

**NORTH CAROLINA
GEOLOGICAL AND
ECONOMIC SURVEY**

JOSEPH HYDE PRATT, STATE GEOLOGIST

ECONOMIC PAPER NO. 22

FOREST FIRES AND THEIR PREVENTION

INCLUDING

FOREST FIRES IN NORTH CAROLINA DURING 1910

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DURING 1910

BY

J. S. HOLMES, Forester



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1911

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LETTER OF TRANSMITTAL

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

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

SIR:—I herewith submit for publication as Economic Paper 22 of the reports of the North Carolina Geological and Economic Survey a report on Forest Fires and their Prevention, including statistics regarding Forest Fires in North Carolina during 1910, which has been prepared by Mr. J. S. Holmes, Forester to the Survey. The statistics are more complete and accurate than those collected for 1909 and more intelligent answers were received from inquiries during this second year of collection.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

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FOREST FIRES AND THEIR PREVENTION

BY J. S. HOLMES.

INTRODUCTION.

During 1909 the United States Forest Service attempted to collect uniform data on the prevalence and destructiveness of forest fires in all the various States. The North Carolina Geological and Economic Survey co-operated with the Forest Service in this work in this State, and got together some very interesting figures. Though admittedly incomplete, these were published by the State Survey in Economic Paper No. 19, "Forest Fires in North Carolina During 1909." This publication has been scattered widely through the State, and is still available for distribution. It should be read in connection with the present report in order to best understand the application of the figures and to obtain much information which it was thought best not to repeat.

Owing to the failure of many of the States to obtain sufficient reliable information, the general fire study of the Forest Service, which was intended to be annual and permanent, has been discontinued. The North Carolina Geological and Economic Survey then had to decide as to the advisability of continuing the collection of these figures unaided. Though the data collected last year was far from satisfactory, still it was thought that the economic and educational value of such figures was great enough to warrant the expense of collecting them. With the hope, therefore, of increasing their accuracy and broadening their influence, the Survey determined to continue the collection of this information in regard to the annual destruction by forest fires.

Accordingly, as soon as the year closed, question blanks were sent out to about eight hundred correspondents in all parts of the State, together with a stamped envelope for reply. These forms contained the same questions that were asked last year, but, in order to make the replies more definite and accurate, the correspondents were asked to confine their figures to one or more specified townships, and not try to estimate for the whole county. This method has succeeded much better even than was expected. No correspondent attempted to answer for more than one or at the most, two townships, and, as a consequence, the figures included in this report, though attempting to represent an even smaller part of the State than last year, are, it is thought, considerably more accurate. Still it must not be forgotten that all figures given are

estimates, and sometimes only very rough estimates at that, as it would have been impossible to obtain definite figures without an immense amount of trouble and expense.

THE WEATHER IN 1910.

As the condition of the weather, especially the amount and local distribution of the precipitation has a great deal to do with the frequency and severity of forest fires, a brief review of the weather conditions for 1910 will add interest and value to this report.

The past year was noteworthy for two quite severe droughts, extending over the entire State, though generally more severe in the eastern part. The greatest deficiency in precipitation occurred in March, the rainfall for that month being less than for any previous March for which there are any records. Practically no rain fell after March 12th. This droughty condition, which lasted up to the middle of April, and was accompanied by high winds, made the danger from forest fires very great. Destructive fires broke out in many counties before the end of March and continued with increasing frequency and severity up to the middle of April, when a general rain restored normal conditions. June was a wet month, the rainfall all over the State being markedly in excess of the normal. Heavy summer rains continued at intervals until September, when dry weather again commenced, though in the mountains rain fell generally until October. The fall drought lasted until December 3d. November was very dry, only about one-fourth of the normal rainfall occurring over the whole State. Very severe fires occurred during this season, both in the mountains and in the eastern part of the State. Altogether, the year 1910 showed a slightly greater rainfall than the previous year, though a little less than the normal amount of precipitation was recorded.

TABULAR STATEMENT.

The following tables have been compiled from the information furnished by voluntary correspondents all over the State. There was only one county which did not send in any report, and most counties were represented by three or four correspondents. This, it is realized, is quite insufficient to get complete reports, but it is enough to give some idea of the magnitude of the loss which is yearly experienced, and this, it must be remembered, is the chief object of these tables. It is hoped that another year the number of voluntary correspondents may be greatly increased, thereby enabling the Survey to publish much more complete figures.

TABLE 1.—FOREST FIRES IN NORTH CAROLINA DURING 1910. COMPARATIVE STATEMENT. SUMMARY OF REPORTS FROM CORRESPONDENTS BY REGIONS, FOR 1910 AND 1909.

	Mountain.		Piedmont.		Coastal Plain.		State.	
	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.
Total number of townships in region	166	.....	450	.....	364	.....	980	.....
Number of townships reporting....	51	.....	146	.....	131	.....	328	.....
Number of replies received.....	48	47	142	61	131	50	321	158
Number of forest fires reported.....	136	249	258	86	312	272	706	607
Total area burnt over, in acres	80,825	166,295	158,948	100,670	339,780	139,100	579,553	406,065
Total area growing merchantable timber burnt over, in acres.....	64,250	128,145	46,839	77,735	142,010	51,025	253,099	256,905
Total area of second growth, not yet merchantable, burnt over, in acres.....	7,190	13,100	55,712	14,555	78,735	27,050	141,637	54,705
Total area of cut-over land burnt over, in acres.....	9,385	25,050	56,397	8,380	119,035	61,025	184,817	94,405
Total standing timber destroyed in M. ft. bd. measure.....	6,915	17,325	12,553	11,027	42,550	9,280	62,018	37,632
Value of timber destroyed, in dollars.....	\$ 25,095	\$ 47,520	\$ 35,930	\$ 33,374	\$ 108,995	\$ 26,360	\$ 170,020	\$ 107,254
Value of forest products destroyed, in dollars.....	\$ 28,215	\$ 17,075	\$ 100,415	\$ 39,425	\$ 129,545	\$ 30,245	\$ 258,175	\$ 86,745
Value of improvements destroyed, in dollars.....	\$ 19,375	\$ 26,550	\$ 25,615	\$ 14,750	\$ 53,805	\$ 17,105	\$ 98,795	\$ 58,405
Number of lives lost.....	1	0	1	0	3	0	5	0
Cost to private individuals to fight fire.....	\$ 13,155	\$ 6,650	\$ 10,503	\$ 1,059	\$ 11,780	\$ 6,355	\$ 35,438	\$ 14,064

TABLE 2.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.
COASTAL PLAIN REGION.

Counties.	Total No of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.				Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.	Merch. Timber Destroyed—M.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.										
Beaufort.....	6	2	2	4	3,000	1,500	1,500	1,500	5,000	7,500	5,000	1,000	1,000	1,000	15,200	4,250	1,000	625
Bertie.....	9	4	4	14	13,450	2,400	1,050	10,000	120	300	120	10,000	120	300	15,200	4,250	1,000	625
Bladen.....	15	6	7	14	15,300	10,700	3,200	2,000	10,950	20,300	10,950	2,000	10,950	20,300	12,800	1,500	800	800
Brunswick.....	6	3	2	11	25,500	10,200	300	15,000	900	2,100	900	15,000	900	2,100	200	5,050	25	25
Camden.....	3	2	2	0														
Carteret.....	9	2	2	7	15,000	9,000		6,000	1,400	2,700	1,400	6,000	1,400	2,700	2,000	1,000	50	50
Chowan.....	4	3	4	2	2,000		1,000	1,000										
Columbus.....	14	3	4	28	70,500	45,500	5,000	20,000	2,125	3,400	2,125	20,000	2,125	3,400	6,500	11,200	2	3,050
Craven.....	9	4	4	7	6,000	2,000	1,500	2,500	100	600	100	2,500	100	600	20,000			
Cumberland.....	12	7	6	37	53,200	21,150	20,650	11,400	4,320	18,300	4,320	11,400	4,320	18,300	6,300	11,000	1	2,550
Currituck.....	5	4	5	1														
Dare.....	5	3	3	0														
Duplin.....	13	5	5	6	1,090	520	50	520	255	2,800	255	520	255	2,800	3,350	455		225
Edgecombe.....	14	1	1	0														
Gates.....	7	5	4	15	3,650	2,225	725	700	3,020	6,660	3,020	700	3,020	6,660	14,030	1,220		1,100
Greene.....	10	3	3	1	10	10												
Halifax.....	12	3	3	16	3,250	600	1,150	1,500		6,000		1,500		6,000	1,500	1,000		210
Harnett.....	13	5	4	13	62,000	8,500	22,900	30,600	3,010	9,020	3,010	30,600	3,010	9,020	12,000	6,000		300

FOREST FIRES AND THEIR PREVENTION.

