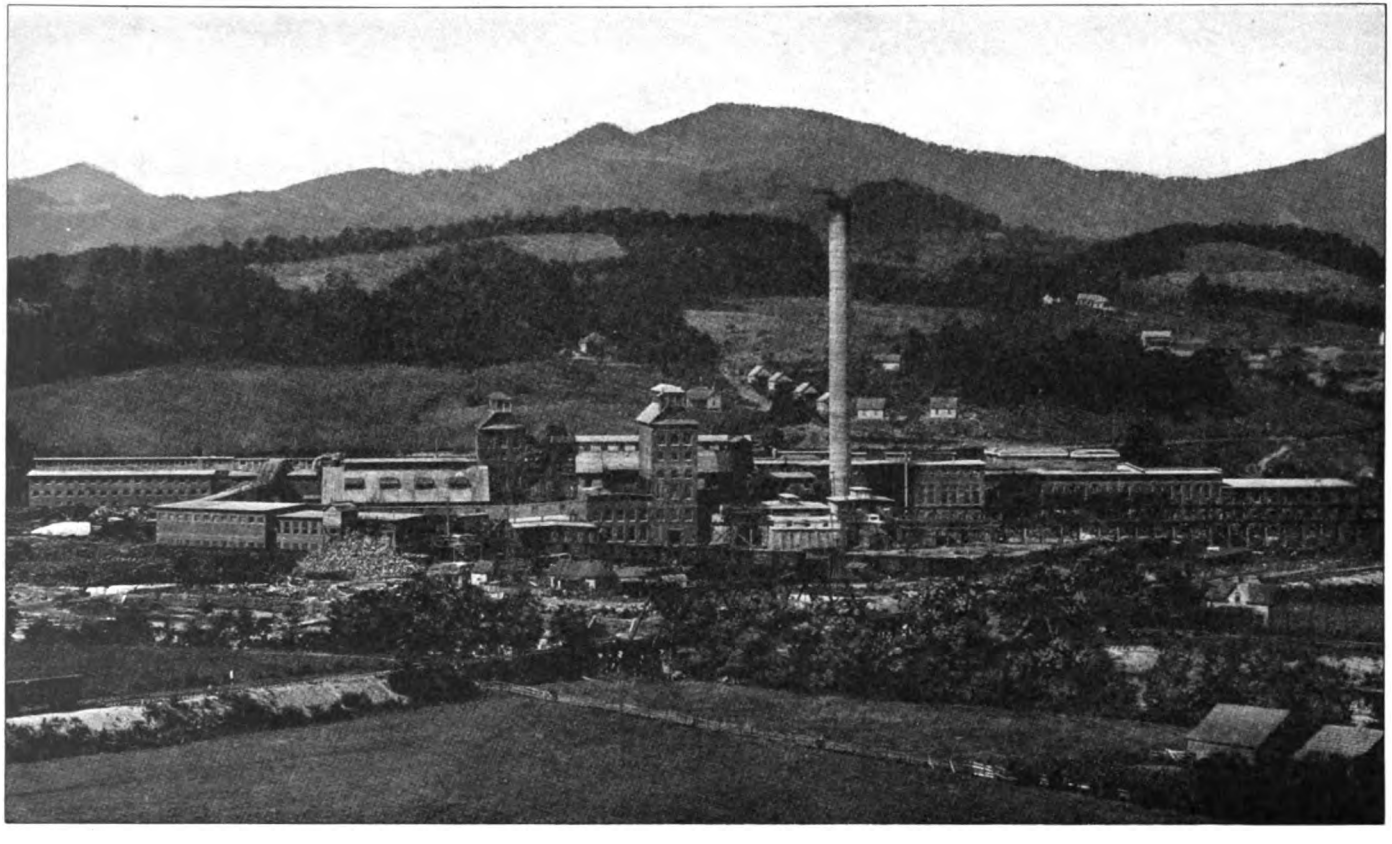
Table 4 gives the approximate amount of chestnut wood cut for tanning extract in the various counties in 1909. It will be seen that the counties without railroad facilities furnish none of this product.

TABLE 4.—OUTPUT OF CHESTNUT TANNING EXTRACT WOOD IN 1909, IN CORDS OF 160 CUBIC FEET, BY COUNTIES.

Counties	Cords	Counties	Cords
Cherokee	10,500	Henderson	13,485
Clay	----------	Buncombe	9,142
Graham	990	Madison	582
Swain	15,360	Yancey	----------
Macon	2,326	Mitchell	2,090
Jackson	13,039	Watauga	----------
Haywood	8,510	Ashe	----------
Transylvania	18,060	Alleghany	----------
Total	----------		94,584

The greater part of the wood is cut and delivered to the railroad by the small farmers during the season when there is not much to do on the farms. The factories will buy any grade of wood so long as it is sound, large enough, and sufficiently straight to be used with their machinery. Dead trees as well as defective live ones can be used, and much timber for which there is no other market is sold for this purpose. The methods of getting the wood to market vary. In some cases it is hauled down the slope in the log, in others cut into shorter lengths and "ball-hooted" (rolled) down to the place where it is cut into five foot lengths and split; in still other cases it is cut and split on the slope and sent to the bottom in portable V-shaped troughs. The split wood reaches the railroad by wagon hauls or by flumes, the latter being much cheaper. On account of the weight of the wood and its comparatively low price, long hauls are not possible. The average haul is from two to three miles to the railroad or flume, though where roads are good, chestnut wood is sometimes hauled as far as eight or ten miles. The approximate cost of delivering wood at the station is about as follows: cutting, logging, and splitting the wood, $1.50 a cord; hauling to the railroad, 50 cents a cord per mile. Where large logging operations are going on, cord wood is often brought out over the tram road.

The process of extracting the tannin is about as follows: The wood is put into a chipper or "hog," which chips it up into small pieces from one-fourth to one-half inch thick, and not over an inch in length. From



PULPWOOD AND TANNING EXTRACT INDUSTRIES. WORKS OF CHAMPION FIBRE COMPANY, CANTON.

the chipper it is carried to large vats. Through these vats boiling water is circulated for about 24 hours, being pumped from one vat to the next. The liquid thus obtained is finally boiled down under pressure, until enough water is driven off to obtain an extract of the desired strength. In this form it is shipped in tank cars to all parts of the country. For export the liquor is still further boiled down till the tannic acid crystallizes and forms a powder. This is shipped in barrels or sacks. An average of 70 gallons of the liquid extract, containing about 8 per cent pure tannic acid, is secured from each cord of wood.

The value of this industry, not only to the people but to the forests, is not fully realized. The total stand of chestnut in the region is about three billion board feet. Probably not more than 10 per cent of this can, under present market conditions, be profitably used for the manufacture of lumber, so that there are at least five million cords of chestnut wood now standing. The greater part of this timber is over-mature and deteriorating in quality, so that the longer it is left standing the greater will be the loss. The tannin industry allows the utilization of this material. This utilization, when properly carried out (see Management, p. 78) means that land now covered with such trees and therefore producing nothing can be made to grow new and better crops of chestnut.

PULP WOOD.

Small amounts of pulp wood, chiefly poplar and linn, have been cut and shipped from the mountain region of North Carolina to pulp mills in adjoining states for the past ten years or more. Three or four years ago, however, after the Champion Fiber Co., of Canton, Haywood County, began buying wood, the industry became important. This company, which operates the only paper manufacturing plant in Western North Carolina, uses some nine different species of timber, employs more than 600 hands, and converts into paper practically all the pulp wood cut in this region, besides a large quantity of chestnut extract wood.

Five different classes of wood are used by this factory, all of them being manufactured by chemical processes into the better quality of magazine paper, while "screenings" and other waste are made into coarse, heavy wrapping paper. It is planned to make each cord of wood produce, on an average, a thousand pounds of pulp. As each class of pulp wood, in this region, is handled in a somewhat distinctive way, and the production of each has a somewhat varying effect upon the forest, these classes are separately described.

Chestnut.—Chestnut furnishes nearly half of the wood used for pulp by this factory. By the process invented a few years ago by Omar Carr, the Champion Fiber Company now manufactures into pulp the wood from which they first extract the tannic acid. The wood is bought in the open market, coming chiefly from points along the Murphy branch of the Southern Railway on which this plant is situated.

Table 5 gives the approximate amount of pulp wood cut in 1909, exclusive of chestnut, which is included in table 4, by kinds and counties. As with chestnut extract wood, only those counties that have railroad facilities market this material.

TABLE 5.—OUTPUT OF PULPWOOD IN 1909, IN CORDS OF 160 CUBIC FEET, BY CLASSES AND COUNTIES.*

Counties	Poplar and Basswood	Pine	Hemlock	Spruce and Balsam	Total
	Cords	Cords	Cords	Cords	Cords
Cherokee	1,000	100	750	----------	1,850
Clay	----------	----------	----------	----------	----------
Graham	10	----------	75	----------	85
Swain	540	----------	1,503	----------	2,043
Macon	150	----------	229	----------	379
Jackson	1,948	1,141	5,438	6,000	14,527
Haywood	2,860	----------	16,990	16,240	36,090
Transylvania	4,000	380	20	----------	4,400
Henderson	1,350	150	----------	----------	1,500
Buncombe	250	315	----------	----------	1,065
Madison	20	110	630	----------	760
Yancey	----------	----------	----------	----------	----------
Mitchell	200	----------	----------	----------	200
Watauga	----------	----------	----------	----------	----------
Ashe	----------	----------	----------	----------	----------
Alleghany	----------	----------	----------	----------	----------
Totals	12,328	2,696	25,635	22,240	62,899

*A large part of the chestnut tanning extract wood is also manufactured into pulp.

The five foot sticks into which the wood is cut are first sawed into 20-inch lengths, for convenience in handling. The bark, with any dark or decaying wood, is then chipped off by the "barkers"; this bark, along with that taken from the hemlock, is then carried to the vats, in which it is boiled for the extraction of tannic acid. After this is extracted the refuse is taken to the engine house, and used as fuel. The trimmed sticks of chestnut are cut into small pieces by the "chipper," and after the tannin has been extracted the chips are screened to get rid of dark knots or other pieces that would injure the paper, and reduced to pulp by the soda process.

Spruce.—Practically all of the spruce, which includes from 20 to 30 per cent balsam, is cut by the company itself from the mountains of Haywood and Jackson counties where the Champion Fiber Company controls thousands of acres of spruce timber. Logging is done in much the same way as for the production of lumber, though the altitude at

which the spruce forests grow and the steepness of the slopes necessitate some variation in method. In one operation, tree-length logs are pulled up one side of a mountain by steam skidders at the top. Here the trees are cut into log lengths, skidded to a log slide, down which they plunge to a yard some thousand feet below. In the yard, the logs are cut and split into blocks, and put into a flume which carries them six or eight miles to the railway. In another operation skid roads are made about fifty yards apart on the side of the mountain, and the logs are "ball-hooted" into these skid roads, then taken by teams to a narrow gauge railroad which carries them to a mill, where they are cut into lengths and quartered, and then shipped to the pulp mill. It can readily be understood that such operations are quite expensive, and probably would not be carried on by the company if a sufficient supply of this kind of pulp wood could be assured at the present price, $6 a cord at the railroad.

This industry is the only one that is using spruce and balsam to any extent and probably the only one which can afford to cut or buy spruce under prevailing conditions. This cutting is leaving the spruce forests in very poor condition. All trees down to four inches in diameter are cut, and those smaller than this are generally so broken and crushed that they can never be thrifty. Then also, fire is likely to get into the cutover area and destroy not only the young growth but all the vegetable matter in the soil, so that little but the bare rock remains. If fires can be kept out, the "slash" will eventually decay, and a second growth of balsam and spruce may come in. The only hope for this southern extension of the spruce forests seems to be in keeping out fire.

Spruce and balsam, which furnish about one-fifth of the wood used for pulp, are treated by the sulphite process. The white color and long fiber of the wood give a good quality of paper without bleaching.

Hemlock.—Ten to twenty years ago millions of feet of hemlock timber were cut and left lying in the woods to rot, the bark alone being sold to the tanneries; this was done because of the low price of hemlock lumber. Only within the last few years has hemlock become prominent as a source of pulp, and only since the establishment of the mill at Canton has it found a market in this region.

At the present time, where transportation facilities are adequate, the wood is worth two or three times as much as the bark on it. One cord of peeled wood at the railway is worth, on the average, $6.00, whereas formerly this cord would have furnished 1-3 of a cord of bark worth about $2.35.

Approximately two-fifths of the total amount of pulp wood marketed

in this region in 1909 was hemlock. This was cut principally by the pulp company itself. Local operators usually peel hemlock, because both the bark and the wood then dry out better, making transportation charges less on account of the decreased weight, and also because the bark and the wood will bring better prices when sold separately. Most of the readily accessible hemlock has been cut, so that the greater part of the future output of this class of pulp wood will probably be taken out in connection with some large lumber or cordwood operation where a flume or dummy line is used. Hemlock wood, like the spruce, is treated by the sulphite process.

