
Soil Survey

Madison County North Carolina

By

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and North Carolina Agricultural Experiment Station



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SOIL SURVEY OF MADISON COUNTY, NORTH CAROLINA

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INTRODUCTION

The soil survey map and report of Madison County, N. C., are intended to convey to a wide variety of readers information concerning the soils, crops, and agriculture of the county.

Farmers, landowners, prospective purchasers, and tenants are ordinarily interested in some particular locality, farm, or field. They need to know what the soil is like on a certain piece of land, what crops are adapted, what yields may be expected, and what fertilization and other soil-management practices are needed for best results. Many people

¹The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

do not wish to read the entire soil survey report, and they need not do so to obtain much of the information essential to their purpose.

A person interested in a particular piece of land should first locate it on the colored soil map accompanying the report. Then, from the color and symbol, the soil may be identified in the legend on the margin of the map. By using the table of contents, the reader can find the description of the soil type or types. Under each soil type heading is specific information about that particular soil. There is a description of the landscape, including the lay of the land, drainage, stoniness (if any), vegetation, and other external characteristics; and the internal or profile characteristics of the soil—its color, depth, texture, structure, and chemical or mineralogical composition. The description includes information about present land use, crops grown, and yields obtained, and statements concerning possible uses and present and recommended management.

By referring to the section on Productivity Ratings, one may get an idea of how the soil types compare, one with another, as to productivity for the various crops and how well they are suited for the growing of crops or for other uses. Further ideas concerning land use and soil management can be obtained from the section dealing with those subjects.

For the person unfamiliar with the area or region, there is a general description of the area as a whole in the first part of the report. Geography, physiography, regional drainage, relief, vegetation, climate, population, transportation facilities, and markets are discussed. A brief summary at the end gives a condensed description of the area and important facts concerning the soils and agriculture.

The agricultural economist and the general student of agriculture will be interested in the sections on Agriculture, Productivity Ratings, and Land Uses and Agricultural Methods.

Soil specialists, agronomists, experiment station and agricultural extension workers, and students of soils and crops will be interested in the more general discussion of soils in the section on Soils, as well as in the descriptions of soil types. They will also be interested in the section on Productivity Ratings and that on Land Uses and Agricultural Methods.

For the soil scientist, the section on Morphology and Genesis of Soils presents a brief technical discussion of the soils and of the soil-forming processes that have produced them.

COUNTY SURVEYED

Madison County is in the western part of North Carolina (fig. 1). The southern boundary is about 12 miles from Asheville, N. C., and the western and northwestern boundary is the North Carolina-Tennessee State line. The county is irregular in shape, as most of the boundaries follow either mountain ridges or streams. It comprises an area of 450 square miles, or 288,000 acres.

Marshall, the county seat, is situated on the French Broad River in the southeastern part of the county and is about 15 miles northwest of Asheville by air line. Knoxville, Tenn., is 99 miles west of Marshall by road. These towns are connected by a paved highway and by railroad.

Marshall had a population of 1,132 persons according to the 1930 census. The town was established as the county seat in 1855 and

was named in honor of John Marshall, Chief Justice of the United States. Other towns are Mars Hill, with a population of 455 in 1930, and Hot Springs, with a population of 637. These small towns furnish only a limited market for local products. Practically all of the cattle and farm produce are marketed in larger nearby towns, including Asheville and Knoxville. The small towns are useful to agriculture only in obtaining supplies and in marketing poultry and a few dairy products.

The western part of North Carolina embraces a part of the Blue Ridge physiographic province. This section consists of a series of valleys or intermountain areas that lie about 2,000 feet above sea level and are separated by mountains, some of which rise to an elevation of 6,000 feet or more. As a whole, Madison County is rough and rugged, as most of the mountain slopes are very steep—in some places precipitous.

The streams have played a major part in making the relief what it is today. In places they have cut valleys several hundred feet deep, and in some places these valleys, or gorges, are flanked by precipitous walls. Two types of relief are prominent, namely, (1) intermountain areas and (2) mountain areas. All the land falls into one or the other of these classifications of relief, with the exception of narrow areas of almost flat land along some of the streams.

The intermountain areas comprise a series of low hills with an average elevation of about 2,300 feet separated by valleys, of which the deepest lies about 1,600 feet above sea level. Streams have dissected these low, steep hills so badly that comparatively little level land remains. No outstanding mountains or peaks occur in this section. Slopes to streams are steep, and only in very few places does any bottom land occur at the foot of these slopes or along the streams. Intermountain areas are near Mars Hill, Marshall, and Walnut, and along Sandymush Creek.

The mountain areas, which embrace a major part of the county, are steep, rough, rugged, and precipitous. They are too steep for agricultural use, except that some small areas could be used for pasturage under careful management. Some areas on the tops of mountains and in the mountain gaps between the high knobs and peaks compare favorably with the intermountain areas in relief; but, owing to the high elevation, which affects the climate, such areas have only limited use. Bald and Max Patch Mountains represent typical mountain areas.