Hertford.....	6	4	3	5	450	400	50	100	350	5,000	250	1,500
Hyde.....	4	2	2	5	2,000	500	1,500	100	500	250	.....	.....
Johnston.....	16	3	3	0	.....	.....	.....	.....	.....	.....	.....	.....
Jones.....	7	1	1	2	10,000	10,000	.....	500	1,000	10,000	.....	.....
Lenoir.....	12	7	7	7	5,200	3,400	.....	200	5,400	8,000	2,300	400
Martin.....	10	1	1	0	.....	.....	.....	.....	.....	.....	.....	.....
Nash.....	12	5	4	8	1,400	600	350	450	350	450	.....	60
New Hanover.....	4	1	1	12	1,000	.....	500	500	.....	.....	.....	.....
Northampton.....	9	2	3	3	25	25	.....	10	30	30	100	25
Oswlow.....	5	2	2	5	7,000	4,500	2,500	2,500	.....	.....	100	.....
Pamlico.....	4	5	4	21	14,175	4,100	3,000	7,015	3,020	585	150	25
Pasquotank.....	6	3	3	5	320	310	10	20	60	.....	10	.....
Pender.....	10	1	1	3	5,000	.....	5,000	200	200	.....	100	50
Perquimans.....	5	3	3	4	350	200	50	100	.....	.....	20	.....
Pitt.....	11	6	8	14	9,800	1,000	5,700	3,100	16,000	5,580	5,075	50
Richmond.....	7	3	3	20	2,800	500	1,450	850	600	500	500	200
Robeson.....	19	3	3	4	1,500	1,000	500	80	160	160	.....	75
Stumpson.....	16	2	2	3	1,000	300	100	600	775	3,000	300	200
Scotland.....	4	1	1	2	2,000	300	200	1,500	.....	2,000	1,000	.....
Tyrrell.....	5	1	1	0	.....	.....	.....	.....	.....	.....	.....	.....
Washington.....	4	3	2	1	500	250	250	.....	.....	.....	.....	.....
Wayne.....	12	6	7	12	710	300	50	300	870	670	225	200
Wilson.....	10	1	1	0	.....	.....	.....	.....	.....	.....	.....	.....
	364	131	131	312	339,780	142,010	78,735	119,035	42,550	\$129,545	\$ 53,805	3 \$ 11,780

TABLE 3.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES, PIEDMONT REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.						Value of Merch. Timber Destroyed, M.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Akers.	Merch. Timber—Akers.	Second Growth—Akers.	Cut-over—Akers.	Merch. Timber Destroyed, M.	Value of Timber Destroyed.						
Alamance.....	13	6	5	5	3,100	1,000	1,000	1,000	50	\$ 400	\$ 1,000	\$				
Alexander.....	8	5	6	3	250	200	50		510	1,250	500	200				
Anson.....	8	0	0	0												
Burke.....	11	2	2	12	10,000	8,000	2,000		2,000	4,000						
Cabarrus.....	12	3	4	5						1,000						
Caldwell.....	12	4	3	9	5,300	2,100	1,000	2,200	300	600	1,200	1,100				300
Caswell.....	9	3	3	0												
Catawba.....	8	5	3	2	50	15		35		100						
Chatham.....	14	4	4	8	1,700	675	790	295	1,020	1,480	1,300	1,000				
Cleveland.....	11	3	3	3	50	18	22	10	50	125						
Davidson.....	17	6	5	4	34	14	1	19	2	160	20	5				
Davie.....	7	2	4	1	50	25	25				25	800				
Durham.....	6	1	1	1	100	75	25									
Forsyth.....	14	3	3	1	75	40	40	35								20
Franklin.....	10	4	4	14	1,650	500	200	950	85	150	1,000	200				2,600
Gaston.....	6	3	2	1	40	15	25		80	400	400	500				
Granville.....	9	4	5	7	200	100		100								
Guilford.....	18	2	2	0												
Iredell.....	16	6	6	13	1,435	915	400	120	350	1,700	1,500	2,225				250

FOREST FIRES AND THEIR PREVENTION.

Lee.....	7	4	4	24	1,450	725	135	590	675	2,800	275	1,000	535	
Lancolt.....	5	2	1	1	75	60	5	10	150	500	500	1,000	-----	
McDowell.....	10	5	16	19,500	9,750	8,000	1,750	1,750	145	3,065	2,800	550	1650	
Mecklenburg.....	15	6	4	3	16	11	5	-----	30	650	-----	1,400	-----	
Montgomery.....	11	5	5	4	39,100	8,030	8,020	23,050	600	1,200	20	30	50	
Moore.....	9	4	3	22	51,000	4,100	26,400	20,500	1,100	3,300	75,100	12,200	4,025	
Orange.....	7	5	2	5	25	-----	25	-----	-----	-----	-----	-----	-----	
Person.....	9	3	2	1	50	30	10	10	-----	-----	-----	-----	10	
Polk.....	6	6	8	38	12,900	5,300	4,000	3,600	290	580	5,040	400	65	
Randolph.....	19	3	3	7	500	175	100	225	25	55	-----	200	200	
Rockingham.....	11	1	1	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Rowan.....	14	5	6	5	500	200	90	210	-----	-----	-----	2,000	(?) 1	
Rutherford.....	12	2	1	7	600	-----	600	-----	-----	-----	-----	-----	100	
Standy.....	8	2	2	3	300	205	85	10	103	765	1,565	400	25	
Stokes.....	8	4	4	6	320	158	109	53	5	30	10	-----	-----	
Surry.....	14	4	4	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Union.....	9	1	1	0	-----	-----	-----	-----	-----	-----	-----	20	5	
Vance.....	8	4	5	2	210	210	-----	-----	-----	-----	-----	-----	-----	
Wake.....	19	1	1	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Warren.....	12	4	3	14	5,100	1,025	2,550	1,525	5,003	10,020	2,020	700	(?) 1	
Wilkes.....	20	5	6	3	3,008	3,008	-----	-----	-----	-----	-----	100	58	
Yadkin.....	8	4	5	8	200	100	100	100	-----	1,000	200	100	-----	
Total	450	146	142	258	158,948	46,839	55,712	56,397	12,553	\$ 35,980	\$100,415	\$ 25,615	5	\$ 10,563

FOREST FIRES AND THEIR PREVENTION.

TABLE 4.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES, MOUNTAIN REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.					Mch. Timber Destroyed M	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Acres.	Mch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.	Merch. Timber—Acres.						
Alleghany.....	8	1	1	0						500	\$ 1,250	\$ 1,500	\$ 100		
Ashe.....	15	1	1	1	150	100		50		300	900				100
Buncombe.....	13	5	4	6	1,300	1,000	150	150		10	50	500	200		
Cherokee.....	6	2	2	25	4,000	4,000				30	70	45			65
Clay.....	5	3	3	9	1,500	1,300	160	40		700	3,700	3,000	300		100
Graham.....	3	2	2	7	18,000	14,700		3,300		1,000	3,000		5,000	1	10,205
Haywood.....	13	6	6	17	5,100	3,190	1,050	800		70	1,650	420	800		200
Henderson.....	8	5	6	13	7,000	5,050	1,075	875		200	1,000	1,000	25		25
Jackson.....	15	2	2	25	10,000	10,000				2,000	4,150	50	50		510
Macon.....	11	6	4	14	10,000	9,000	1,000			5	15	1,000	1,700		450
Madison.....	16	2	2	2	1,100	900	100	100			1,210	10,700			500
Mitchell.....	14	5	5	4	4,900	4,400	500	2,400							
Swain.....	5	2	3	6	7,200	3,200	1,600								
Transylvania.....	9	2	2	3	75	10	55	10							
Watauga.....	14	6	4	4	10,500	7,400	1,500	1,600		2,100	8,100		10,200		
Yancey.....	11	1	1	0											
	166	51	48	136	80,825	64,250	7,190	9,385		6,915	\$ 25,095	\$ 28,215	\$ 19,375	1	\$ 13,155

TABLE 5.—COMPARATIVE STATEMENT OF AVERAGES BY REGIONS FOR 1910 AND 1909.

	Mountain.		Piedmont.		Coastal Plain.		State.	
	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.
Percentage of townships reporting..	31	.....	32	.....	36	.....	33.5	.....
Average area of each fire, in acres..	594	668	616	1,171	1,089	511	821	667
Average damage by each fire, in dollars.....	631	393	668	1,030	974	294	775	439
Average area burnt over per township reporting, in acres.....	1,585	.....	1,089	.....	2,594	.....	1,805	.....
Average damage per acre, in cents.	1.06	.59	1.08	.88	.90	.57	.97	.66
Average cost to fight fires per acre burnt over, in cents.....	.16	.04	.06	.01	.03	.04	.06	.03½

NUMBER OF FIRES.

Of the 800 blanks sent out, only 320, or 41 per cent, were filled out and returned. Though these covered only one-third of the townships of the State, it is probable that they include the greater part of the more important fires, though many other fires have occurred in townships not reported on. This has been ascertained from clippings taken from the local press of the State, which mention additional fires in at least ten counties.