The demand created by this industry is of great advantage to all who own hemlock stumpage. Although it pays better to convert the better class of timber into lumber than into pulp, yet there is a large proportion of wind-shaken and small timber (30 to 50 per cent of low grade in many stands) which pays better as pulp. Some operators even claim that it is more profitable to cut hemlock indiscriminately for pulp. Even in a lumber operation there is generally a large amount of hemlock timber that can be disposed of for pulp wood which would otherwise be wasted. This demand therefore makes possible a close utilization of hemlock, and avoidance of waste. The close cutting of this species is of value to the forest, for usually there are other better species to take the place of the slow growing hemlock.

Poplar.—Poplar pulpwood, locally called "soft" wood, includes poplar, linn, buckeye, and cucumber. About 20 per cent of the pulp wood now consumed is of this class. No distinction is made between the species, and all four may be mixed in the same cord. These soft woods are treated by the soda process, and because of the light color of the wood make a very good quality of paper. The timber when cut is usually peeled in the woods. The peeled wood brings at the railroad an average of $5 a cord, while the wood with the bark on is worth from fifty cents to a dollar less. These woods peel readily when they are cut in the spring and summer, which is a disadvantage in that it not only prevents profitable winter work, but it discourages sprout reproduction.

As all the species of this class of pulp wood make valuable lumber, with the possible exception of buckeye, only such trees as will not make a good grade of lumber are usually used for pulp. Two different qualities of this soft wood timber are used: first, the lops and tops left after lumbering, and the hollow and otherwise defective mature trees, together with the slab waste at the mill; and, second, immature second growth. A close utilization of the timber is of great advan-

tage to the forest and to the operator, though there are two distinct drawbacks. First, it occasionally happens that a defective tree is needed for seed, either to prevent the occurrence of a blank or to favor the reproduction of poplar, linn, or cucumber as against that of less valuable trees. Secondly, the marketing of young immature trees, which when larger will furnish valuable lumber, may not always be the most profitable use to make of them. Young poplar trees under 12 inches in diameter are growing very rapidly, and it is a question whether it would not pay better to allow them to grow than to cut them at this stage for pulp. However, where a permanent market for this class of material is assured, and adequate fire protection is afforded, a short rotation of these quick growing soft wooded trees for pulp can be profitably practiced.

Pine.—At present pine forms between 4 and 5 per cent of the pulp wood used in Western North Carolina. Up to a year or two ago its use was only experimental, but it has passed beyond this stage. Although all the species of pine common to the region have been used, the greater part of the cut in the past year or two has been white pine and old field pine.* Pine is usually shipped with the bark on, because it is hard to peel by hand. In this condition, it brings an average of $3.50 a cord delivered at the railroad. It is usually treated by the soda process, but makes a rather dark colored pulp even when bleached. Little white pine is available for this purpose in the mountain counties, so that its use is not likely to be very much extended. The old field pine or "jack pine," as the buyers often call it, is quite abundant through the French Broad Valley and in several other parts of the mountains. The increase in the use of second growth pine for pulp will probably mean a steady market for this material. This steady market will be a great help to farmers in this part of the country, because many old fields which are too poor or too subject to erosion to grow corn are able to produce pine. A stand of pine 30 to 40 years old will probably be found the most profitable crop on such areas.

TAN BARK.

The tanbark industry, except for a few cords each year to supply the small local tanneries, started about 20 years ago when several large tanneries were established in the western Piedmont region, and began to draw much of their supply from the mountains to the west. It was not, however, until eight or ten years ago, when plants were established within this region, that any general demand for bark arose. Since

*Old field pine is the general name for second growth short leaf, pitch pine and scrub pine coming up in old fields

that time the supply of tanbark has rapidly diminished until now it is restricted to the rougher and more inaccessible districts, and the price has nearly doubled.

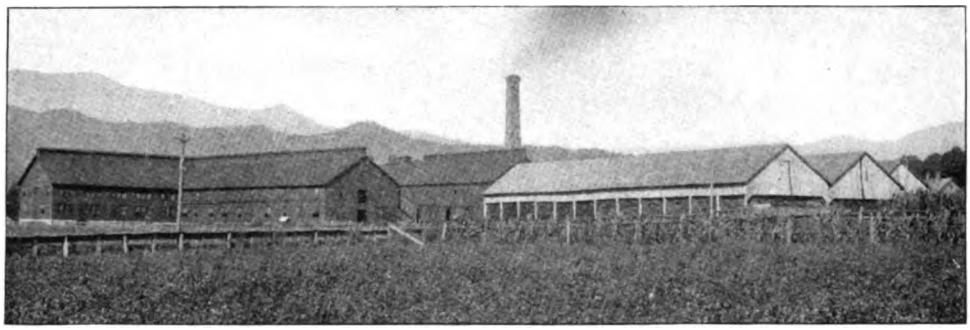
Table 6 shows the approximate amount of tanbark cut in 1909 by species and counties. Considerable bark was cut in the counties remote from railroad facilities; the high price justified a long haul.

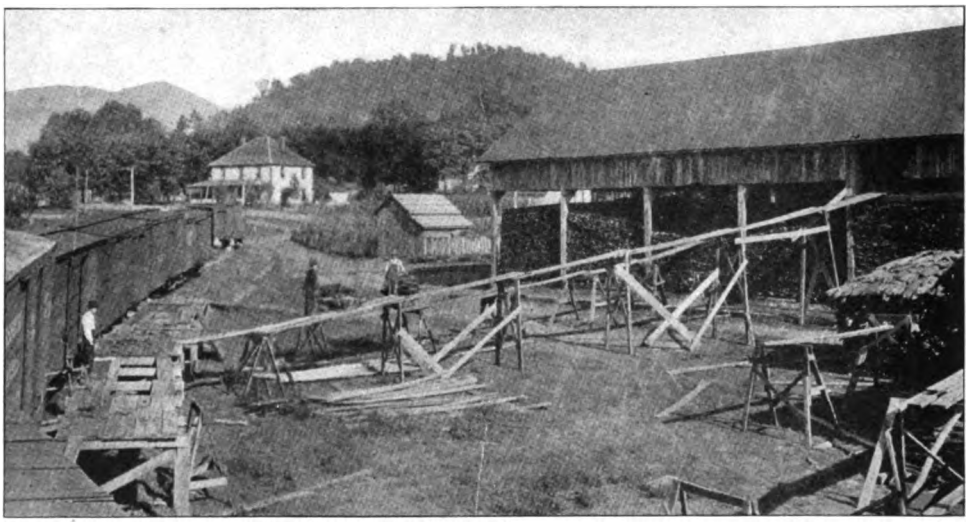
TABLE 6.—OUTPUT OF TANBARK IN 1909, IN CORDS OF 2,240 POUNDS, BY SPECIES AND COUNTIES.

Counties	Chestnut Oak	Hemlock	Other Oaks	Total
	Cords	Cords	Cords	Cords
Cherokee	2,000	250	700	2,95
Clay				
Graham	240	313		553
Swain	3,775	1,020	665	5,460
Macon	2,014	400		2,414
Jackson	2,194	253	180	2,632
Haywood	750	1,084		1,834
Transylvania	2,250	350		2,600
Henderson	2,460			2,460
Buncombe	2,595	325	825	3,745
Madison	480	646		1,126
Yancey		200		200
Mitchell	230	1,400		1,630
Watauga		1,000		1,000
Ashe				
Alleghany	1,000			1,000
Totals	20,088	7,246	2,370	29,604

Five large tanneries, at Andrews, Sylva, Hazelwood, Asheville, and Rosman, are in operation west of the Blue Ridge. Their combined annual consumption of bark amounts to about 24,000 cords, which comes mainly from this region, and takes practically the entire output. Only a few thousand cords, chiefly from the easternmost counties, go to outside tanneries.

About two-thirds of the bark from the mountain counties is chestnut oak. This tree has been cut and peeled for bark on most of the lands within 15 or 20 miles of the railway, except such as have been reserved by lumber companies, and sometimes by the tanning companies themselves. So far the bulk of the chestnut oak bark has been cut and marketed by farmers, who got for this product nearly $180,000 in 1909. Chestnut oak, as well as black and white oak, and, occasionally, scarlet, red, and Spanish oak, are peeled in the spring from the time the buds first begin to swell to the time the leaves are fully formed, chiefly during April and May. After being peeled, the bark is allowed to dry out thoroughly, so that it will keep when stacked away in bulk, and so that it will be light for hauling, which is done through the summer, generally after the crops are "laid by." Yet at present prices—about $8.50





TANNING INDUSTRY.

A. TANNERY OF COVER & SONS, ANDREWS.
B. UNLOADING BARK FROM CARS AND STORING IN SHED.
C. A LARGE CROP. STACKING SURPLUS BARK IN THE OPEN.

per cord at the railroad—there is little clear profit, though it furnishes ready money for work at a time when men and teams would otherwise be idle.

In Table 3 "chestnut oak" may include many others, because some counties did not differentiate the species. The price of black oak averages about $5.25 per cord delivered at the railroad, and white oak runs about 50 cents more. If the demand for the bark of these two oaks would justify an increase in price, the bark could be utilized in connection with lumbering. As it is now the bark is nearly all wasted because it will not pay to save it.

Hemlock bark, though forming only about one-tenth of the annual consumption in the region, comprises about one-quarter of the output. This discrepancy is due to the fact that much of the bark from the eastern counties, which produce mostly hemlock, goes to the tanneries outside this region. Formerly much hemlock was cut for bark and the timber wasted; recently, however, hemlock has been cut for lumber and the bark wasted. In some logging operations, in which the wood was used for pulp, the bark, although peeled, has been left on the ground and wasted, presumably because the price of $7 per cord does not justify the extra cost of handling. It would be advisable to carry on the production of hemlock pulp wood and of hemlock bark together, for the waste of bark is too great an item to be overlooked in a modern operation.

The percentage of tannin varies considerably with the species. Hemlock contains from 8 to 10 per cent, while black oak contains 11 to 12 per cent, and chestnut oak 12 to 13 per cent. The price of the bark is not regulated entirely by the percentage of tannin, though this has a good deal to do with it. The presence or absence of certain coloring matter in the bark has considerable influence on its value for tanning. The value of black oak bark is lessened by its color, whereas that of chestnut oak is enhanced, because it gives the "oak color" which is wanted for the best leathers. The tannin in all barks is soluble even in cold water. For this reason bark is seldom transported to the railroad by flumes, though in one case at least the bark was tied to the top of bundles of boards which were being flumed, and in this way kept dry. Some tanners claim that as much as 25 per cent of the tannin is leached out by running bark down flumes. It has been estimated also that during a wet summer, unless the bark is thoroughly protected from rain, as much as 20 per cent of the tannin is lost. If bark is packed so that rain does not run through it, it will keep without deterioration for several years.

Bark peeling is a declining industry, and will cease with the exhaustion of the mature timber. Chestnut oak and hemlock grow but slowly, and the bark of young trees is comparatively thin; prices will rise, but the increasing use of tanning extract from other materials will supplant bark.

MINOR TIMBER INDUSTRIES.

TIES.

No ties are shipped out of this region, chiefly because of the high freight rates, and only enough ties are produced to supply local demands. Hewed ties are got out by small farmers who deliver them on the railroad right of way, where they are taken up by the company. Many of the small sawmills cut ties out of the timber which will not make good lumber. During the past two or three years, while the Carolina, Clinchfield and Ohio Railway was under construction, many small sawmills cut nothing but ties, but this large production has now practically ceased. Only first class white oak ties (which include those made from chestnut oak and post oak, as well as locust, walnut, sassafras, and cherry), are in demand. Prices for white oak ties in 1909, in the mountains, averaged 33 to 35 cents for first class ties, and from 20 to 25 cents for second class ties. Actually, however, a small proportion of chestnut and red oak ties are often used in railroad construction, while trolley roads frequently purchase chestnut ties exclusively. Logging roads, being temporary, generally use for ties those trees that are not wanted for lumber.

Table 7 gives the approximate number of ties cut in this region in 1909, but does not include those cut by lumber companies for their own roads.

TABLE 7.—OUTPUT OF CROSS TIES IN 1909, BY SPECIES AND COUNTIES.

Counties	White Oak	Other Species	Total
	Number	Number	Number
Cherokee	10,000		10,000
Clay			
Graham			
Swain			
Macon			
Jackson	1,000		1,000
Haywood	12,000		12,000
Transylvania	22,500		22,500
Henderson	20,000		20,000
Buncombe	36,000		36,000
Madison	1,600		1,600
Yancey	10,000	5,000	15,000
Mitchell	29,500	7,500	37,000
Watauga			
Ashe			
Alleghany			
Totals	142,600	12,500	155,100

POLES.

For the past few years the chestnut pole market has been very depressed, as some of the largest consumers have been doing little buying. Table 8 gives the output of poles for those counties of the region in which poles were cut for the market.

TABLE 8.—OUTPUT OF POLES, PINS, SHINGLES AND MISCELLANEOUS MATERIAL IN 1909, BY COUNTIES.

Counties	Chestnut Poles	Oak Pins	Locust Pins	Shingles	Miscellaneous Products	
	No.	Thousand	Thousand	Thousand	Thousand ft. B. M.*	Cords**
Cherokee	450			200	200	
Clay						
Graham						170
Swain						
Macon	5,000	700	500	150		420
Jackson	5,060	5,000		115	30	10
Haywood				1,200		
Transylvania						
Henderson				780		
Buncombe	1,287			730		
Madison				14	25	
Yancey	700				100	
Mitchell	4,300		100	170	150	44
Watauga				200		
Ashe				250		
Alleghany				150		
Totals	16,797	5,700	600	3,959	692	644

*Includes handles, pump logs, poplar bowls, spools, bobbins, etc.
**Includes dogwood shuttles and kalmia pipe blocks.