The elevation² of Madison County ranges from 1,259 feet at Paint Rock, where the French Broad River flows into Tennessee, to 5,168 feet on the top of Sandymush Bald. Elevations for some of the highest mountains are as follows: Sugarloaf Knob, 4,540 feet; Frozen

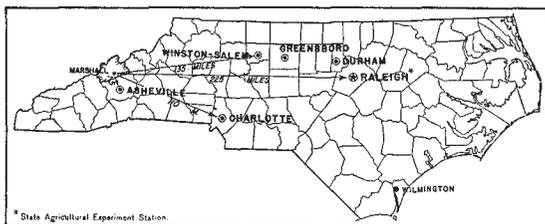


FIGURE 1.—Sketch map showing location of Madison County, N. C.

² Elevations taken from United States Geological Survey topographic maps.

Knob, 4,000 feet; Bluff Mountain, 4,640 feet; and Max Patch Mountain, 4,660 feet. Elevations of the various towns and villages of the county are as follows: Marshall, 1,646 feet; Mars Hill, 2,416 feet; Hot Springs, 1,326 feet; Paint Rock, 1,259 feet; and Barnard, 1,529 feet.

The streams have thoroughly dissected the Blue Ridge Plateau. They have cut very narrow V-shaped valleys and gorges and have created an extremely rugged land form. Drainage is good to excessive. The streams are swift and transport large quantities of material. There are numerous rapids and waterfalls where water power could be developed.

The drainage pattern of the county is dendritic. Flowing from southeast to northeast, the French Broad River, together with its tributaries, drains the entire county. The main tributaries of the French Broad River in this country are the Ivy River and Laurel, Sandymush, Little Pine, Pine, and Spring Creeks. The French Broad River is a tributary of the Tennessee River, which, in turn, flows into the Ohio River near Paducah, Ky.

The original forest vegetation was typical of the mountainous counties of North Carolina. The original hardwood forest consisted chiefly of chestnut, chestnut oak, white oak, red oak, hickory, maple, poplar, and walnut. Some white pine, spruce, and hemlock were mixed with the hardwoods. At present all the chestnut is dead, owing to the blight. Most of the original forest has been cut over at least once. Practically all of the rough mountain areas are in forest at present. Where the forest has been cut over for timber and not cleared, it has reforested naturally to hardwoods, chiefly chestnut, oak, white oak, and red oak. Where the timber has been removed and the land has been cultivated and then left to reforest, white pine or locust generally comes in. Mountain-laurel and rhododendron form a thick undergrowth in many places, and galax makes up the undergrowth on the mountains. Bluegrass grows on the mountains and in some of the coves, whereas broomsedge and a few other grasses grow plentifully on the lower land.

The forest area in 1929 was approximately 155,391 acres³ and comprised about 56 percent of the total land area. More than 68 percent of the forest area was in farm woodland, including 44,000 acres of woodland pasture. Of the forest land outside of farms, nearly 90 percent was held in large timber tracts. The principal merchantable species are chestnut (although dead, the trees are being sold for timber), 45 percent; oaks, 20 percent; and yellow pine, 5 percent. The estimated present total stand of 45,000,000 board feet of saw timber is fairly accessible by road and railroad.

The county lies between two large wood-using centers, Asheville, N. C., and Newport, Tenn., and it has excellent transportation facilities to both places. Several sawmills produce about 4,000,000 board feet of lumber annually. Considerable quantities of pulpwood and railroad ties are produced each year.

When white men first arrived during the Revolutionary War, this area was inhabited by the Cherokee Indians. Madison County was formed from parts of Buncombe and Yancey Counties in 1851 and

³ NORTH CAROLINA DEPARTMENT OF CONSERVATION AND DEVELOPMENT: COMMERCE AND INDUSTRY DIVISION. NORTH CAROLINA: RESOURCES AND INDUSTRIES. 287 pp., illus. 1929.

was named in honor of James Madison, the fourth President of the United States. The early settlers were chiefly of English, Scotch-Irish, and French descent.

The population of the county according to the 1930 census was 20,306, of whom 98.6 percent are native-born whites, 0.1 percent foreign-born whites, and 1.3 percent Negroes. Settlement is more dense in the eastern than in the western part. In the western part people locate in small settlements where the best farm land is to be had. A few people live far back in the rough mountain areas and depend chiefly on the forest and mineral resources for their livelihood. The average density of population for the county is 46.6 persons to the square mile.

A line of the Southern Railway traverses the county. There are four paved highways. Like the railroad, United States Highways Nos. 25 and 70, which are coextensive, follow the French Broad River; whereas United States Highways Nos. 19 and 23, also coextensive, cross the extreme eastern part of the county through Buckner. Most of the other public roads are good and, except for short periods during the winter, can be traveled throughout the year.

Telephone service is available in many parts of the county. A few farmhouses have either telephone or electric service—some have both. Almost all the villages have telephone and electric service. Churches and schools are adequate and conveniently located. School busses transport pupils to and from the schools. Pure water is easily obtained from wells, springs, or unpolluted streams. A college is in Mars Hill, and a school for girls is in Hot Springs.

Some feldspar is mined in the vicinity of Ivy, and lumbering operations are carried on wherever there is any commercial timber. The value of the forest products produced annually amounts to about \$60,000, and the value of minerals mined in 1926 was \$103,996.