No doubt many fires also took place in townships making reports which the correspondents, owing to their location in a different part of the township, had not heard of.

From tables 1, 2, 3, and 4 it will be seen that 726 fires were reported, or an average of a little over two fires to the township reporting. This is only slightly in excess of the total number of fires reported for 1909. While there were barely half the number of fires reported from the mountain region, there were nearly three times as many in the Piedmont region as were reported for 1909. This is probably due in large part to the two droughts, which were so severe over the eastern part of the State, and which were much less felt in the mountains. The comparatively small number of replies received from the western part of the State might also partly account for it.

AREA BURNT OVER.

About 580,000 acres of land were reported burnt over during 1910. This is 43 per cent in excess of the amount burnt over last year. The comparative freedom of the mountain counties from fires shows itself in the 80,000 acres burnt over, which is less than half that was burnt over in that region in 1909.

Nearly half of the burnt-over area of the State was supporting a growth of merchantable timber, though probably the greater part of it had been culled to some extent. The division of the area into merchantable timber, second growth, and cut-over, is only approximate and can not be taken as definite figures. Nearly all merchantable timber in the hardwood forests contains more or less second growth, while a great part of the cut-over lands also contains much young growth. Such figures, therefore, can not be accurate, and are of use chiefly in giving some idea of the damage done by fires.

MERCHANTABLE TIMBER DESTROYED.

The amount of merchantable timber destroyed, compared with the area burnt over containing such timber, appears to be very small. This is due to the fact that, as a rule, mature timber is not killed outright by the ordinary forest fires in this State, unless the fire occurs in the late spring. Most fires, however, do seriously injure mature standing timber, and often the death of timber which is attributed to insects is really primarily caused by forest fires. In spite of this, however, there is a reported loss of 62,000,000 feet of merchantable timber from fires. This is nearly twice as much as was reported destroyed in 1909.

FOREST PRODUCTS DESTROYED.

The value of forest products destroyed in 1910 is about three times as much as that listed for 1909, and amounts to over a quarter of a million dollars. This includes sawlogs, lumber, cordwood, bark, and other material.

Although this large item of loss is no doubt much below the real figure, it is, however, enough to make people realize the advisability of taking active steps to prevent such fires.

IMPROVEMENTS DESTROYED.

Farm improvements, chiefly fences and outbuildings, are included under this head. Ninety-eight thousand dollars was lost by the destruction of this class of property alone, more than half of it in the Coastal Plain region. This, as will be seen from Table 1, is also largely in excess of that of 1909.

LIVES LOST.

The year 1910 will long be remembered as one of the most destructive to life and property from forest fires throughout the country. During the month of August scores of lives were lost in the forest regions of the northwestern States.

Though we are apt to think that our fires are altogether different from those in the West, yet a loss of five human lives through forest fires occurred in North Carolina in 1910. Besides the woman burnt in Cumberland County, referred to in last year's report, a colored girl and an old woman were burnt to death in Columbus County while trying to protect their property from the flames. Two men lost their lives fighting fire in the western part of the State, one in Haywood County, and the other one near Marion in McDowell County. Such deaths are usually spoken of as accidental, but they are preventable accidents, for they would not have occurred had it not been for the criminal carelessness of those who let the fires get out.

COST TO FIGHT FIRES.

More than \$35,000 was spent by private individuals and lumber companies in 1910 in extinguishing forest fires, or two and a half times the amount spent the previous year. This does not comprise the total cost of fighting fire even in the townships reporting, for, as a rule, small fires and those on private land are fought, when any effort is made to extinguish them, by the voluntary help of the neighbors. A glance at the figures in Table 5 shows that about sixteen cents per acre burnt over was spent in the Mountain region to fight fires, while only about three cents per acre was spent in the Coastal Plain. This does not mean that the mountain people are not willing to fight fire unless paid for it, for they are just as ready as any one else to assist their neighbors in such emergencies. It means that the lumber companies and other timberland owners of that region are more alive to the destruction caused by fire than those of the Coastal Plain region. This is partly because many owners of mature timber in eastern North Carolina still burn to protect their timber from more destructive conflagrations, but chiefly because many of the eastern lumbermen own the timber without the land, and so have no interest in protecting the young growth, while those in the Mountain region usually own both land and timber and are anxious to keep fire out. It is an encouraging sign that while twice as much was spent in 1910 in fighting fires in the mountains as was spent in 1909, only half as great an area was burnt over. While the weather was in part responsible for this there is no doubt that the increasing watchfulness and effort on the part of landowners is bringing results.

LOSS FROM FIRE NOT INCLUDED IN THE TABLES.

A loss of considerably over \$500,000 in one-third of the townships of the State seems a large sum, and yet it is far from representing the

entire damage, even of the fires that were reported. The injury to the standing timber which is not killed is often just as heavy as that caused by the destruction of the trees.

The damage done to young growth and reproduction is usually considerably greater than that done to the mature timber, but as it is in most cases difficult to put a cash value on this young growth, because it has no sale value, it is usually left out of all estimates of damage. There is now, however, a tendency to take into account the young growth destroyed by a fire, as is evidenced by two correspondents; one in the mountains, who estimated a loss of \$5 per acre in the destruction of young growth; the other on the coast, who put down a loss of \$1,000 in young growth, caused by burning over 500 acres of land. These, which are no doubt very conservative estimates, go to show that some landowners are realizing the loss to the future forest that is taking place. Next year an attempt will be made by the Survey to get correspondents to include damage to young growth by furnishing question blanks with a space for this purpose.*

The gradual killing out and disappearance from the forest of such valuable species as poplar, white pine, and chestnut, and the substitution for them of the inferior, though more fire-resistant kinds, means a serious loss to the landowner which will be appreciated more thoroughly by the next generation because the change is comparatively slow. Such a loss is hard to estimate for any one year, but it will manifest itself in the gradual decline in the value of the property.

The gradual, though certain, impoverishment of the soil through the constant burning of the leaves, causes great loss in the value of the land on which the forest is growing. This loss shows itself in the slower growth of the trees and in the decline in value of the land for agricultural purposes.

The washing of the soil by the rains is one of the forms of damage caused by forest fires. The coating of leaves protects the top soil, and when this is removed the rains rush off to the streams, removing the surface soil, and filling up the streambeds with silt and sand, thereby damaging the land and seriously interfering with the navigability of the streams.

CAUSES OF FOREST FIRES.

The principal causes of forest fires, as given by the various correspondents for their own townships, have been compiled and are given in percentages in Table 6.

*Damage to young growth from forest fires is discussed pretty fully in Economic Paper 19, "Forest Fires in North Carolina During 1909," page 25.

TABLE 6.—CAUSES OF FOREST FIRES IN THE DIFFERENT REGIONS OF NORTH CAROLINA IN 1910, IN PERCENTAGES.

	1910.				1909.
	Mountain	Piedmont.	Coastal.	State.	State.
Farmers burning brush, grass, rubbish, etc.....	8	23	7	13	10
Hunters.....	2	6	6	6	16
Cigars, cigarettes, matches, etc.....		5	2	3	3
Careless and negligence of individuals.....	11	23	22	20	15
Railroad locomotives, sparks from.....	18	13	27	20	17
Logging locomotives, dummy engines, etc.....	8	3	15	9	5
Sawmills, etc.....		10	2	5	3
Traction engines.....		3		1	
Accidental, caught from burning buildings, etc.....		2	1	1	1
To improve the range.....	8	1	3	3	4
Set by chestnut gatherers, root diggers, etc.....		1			2
Without much object, to see it burn, etc.....	13			2	13
Malice or incendiary.....	16	6	7	9	4
Unknown causes.....	16	4	8	8	7

This table shows that over three-fourths of the fires reported from all over the State were thought to be unintentional. Forty-two per cent of all the replies given by correspondents can be classified under the head of individual carelessness, which is practically the same figure as was obtained last year. In the Piedmont region, however, where burning to improve the range is practically eliminated as a cause of fires, fifty-seven per cent of the correspondents attributed the fires to individual carelessness. Farmers burning brush, grass, stumps, and rubbish are said to be responsible for about one-third of these "individual" fires, while probably a majority of those attributed to general carelessness should come under this head. This is by far the most frequent cause of fires originating from the individual. More care in the setting of such fires, and watching them till they are burned out and harmless, would prevent many of the most serious and destructive fires.

Sparks from engines is a very fertile cause of forest fires, over one-third of the correspondents giving this as the principal cause in 1910. Railroad and logging locomotives are the chief offenders, twenty-nine per cent of all the correspondents accusing them. This is considerably more than fell to their share in 1909. These railroad fires are in large part preventable, and as soon as property owners along the lines of railroads unite in demanding protection, it can be secured.