Prices of poles range from 75 cents to $3.35 for sizes varying from 22 to 45 feet in length, and these prices have varied but little for the past two years. At these prices young chestnut timber will bring two or three times as much for poles as for tanning extract wood. Only the straight and comparatively small trees, however, are suitable for poles.

If the demand is sufficient the production of chestnut poles will be one of the most important timber industries of this region, for with improved methods of management a large number of poles per acre can be produced in a comparatively short time.

PINS.

In past years the manufacture of locust insulator pins was a widespread industry, but there has come about an exhaustion of the old timber in all but the remote forests and a sudden decline in the demand. During the summer of 1909 hundreds of thousands of split locust pins, cut one to two years before, were lying in the woods, and manufactured pins were stored in sheds, waiting until a rise in price would justify their removal. About the year before some mills began making oak

"screw boxes" which are used over an iron pin. These can be made much more cheaply than locust pins, and are, in many cases, displacing them.

Locust pins 18 inches long, 2 inches by 2 inches, bring $7 per thousand at the yard, whereas oak pins 18 inches long, 1 1-2 inches by 1 1-2 inches are delivered at the mill for $3. Table 8 shows that pins were cut in only three counties during 1909.

SHINGLES.

Shingles are cut only for local consumption, and very few find their way into the open market. Shaved shingles, and, to a large extent, split shingles, have been superseded by sawed shingles. These are often made by the small custom sawmill, though some mills cut nothing but shingles, and others confine themselves to the manufacture of shingles and laths. Some sawmills cut up their cull lumber, for which there is little sale, into shingles, which sell readily at the mill for $3 to $3.25 per thousand. Shingles are, however, usually cut from blocks, which are sections of logs the length of the shingle. White pine and yellow pine are preferred where these woods are available, though the larger proportion cut in this region are of chestnut and the various kinds of oak. Table 8 gives the approximate number of shingles cut in the various counties in 1909. It also gives under "Miscellaneous Products" the output of timber for several small industries during the same period.

MISCELLANEOUS PRODUCTS.

The manufacture of *hickory handles* is on a small scale, due largely to the scarcity of suitable timber. The requirements as to quality are still so exacting that little old growth timber can be used, and second growth is scarce, especially in the better forested counties. A price equivalent to from $25 to $35 per thousand feet board measure is paid for suitable stuff. Hickory timber is usually neglected in lumbering operations, because the rigid inspection keeps down the profit.

Along the Murphy Branch a few small logs are cut and shipped to Bryson City for manufacture into *porch columns* and *pump logs*. Poplar, linn, cucumber, bellwood, sourwood, sassafras, and sweet gum are used. Logs vary in length from 6 to 10 feet. Prices range from 3 3-4 cents per running foot for 8-inch logs to 7 cents for 11-inch logs. Logs over eleven inches bring from $10 to $12 per thousand feet log scale.

The turning of *bowls* from poplar blocks is a small industry. The blocks are made by cutting the logs into sections the length of the diameter of the log and then splitting them in half. In this form they

are delivered at the mill. From $10 to $15 per thousand feet log scale is paid for these blocks at the mill.

A small factory has recently been started in Mitchell County for the manufacture of specialties used in textile manufactures. *Bobbins, skewers,* and *spools* are made from beech, birch, and maple left on areas after lumbering. *Clearer rolls* are made from cull poplar and other suitable woods. Logs down to 8 inches in diameter, 8 feet long are used, for which an average price of $5 per thousand feet log scale is paid.

For many years dogwood has been cut for the manufacture of *shuttles.* Small portable mills cut the wood into blocks of varying sizes, the ends of which are generally dipped in paraffin to prevent checking. In this form they are usually shipped out of the State, some of them being exported to France. Some dogwood blocks are hauled 40 miles to a shuttle mill at Westminster, South Carolina. Dogwood brings from $6 to $8 per cord at the yard, but the demand at present is very limited, while the supply is nearly exhausted.

Two small mills cut blocks from the stumps or burls of the Kalmia, or mountain ivy for the manufacture of tobacco *pipes.* These burls, which weigh anywhere from 5 pounds up to 600 pounds, are brought in by the surrounding farmers, who receive about $5 a ton for them.

TRANSPORTATION.

RIVERS.

Some 15 to 25 years ago, before the development of the present system of railroads, much of the finest poplar timber in these western counties was taken out by floating it down the streams. That was also before the present high price of timber and the waste involved in such a method of transportation made it prohibitive. The logs were cut and put in the small creeks and either allowed to remain until high water took them out, or else were splashed out by a system of dams. When the logs reached the river, their transportation depended entirely upon the natural rise of the water. Often millions of feet of the finest timber remained in the rivers to rot on rocks and shoals. The rivers are no longer used for this purpose, and the smaller streams only to a very limited extent. The water courses in these mountains have too rapid a fall and are in consequence too rough to allow the use of this method under present market conditions.

RAILROADS.

Several standard gauge railroads traverse the region. The Southern Railway runs in eight of the sixteen counties, while the Carolina, Clinch-

field and Ohio, the Blue Ridge and Atlantic, the Louisville and Nashville, and the Tennessee and North Carolina Railways all enter the region. A narrow gauge road, the East Tennessee and Western North Carolina Railroad, crosses Mitchell County from the Tennessee line to Pineola. All these roads handle large quantities of forest products, and render possible the profitable operation of such industries as the large pulp mill at Canton, the extract plants and tanneries at Andrews, Sylva, Hazelwood, Asheville, Brevard, and Old Fort, as well as the large lumber trade from Asheville as a center.

To bring all the forest products, either in their raw or manufactured form, from the woods to these railroads, three different avenues of transportation are now being used, the private or dummy railroad, the flume, and the wagon road.

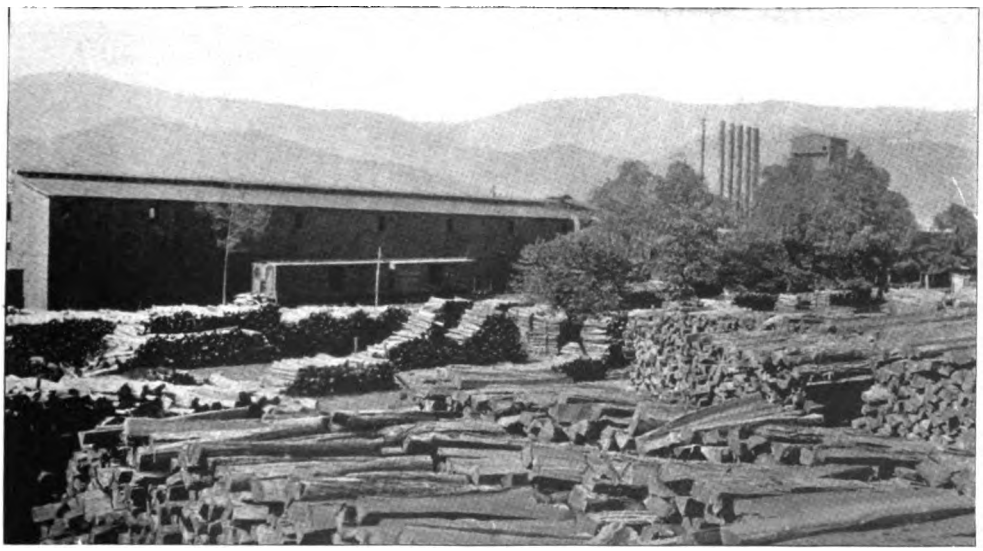
DUMMY LINES.

The dummy roads are temporary, usually narrow gauge railways with either wooden or iron rails, generally laid down for a specific lumber operation. There are such lines at Andrews, Judson, Whittier, Balsam, Hazelwood, and Swannanoa. Some of these lines are made standard gauge, which gives them the advantage of not having to transfer the freight at the point of junction. The dummy road is usually the best method of handling logs for distances of over a mile and for handling lumber up to 6 or 8 miles, if there is enough of either to justify the expense of construction.

FLUMES.

Flumes are used to a large and increasing extent in the western counties, chiefly for the transportation of cordwood for pulp or tanning extract, but also to some extent for lumber. To make a flume project feasible, the stream should have a fairly even rate of fall and should contain enough water to keep the flume full. The first flumes, put in over 6 or 8 years ago, were "box flumes," with flat bottoms and straight sides. These answered very well for lumber, but it was found that cordwood would jam in them and quite often force off the sides, thus cutting off all the water beyond the stoppage. This has been obviated by using the V-shaped flume, which causes the wood to be thrown out as soon as it jams, and thus prevents injury to the sides and allows the water to go on down the flume. Practically all flumes in this region are now constructed like this, and most box flumes have been converted by putting the "V" inside the box. Flumes varying from 6 to 18 miles in length are now being successfully operated at Nantahala, Cherokee, Dillsboro, Addie, Swannanoa, and other points along the rail-

A. SPRUCE PULPWOOD, FROM FLUME TO CARS.



B. CHESTNUT EXTRACT WOOD IN YARD OF CHEROKEE TANNING EXTRACT CO., ANDREWS.

roads, bringing out large amounts of chestnut and pulp wood that would otherwise be inaccessible.

Some operators have objected to sending lumber down the flume because they say the ends of the boards are battered or rubbed enough to spoil their fresh, finished appearance. This objection has been overcome in two ways. By one method the boards are nailed end to end so that in the flume there is a line of a dozen or more boards, each fastened to the one in front of it by one small nail driven through them both. This allows enough movement to follow the curves of the flume and prevents the lumber jamming while it prevents also the rubbing of the ends. The other method is to send the boards down the flume at their full length untrimmed. The trimmer is installed at the outlet of the flume, and can often be run by the water that comes down the flume. In one large flume, in a county adjoining this region, the lumber was floated down tied into bundles, and tanbark could be sent down at the same time on top of the lumber.

The cost of building a flume varies greatly. Some small ones have been put up for $400 a mile, while others cost as high as $1,500 a mile. The average cost would probably be about $1,000 a mile. The comparatively large initial cost and the necessary restriction as to location make flume building an operation for the larger interests, and the average man who has cordwood to deliver at the railroad depends on the public roads.

WAGON ROADS.

Probably three-quarters of all the timber is hauled to the railroad over the county roads, so that they are the most important avenues of transportation. While the movement for good roads is spreading rapidly and many of the mountain counties have done much to improve their main highways, there is still large room for further improvement. The length of haul for forest products varies from a minimum of two for cordwood up to twenty-five miles for tanbark and lumber, and even forty miles for dogwood blocks. The average haul, however, is about 8 miles, at an approximate cost of thirty-three and one-third cents per mile per ton. It has been calculated that in general it costs at least twice as much to haul timber from the stump to the railroad, as the timber is worth standing in the woods.

The size of the hauling bill is mainly due to lack of good roads. The roads are commonly worked by the old labor tax system which requires every able-bodied man between the ages of eighteen and forty-five to work a certain number of days each year. A gradual change is going on, and various counties are trying other systems in an effort to

secure better results. In some cases the old method has been given up before the new one has been found to be effective. In some counties the road improvement work has been placed in the hands of the townships. This has worked well in a few instances, but in others has failed. On the whole, it does not seem to be the wisest policy. For good roads are a matter of the utmost importance to the whole county, and even to the State, and it would therefore seem logical for the State and county (in coöperation) to construct and maintain at least the most important highways. The construction and maintenance of macadamized roads is also so expensive an undertaking that it would seem unfair to ask the townships to undertake it, even though they realize that the cost of good roads is far more than repaid by the reduction in the cost of transportation.

Convicts are employed on the public roads in four counties, and the benefit here is marked. Every county could use at least its short term prisoners in charge of a man who understands road making. This force could be used for permanent work, and for jobs too large and too heavy for the average road-hand, such as blasting rocks, changing grades, and making causeways and culverts. Much good would follow at comparatively little cost. A convict chain gang need not take the place of the old method of working the road, but could be used as an auxiliary.

A few miles of macadam road have been constructed in Cherokee, Haywood, and Henderson counties, and sixty miles or more in Buncombe County, where, however, there is some loss in effectiveness from lack of proper maintenance. It seems to be the general belief that after a good road is constructed there is no need to repair it; yet improved roads wear out just as any others. The Appalachian Good Roads Association, organized in Asheville in the fall of 1909, gives good promise, and a practical interest in road improvement has resulted in several of these counties.

FOREST MANAGEMENT.

Forest management is the practical application of the principles of forestry to the handling of forest lands. Its object is to make such lands continuously produce at the least cost the largest amount of the most valuable forest product (sawtimber, pulpwood, poles, etc.) which they are capable of producing. To do this it is necessary to secure a full stand of the most valuable species best suited to a particular area, and to keep them growing as rapidly as possible.

The farmer looks beyond the present crop and keeps up the fertility

of his farm. The orchardist plants apples or pecans, and spends money and time for several years without receiving any immediate returns. The forester looks forward in the same way, though through a longer span of years, for his returns. The timberland owner should harvest his timber crop in such a way that the capital invested in the land itself will not be lost, but will bring increased future returns.