According to the above table, intentional fires are most frequent in the Mountain region, where thirty-seven per cent are said to be purposely set. This is a large proportion, though it is an improvement over the report for the previous year, which showed that in the mountains nearly half the fires were set on purpose. This large number of intentional fires is in part due to the destructive habit of burning the woods to "improve the range" for loose cattle, which ought to be confined to their owner's land, and in part to an unfortunate feeling of antagonism in some localities against large landowners who are trying to protect their forests. The large increase in malicious or incendiary fires all over the State is a regrettable feature of the 1910 figures and one that is not easy to explain. It indicates very clearly, however, that more stringent laws and better law enforcement are needed in order to check this nuisance.

PREVENTIVE AND PROTECTIVE MEASURES.

We have in North Carolina a reported loss from forest fires in 1910 of \$560,000. This report covers only one-third of the townships of the State, and does not include injury to standing timber, damaged, but not killed; to young growth; to soil and streams by any of the fires. There can be little doubt, therefore, that the total loss through forest fires in North Carolina during 1910 amounted to at least a million dollars. In addition to this there was very serious loss of life from the same cause. Is it not time that North Carolina as a State, and we as individuals, took some steps to abate this nuisance?

If there was any one measure that would stop these fires we could easily be persuaded to adopt it, but, unfortunately, there is no such specific. There is, however, much that we can all do and the following preventive and protective measures are strongly advocated.

PRIVATE MEASURES.

The owner of woodland, whether a corporation or a private individual, can do much towards protecting his property from fire, though to achieve the greatest success all such efforts should have the hearty co-operation of the community and the State. Fire lines cleared out around or through a property are very effective in stopping a moderate fire. When a strong wind is blowing and the fire is very heavy, such a fire line is invaluable as a vantage ground from which to start a back fire. Adequate fire lines can be constructed at from \$10 to \$50 per mile, according to the nature of the ground over which it has to be made. Such a fire line has been made over the rough mountain country of northeast McDowell County at less than the higher figure.

Patrol is probably the most effective single means that the individual can put into practice, though quite expensive. Efficient patrol will cost from one to three cents per acre per year. Some companies, especially in the mountainous part of the State, employ one or more men to look after their forest land, and often part of their duty is patrolling. If this were more generally practiced many fires would be prevented, and many more extinguished before they had gotten beyond control.

Warning notices, calling the attention of the passers-by to the danger of forest fires, are used to a large extent in the National Forests of the West, and are employed on many of the private or corporate holdings in the North and East, and to some extent in the South, though in this State they are little used, except to include a prohibition against setting fire to the woods in a general trespass notice. A carefully-worded reminder, posted where it will be seen and read, is calculated to help materially in suppressing the "careless" fire.*

Farmers can do much to prevent the disastrous spring fires by burning in the winter as much as possible what brush and rubbish it is necessary to remove in this way, and by never leaving even an innocent-looking fire until it is quite out. Renters, who very often own no land and are absolutely irresponsible, should be bound by a contract not to set out fire in dry weather. If every renter who let fire escape and burnt up his landlord's woods were in the future denied a place to rent in that neighborhood, this class of offenders would learn to be more careful.

A stipulation against setting fire to the woods should always be included in a contract for the sale of timber. There is no more reason for the purchaser of mature timber to destroy all the reproduction and young growth on the ground by fire than there is for a man who buys the apple crop to cut down and destroy an orchard in order to harvest the fruit, and the sooner landowners realize this the better it will be for their interests.

CO-OPERATIVE ASSOCIATIONS.

Co-operation between individuals for the purpose of fire protection adds very much to the effectiveness of private efforts. The individual suffers as much and sometimes more from fires that start beyond his boundary than from those originating on his land; especially if he is patrolling and his neighbor is not. No matter how careful a man may be or how much he spends on fire protection, the fires that originate and develop great headway before they come onto his property, can not be controlled. Besides the attainment of efficiency through co-operation,

*Fire lines, fire patrol and fire notices are more fully discussed in Economic Paper 19, "Forest Fires in North Carolina During 1909," pp. 43-47.

the cost of protection is reduced to a minimum. One man can patrol much more territory if he feels responsible for all the area that comes within his vision than if he has to look out for boundary lines and his operations are restricted. Some form of co-operation is essential for the most successful fire-fighting.

The value of co-operative associations has been pretty clearly demonstrated in several of the far western States during the past two or three years. Two separate kinds of associations for forest protection have been formed; the one chiefly educational, the other engaging in the actual protective work.

Associations Chiefly Educational:—The Oregon Forest Fire Association is a representative of this class. It does not itself engage actively in fire work, but is a rather loose affiliation of individual patrol systems, each doing its fire work independently, but using the central facilities for legislative and publicity purposes and particularly to stimulate the installation of further individual patrols. The formation of local co-operative patrol associations is also encouraged. In fact, its main purpose is for the general promotion of patrols in the State, of giving out information regarding the best methods of protection, endeavoring to induce the public to be more careful in the use of fire, and trying to persuade owners to maintain patrols. There is a large amount of work of this nature to be done and it will help the general movement, but of course, the only way to prevent fires is to have patrolmen on the ground. Such an association denotes a less advanced stage in co-operative effort—for a large number of independent patrols cannot equal systematic co-operative management of the work in either economy or results—nor does it have the same public standing. Moreover, without actual work to do the association finds it hard to gain members or preserve its solidarity. Such an organization in North Carolina would not be of the greatest value. The field is covered already, to a certain extent, by the North Carolina Geological and Economic Survey, which is only kept from doing much more in this line by lack of funds.

Associations Chiefly Protective:—What is wanted among timberland owners in North Carolina is a close organization which can go ahead and carry out patrol and other means of protection. This is being done in the northwest by the Washington Forest Fire Association and the several Idaho timber protective associations, which latter, it is generally conceded, afford the most efficient protection in the country. The organization of these Associations includes a board of directors who have power to levy and enforce the payment of assessments to defray expenses in proportion to the number of acres owned by each member.

The actual work of protection is put in the hands of a committee which hires patrolmen and fire fighters and incurs all other expenses necessary to protect the territory from forest fires. In one of the most successful of these Associations the patrol averages one man to sixteen thousand acres, and although they have had some hazardous seasons their loss has always been very small. It is figured that it is a better policy to maintain a close patrol to discover small fires when they first start than to cut down the expense of the patrol, and then rely upon putting a large force of men on to fight fire after it gets well started. The cost of this association averages about three cents per acre per year, though on account of a very exceptional season it went over that in 1910. The total cost of the Washington Forest Fire Association was 2.3 cents per acre in 1910, and only 1.4 cents in 1909, though much more than the acreage belonging to members was patrolled, in order to better protect their own lands.

Not only do these associations do their own protective work, but they co-operate with the State and National Governments in fire protection. In North Carolina there is a large opening for this feature of their work. The State has at present no fire-fighting force with which to co-operate, but it is hoped that this will be provided for by the next Legislature. The U. S. Department of Agriculture, however, is anxious to spend part of the amount provided for co-operation with States by the Weeks bill in fire protection in North Carolina. It was suggested that the basis of such co-operation might be furnished by a Forest Protective Association working through the State Geological and Economic Survey. It has been decided, however, that this does not come within the meaning of the Act.

There are endless ways in which the activities of such an Association could work for the better protection and consequent enhancement in value of our forests, and the timberland owners of the State are recommended to look thoroughly into this question and, if possible, make trial of this method of protection.

STATE MEASURES.

Present Laws.

In 1777 the General Assembly of North Carolina passed a statute making it unlawful for any one to set fire to the woods, except it be his own property, and in that case not without first giving two days notice in writing to adjoining property owners. After 134 years this law still remains on our statute books, the best and practically the only law we have on the subject. In its present form in The Revisal of 1905 it reads:

3346. *Woods.*—If any person shall set fire to any woods, except it be his own property, or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

The law therefore forbids setting fire to woods, even though it be one's own property, without giving two days notice in writing to adjoining landowners. This law is rarely enforced, because the "two days notice in writing" is considered an impractical measure, and also because the strong objection among most people to prosecuting their neighbors acts as a deterrent. One of the most frequent causes of fire, that from burning brush while clearing up new grounds in the spring, is not covered by this law, for the courts have held that these "new ground" fires do not come within the statute. This law is susceptible of considerable improvement and should be amended.

Since the great extension of railroad facilities all over the State, the practice of hauling farm crops and merchandise long distances to market, which used to be the universal custom, has almost ceased. In the rougher and more remote parts of the State, however, where more than one day's trip is required to reach the market the abandoned camp-fire is still a menace. That North Carolina has a law against leaving such fires unextinguished is often not known by wagoners, and a notice quoting the following section posted near frequented camping places would often be of great advantage to the passer-by, as well as a safeguard to the property owner.

3347. *Woods, from Camp Fires.*—If any wagoner or other person encamping in the open air shall leave his camp without totally extinguishing the camp fires, he shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not exceeding fifty dollars, or imprisoned not exceeding thirty days.

These two laws, the most important dating back some 130 years, constitute the present working forest-fire laws of North Carolina. Even these, however, are rarely enforced.

In order to ascertain as nearly as possible to what extent these laws were being carried out, the North Carolina Geological and Economic Survey asked all their forest-fire correspondents the following question: "Has any one, so far as you know, been prosecuted for setting fire to forests in your county or township during the past year? If so, with what result?"

This question was answered in the negative by 195 of the correspondents. Out of the 218 who answered this question usually in one word as "No," "None," or "Nobody," only 23 mentioned any action being taken against those who set out fire, and of these only nine could have been brought under the law against setting fires, the rest being civil suits for damages, chiefly against railroads and lumber companies. The sum total of convictions, for the careless or intentional setting of at least 700 fires in this State during 1910 is four; two in the mountains, in which the parties were "fined light, say \$5 each and costs," and two in the Coastal Plain region, one of whom was let off by paying "good" costs; and the other, to the honor of Pitt County be it said, was given the maximum fine, \$50 and costs. The other suits were, in the words of the correspondents, "Nol prossed," "Compromised, defendant paying \$37.50 damages," "Case before grand jury, but no bill found," "Not a true bill," "Case not yet tried."

The apparent inefficiency of the law is due to the inadequacy of the laws themselves and to the indifference of the people in the matter of burning the woods. This is well illustrated by the following replies from a few of the correspondents in answer to the above question in regard to prosecutions under the fire laws: "Not one. We need more stringent laws as to the careless handling of fire"; "No one. Need more laws"; "Cannot get sufficient proof to get true bill or convict"; "Nobody prosecuted, everybody seems to be afraid to prosecute for fear of being burned out"; "I think not. It would be difficult to convict as it is a 'sport' engaged in by a large percent of our people"; "No; but ought to have been"; "Don't know of any. They are hard to catch and hard to convict in a fence-law territory"; "One was threatened with prosecution"; "No; only for want of officers to enforce the law."

The General Assembly of 1909 passed a law allowing the Governor, at his discretion and on application of the owner, to declare any wooded land which lies above 2,000 feet above sea level a "State forest." The Governor may then, at the request of the owner, appoint such forest wardens as the owner of the land may request, said wardens to have the power of arrest without warrant and to be paid entirely by the owner. For this privilege the landowner pays an annual tax of half a cent per acre into the county treasury for the benefit of the school fund.

No property owner has yet taken advantage of this law, and it is practically a dead letter, the owners probably thinking that the efficiency gained by giving the wardens power of arrest is not worth such a substantial tax.

Proposed Laws.

As we have previously seen, the largest number of fires are due to the carelessness or indifference of individuals, and to the negligence of railroads, lumbermen, and other operators of engines. In order to successfully cope with this situation, we need: (1) Better laws to control the private citizen; (2) Stricter regulations controlling the railroad and other engine users; (3) A system maintained by the State, or the State and counties together, to properly enforce the forest-fire laws. These three features may be combined in one act, as was done in the bill which was introduced into the last Legislature, or they may be passed as three separate acts, as is here proposed.

Fires Set by Private Individuals:—The present law, which has previously been given, should be amended to include grassland, but the two days written notice required should apply to woods only, or should be eliminated altogether. By broadening the second section to make it include hunters and other persons, some approach to controlling that fertile source of forest fires would be made.

In New Jersey and several other States to the north and west of us, the burning of woods, brush, stumps, rubbish and other material is not allowed during a dry season, and in some cases throughout the year, without a written permit from the proper officer. This has been found to work well in preventing fires, especially the destructive early spring fires. In North Carolina, however, we are hardly ready for such a law. A law to compel all who burn material to watch it till it is extinguished would seem to meet a definite need and would be more easily enforced.

The following suggested bill contains all of the above features:

A BILL TO BE ENTITLED AN ACT TO PROTECT THE FORESTS OF THIS STATE FROM FIRE.

The General Assembly of North Carolina do enact:

SECTION 1. That section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five be amended to read as follows: If any person shall set fire to any grassland, brushland or woodland, except it be his own property, or, in that case without first giving notice to all persons owning or in charge of lands adjoining to the land intended to be fired, and also taking care to watch such fire while burning and taking effectual care to extinguish such fire before it shall reach any lands near to or adjoining the land so fired, he shall for every such offense be guilty of a misdemeanor and be fined or imprisoned in the discretion of the court. This shall not prevent action for damages sustained by the owner of any property.

SEC. 2. That section three thousand three hundred and forty-seven of The Revisal of one thousand nine hundred and five be amended to read as follows:

Any wagoner, hunter, camper or other person who shall leave a camp-fire without fully extinguishing it, or who shall accidentally or negligently, by the use of any torch, gun, match or other instrumentality, or in any manner whatever, start any fire upon any grassland, brushland or woodland, without fully extinguishing the same, shall be guilty of a misdemeanor, and upon conviction shall be punishable by a fine of not less than twenty-five dollars nor more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 3. All persons, firms or corporations who shall burn any tar kiln or pit of charcoal or set fire to or burn any brush, grass or other material whereby any property may be endangered or destroyed, shall keep and maintain a careful and competent watchman in charge of said kiln, pit, brush or other material while burning. Any person, firm or corporation violating the provisions of this section shall be guilty of a misdemeanor.

Railroad Fires.—The railroads and lumber companies, though great offenders, having caused probably one-third of the fires in the State in 1910, are also great sufferers, being generally held responsible for injury and made to pay damages. A few of the replies to the question asking about prosecutions are here quoted: "Railroad paid for several acres of timber"; "Railroad compromised, nothing done about the rest"; "No; the railroad people always pay damage"; "The railroad has paid about \$1,000"; "No; Railroad Company paid about \$2,000"; "The Railroad Company goes over the ground and sees how much it burns over, and pays about thirty-five cents per acre"; "Set by traction engine, and damage paid"; "Lumber Company sued for \$5,000"; "Lumber Company forced to pay damages"; "Suit entered against one lumber company." These prosecutions are, of course, as said before, brought under the civil law, and do not invoke the present fire laws. They do, however, show that it is as much to the interest of the railroads as to that of the owners of woodland that fires should be prevented. Until there is some general demand, however, that the railroads take necessary precautions, they prefer to drift along in the old way, paying damages now and then,—the average cost of which they know—rather than advocate new laws, which, though they might save them money, still would cost them an unknown amount to carry out. When reasonable laws are once passed the railroads will undoubtedly co-operate actively in their enforcement, trusting thereby to cut down their large annual bill of damages.

During the last session of the Legislature the following bill was drawn up, after careful discussion and criticism of every point by the representatives of the people and of the railroad and lumber companies. It was at first introduced as part of the general forestry bill, but was later drawn up as a separate law. It is in this form that its passage by the next Legislature is strongly urged.

A BILL TO BE ENTITLED AN ACT TO REQUIRE THE RAILROADS OF THE STATE TO TAKE CERTAIN PRECAUTIONS FOR THE PREVENTION OF FOREST FIRES.

The General Assembly of North Carolina do enact:

SECTION 1. All persons, firms or corporations operating any railroad, logging road or tramroad through woodland within this State shall keep their right of way cleared of all combustible materials within a horizontal distance of one hundred (100) feet, nowhere to exceed one hundred and fifty (150) feet surface measurement, from the outer rail on each side of the track, by burning or other method. Combustible material, as referred to in this act, shall be construed to mean only such brush, grass, leaves or other material that would ordinarily become ignited from a spark from the engine. When the right of way owned does not extend to the width of the cleared space or fire line herein required, the right is hereby granted to said persons, firms or corporations to enter upon adjoining lands not owned by them, for the purpose of clearing off and maintaining the cleared space or fire line herein required. If any landowner should object to the clearing off and maintenance of the fire line herein required, he shall not be entitled to collect any damages thereafter occurring from fires caused by sparks from the engines of said persons, firms or corporations. Each railroad, logging road or tramroad affected hereby shall be required to clear off each year not more than one-fifth (1-5) of the total length of the fire line required by this section until all has been completed, and shall continue to keep such fire line clear after it has once been cleared off. The part of the mileage to be cleared off by such railroad shall be designated by the Geological Board after conference with the proper officer of such railroad, logging road or tramroad. Any railroad wilfully violating the provisions of this section shall be liable to a penalty of not less than ten (\$10.00) dollars or more than twenty-five (\$25.00) dollars for every mile or fraction thereof of fire line not cleared according to the provisions of this section: *Provided*, that this section shall not be construed to prohibit or prevent any railroad company from piling or keeping upon the right of way, crossties or other material necessary in the operation or maintenance of such railroad or materials intended for shipment over such railroad; nor is it intended to require the removal of buildings, fences or other necessary or valuable improvements from the fire line herein required: *Provided further*, that the notice to the adjoining landowners required by section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five shall not apply to any burning necessary to carry out the provisions of this section: *Provided further*, that nothing in this section shall be construed to require the railroad company to clear the fire line on property not owned by said company should the owner object, and no failure on this account shall be charged against the railroad company as a violation of this act.