The management of a forest falls naturally under two main heads: (1) The removal of the timber and reproduction of the new stand; and (2) The care of the stand. Under (1) the following topics will be treated: (a) Waste in logging; (b) Injury to young growth; and (c) Methods of cutting to secure reproduction and to benefit the trees left. The methods of cutting will be given for each of the forest types which have been treated under Forest Description. Under (2) the following topics will be treated: (a) Thinnings (cuttings in young stands to increase the rate of growth and favor the more valuable trees, but which should also yield at least a small money return); and (b) Protection, chiefly against fire and grazing.

Also under forest management are generally included the sale of timber, and forest extension, which is artificial reproduction of patches where the forest has failed to reproduce naturally, or of land which, though now bare, is best suited to forest growth. These two subjects are, however, so new and so little understood by forest owners throughout the United States that it will be clearer to treat them independently of forest management.

REMOVAL OF THE TIMBER AND REPRODUCTION OF THE NEW STAND.

WASTE IN LOGGING.

There is great waste in the manufacture of timber, from the forest to the consumer. Much of this waste, however, is unavoidable under present conditions. Fifteen to twenty years ago thousands of the finest poplar trees in the mountains were cut down and only two or three of the best logs taken from each tree. The rest was left in the woods to rot. Much more recently millions of feet of hemlock timber were cut and left lying in the woods, only the bark being used for tanning. Such wholesale waste has to a large extent ceased on account of the big rise in the value of timber. There is, however, still much room for more economical methods.

Waste in logging is of two kinds: (1) The incomplete utilization of the trees that are cut; and (2) the failure to cut merchantable trees which will probably decay or blow down before there will be another opportunity to log the area.

Incomplete Utilization.

Much merchantable timber is wasted through cutting high stumps. As the lower part of the tree usually makes the finest quality of lumber, the frequent loss of twenty-five to fifty board feet of this high grade lumber from each tree amounts to a considerable item. Where trees are felled with an axe, as much as twelve inches in the length of a log is lost in the form of chips. All timber should be cut with the saw, and the stumps should be cut low, rarely more than eighteen inches in height.

In some operations much merchantable timber is left in the tops. When the cutters are restricted to definite sized logs, such as twelve, fourteen, or sixteen feet long, short logs are left which might be utilized if eight or ten foot logs could be used. A short log, even if knotty, will often make ties. Such a log can be left on the last cut and cut into proper lengths at the mill. Much of this waste in the tops is unavoidable on small operations, because the material, though merchantable, would cost more to place on the market than it can be sold for. However, where a small profit may reasonably be expected from the handling of such material it is only fair that the landowner selling stumpage should insist on its being utilized.

Much loss is often incurred, especially in logging yellow poplar, from the breaking of the trees in felling. Poplar is very brittle and when felled across rocks or very uneven ground, the upper part of the tree is likely to be broken. This can usually be avoided by care on the part of the felling crew.

Perhaps the greatest waste of timber that is going on in the mountains at the present time is in connection with the cutting of chestnut oak for bark. Because of its poor quality for lumber and the great distances to market, the logs from which the bark is peeled are very often left in the woods to rot. Chestnut oak makes first quality ties, so that if the material were near enough to a railroad to warrant its manufacture into ties it could be used for this purpose. In Eastern Kentucky this is usually done, ties often being hauled fifteen to eighteen miles. The low price paid for ties in Western North Carolina does not warrant such a long haul. It would be much better if the owners of chestnut oak timber would postpone selling the bark until there was a market for the timber.

On the other hand much bark of both chestnut oak and hemlock is wasted in lumbering operations because it is claimed that the price paid for this material does not warrant the trouble and expense of peeling and marketing it. If the species that are used for bark could be

cut and peeled the spring before the rest of the area is logged over the bark might be got out to the railroad first and be out of the way of future logging operations. This has been done successfully in some of the hemlock forests of East Tennessee.

Failure to Cut Merchantable Trees.

Many trees which contain merchantable material are left standing in lumbering operations, because it is feared that the profit in handling them will not be large enough. These trees are often over-mature and deteriorating, and will be worthless by the time the area is logged again. Obviously the failure to cut such trees means just as much direct loss to the owner selling stumpage or cutting his land as does the failure to completely utilize a tree which has been cut. After these trees die and while they are still standing, they greatly increase the fire danger by their tendency to scatter sparks for great distances.

Some of the trees may be merely crooked and defective, instead of over-mature and decaying. In this case, though there may be no direct loss from leaving them, it is probable that the indirect loss will be considerable; for they generally take up a good deal of room in the forest and hinder reproduction and growth.

Of course, it is difficult to induce lumbermen to cut trees yielding a doubtful profit, but some arrangement might be agreed upon whereby the stumpage price of such material might be greatly reduced or done away with altogether. Even if no returns at all were obtained from such trees the forest would be greatly benefited by their removal, because of the lessened fire risk and increased productivity.

INJURY TO TREES LEFT STANDING.

Often the injury to trees left standing is so great that even where only the larger trees are cut the tract looks as though a clear cutting had been practiced. Felling a large tree into a clump of young growth or into a small tree to break its fall is most destructive to the forest. Young chestnut, poplar, linn, and other valuable trees, too small to be merchantable, are thus destroyed or very seriously damaged. When it is desirable to break the fall of a tree, only the most worthless trees should be chosen for this purpose. Care should be taken to fell trees away from healthy groups of young growth, not only to prevent the damage in felling, but also that the dry tops may not be a fire menace.

In logging operations, where skidders are used, skidding lines should be laid out with some regard to the young growth. With the exercise of a little care, suitable skid roads can be made with a minimum of

damage. Guy chains may be fastened to stumps instead of to trees, and the live trees saved from serious injury.

Although much improvement has taken place in utilization in the last few years, the injury to young growth still continues, because the land owner does not realize that a thrifty forest cover adds considerably to the value of a property.

METHOD OF CUTTING TO SECURE REPRODUCTION.

The recommendations given under this heading can be made effective by the landowner only by providing that whoever cuts the timber, whether it be a purchaser of stumpage or his own logging crew, shall cut only such trees as he (the owner) or his agent have marked for cutting. Otherwise, but little improvement can be expected. In marking trees for cutting a blaze should be put on the lowest possible part of the stump, preferably on a projecting root or buttress, as well as on the trunk. The object of the blaze on the root is so that the owner can tell whether or not any unmarked trees have been cut. It is necessary, after cutting the blaze, to stamp the wood with a hammer bearing a design (the owner's initial will do) which can be made by the local blacksmith. This stamp will make it difficult for the felling crew to cut unmarked trees by imitating the owner's mark. The blaze on the trunk need not be stamped, because its object is merely to enable the man doing the marking to tell from a distance whether or not a tree has already been marked, and, to a certain extent, to help the felling crew.

The following recommendations will give the owner an idea of the general principles which should guide him in marking the trees to be cut on each forest type. Although there will be variations in type which it will be impossible to cover fully, yet an understanding of the principles involved should enable the owner to figure out such problems for himself without difficulty. Before studying the recommendations for any one type it will be well to look up that type in "Forest Distribution by Types" in order to be familiar with the tree and conditions on the type.

Spruce Forest.

The spruce forest is composed almost entirely of spruce and balsam. As noted under "Forest Distribution by Types," it occurs on the tops of the mountains, and is of the utmost importance in holding moisture and regulating the flow of streams. It would serve the interests of the State better if kept as a protection forest and cut only lightly or not at all. But since it is all privately owned, this is out of the question. The best that can be expected is that the owner will cut with as much

regard for the public interest as is consistent with his legitimate profit, and in such a way that the land will be kept permanently forested.

The object of management should be to secure adequate reproduction of these two species. The present methods of cutting do not secure this result. The practice of cutting down to four inches in diameter removes practically all the seed trees from the cutover areas, and the careless destruction of most of the trees below this size removes the greater part of the young growth, which would in time become large enough to bear seed. The sole dependence, therefore, for reproduction under present conditions is in the seed that has already fallen or that is scattered during the process of cutting. Even this reproduction is seriously menaced, for the seedlings, which prefer a light shade, are often either deprived of shade altogether or are smothered out with the dense tops and leaves.

In cutting for pulp, every effort should be made to save all trees under a merchantable size, especially the spruce. For, though the small growth may be scattered irregularly over an area, even single trees will serve as centers from which an area can be re-seeded. Large trees, however, are liable to be thrown by the wind if left singly in exposed places, on account of their shallow root system. For this reason the plan of leaving groups of young trees, some of which are seed bearing, is strongly recommended.

The following considerations should govern the choice of groups:

First, the trees comprising the group should be the most vigorous in the stand, those most likely to live a considerable period of years and resist windthrow.

Second, each group left should be so situated that the prevailing wind will blow from the group toward the opening bare of reproduction which it is desired to seed up.

Third, groups should be distributed as evenly as possible over the area, though there should be more groups where reproduction is poor or lacking than where good patches of reproduction are found.

Fourth, the size of the groups will vary with the situation. In a sheltered hollow where the danger of windthrow is not great, three or four trees or even less may suffice, whereas on exposed slopes or ridge tops a group of fifteen or twenty or even more trees may be necessary to insure mutual protection.

Where the stand is composed of groups of trees, each group of a different age, the system of cutting should be different from that prescribed above. Here only the groups of larger trees should be cut, and the groups of smaller and younger trees, about 6 inches in diameter (at breast height) and under should be left. But small suppressed

trees which occur in a group of larger trees should be cut with the rest of the group. The result will be scattered openings surrounded by young growth, instead of scattered groups of trees surrounded by clear cut areas as under the first case.

The most important consideration in any logging operation in the spruce forest, even of far more importance than the system of cutting, is protection against fire. Fire is extremely destructive in any class of forest, but particularly so in spruce. In hardwood forests some of the seedlings killed may come up again by sprouts, in spruce forests new seed must fall and germinate; in hardwood forests a fire injures the base of the larger trees and kills the smaller ones, in the spruce forests a fire kills all trees outright; in hardwood forests a fire greatly damages the forest floor and hinders the growth of trees, in spruce forests a fire utterly destroys the forest floor and banishes the very possibility of the existence of a forest.

The safest means of obviating the danger of fire caused by the inflammable material left after logging is to pile and burn all the brush, burning with every precaution and at a time when fire is least likely to spread. This, however, would cost from 25 to 50 cents per thousand feet cut, and is therefore hardly to be expected of the lumberman, particularly where the timber is difficult of access and expensive to log at best. The most effective alternative, and one costing but little, is to lop the branches from the tops so that they will lie flat on the ground. In the State Forest Preserve counties of New York the cost of lopping the tops is only ten cents per cord; and many operators find that this cost is counterbalanced by the timber saved and by the greater ease in skidding. The result is that the brush will rot and cease to be inflammable in about three or four years, whereas if left just as it fell it will be a fire menace for ten or fifteen years. In addition to lopping the tops, the owner should guard carefully against the occurrence of fire while logging is being carried on. He should provide beforehand that any fires which do start shall be immediately extinguished.

Hardwood Forest.

The chief object of management in the hardwood forest, as in the spruce forest, is to secure adequate reproduction. Since many of the hardwoods reproduce largely from sprouts, methods of handling will differ to some extent from those suited to the spruce forests. Fire is still the greatest enemy to be combated, and must have continued attention. The results of a single fire are not so disastrous for the future prospects of a crop as in the spruce forest, because of the power of many of the hardwoods to grow again from the roots after once being

killed to the ground by fire. This power, however, is possessed more especially by the inferior species. Burning, in the hardwood forest, though rarely destroying the whole forest cover, greatly injures its permanent value by favoring the growth of less desirable kinds of timber through making it very difficult for the more valuable species to reproduce themselves. Lumbering by the present methods also has a very strong tendency to increase the percentage of the least desirable trees in the second growth, by cutting too closely the more valuable kinds without proper provision for seed trees or other means of reproduction. Two methods of cutting timber in the hardwood forests may be practiced, the selection method and clear cutting; the selection system, however, is the one best suited to most conditions of this region.

Selection Method.—A rough form of the selection system of cutting is now being practiced on most areas which are being logged in these mountains, though in a few cases, near towns, where the sale of firewood justifies it, an approach to clear cutting is occasionally practiced.

Where the selection system is practiced as a forestry method, only such trees are cut as are financially mature, that is, those that have attained to such size that the largest amount of money can be realized, counting interest on the capital invested. This size varies according to the species of tree, its location, and the various market demands for that species. For this reason, in a forest composed of many different species, only a few trees per acre are likely to be mature at the same time. By cutting out these trees space is made for the better development of the remaining trees, and for the growth of reproduction between them.

Clear Cutting.—Clear cutting is applicable only in even-aged or approximately even-aged forests. The method may be carried out in one of three ways: (1) by two or three successive cuttings a number of years apart, leaving the area covered with young growth after the last cutting; (2) by cutting everything in one operation, relying on sprouts for reproduction; (3) by cutting everything with the exception of a few seed trees which are left for reproduction. The first form of the method is recommended only where the forest is so near a market that cuttings which do not remove the bulk of the timber in one cut will pay. The method can not be applied in any form unless there is a demand for the small as well as for the large material. An example of the second form of the method is around the iron furnaces in Mitchell County. Here the forest was cut clean and has since reproduced itself from sprouts. For the present the chief use of this method will be around towns, brick kilns, or other places where small material can be marketed, and, to a certain extent, on smaller woodlots. Cases of clear cutting in

order to use the land for agriculture do not come under this method, for their purpose is not the reproduction of a future forest.