Sec. 2. When engineers, conductors or trainmen employed by any railroad discover that fences or other material along the right of way or woodland adjacent to the railroad are burning or in danger from fire, they shall report the same promptly at the next telegraph or telephone station at which the train is scheduled to stop, or at any other stops necessary in the operation of the train. The reporting of such fires shall not be construed to mean that the railroad companies making such report are responsible for such fires, nor shall such report be used in evidence in a suit arising from such fire, but is simply for the purpose of giving information as to the existence of a fire. In seasons of drought the rail-

road companies shall give instructions to their section foremen for the prevention and prompt extinguishing of fires originating on their right of way, and they shall cause warning placards, furnished by the Geological Board, to be posted at their stations in the vicinity of forest lands. Any railroad company wilfully violating the requirements of this section shall be guilty of a misdemeanor, and railroad employees wilfully violating the requirements of this section shall be guilty of a misdemeanor.

SEC. 3. For the purpose of this act woodland is taken to include all forest areas, both timber land and cut-over land, and all second growth stands on areas that have at one time been cultivated.

This law requires the railroads to clear off a strip 100 feet wide on each side of their track, where it runs through woodland. It has been demonstrated after careful study that most of the live sparks from railroad locomotives fall within the zone between 50 and 100 feet on each side of the track, and very few fall beyond that distance. Keeping this strip clear would then prevent most of the fires caused by railroads and logging roads, which, as we have seen above, constitute about one-third of the fires in the State.

Fire Warden System.—The most important problem in the formulation of forest laws is providing effective machinery for putting them into force. Eighteen States have already organized fire protective systems, the purpose of which is to enforce the forest-fire laws of these States. Little or nothing has been accomplished in States without such systems, though several, like our own, have some excellent laws. A fire warden system generally consists of district, township, or county wardens, who, as a rule, are responsible to some one State official, either the State Forester, the State Forest Commissioner, or State Fire Warden, who is specifically charged with fire-protective work and usually also with the forestry work of the State. It is the duty of the wardens to extinguish fires, arrest offenders against the fire laws, investigate the causes of fires, post warning notices against fire and in some cases to patrol the forests during dry weather. They are paid by the State, or by the county, or by the State and county combined, usually by the hour or day, for the time actually employed. In fixing a rate of payment, care is taken not to make it high enough to tempt unscrupulous men to set fire to the woods with the object of drawing pay for extinguishing it. This practice may, of course, be occasionally resorted to, even where the pay is not high, but an efficient county fire warden would soon discover the perpetrators or at least have his suspicions aroused, and one or two drastic sentences, upon conviction, would put a stop to the practice. There are many counties in North Carolina where fire wardens are not

needed, but in counties having fifty per cent and over of their area in woodland they would quickly pay for their cost. If only a few counties were given the advantage of such a law to start with, the demand for fire wardens would rapidly spread, as their usefulness became apparent. The following bill, in a somewhat different form, was introduced into the Legislature of 1911, but failed to pass, chiefly because a special tax of half a cent per acre on all woodlands in the State was asked, to provide revenue for its enforcement. This method of raising the necessary money is perfectly fair and equitable, but until the system can be inaugurated and tested in those counties that most need fire protection, it is thought that a direct appropriation would be much simpler and more practicable.

A BILL TO BE ENTITLED AN ACT TO AUTHORIZE THE APPOINTMENT AND PAYMENT OF FOREST WARDENS.

The General Assembly of North Carolina do enact:

SECTION 1. On petition of four or more owners of timber lands in any one township, owning in the aggregate five thousand acres or more, or the owners of one-third of the forest land in the township, the county commissioners shall appoint, subject to the approval of the Geological Board, a forest warden for that township and as many deputy forest wardens to act with him as the Geological Board may deem necessary for the proper enforcement of this act. All forest wardens and deputy forest wardens must be legal residents of the counties in which they are employed.

SEC. 2. Forest wardens and deputy forest wardens shall have charge of measures for controlling forest fires; they shall make arrests for violations of the forest laws; shall post along highways and in other conspicuous places copies of the forest fire laws and warnings against fires which shall be supplied by the Geological Board; and they shall perform such other duties as shall be considered necessary by the Geological Board for the protection of forests. The forest wardens of the township in which a fire occurs shall within ten days make such report thereof to the Geological Board as may be prescribed by them. Each deputy forest warden shall promptly report to wardens any fire in his district.

SEC. 3. Any person who shall maliciously or wilfully destroy, deface, remove or disfigure any sign, poster or warning notice, posted by order of the Geological Board under the provisions of this or other act for the purpose of protecting the forests in this State from fire, shall be guilty of a misdemeanor and upon conviction shall be punishable by a fine of not less than ten dollars or more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 4. Any person discovering any forest fire shall immediately give notice to the nearest forest warden or deputy forest warden in that or adjoining townships. All able-bodied male persons between eighteen and forty-five years of age can be summoned by forest wardens or deputy forest wardens to assist in extinguishing forest fires and shall be paid for such services at a rate not to exceed fifteen (15) cents per hour. Any person summoned by a forest warden or his deputy and not attending, without reasonable excuse, shall be subject to a fine of five (\$5) dollars.

SEC. 5. Forest wardens and deputy forest wardens shall have the same power as deputy sheriffs, so far as the provisions of this act are concerned. Neither forest wardens nor their deputies shall be liable for trespass while acting in the performance of their duties, nor shall any person be held guilty of trespass for going on lands when summoned by an officer to control fire.

SEC. 6. Forest wardens and deputy forest wardens shall receive compensation from the State at the rate of twenty cents per hour for the time actually engaged in the performance of their duties and reasonable expenses for equipment and transportation incurred in fighting or extinguishing any fire, according to an itemized statement to be rendered the Geological Board every month and approved by them. Forest wardens shall render to the Geological Board a statement of the services rendered by the men employed by them or their deputy wardens, as provided in this act, within one month of the date of service, which said bill shall show in detail the amount and character of the service performed, the exact duration thereof, the name of each person employed, and any other information required by the Geological Board. If said bill be duly approved, it shall be paid by direction of the Geological Board out of the State Treasury; and the State Treasurer is hereby authorized and required to collect one-half of the wages and expenses incurred by the forest wardens and deputy forest wardens under this section and section three (3) of this act, from the county in which they are incurred.

SEC. 7. The sum of ten thousand dollars annually is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the purpose of carrying out the provisions of this act, the same to be drawn upon as directed by the Geological Board.

NATIONAL MEASURES.

Co-operation Under the Weeks Bill:—With the recent passage by Congress of the Weeks Bill (Pub. No. 435) “to enable any State to co-operate with any other State or with the United States for the protection of the watersheds of navigable streams, etc.” an opportunity has been opened to secure fire protection, for at least the mountain portion of the State, at one-half the actual cost of such protection. This bill provides, among other things, as follows:

SEC. 2. That the sum of two hundred thousand dollars is hereby appropriated and made available until expended, out of any moneys in the national treasury not otherwise appropriated, to enable the Secretary of Agriculture to co-operate with any State or group of States, when requested to do so, in the protection from fire of the forested watersheds of navigable streams; and the Secretary of Agriculture is hereby authorized, and on such conditions as he deems wise, to stipulate and agree with any State or group of States to co-operate in the organization and maintenance of a system of fire protection on any private or State forest lands within such State or States and situated upon the watershed of a navigable river: *Provided*, that no such stipulation or agreement shall be made with any State which has not provided by law for a system of forest fire protection: *Provided further*, that in no case shall the amount expended in any State exceed in any fiscal year the amount appropriated by that State for the same purpose during the same fiscal year.

Under this law the Federal Government is empowered to co-operate with the various States in the organization, direction, and extension of a fire protective system, by putting in a sum of money equal to that appropriated by the State for this purpose. It can, however, only co-operate with States which have some form of State fire protection already. North Carolina has no such system, and though the Federal officials have showed a strong desire to spend part of this money in this State, nothing can be done to take advantage of this proffered co-operation until a regular State system of fire protection can be established. Should the Legislature in 1913 pass a law like that suggested on pages 32-33, appropriating \$10,000 for fire protection, an equal sum might, under the Weeks law, be procured from the Federal Government, making \$20,000, with which a good start could be made towards the prevention of forest fires in North Carolina.

Owners of forest land should make every effort to take advantage of this great opportunity by seeing to it that men actively in favor of forest protection are nominated and elected to the next General Assembly.

EDUCATIONAL MEASURES.

The majority of our people have been raised where there was always abundance of wood for fuel and for other local necessities, and where the selling of timber off the land has been looked upon as something extra made over the ordinary income. Timber has never been rated at its true value, namely, its cost value to grow, because there has been abundance of timber ready grown to our hand. It is not strange then that there is so much indifference to the growing necessity of fire protection. Economic conditions have been changing so rapidly of late years that it is only those who are in close touch with the markets of the country and who are studying the progress of events that realize the necessity for conservation of our forests.