The selection of seed trees, coming under the third form of this method, is of the utmost importance. Even where there seems to be adequate seedling reproduction already on the ground, the future forest crop should be assured by saving some seed trees. This is made advisable on account of the great risk from fire. Should the first crop of seedlings be destroyed there could be no second crop if no seed trees were provided. Though the present provision for reproduction may be adequate, the risk in removing all trees that could furnish seed is too great to be incurred.

Seed trees should be chosen with regard to their special fitness to reseed the area in question. Where possible they should be strong, healthy young specimens with full crowns and having plenty of light and moisture. Such trees not only produce the best seed, but they are the most profitable to retain on the land because of the rapidity of their growth. They should be trees exposed to the wind so that the seed will be scattered as far as possible. There is great temptation often to reserve for seed trees such specimens as are not salable, such as hollow, crooked, broken, or diseased trees. Damaged trees do not yield a large quantity or a good quality of seed, and make comparatively poor seed trees. It may, however, be advisable to reserve such trees. Crooked and forked trees, if sound and healthy, make good seed trees. If, however, a second cutting is expected during the life of the seed tree, it would probably be best to leave trees that will grow rapidly into valuable timber.

The hardwood forest may be divided into four types: the plateau, the chestnut (subdivided into ridge, slope, and cove), the red oak, and the beech and maple. The management for each of these types will be given separately.

Plateau type.—Most of this type is owned as small woodlots (small areas of forest land on farms). Therefore the management should aim to furnish the various classes of material needed by the owner himself and by the local market, as well as to keep the land as productive as possible.

There are several forms of forest common to this type, each one requiring slightly different management, because the variation of species makes it necessary to vary treatment of the forest. Where the forests are composed entirely of hardwood species, represented mainly by black oaks, in most cases any tendency of the more desirable species to reproduce should be encouraged. Yellow poplar, if present at all, should be given every opportunity to reproduce, by leaving seed trees wherever possible, and by keeping out fires. Chestnut and hickory are both val-

uable trees, and reproduction from these, both seedling and sprout, should be encouraged. Since black oak, because its growth is fairly rapid, is possibly the most valuable of the oaks in this type, it may be favored over other oaks. Sprout reproduction of the desirable species may be encouraged by cutting during the winter and spring. The least valuable species can be discouraged by cutting them in the summer, thus weakening their sprouting capacity. Seedling reproduction is encouraged by leaving seed trees of the desired kinds so placed over the area that the most valuable species will seed up those areas best adapted to their growth.

All old trees except those necessary for seed trees should be removed, if the sale of the material can be made to pay the cost of removal. As a great part of the forests of this type are in the form of farmers' woodlots, much of the old timber can be cut for firewood and other domestic purposes. The great object in these woods should be to substitute healthy, thrifty growing trees of the more valuable species for the old, slow growing cull trees, which now occupy a large part of the forest.

Where shortleaf pine is present in these forests this tree should be favored in all the poorer situations, as it grows fairly rapidly, and early attains merchantable size. Many of the present hardwood stands would be greatly improved by converting them into shortleaf pine stands, and this should be the object of management where poplar, chestnut, and hickory do not thrive. This conversion may be accomplished in a large measure by leaving three or four good seed trees to the acre of shortleaf pine. Seedlings of this species will thus take the place of the hardwoods when they are removed. Such converted forests are seen throughout this type, and form some of its most valuable stands.

On areas where pure pine stands occur, shortleaf should be favored at the expense of pitch pine and scrub pine. Shortleaf seeds readily, and there should be no difficulty in re-seeding a second growth forest containing a large percentage of shortleaf, if seed trees of this species are left and the other pines cut close. Where white pine occurs in this pure pine type, its reproduction should be encouraged in every possible way.

In certain parts of the plateau type white pine flourishes, and is one of the most rapid growing trees. These trees should be encouraged in all lumbering operations by leaving seed trees, and by protecting any white pine which has already started in the forest. There are many areas both in the old fields and in the cutover forest, where white pine forms a large percentage of the stand, and in all such areas it is the most valuable tree that can be grown. White pine does not bear seed abundantly, but the seeds scatter a long distance, so that two or three trees to the acre should be sufficient.

Many of the old fields in this type have come up to fairly dense stands of the three or four common species of pine, collectively known as old field pine. Many of these stands are being cut over for both pulp and firewood. The land is then either cleared and cultivated or allowed to make another growth of forest. If the area is needed for agriculture, special steps should be taken to insure its early seeding to shortleaf by saving a few trees to the acre.

With pine as with spruce, protection against fire is the first step in forestry.

CHESTNUT TYPE.—The two trees most characteristic of this type, chestnut and yellow poplar, are also the most valuable, since there is a large and increasing demand for both. Chestnut is used for lumber, tanning extract, pulp, telephone poles, and ties; poplar is used for lumber and pulp. Both trees grow rapidly while young, and early attain merchantable size.

The type may be divided, as under Forest Description, into three sub-types, Ridge, Slope, and Cove. Since each of these sub-types require somewhat different systems, each will be treated separately.

Ridge.—The two predominant trees in the ridge sub-type are chestnut and chestnut oak. Since chestnut is the more valuable tree of the two the object should be to increase its proportion in the stand. It should, however, not be made into a stand of pure chestnut, because pure stands are much more subject to ravages by insects and blights than are mixed stands.

Sprouts, in an ordinarily thrifty stand of chestnut, can be depended upon for reproduction. But in this case many of the trees are so old and damaged by fire that they would probably give but poor sprouts and sometimes perhaps none at all. Therefore, an increase of seedling reproduction, both to keep the stand fully stocked at present and to form a basis for sprout reproduction in future cuttings, is essential.

The best method of securing seed reproduction of chestnut is to make numerous small openings, not over 100 feet in diameter, by the removal of chestnut oak and other less valuable trees, leaving as much of a fringe of chestnut around each opening as is possible. The openings can not be made large because chestnut, being heavy seeded, does not scatter its seed any distance from the mother trees.* When sufficient seedling reproduction has come into the opening another cut can be made. If the chances for sprout reproduction are favorable, this cut will remove the remainder of the stand; if, on the other hand, sprout reproduction will be unreliable, and more seed reproduction is

*An exception is the carrying of seed by squirrels and other rodents, who either lose it or bury it and then forget it, giving it a chance to germinate. But this agency can not be depended upon.

needed, part of the stand should be left for seed, and may be taken later at a third and final cutting.

This system, however, will be practicable only where the forest is so accessible that cuttings yielding comparatively small volumes per acre and repeated at 5 to 15 year intervals will pay.

It will probably more often be necessary to make large openings in order to secure a larger cut per acre. In this case the trees left should be the younger and more vigorous ones of whatever species. It will be advisable, of course, to leave as large a proportion of chestnut as possible in order to seed up the area.

When cutting is done in the late fall (after the leaves have turned or fallen) and in the winter, and where there are enough trees which are not too badly damaged to produce good sprouts, it may be possible to make practically a clear cutting leaving a few seed trees of chestnut, chestnut oak and possibly yellow poplar.

This, however, can not be done in the spring and summer without injury to the future stand and even sometimes risking its existence. Chestnut cut in the spring and summer sometimes produces fair sprouts, but never as vigorous ones as do trees cut in the late fall or in the winter, and sometimes produces none whatever. Summer is the worst season for sprouting; even such sprouts as are produced in summer are often killed back by autumn frosts before they have been able to form woody tissue. As a general rule, therefore, large openings, even almost clear cuttings with seed trees, will be safe (though not the best form of management) in the fall and winter, but very unsafe in the spring and summer.

Wherever chestnut oak is found there is generally an abundance of seedling reproduction on the ground. If, however, this advance reproduction is absent, a few seed trees to the acre left after cutting should suffice; because chestnut oak generally reproduces excellently by seed.

Where hickory is present it should be encouraged. Wherever in cutting in the autumn and winter hickory is found and is sufficiently vigorous to reproduce by sprouts, it should be cut; because second growth hickory is valuable whereas first growth hickory is not. If it is unlikely to sprout, and there is no seedling reproduction around it, the hickory might as well be left for seed.

Great damage is suffered by this forest from hogs. These animals eat the chestnuts and acorns, and thus prevent seedling reproduction. They should be excluded for a few years before cutting, during cutting, and after cutting until the new forest has become fully established.

Slope.—There are many valuable trees on the slopes, though chestnut and poplar will have the most certain future value. The object of management, therefore, should be to procure abundant reproduction of these two species. In most cases chestnut can be reproduced adequately by sprouts. This tree should always be cut in the winter or spring, and never during the late summer and early fall. Poplar will reproduce by sprouts from young trees, but older trees lose this power of sprouting. Seedling reproduction, therefore, should be obtained wherever possible. Poplar should be saved to the last in logging, so that the seeds may be scattered over the area that has already been lumbered. By cutting the chestnut and other species first, opportunity will be given the poplar to seed and the chestnut to sprout.

Red oak, white oak, and hickory are valuable and should be encouraged over such trees as black oak, black gum, and maple. Red oak is probably the most valuable oak for the mountain slopes, as it grows rapidly and makes a very fine quality of lumber. It reproduces chiefly by seed, so that hogs should be excluded from the forest for some time before and after lumbering. Seed trees of this species should be left where there is not sufficient poplar and chestnut to thoroughly restock the area.

White oak, though slow growing, is of great value for barrel staves. The seedlings of white oak require more light than those of red oak, and may be secured effectively by leaving seed trees in fair sized openings (100 to 200 feet in diameter). To secure seedlings of red oak the stand should be left at about half density.

Part of the Slope sub-type contains a considerable mixture of hemlock. In future forests this tree should not be allowed to form part of the main stand (its crown at the same height as that of other trees), but should be kept in the understory. It thrives in the shade, and if kept under the main stand where its crown does not interfere with other trees, it serves a useful purpose in keeping the forest floor in good condition, and also in furnishing a little addition to the regular forest crop. In general, lumbering operations where large openings are made, and the bulk of the reproduction is to be from sprouts it will be well to leave a few hemlock seed trees. Sprouts grow so rapidly at first that they will be in no danger from the hemlock seedlings. These seedlings will endure under the shade of the sprouts and form a valuable understory.

Linn reproduces almost entirely by sprouts from stumps. Large sprouts often form about the bases of mature trees. These sprouts should be protected in lumbering as much as possible. Cattle should

also be kept from the woods during and after logging where any attempt is made to reproduce this species, as they destroy all that they can reach.

It is very important to keep hogs out of this sub-type before, during, and after lumbering of the ridge.

Cove.—The mountain cove is the home of the yellow poplar, and of the chestnut. Other important trees are white oak, red oak, ash, linn, hickory, and cucumber. The most profitable tree to grow is yellow poplar, and the next is chestnut. White oak and ash should also be encouraged because, although slow growers, their wood is of great value. None of these trees should be discriminated against, because all are of considerable value.

Poplar should be reproduced by seed because only the younger trees sprout. With chestnut it will generally be safe to depend upon sprout reproduction except when the trees are cut in the spring and summer. The method of cutting should, therefore, be to leave poplar seed trees either in the middle of or alongside of large openings of about 200 feet in diameter. If it will be possible to cut again within 10 years, the large mature trees can be left, because not only will they yield large quantities of seed, but in all probability they will also greatly increase in value. If no cut is expected for a period longer than 10 years, it will be advisable to leave the most vigorous young trees, which are but of small value for lumber or pulp now, but which will grow rapidly and will yield the seed necessary to fill the openings with young poplar. Where logging extends over a period of a year or more the poplar should be cut last, thus allowing it to at least partly seed up the area opened up by cutting the other species.

With chestnut cut in the fall and winter it will be possible to make very large openings or nearly clear cuttings, except for leaving the straightest young trees to grow to telephone poles. These should be left in groups wherever possible so that they will continue their height growth instead of becoming branchy. When cutting is done in the spring and summer a certain amount of seedling reproduction of chestnut must be secured to make up for the poorness of the sprouts. The openings should then be made smaller.

White oak and ash must be reproduced chiefly from seed. The seedlings of both species need light. Therefore the method of cutting to secure this reproduction will be to make an opening around a seed tree. It will be better to leave a vigorous young tree than a defective old one in the opening, because, although the quantity of seed may not be as great, yet the smaller tree will interfere less with reproduction coming up under it, and can be utilized in a future cutting. The opening for

white oak need not be large, generally not over 100 feet across, because the acorns are heavy and most of them fall almost under the crown of the tree. The opening for ash may be two or three times as large because ash seed is light and is carried by the wind.

Hogs and cattle should be kept out just before cutting and for five years or more afterwards. Hogs prevent the reproduction of chestnut and oak by eating the chestnuts and acorns; and cattle destroy the sprouts of many species.

There is ordinarily less danger from fire in this sub-type than in others because of its moist condition. Strict precautions must be taken, however, against fire, especially after cutting, when there is dry slash on the ground.

Red Oak Type.—Although this type is of little importance at present, because of the altitude at which it occurs, the inferior quality of its timber, and the steepness of its slopes which make it difficult to log, yet it will be just as well to give some idea as to how it should be cut. The method of cutting will be of importance because the steep slopes which make the forest of less value from a logging point of view, make it of even greater value in controlling stream flow.

Red oak reproduction is the first consideration in any method of cutting in this type. This reproduction must come almost entirely from seed, and seedlings come in best in the half shade of the parent stand. Therefore, unless the ground is already well stocked with seedlings, which is sometimes the case, it will be unsafe to make large openings or to cut clean, leaving only a few seed trees. The surest method of securing reproduction is to cut from one-half to two-thirds of the present stand, leaving the younger and more vigorous trees as evenly distributed over the area as possible. These trees will insure a restocking of the area and will prevent erosion and the consequent damage to streams. They can be cut when the area is logged again, in 40 or 50 years, or in less if the opportunity arises.

Wherever chestnut and linn are encountered in logging they should be cut and small openings made around the stumps, so as to give them an opportunity to send up vigorous sprouts.

Hogs and cattle must be kept out before and after cutting, to insure the reproduction of red oak and linn.

Beech and Maple Type.—Although beech and maple are the most abundant trees in this type, they are of far less value than the less common trees which occur in mixture, the linn, buckeye, cucumber, chestnut, and cherry. Unfortunately lumbering removes only the more valuable trees and leaves the beech and maple to seed up the area, with the

result that the second growth of this type contains an even smaller proportion of the more valuable species.

The problem, then, is to find a market for the beech and maple. Maple is largely used in the North for furniture and veneer. In the United States as a whole more than one million cords of beech, maple and birch are used annually for wood distillation, at an average price of $3 per cord. These industries might profitably be introduced into the North Carolina mountains. Beech and maple could then be cut, leaving the more valuable species to seed up the area and thereby increasing the future value of the forest.

CARE OF THE STAND.

The care of the stand falls naturally under two headings: (1) thinnings and other cultural operations; (2) protection against fire, grazing, wind, insects, etc.

THINNINGS.

A thinning is a light cutting, generally in a young stand, to remove trees which will never amount to anything or which are hindering more valuable trees. In Europe, where forestry has long been established and intensively practiced, thinnings are one of the most important forest problems. In the United States, however, they need scarcely be considered for the present, except in small pieces of forest, such as farm woodlots. In these woodlots thinnings should be of considerable value.

All the crooked and poorly formed trees, and all trees which have been so crowded that they would be unable to recover even if given sufficient light, should be cut. All trees of inferior species which are interfering with more valuable trees should also be removed. Where two trees of equal value are crowding each other the less promising one should be taken and the better one left.

The result will be threefold: first, the proportion of valuable species will be increased; second, the rate of growth of the stand will be greatly increased; third, a certain amount of material for fence posts and cordwood will be obtained. Thinnings are, therefore, decidedly worth while. It may be well before cutting, even when the owner does the cutting himself, to mark the trees to be taken. This avoids confusion and gives some idea of what the stand will look like after the operation has been completed. Thinnings may be made every ten to fifteen years, or as often as enough material can be cut to pay for the operation.

If the owner has a little spare time it will often pay him to go into a stand of coppice five to fifteen years old and cut out the crooked sprouts and the sprouts of inferior trees interfering with those of more

valuable ones. This will greatly increase the proportion of valuable trees in the final-stand, and will stimulate growth, although it will probably not yield much immediate return in material. This operation is called a cleaning.

PROTECTION OF THE FOREST.

Fire and stock are the two principal enemies of the forest, and do vast amounts of injury every year. Outside of these and the damage caused by indifferent handling, the forests of this region are subject to but little injury. In some parts of the State, large areas are being destroyed by insect pests, but in Western North Carolina no such general destruction has taken place. Small patches of second growth pine are occasionally destroyed by bark beetles, which usually spread from some tree which has been weakened by injury. Such a "deadening" may be checked by cutting down and burning during the winter months the bark of trees which are infested. The presence of insects is discovered by exudations of pitch on the outside of the tree. Several of our hardwood trees are more or less injured by insects, notably the chestnut by borers. Borer holes are so common in chestnuts that there is a recognized grade of lumber called "wormy" chestnut. A large part of this, however, is due to the previous injury of the tree by fire, so that the prevention of insect attacks can to a certain extent be effected by stopping forest fires. Decay, due to fungi, is found in many forest trees, chiefly white pine and red oak. There is little that can be done under methods of forestry now practicable to lessen the injury from this cause, though the cutting out and close utilization of trees affected by fungus tends to lessen the chances of its spreading.

Wind occasionally blows down a few trees, though the injury from this cause is less in the mountains than in any other part of the State.

Along the tops of the ridges and in other exposed places, sleet frequently breaks the timber considerably, allowing the easy entrance of insect and fungus diseases. Nothing, however, can be done to prevent this, though the encouragement of species of trees in second growth that are the least easily broken, would in time tend to reduce the damage from this cause.

*Fire Protection.**

Fire is the greatest destroyer of the forest, yet no organized effort has ever been made in this State to prevent or control it. It has been estimated that during 1909 the owners of forest land in North Carolina lost at least half a million dollars through fires. In the mountain counties

*For a fuller discussion of this subject the reader is referred to Economic Paper No. 19 of the North Carolina Geological and Economic Survey, "Forest Fires in North Carolina During 1909."

alone the estimated loss was more than $6,000 per county. These estimates do not include the indirect loss, such as the destruction of young growth and the impoverishment of the soil. It is probable that from 15 to 30 per cent of the forest area of several of the counties is burnt over annually. Much of this is burned over intentionally, and, though there is some sentiment against this practice, yet the feeling is not strong enough to prevent it. Forest fires rarely kill mature hardwood timber, except probably in the spring after the sap has started to rise. For this reason it has often been asserted that the timber is not injured by an ordinary leaf or ground fire. This is far from being so, however, for it has been estimated that the value of the standing chestnut timber alone in this region has been reduced by at least $2,000,000, chiefly through damage from fire.

Nevertheless, the chief damage is not to the mature timber, but to the young growth and reproduction. Over a large part of this region yellow poplar and other valuable species have been prevented from reproducing in the second growth forest by the burning of leaves and the consequent killing of the seedlings when one or two years old. The total damage from this cause can not be estimated, though it is surely very great. For instance, a twenty-year-old stand of yellow poplar will yield fifteen cords of pulpwood an acre, worth at least $2 a cord or $30 an acre. If this stand is killed by fire when it is two years old, there will be no direct loss of anything which has a present market value. But the owner will lose property which in 18 years would have yielded him $30 an acre. If a man owns 100 acres of this land he will have practically nothing in 18 years (unless the stand reproduces again) whereas if he had protected his land against fire he would have had $3,000.

Burning the woods always results in serious injury to the soil. With farm land the owner occasionally has to put back in the form of fertilizer what he takes out of the soil in the form of crops. In the forest the trees fertilize the soil with their leaves. Therefore fire, by destroying the leaves, makes the soil poorer year by year. The loss of the leaves also allows free course for the surface water and rain to flow off, washing away the richer surface soil. This results not only in the slower growth of the timber, and a decrease in value of the land, but it is a serious menace to land owners and water users all along the streams, through the increase of floods and the deposition of sand and silt.

The way to stop fires is to prevent them from starting, which can probably best be done by patrol. In this the State can take the leading

part by passing laws providing for a fire protective system and making an adequate appropriation to operate it. In the absence of effective forest fire legislation the State, as well as private owners of timberland, can do a great deal in educating the public to be careful in the use of fire in dry seasons, and to extinguish forest fires before they get too large to be easily controlled. In New Hampshire and some of the Northwestern States, particularly Washington and Oregon, timberland owners have formed protective associations for patroling the forest. The cost is pro rated, and amounts to from one to three cents per acre per year.

Among the effective measures for preventing forest fires in Western North Carolina, in addition to patrol, are lookout stations, fire lines, and liberal posting of warning notices. Lookout stations are very effective supplements to patrol. Located on prominent elevations they are a means of detecting fires at long distances as soon as they start. The best lookouts are connected by telephone with central points. Thus fires can be reported by the watchman quickly, and men hurried to them. The effectiveness of fire lines and warning notices is discussed in Economic Paper No. 19 of the North Carolina Geological and Economic Survey, "Forest Fires in North Carolina During 1909."

Fire Laws. There is immediate need for a Statewide law for the protection of the forests from fire. The following points are suggested for consideration in framing such a law: (a) A fire warden system with a strong and active organization to prevent and extinguish fires and enforce all the forest laws; (b) regulations requiring the railroads to take certain measures to prevent fires; (c) amendments which will effectively restrict the use of fire by private individuals.

(a) The fire warden system should have at its head a State Fire Warden authorized to appoint, upon the recommendation of the county commissioners of any county, one or more fire wardens in each township where there is enough woodland to make such an appointment advisable. The wardens should be subject to the call of the State Warden, when, in his judgment a dangerous season exists. Their duties would include patrol; posting warning notices; extinguishing forest fires; investigation of the causes of all forest fires and the collection of evidence sufficient to convict offenders against the forest laws. They should report at regular times, in addition to reporting on all forest fires. They should be authorized to summon help in fighting forest fires, and should be given the power of arrest without warrant. They should be directly responsible to the State Warden to whom they report. Prosecutions for setting fires or other infraction of the forest

laws should be instituted by the State Warden. This would largely prevent such prosecutions being attributed to personal motives.

(b) Many forest fires are set by sparks from railroad locomotives and by the careless burning of rubbish along the tracks by section hands. Unfortunately, there has been little disposition on the part of the railroads to take any steps to prevent these fires. This indifference has in part been due to the indifference of the owners of forest land along their lines. The railroads would probably be willing to coöperate in the prevention of fire, if these owners showed more interest in fire protection. A law requiring the railroads to keep a strip 100 feet wide on each side of their track clear of all combustible material would tend to prevent a great many fires started by railroads. It has been found from careful investigation that most of the sparks from a locomotive engine fall between 50 to 100 feet from the road bed; therefore, if such a strip were kept clear, fires resulting from sparks would be far less frequent. But since the right of way owned by the railroads does not always extend to this width, there might be difficulties in the way of such a law. The railroads could, however, secure the owner's consent to enter on adjoining lands in order to clear off the combustible material to this width; and in case the owner refused, the railroad could be relieved of responsibility for any fire which it might start on his land.

Many States have been forced to pass stringent laws requiring the railroads to use spark arresters on all of their locomotives. One or two logging operators in this region use spark arresters in their engines with fairly satisfactory results. Wherever these have been used there has been great objection to them on the ground that they cut off too much draft. This defect will no doubt be overcome in the near future and their use become general. The American Spark Arrester Co., of Indianapolis, Ind., are now conducting what promise to be successful experiments along this line. The present development of these devices, however, warrants their use in emergencies; and a law might be framed so that their use would be compulsory only in dry weather, when every precaution is made necessary.

(c) Most of the serious forest fires in the mountain counties have been set by men carelessly burning brush and rubbish in dry weather in the spring. These men, many of whom are only renters and have little or no property of their own, can not be controlled by the present fire laws. Therefore, a new law prohibiting the burning of brush during dry seasons unless very thorough precautions are taken to prevent the spread of fire, is needed. Such a law, made effective by re-

quiring that persons burning brush in the dry season shall obtain a permit from the fire warden, is in force in several States and is working well.

PROTECTION FROM STOCK.

The forests of North Carolina have suffered very severely from the indiscriminate ranging of stock. In the eastern part of the State, the reproduction of long leaf pine over vast areas has been largely prevented by hogs. Even in the hardwoods in the western part of the State, serious damage has been done, and is still being done by both cattle and hogs. The injury from stock varies according to the age and condition of the forest. The most serious injury is done during the first few years after lumbering, when young growth is starting. Cattle are extremely fond of linn sprouts, and will effectively prevent the reproduction of this species after lumbering. They also browse on the young poplar, and, if numerous, will break and bite off the shoots of many other species. Hogs eat large quantities of chestnut, oak, and hickory seed, and may often prevent seedling reproduction of these trees. Both hogs and cattle should always be excluded from cut over lands and from areas of second growth until the trees are too large to be injured. In a fully stocked second growth forest, or in mature timber where reproduction is not yet desired, the injury done by stock is not great.

The most serious injury from stock has been an indirect one. The practice of burning the woods for the improvement of the cattle range, has been brought down from the time of earliest settlement. Long ago, when there was little cleared land, there was some excuse for this practice, but conditions have changed; there is now more than enough land cleared and subsequently abandoned to wild growth to furnish pasturage to all stock; and the introduction of Japan clover within the last fifteen or twenty years has turned these old fields into rich pastures. Many people, not realizing the change which the introduction of this plant has brought in the cattle industry, still continue to burn the woods, to the incalculable damage of the forests. It was estimated that in one of the counties of this region, for every head of cattle which ranges the woods, 67 acres of forest land are burnt over every year, and that young growth to half of the value of these cattle, is being destroyed by fire each year.

The people of North Carolina have a remedy and they are gradually applying it. The stock law is a local option measure, and any county, township, or district can, by a majority vote, make it effective. It is now enforced over five entire counties in this region, and over

the better settled portion of nine other counties. There are still, however, two entire counties over which stock is allowed to run at large. But the law is being extended year by year, and before long will cover not only this entire region, but the whole State as well.