A campaign of education along these lines must be carried on all over the State, not only to show the property owners themselves and the other grown citizens that it is to their interest and that of their children to protect and perpetuate the forests; but also and probably chiefly, to educate the children, to bring them up to realize that a new condition exists, and that the trees and the forests are really growing crops, and very necessary and valuable crops, and that as such they require care and attention as much as any farm crop.

The children of today are the property owners and lawmakers of tomorrow, so while we do not cease to advocate forest protection amongst the present-day citizens, let us at the same time train our future citizens to appreciate its necessity.

ARBOR DAY.

Probably the best and most attractive as well as the most practical way just at present, to inculcate a knowledge and love of trees among even the smallest children, is to make the observance of Arbor Day an annual feature in all the schools of the State. This would reach all of the children of the State once each year and would give them information in a form in which it would be remembered.

Few children, or grown people either for that matter, can distinguish a longleaf from a shortleaf pine seedling, know the conditions most favorable for the best growth of even our commonest forest trees, or can tell one oak or one pine from another by the bark, the buds, the leaves or the fruit.

In order to foster a love of trees among children and to teach them elementary facts about them, as well as to encourage the planting of trees and the intelligent care of forests by their elders, the practice of observing Arbor Day has been introduced into nearly every State in the Union, and in many States it is a legal school festival. In North Carolina the day was observed as far back as 1893, but unfortunately it has never received general recognition. Only a school here and there has observed the day with appropriate exercises, when some of the teachers or patrons have been especially interested in the subject.

In 1896 the School Committee of the town of Durham passed a law providing:

SECTION 1. That the second Friday in April of each year shall hereafter be known in the Durham Public Schools as Arbor Day.

SEC. 2. In order that the children in our public schools shall assist in the work of adorning the school grounds with trees, shrubs and flowers, to develop and stimulate a love and reverence for nature, to inculcate economic and æsthetic purposes which will result in beautifying the home and increasing the comfort and happiness of our people, it shall be the duty of the Superintendent of Schools to provide for and conduct such exercises as shall best accomplish these results.

An Arbor Day program was prepared and published in a twelve-page leaflet. This program, as carried out on April 10, 1896, is here given, by headings, in order to convey to those who have never attended such a celebration some idea of how attractively it may be carried out.

DURHAM PUBLIC SCHOOLS.

ARBOR DAY.

ASSEMBLY HALL, APRIL 10, 1896.

1. Music Orchestra
2. Arbor Day Song.
3. Responsive Exercises (in the words of Scripture).

4. Prayer (to be recited in concert).
5. MusicOrchestra
6. Class Exercise, Telling About Arbor Day.
 - (a) What is Arbor Day?
 - (b) Tell something of the origin of Arbor Day.
 - (c) Why do we observe Arbor Day?
 - (d) Why do you name your trees for some celebrated person?
 - (e) How are books and trees related?
 - (f) Tell me something about tree religion.
 - (g) What about trees as living things?
 - (h) Why should the forests be preserved?
 - (i) What do we get from the forests?
 - (j) You haven't told me anything about flowers.
 - (k) What trees do you think the best for school grounds?
 - (l) Tell me how to plant a tree, size, etc.
7. Some Things said About Observing Arbor Day.
8. Song of Dedication.
9. Reading—The Tree of the Field is Man's Life.
10. Reading—The Talk of a Tree.
11. MusicOrchestra
12. Recitation—Selections from Bryant, Irving, Emerson, and others.
13. Recitation—Resolution Protesting Against the Destruction of Trees.
14. Exercise—The Arbor Day Queen.
15. Reading Letters About Arbor Day from Distinguished North Carolinians.
16. Recitation—The Woodman and the Tree.
17. MusicOrchestra
18. Song—The Chorus of the Flowers.
19. Acrostic—Arbor Day.
20. Song—Love of Nature.
21. March—Washington Post.
22. Exercises at the Tree.

(Pupils from each schoolroom march to the school grounds, five of the class carrying spades, the handles being decorated with school colors—white and orange—and form a circle around the spot where the tree is to be planted.)

 - (a) Placing the tree in position.
 - (b) Tree planting Song.
 - (c) A brief statement by the teacher concerning the person to whom the tree is dedicated.
 - (d) Recital of quotations from writings of persons thus honored.
 - (e) Pupils place the soil around the tree with their spades.
 - (f) March to class room.

Recently the Forester of the North Carolina Geological and Economic Survey was invited to make an address at an Arbor Day celebration at Southern Pines, in which the whole town took a gratifying interest. The Civic Club, an organization of the women of the place, was the prime mover, while the teachers and the school children united with the club to make the occasion a great success. Trees and shrubs were

planted on the school grounds in the morning and in the afternoon drills, songs, and recitations, illustrating the child's relation to the trees and flowers around him, were very well given by the children in the large school auditorium.

Such a celebration might be held annually by every school in the state with great profit to the children, and with increasing interest on the part of the parents. There is a growing tendency among the men to leave the education of the children more and more to the women, and the next generation will have special cause to bless their mothers for opening their eyes to the beauty and usefulness of the trees if the women, who, through their clubs are doing such good work for civic improvement and the betterment of education, would take up this matter all over the State and work for a general Arbor Day observance.

In most States some special day is selected as Arbor Day by the Governor or Superintendent of Education, or some other authority, and all schools are expected to observe that particular day. In North Carolina, where the school year varies so in the different counties, and where the time for planting trees varies with the different regions of the State, it would probably be better for each County Superintendent, or even each School Principal, to set the day which would be most convenient to him and most appropriate to the season and locality. Where only a summer and fall school session is given, October in the mountains, November in the Piedmont section, and December in the eastern part of the State would be suitable times, while where a nine or ten months school is the rule, March or April would be more suitable, as children, and older folks too, for that matter, naturally turn to the woods and fields in the spring-time. Some Friday would usually be selected as interfering less with the routine of school work, though such interference really often turns out to be rather a help than hindrance to the work.

FORESTRY IN THE PUBLIC SCHOOLS.

There are two ways in which Forestry can be taught in the Public Schools without adding another course to the already crowded curriculum: first, by means of an auxiliary reader; and second, by correlating the various phases of Forestry with those courses taught in the school which are naturally connected with it.

1. The present system in North Carolina requires the use of "basal" readers in the various grades. These are supplemented by auxiliary readers on a great variety of subjects, such as: geography, household economics, etc. The use of these is optional, the County Superintendent or the Principal deciding on the subject which will be most helpful

to each particular class. So far there is no auxiliary reader on the subject of Forestry, or even on the more general and comprehensive subject of Conservation. There is room for a book of this character, and it is to be hoped that one will shortly be provided. Such a book should set forth in simple language the fundamental principles of Conservation and then show how these are related to the economies of everyday life.

2. In his circular "Forestry in the Public Schools" (Circular 130, Forest Service, U. S. Department of Agriculture), Prof. Hugo A. Winkenwerder advocates and outlines plans for the study of Forestry in connection with studies which are already being taught. He states that the object of this circular is to indicate to teachers who are interested the courses in which Forestry deserves a place and to assist them in choosing the proper subject-matter. A description of the location, extent, and character of the forests of the locality in which the teaching is done, of the State, and of the country as a whole, should form part of the study of geography as taught in all the common or secondary schools of North Carolina. Their economic value as sources of useful products, for conservation of water, for protection, and their influence on erosion and soil protection, as well as their æsthetic value, should be brought out as well as the necessity of forest protection, especially for protecting them from fire. Nature study, where it is taught, opens the way for some elementary forestry; in fact, the study of the trees, the shrubs, and the seedlings found in the woods is the most attractive form of nature study, and develops very rapidly the habit of observation, which is the chief object aimed at in all such training.*

In the High Schools, along with United States History, can be taught the importance of the forests to our development, the growth of the forestry movement, and of the National Forest Policy. The protection of forest property and the policies relating to public lands should form a part of the course in Civics. A course in physical geography is not complete without considering the relation of forests to climate; the influence of forests upon water and soil conditions; the relation of forests to erosion, and to reclamation. Commercial geography must include the importance of forests as a national resource, the distribution of forests, the products of the forest and the influence of forestry on commerce. It is impossible to enumerate the opportunities which the forest offers to teachers of botany.

In the farm-life schools and others of a similar nature practical forestry should be one of the important studies, and the school-farm should

*A special circular, "Forestry in Nature Study," issued by the U. S. Department of Agriculture, gives outlines of instruction in this subject for all terms and grades in the public schools.

furnish sufficient area in woods to give practical work in forest management. Nearly all North Carolina farms contain a large proportion of woodland, and it is as important for farmers to know how the yield may be increased on this as on the cleared land.

FORESTRY IN THE COLLEGES.