SALE OF STANDING TIMBER.

Much of the waste and destruction of young growth and reproduction incident to the average logging operations is due to the indifference or carelessness of the owner. This carelessness is generally displayed in the manner of making a contract or in signing the contract drawn up by the purchaser, or more often in having no contract at all. Many years ago much standing timber was sold by the individual tree; in some counties the marked trees are still standing, thus preventing the growth of young trees. The owner of the land is paying taxes on it every year, and yet he is losing the growth both on the trees he sold and on the other timber because no stipulation was made in the contract as to when these trees were to be removed.

In selling stumpage (standing timber) the owner must understand thoroughly the market conditions, that is the price which each forest product (lumber, extract wood, pulp, poles, ties, etc.) will bring delivered at the railroad. He must also be thoroughly familiar with the transportation problem; that is, he must know just how much it will cost to get the product to the railroad. He should also know how much it will cost to log the area which he has to sell, and how much to manufacture the product. In other words, he should have an idea of how much it will cost the purchaser to market his product and how much he (the purchaser) is likely to get for it. He will then know how much profit the purchaser expects to make and will be able to decide upon a price for his standing trees which shall be fair to the purchaser (making due allowance for risks in fluctuating markets, etc.) and to himself.

It is always advisable to require the purchaser to pay on the actual amount cut rather than to pay a lump sum for the estimated amount on the area. If he (the owner) is unable himself to scale the logs in the woods, he can take the returns from the purchaser and check them by occasional visits to the woods or to the mill.

In order to secure reproduction and provide for the future productivity of his land, the owner should mark the trees to be cut as recommended under Forest Management, and should see to it that all these trees are cut and none others. He should not only provide for the full utilization and satisfactory removal of the timber to be cut, but he should also provide against unnecessary destruction of the young growth

on the ground. A contract of sale should be drafted with considerable care. For the protection of the seller the contract should embody the following points drawn up in legal form:

(a) Define the area included in the sale.

(b) Stipulate the price by the unit of measure agreed upon, whether it is cord, thousand feet board measure, number of poles, etc.

(c) Specify the method by which the timber is to be measured. If the logs are to be scaled, whether Doyle, Scribner, Favorite, or other rule is to be used; if by lumber measure, whether log run or graded. If cords are used, specify whether 128 or 160 cubic feet to the stacked cord is intended.

(d) Specify time limit within which operation must begin and must be completed.

(e) Specify species, size, and condition of timber which is included in the sale.

(f) Specify the number, kind, and quality of seed trees which are to be left on the area.*

Besides the above points, the contract should include certain clauses to govern the cutting and removal of the timber. The following cover the ground fairly well, and are suggested for consideration in the preparation of the contract:

1. Only the species and classes specified in the contract (or such trees as have been marked for cutting) may be cut, and all of these must be cut.

2. Trees marked for cutting which remain uncut at the expiration of this contract shall be paid for at double the stumpage price agreed upon.

3. All unmarked trees which have been cut shall be paid for at double the stumpage price agreed upon.

4. All sound stumps must be cut not more than.....inches above the ground, in order to save waste in timber, and all tops must be utilized to a diameter of.....inches.†

5. No unnecessary damage will be done to young growth or to trees left standing, and no trees shall be left lodged in the process of felling. Any young growth or trees left standing which are badly injured or killed through carelessness shall be paid for at the rate of $..... each. If it should be necessary to fell a tree into young growth, the

*This is only in case the owner does not mark the trees to be cut or the seed trees to be left. It is always advisable for the owner to mark these trees himself. The mere specification of seed trees in a contract is always unsatisfactory.

†The diameter of the tops should be as small as market conditions and the accessibility of the timber will allow.

least valuable species, such as maple, gum, or beech shall be chosen in preference to the valuable ones, such as poplar, chestnut, or linn.

6. Only the inferior species must be used for necessary logging purposes, such as construction of skids, slides, bridges, tram roads, flumes, etc., and such material must be paid for at the price agreed upon.

7. Saw timber for flume construction will be paid for at a fixed price per thousand feet. Chestnut and hemlock as well as the inferior species shall be used for this purpose.

8. Right of way for flumes or tram roads over the seller's land will be allowed to the purchaser free of charge during the life of this contract, but where they cross a road adequate and satisfactory crossings must be constructed by the purchaser.

9. All improvements constructed by the purchaser on the seller's land which are not removed within.....months after the expiration of this contract, shall become the property of the seller.

10. Fire must be kept out of the woods, the purchaser to be held responsible for loss from any fire on his sale area.

11. Title to the timber shall remain in the seller until it has been scaled, measured, or counted, and paid for.

FOREST EXTENSION.

Abundant reproduction of seedlings or sprouts, or of both, is generally obtained after cutting.* Therefore in forested land artificial reproduction will seldom be necessary. But land which has once been cleared, and which is no longer being used for agriculture, frequently reverts to forest very slowly. In order, therefore, to put such land to a profitable use and prevent its rapid deterioration through erosion, it may often be advisable to resort to artificial reforestation.

Artificial reforestation may be effected by two methods: first, by the planting of young trees grown in a nursery; and second by the sowing of seed directly in the area to be reforested.

PLANTING.

The surest way to secure a satisfactory stand of forest trees is to plant the young trees. The most precarious time in the life of a tree is from seed to two or three years of age. This period is rendered safer by the use of nursery grown material. But since planting is more expensive than sowing, a careful study is necessary to determine which of these operations is best.

Planting in the mountains should usually be done in the spring as soon as the ground can be worked. In this way growth starts imme-

*In the spruce forest this is true only if fire is kept out.

diately and the plants have a good chance to become established. The next best season is in the late autumn after the leaves have fallen. In this case the plants rest during the winter and are ready to begin growing the first thing in the spring. In either case planting should not be done while the young tree is growing. In the spring it should be done before growth begins, in the autumn after growth has stopped. If the trees are planted amongst the grass, weeds, and briars of an old field, some precautions must be taken the first summer to keep them from being choked out. Full instructions as to the methods of planting may be obtained by writing to the Forest Service, U. S. Department of Agriculture, Washington, D. C.

In the parts of the mountains where white pine grows naturally, as along the Blue Ridge and in many parts of the Plateau type, it is probably the most profitable tree to plant. The young trees can be purchased very reasonably at the principal forest nurseries, and a large proportion of those set out usually live. From two to four year old plants should generally be used. If the ground is not thoroughly prepared, material once or twice transplanted in the nursery is preferable to seedlings. White pine should be planted from five to seven feet apart each way, so that the trees will early form a complete cover for the ground; they will then be able to prune themselves naturally, make the most satisfactory growth in height and produce the best quality of timber.

Throughout the Plateau type there are many areas in which shortleaf pine will grow more satisfactorily than white pine. This species has been planted in Buncombe County both pure and in mixture with white pine or with some of the hardwoods, and has given great satisfaction. Shortleaf pine seedlings are not as readily procured from nurseries as are the white pine, and where very considerable areas are to be planted it may often be advisable either to make arrangements with some nurseryman to raise the desired seedlings, or else to raise them one's self. This latter should not as a rule be undertaken, however, unless the magnitude of the operations warrants the employment of a man for this special purpose. Shortleaf pine should be planted in the same way as white pine. These trees can be mixed alternately with some hardwood, preferably sugar maple. The mixture of the hardwood benefits the pines by causing better self-pruning, and by making a denser shade near the ground which keeps the soil in good condition. It is not usually advisable to plant shortleaf and white pine in mixture, as the conditions that suit one do not suit the other.

Certain coniferous species not native to this region do very well un-

der certain conditions, notably the European larch and the Norway spruce. These, however, should be planted at first only in an experimental way.

Black locust is perhaps the most important hardwood tree for planting in this region. Locust is rapidly disappearing from the forests, and its use for posts will make a continual demand for it. Its rapid growth and hardihood make it very satisfactory to plant in many situations.

Locust grows naturally all over the region, but succeeds best on the Chestnut type above 2,500 feet in elevation. Many areas when cleared and subsequently abandoned come up naturally to locust. It would often pay to fill out these scattered stands by planting, as more rapid height growth would be secured, and a better quality of post can be raised where the stand is fairly dense. A few acres of thrifty locust would supply a large farm with posts, and when once planted the supply would be permanent. Locust reproduces so abundantly from sprouts after cutting that there would be no need to replant. It is also one of the best trees to hold the soil because of its long tough roots. Like all the pea family, the locust is a great renovator of the soil, taking nitrogen from the air and storing it in the soil, so that the longer an area stays in locust the richer it becomes. By the time a crop of locust planted in an old field becomes mature, the soil will be rich enough to grow good agricultural crops.

Locust should be planted from four to six feet apart each way. The soil should be prepared by plowing, and might be cultivated with advantage once or twice after planting. This gives the young trees a healthy start which enables them to maintain a rapid growth. Plants can be obtained at very reasonable prices at any forest nursery. In the Ohio River valley there are many firms which make a specialty of growing locust seedlings. One-year-old seedlings may be used to advantage where the ground is in good condition, but those two years old would be better in most cases. Locust seedlings may easily be grown on the farm by sowing the seed in drills and giving ordinary cultivation.

White pine, shortleaf pine, and locust are the only species recommended for planting in pure stands in this region, though under exceptional conditions others might be planted in a similar way. Most of the hardwood species do better in mixed stands. Yellow poplar has been planted to some extent in other States, but it has been little tried in Western North Carolina. Poplar succeeds well in suitable locations and in a fairly rich soil up to 3,500 feet in elevation. There are

often small areas along streams or in small hollows, that might be profitably planted in this species, since it grows very rapidly, and is unusually free from enemies. When planted in such situations, it may be advantageously mixed with red oak, white oak, hickory, or sugar maple, the poplar trees themselves not making a dense enough shade to insure most favorable conditions. If it is used around the house or along the road for ornamental purposes, the ground, if poor, should be enriched either before or after planting. Two or three year old plants are recommended for general planting, though for ornamental and shade purposes larger trees can be used.

Balsam may be planted above an elevation of 3,500 feet and grows fairly rapidly. Where the object is for ornament or the prevention of erosion or the protection of headwaters of streams, this tree may be used in such situations, but balsam has little commercial value, so its use cannot be generally recommended.

Sugar maple has been planted to some extent in this region, but chiefly in mixture with the more valuable hardwoods and the pines, with the object of improving them. On account of its rather slow growth and small value for timber, it should not be planted by itself. In the more northern States sugar maple has been planted with great success with white pine, one plant of the latter to three of the former. Similar planting has been done quite successfully at Biltmore.

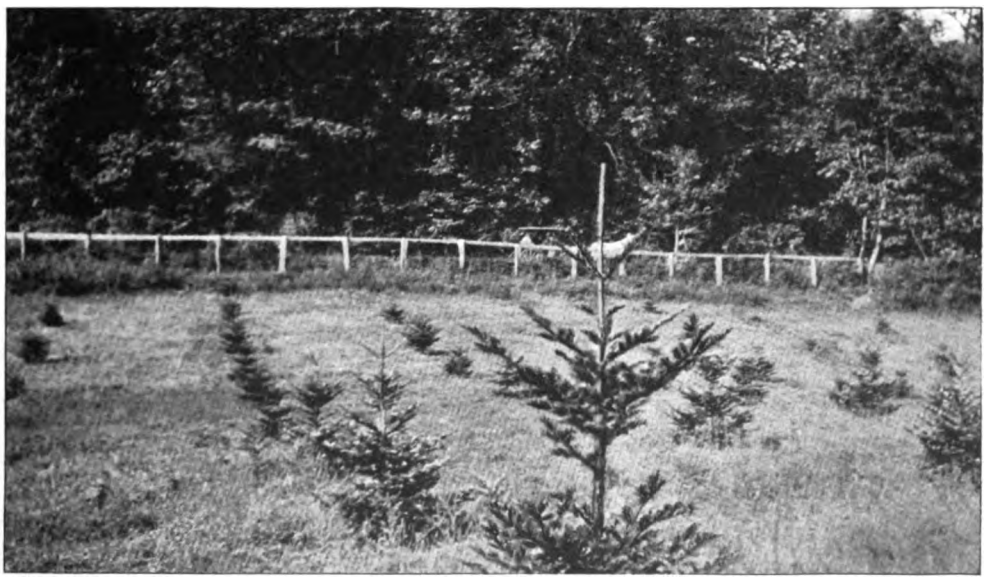
Most of the other hardwood trees which are recommended for reforesting, are best propagated by planting the seed where the trees are to remain because the large taproots, which are developed soon after germination, make it very difficult to transplant them. Walnut, hickory, chestnut, and all the oaks belong to this class. Both because of the frailty of the young seedlings and because the seeds are subject to the attacks of squirrels and other vermin, it is considerably more difficult to obtain a stand of these species than it is to obtain a stand of species which can first be grown in a nursery.

SOWING.

The only species that are generally recommended for propagation by sowing are the nut bearing trees, though occasionally others may be sown to advantage.

Walnut has been transplanted to some extent, but much greater success has been attained by sowing seed where the plants are to grow. Walnut grows well only on rich moist soils. For this reason, and because of its slow growth and doubtful popularity in the future, its general use is not recommended.

A. Sugar maple plantation, 8 years old, Buncombe county.



B. Thrifty growth of balsam plantation, at elevation of 3,800 feet, Watauga county.

Hickory is a much more desirable tree to plant. The timber of second growth hickory brings a good price. There is no doubt that the rapidly increasing shortage of second growth hickory will make a permanent demand for this material, and where planting of hardwoods is undertaken hickory should be in the mixture on all suitable situations. There seems little choice as to the species of hickory to plant, but the kind that grows naturally in the particular locality would probably be best.

The propagation of chestnut by either sowing or planting has met with little success in North Carolina. The difficulty of procuring sound seed, and the destruction of seed by squirrels has made sowing a very precarious and expensive method while the long taproot has made planting difficult.

Seeds of walnut, hickory, or chestnut should be planted in furrows, drills, or seed spots. The ground may be prepared by ploughing a furrow and planting a seed in or beside the furrow, or it may be planted with a mattock, or even with a sharp stick without previous preparation. Mixtures including all of the important nut bearing trees are recommended for general planting, with, however, only a small proportion of walnut. Variations must be made to suit local conditions and the object for which the area is being planted.

The oaks are best planted in seed spots, that is three or four seeds together in a spot of earth loosened up with a mattock. In some States planting the oaks by this method has been found very satisfactory. An alternation of seed spots of oak with hickory should prove a satisfactory method of reforesting suitable areas. If areas are well adapted to the growth of hardwood the different species may be mixed in planting in such a way that an ideal proportion of the valuable hardwoods may be procured.

Sowing of the pines has generally been found very unsatisfactory when the seed has been scattered over the area broadcast without previous preparation of the ground. But when the ground has been previously prepared there is a reasonable chance of success. This preparation may be made in two ways: first, the whole area may be ploughed and harrowed as for an ordinary farm crop; or second, seed spots may be prepared with a mattock. In either case the seed is lightly covered after being sown. The chances of success with the second method may not be quite as great as with the first, but obviously the cost is far less.

The artificial regeneration of the spruce forest will probably not be attempted by private individuals because of the expense of the opera-

tion and the uncertainty of the results. Only a large corporation or the State or National government can reforest spruce by planting in situations such as those in Western North Carolina. Experiments would have to be made with different species and methods.

FOREST TAXATION.

The tax laws now administered in North Carolina have as a rule not resulted in placing an excessive burden on timbered lands, and on this account forest taxation has not as yet become a problem. This fact, however, does not necessarily mean that the present method of taxing this class of property is satisfactory. Admittedly, it is not. Those who have given most thought to the subject are practically agreed that a tax on the timber when it is cut, with a nominal annual tax on the land, is probably best adapted to conditions in this country. Certainly this method is not susceptible to the same inequalities and uncertainities as is the present method. In fixing the land valuation under the principle proposed, the assessor is to give absolutely no consideration to the growing timber.

While at present there is no general complaint from owners that their timberlands are being excessively burdened with taxes, and consequently there seems to be no urgent need for readjusting the tax laws with respect to timbered lands, it is nevertheless believed that the application of the proposed principle of taxing the timber only when cut would do much to further the practice of approved forestry by private owners.

BILTMORE ESTATE.

A report on the forest conditions of Western North Carolina would be incomplete without some account of the forests of the Biltmore Estate. This estate, purchased during the nineties by Mr. George W. Vanderbilt, comprises some 200 square miles of land, and extends from Asheville in a southwesterly direction through Buncombe, Henderson, and Transylvania counties to the Jackson County line, a distance of some 35 or 40 miles.

Mr. Gifford Pinchot, formerly United States Forester, immediately on his return from his studies of forestry in Europe, was employed by Mr. Vanderbilt to investigate the possibilities of forestry on the property and to suggest a system of management. After his work was done, Dr. C. A. Schenck, a German "öberforster," was engaged to devote his entire time to the forest problems of the property. Dr. Schenck, who had had considerable experience in the Old Country, put into operation with great energy the first scientific and practical private forest management in this country.

The greater part of the estate was covered with forest, but heavily culled and with a reduced productivity.

The part of this property lying in the vicinity of Asheville, except that which has been included in the Biltmore Farms, has been known generally as the Biltmore Forest, which comprises some 8,000 acres, of which about 2,000 had at one time been cleared and had become abandoned old fields, is situated on a broad plateau, with an elevation of about 2,300 feet. The forest here is of shortleaf and pitch pines, scattered through a hardwood stand of oak, with a small proportion of most of the other broadleaf species of the region. Because it is within easy hauling distance of Asheville, this forest had been severely culled, so that at the time of purchase there was very little merchantable saw timber left.

Owing to the scarcity of valuable timber and to its nearness to market, this forest was managed primarily for the production of firewood. About 2,500 cords a year have been cut from the poor trees, and have been marketed in Asheville at a good margin of profit, besides improving the stand. This utilization was made possible by the construction of a network of thoroughly good roads over this part of the estate.

In addition, however, to this old forest land that was producing cordwood, there were some 2,000 acres of absolutely nonproductive old fields included in the forest. To save the annual drain of interest and taxes on this area, it was determined to plant it, the first efforts being largely experimental. Practically all the native trees of value, and many exotics, were tried. At present this land supports a planted forest of great potential value. The most successful plantings have been of the native pines, white and yellow (shortleaf), and the larger part of the area contains a predominating proportion of these two species.

The greater part of the Biltmore Estate lies in the mountains along the western side of Buncombe, Henderson, and Transylvania counties, to the east and south of Mt. Pisgah and the Pisgah Range. This comprises some 80,000 acres of comparatively rough forest land, with elevations varying from 2,300 to 6,000 feet, and is known as the Pisgah Forest. Owing to its remoteness and inaccessibility there was a much better stand of timber on this area, little having been taken out except the very largest and most valuable trees. Yellow poplar, chestnut, white oak, red oak, chestnut oak, black oak, hickory, maple, and linn are the principal trees. This part of the estate has been managed as a timber forest, the object being to produce saw timber of the greatest value. Looking toward returns from a rise in timber values rather

than to increase in growth, practically all sound and thrifty trees over two feet in diameter have been saved. Though little lumbering is being done, improvement cuttings have been going on all the time. By the sale of 1,500 cords of tanning extract wood and 1,000 cords of tan bark annually, the removal of much old and decaying chestnut timber and mature and slow growing chestnut oak is accomplished, to make room for the young and thrifty specimens of these, or even more valuable, species.

Roads and trails have been constructed in every direction. A total of 37 miles of main roads, 43 miles of byroads and 198 miles of trails make this one of the most readily accessible, as it was one of the most beautiful and attractive mountain forest properties in the United States.

Every effort has been made to protect these forests from fire. Rangers have been employed to patrol the woods winter and summer. Not only this, but everyone living on or near the property has been encouraged not only to report but to assist in extinguishing any fires that may occur. Altogether, this estate is one of the best examples of the application of practical forestry to be found in this country.

APPALACHIAN NATIONAL FOREST LAW.

A bill, providing for the purchase of forest lands by the Federal Government, commonly known as the Weeks Bill, or the Appalachian Bill, passed the 62d Congress, and became a law when President Taft signed it on March 1, 1911. This law has for its purpose the protection of the watersheds of navigable streams, by the purchase and care of forest lands on the headwaters of such streams, to be held and administered as National Forests. The bill also provides for coöperation between the Federal Government and the different States in the organization and maintenance of systems of fire protection on the forested watersheds of navigable streams. The North Carolina Legislature in 1901 passed an enabling act for the purchase by the Federal Government of lands within the State.

The law carries a Federal appropriation of two million dollars a year for five years for the examination, survey, and purchase of land. Much land in the Southern Appalachians as well as in the White Mountains has already been offered to the government for purchase and not only is the work of examination well under way, but negotiations have been entered into looking toward actual purchase.

For the purpose of coöperative fire protection in the different States, $200,000 is appropriated to be available until expended. Already eight States, Maine, New Hampshire, Vermont, Connecticut, New Jersey,

Maryland, Wisconsin, and Minnesota, have taken advantage of this provision of the law to extend and strengthen their own fire protective organizations. North Carolina can not receive this coöperative assistance until the State Legislature provides for a system of forest fire protection and makes an adequate appropriation for the purpose. The next session of the Legislature should by all means make it possible for North Carolina to receive assistance of this sort.

The forests on the high mountains of the Appalachians should be protected for all time. They can be adequately protected, yet lumbered, if the cutting is properly done. By protecting them, stream flow would be regulated, which would be a tremendous advantage to all those industries now using water power. The protection of the hardwood supply will make permanent the varied industries which now form such a large part of the manufactures of the State. If protected, these Southern mountains are destined to become the chief source of hardwood in this country.

An important industry in this region is the entertainment of tourists and visitors from other parts of the country and even from abroad. The preservation of mountain scenery is necessary if these visitors are to continue to be attracted by the country. The preservation of the streams would preserve the fish, and add one more to the many attractions of this region.

There is perhaps more mountain land in North Carolina suitable for forest management than in any other of the Appalachian States. Large areas in Clay, Graham, Swain, Haywood, Transylvania, Yancey, and Mitchell counties are still in almost unbroken forest, and the proper protection of such areas will be of enormous benefit. Every county should be interested in having at least part of the Appalachian National Forest within its borders.

SUMMARY AND CONCLUSIONS.

Western North Carolina is essentially a timber producing region, much the larger proportion of the land being better adapted to this purpose than to any other. The necessity of retaining on the mountain slopes a forest cover, which will tend to regulate the flow of the streams, and, therefore, be of inestimable value to the manufactures of this and the neighboring States, is a strong additional reason for preserving the mountain forests.

Seventy-six per cent of the land is now covered with forest. It has been estimated that these forests have an average stand of 3,400 feet of timber to the acre, or a total of about 10 3-4 billion feet for the region, much of which, however, is too small or inaccessible at present

to be merchantable for lumber. This timber is now being cut at the rate of about 330,000,000 board feet per annum, exclusive of that used for domestic purposes. This is considerably faster than these forests are growing timber, so that what practically amounts to a yearly deficit must be met by an increase in growth, which can be brought about only by improved methods of management.

If these forest lands are looked upon as continuous and permanent investments, improvements in the methods of handling them are absolutely essential to make such investments profitable. There is a total investment in forest land of about $20,000,000, including both the land and the timber, in the counties under consideration. Outside of the increase in the value of timber, a return worth something over $600,000 (including fire wood and fences) is received. This is equivalent to about three per cent on the investment, but taxes amount to over one per cent, so that the net income on the investment averages less than two per cent outside of the increase in value of the timberlands. From the standpoint of the private owner, this is not a highly profitable investment, but the present profits may be maintained or increased if the lands are protected and properly managed.

At present, owners are depending for profit too much on the increase in value of the property, and so are losing sight of the only permanent and regular source of profit—the annual growth of the forest. The object of all owners of forest lands should be to increase the annual growth so that the largest income possible will be secured from the forest. This must be accomplished by cutting the present stand so that the proportion of the more valuable species in the future forest will be increased instead of diminished, and by providing the most favorable conditions for healthy and rapid growth.

In order to bring about the necessary improvements in the forest conditions of Western North Carolina, the active coöperation of the State, the land owners, and all other persons within the region in suppressing fires is absolutely essential.

The State should assist by every means in its power in the protection of property. The State should pass a good fire law and provide adequate machinery for its enforcement. Such a law should provide for the appointment of county or township fire wardens in accordance with the needs of the different counties, these wardens to be subject to a central State authority and given the power to arrest for violation of the law and to call out assistance whenever needed to fight fires. Their duty should be to prevent fires if possible, extinguish those which have started, and aid the central authority in any prosecution under the

forest and fire laws. The fire law of the State should include a regulation to compel the railroads to use spark arresters in their locomotives, to keep their rights of way clear of inflammable material, and maintain a patrol to follow trains where fires are most liable to occur. The law should prohibit also the burning of brush during dry spring weather, except under proper restrictions. Notices calling attention to the danger from fire and the penalties for violation of the State law should be posted by the fire wardens in conspicuous places throughout the region.

The owners of forest land should be most vitally interested in the improvement of forest conditions, thereby increasing the yield of their own forests, but they are unfortunately in many cases indifferent or inactive. They should aid the State authorities in fire protective work. Where large holdings are grouped more or less closely together, they should form coöperative fire protective associations and employ patrolmen when the fire danger is most serious. They should aid in the posting of fire notices, provided by the State, and prevent serious fires by the construction of fire lines. In addition to fire protective measures, private owners should endeavor to increase the value of their forest property by cutting so as to encourage the reproduction of the most valuable species. They should further provide for the future crop by the care of young growth during cutting and they should exclude stock from the forest areas during and succeeding logging operations. Such precautions should be taken whether the owner logs the land himself or sells the standing timber to be logged by another.

The people of Western North Carolina, whether owners of forest land or not, should endeavor to cultivate a sentiment in each neighborhood in favor of forest protection and against burning the woods. They should assist in every way in their power in enforcing the State laws and aiding fire wardens in the performance of their duty. They should, if the stock law is not operative in their locality, use their influence toward the introduction of such a measure.

PUBLICATIONS

OF THE

NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*

2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 50 cents extra.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

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24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

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