In order to bring this important problem before the young men who are yearly leaving our higher institutions of learning to take part in the management of the State, courses in Forestry should be given in all our colleges and in the State University. Complete courses are not required, but enough should be taught to give the students some idea of the forest problems that confront us and the best way to deal with them. In the A. & M. Colleges more complete instruction should be given; courses calculated to give the student a knowledge of how to manage a wood-lot, how to measure and sell standing timber and log it if necessary, how to protect the forest from fire and insects, what trees to plant and how, when, and where they should be planted. According to the President of the A. & M. College, who would be glad to add a course in Forestry to the curriculum, only one additional man would be required for this purpose. The same is true of the State University. Courses in Botany, Entomology, and Engineering are now given at both institutions. By adapting such courses to the needs of the forester and then founding a Chair of Forestry proper, which would include silviculture, forest management, and lumbering, an excellent course in Forestry could be given. Funds for the foundation of such a chair, however, are not available at either place, and probably will not be until a more general demand for such a course is made. The timber crop is second only in importance to the cotton crop in North Carolina, and most farmers have a larger acreage in woodland than in all other crops combined. It seems, therefore, that more recognition should be given this subject in our State Agricultural College, as well as in the State University.

LECTURES AT FARMERS' INSTITUTES, ETC.

It is not only through the Farm Schools and the A. & M. College that the State is trying to teach the farmer improved methods. For several years past it has been sending experts to all the counties of the State to lecture on improved methods of farming, from soil improvement to poultry-keeping. The timber crop is the only subject that has been entirely omitted from the list of subjects discussed. A talk on forest management or forest protection should be included in every program, for the subject is of the greatest importance to most farmers. Latterly the

Forester of the North Carolina Geological and Economic Survey has joined one of the parties in the western part of the State for a short time each summer and talked to the meetings on this subject, but this is only a very small beginning. An extension of this work all over the State is strongly advocated.

But lecture-work need not be confined to the colleges and the farmers' institutes. Addresses should be made all over the State as opportunity offers, and forest protection advocated before all kinds of audiences. Not till the people begin to think about the subject will they realize the importance of immediate action.

FORESTRY ASSOCIATIONS.

On February 1, 1911, a Forestry Convention met in Raleigh for the purpose of discussing proposed forestry legislation. Though the attendance was not large it was quite representative. Delegates from eighteen counties of North Carolina were present, including lumbermen, furniture manufacturers, railroad men, timberland owners, farmers, foresters and educators. The forestry bills then before the Legislature were discussed in detail, and much interest was shown in them, as well as in a State-wide stock law. A new forestry bill was drawn up at the meeting, which it was recommended be substituted for the two already introduced. This bill, which combined all the features in the three laws suggested on pages 28, 30, and 32, was later introduced in both houses, but failed to pass. The following resolutions were adopted by the convention:

WHEREAS, It has been estimated that there is in North Carolina sufficient forest land to maintain perpetually a supply of raw material for our furniture factories, our pulp mills, and our tanning extract plants, if these forests are conserved and protected from fire; and,

WHEREAS, The forests of North Carolina and the industries dependent upon them represent about one-sixth of the wealth of North Carolina; and,

WHEREAS, These forests are being devastated by frequent fires, causing enormous present and future loss to the owners of forest land and indirectly to the people throughout the whole State; therefore,

Be it resolved, That we thoroughly endorse legislation that will protect our forests from fire, and urge the General Assembly to pass such measures as will enable those portions of the State that desire it, adequate fire protection for their forests; and as the best results can only be obtained when the stock law is in force,

Be it further resolved, That we endorse a State-wide stock law for North Carolina, with a provision allowing any territory voting for that purpose to be exempted therefrom upon erecting proper fence around such exempted territory.

Be it further resolved, That we advocate the teaching of the principles of forestry in the public schools and the introduction of a course in forestry in the A. & M. College.

Such a meeting as this is calculated to do a great deal to advance the cause of forest protection by awakening interest in the question and by unifying effort. With these ends in view it was unanimously decided to organize the convention into a permanent body to be known as the North Carolina Forestry Association, this association to have a President, Secretary-treasurer, and one Vice-President for every Senatorial District in the State in which sufficient interest in forestry had been manifested. The work of the Association was placed in the hands of an Executive Committee, consisting of the President, Secretary-treasurer, and five other members, to be appointed the first year by the president of the Association. The object and aim of the association was declared to be "the protection and perpetuation of the forests of North Carolina." Dr. D. H. Hill, of the A. & M. College, Raleigh, was elected President of the Association, and Mr. J. S. Holmes, Forester of the North Carolina Geological and Economic Survey, Chapel Hill, Secretary-treasurer. The President subsequently appointed the following gentlemen as members of the Executive Committee: Col. B. Cameron, Raleigh; Mr. Clarence Poe, editor *Progressive Farmer*, Raleigh; Dr. J. H. Pratt, State Geologist, Chapel Hill; Mr. H. M. Shaw, president Southern Wheel Company, Oxford; and Mr. E. B. Wright, manager Butter's Lumber Company, Boardman, N. C. The very fact that such prominent men are behind this movement speaks well for its future success and usefulness, and also inspires the confidence of the public in any recommendations it may make.

The organization of county or district associations, in connection with this State Association, to stir up and direct local sentiment, would do more to make the society effective and to forward the forestry movement than any other kind of work that could be undertaken. The good roads movement has received its greatest impetus from town and county good roads associations, though the State organizations have done splendid work. In the same way local forestry clubs, societies, or associations, or forestry branches of other bodies, acting in accord with the State Association, may do a great work in educating the people to a realization of the importance of forest protection. There are forestry sections of several of the women's clubs in the State that are doing good educational work, and the number might, with advantage, be increased. Different phases of forestry will appeal to different organizations; street planting to civic clubs, protection of watersheds and regulation of stream flow to Chambers of Commerce and Boards of Trade, perpetuation of the timber supply to labor organizations and lumbermen, the management of the wood-lot to Farmers' Clubs; but protection of the forests from fire should appeal to all.

DEMONSTRATION FORESTS.

One method of educating the public in improved methods of forest management which is widely practiced in Europe and has been adopted by several of the northern States is by the proper management of State Forests. In different parts of the State areas of land of larger or smaller extent are acquired by gift or purchase, or reserved by the State for the purpose of demonstrating the most practical form of management for that particular locality and for that kind of forest, and on which to conduct experiments to determine practical questions in forest management. In many cases land is given or bequeathed to the State by public-spirited citizens for this purpose.

If the people can be shown the results of proper treatment of the forests in successful fire protection, conservative lumbering, profitable tree planting, and advantageous thinnings, more would be accomplished than by countless lectures and bulletins. On an area in the high mountains experiments might be made to determine the best way to cut spruce for pulp while insuring the perpetuation of these forests. In the mountain hardwood forests methods to increase the proportion of poplar, chestnut, and other valuable species in the second growth might be demonstrated. In the Piedmont region the profits in judicious thinning of shortleaf pine stands could be shown. In the Coastal Plain region successful reproduction of longleaf pine might be demonstrated and experiments made to determine whether longleaf or loblolly pine was the most profitable tree to grow on certain types of soil. On "the Banks" the fixation of drifting sand by forest growth could be shown by planting up the sand dunes, and the profitable use of such areas made apparent by propagation of turpentine yielding pines. All such demonstrations, besides their value for experiments and for showing improved methods of forest management, involve, of necessity, adequate fire protection, and the successful accomplishment of this alone would make the acquirement and management of such demonstration forests justifiable, and fully compensate the State for their cost.

CONCLUSION.

Reports from correspondents in but one-third of the townships of the State give an estimated area of 580,000 acres of woodland burnt over during 1910, with a consequent loss of over half a million dollars in timber and personal property. If the losses from this cause in the remaining townships could be ascertained, and the enormous damage to young growth, soil and streams could be computed, it is very certain that the total loss to North Carolina by forest fires for the past year

would reach a million dollars. Not only this, but a loss of five human lives was caused directly by these same fires, which were in large part due to carelessness, and might and should have been prevented.

In 1909 the damage from forest fires amounted to several hundred thousand dollars, and every year it is much the same, and will continue to be the same until North Carolinians wake up and take some active steps to stop this destruction.

There is pressing need for more effective laws to protect the forests from fires resulting both from the railroads and from individuals. Such laws when enacted must have the support of the people, or they can not be efficiently enforced. What is needed in this as in other lines of business is education. The timber crop is second only in importance to the cotton crop in North Carolina, and occupies ten times the acreage of that staple, yet there is not one school or college in the State in which even elementary forestry is taught. Is it any wonder that the people show such indifference to forest destruction? A more general interest in forest protection must be aroused and more definite knowledge of practical forestry methods imparted to both the young and the older citizens of the State, and this can best be done by teaching the principle of forestry in our schools and colleges.

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. *Postage 10 cents.*
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 30 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.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp. 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Waterpowers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895, 8°, 47 pp., 5 pl., *Postage 4 cents.*
10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology. Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Waterpowers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report of the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp. 22 pl., 5 figs. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Tale and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Tale, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virginina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

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VOLUMES.

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Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

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BIENNIAL REPORTS.

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Biennial Report, 1900-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

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