CLIMATE

This county has a continental climate. The temperature varies widely from season to season and from one section to another. The lowest midwinter temperature is far below the highest summer temperature. Differences in altitude have a marked influence not only on the temperature but also on the rainfall to some extent. In summer the days are pleasant and the nights are prevailingly cool. The winters are cold, accompanied by heavy snowfall, and the ground is frozen for several days at a time. Very little farm work can be accomplished between December and April. With good care, some of the hardiest vegetables survive the winter. Winter crops generally survive the winter in good condition at the lower altitudes, but they are frequently frozen at the higher altitudes. The temperature is lower, the rainfall heavier, and the growing season shorter on the high mountains than in the intermountain areas and valleys.

The average length of the frost-free season is 189 days at Hot Springs. The average dates of the latest and earliest killing frosts at Hot Springs are April 16 and October 22, respectively. Killing frosts have been known to occur as late as May 10 and as early as October 1. This is probably not average for the county, as the elevation here is low for this locality. The average frost-free season in nearly all of the intermountain areas is long enough to mature the crops commonly

grown. Crop adaptations are more restricted in the high mountainous areas. The climate, rainfall, and soils encourage the growing of good pasture grasses and have resulted in making this section notable for the fine quality of beef cattle raised. The rainfall is well distributed throughout the year, but most of it occurs during the growing season. Fall is usually a dry season, and this gives the farmers ample time to harvest and store or market their crops.

Windstorms seldom occur. Hailstorms are not uncommon in summer, but they do little damage to growing crops.

The high elevations of some of the mountains and the prevailing cool climate provide good conditions for certain crops, especially late truck crops. All crops produced on the mountains must have a short growing season and must mature quickly; otherwise the early frost will kill them. The high mountain areas are well suited for parks and scenic areas and afford a good environment for the treatment of certain diseases, especially tuberculosis.

The data in table 1 are compiled from the records of the United States Weather Bureau station at Hot Springs, Madison County, N. C.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Hot Springs, Madison County, N. C.

[Elevation, 1,326 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1925)	Total amount for the wettest year (1920)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	42.0	78	-12	4.50	1.54	4.33	3.0
January.....	41.8	79	-2	3.00	1.85	4.17	4.9
February.....	42.3	83	-4	2.80	2.14	3.86	5.1
Winter.....	42.0	83	-12	10.30	5.53	12.36	13.0
March.....	49.6	90	0	4.50	1.51	5.72	3.2
April.....	57.4	95	18	3.70	3.31	7.09	.3
May.....	65.8	94	31	3.60	1.79	1.91	.0
Spring.....	57.6	95	0	11.80	6.61	14.72	3.5
June.....	72.9	98	40	4.20	1.46	4.33	.0
July.....	75.7	102	50	5.10	3.56	5.83	.0
August.....	74.7	102	47	5.10	.57	11.16	.0
Summer.....	74.4	102	40	14.40	5.59	21.32	.0
September.....	70.6	101	34	2.90	2.06	5.40	.0
October.....	58.9	92	21	2.80	6.19	.41	.3
November.....	49.0	86	6	1.90	2.25	3.28	1.4
Fall.....	59.5	101	6	7.60	10.50	9.09	1.7
Year.....	58.4	102	-12	44.10	28.23	57.49	18.2

AGRICULTURE

Agriculture began in Madison County during the Revolutionary War. The first settlements were made near what is now the town of Mars Hill. For several years crops were grown only in small clearings. Corn, cabbage, and all root crops were successfully grown. Buckwheat and rye did well long before wheat and other small grains

began to thrive. Livestock were fed on potatoes and buckwheat. Hogs were kept in the mountains all winter.

Since the county was first settled the acreage used for field crops and pasture has increased rapidly, and at present practically all of the suitable land is used for these purposes. Even so, only 117,933 acres, or 42.2 percent of the area of the county, represented land available for crops in 1934; that is, it included cropland and plowable pasture. Crops were actually harvested from 41,991 acres in that year. The amount of land in pasture was 98,798 acres, of which 59,022 acres was plowable pasture, 31,413 acres woodland pasture, and 8,363 acres other pasture. Nearly all of the rest of the land is in forest or being reforested.

Changes in the agriculture for the last 55 years may be traced from table 2, which gives the acreages of principal crops, as compiled from the Federal census.

TABLE 2.—*Acreage of principal crops in Madison County, N. C., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
	<i>Acres</i>						
Corn for grain.....	17,816	21,920	27,974	24,052	20,819	15,872	20,925
Oats threshed.....	4,238	7,175	4,955	3,483	2,644	765	581
Wheat.....	7,702	10,580	13,241	7,179	10,205	2,839	6,950
Dry peas.....			93	21	38	140	219
Dry edible beans.....			410	33	2	86	393
Hay and forage.....	1,047	3,979	3,482	7,391	9,329	6,950	6,643
Potatoes.....		262	478	408	451	644	940
Sweetpotatoes.....	25	59	223	142	59	157	306
Tobacco.....	1,626	4,749	1,361	499	1,808	3,167	2,650
Sorghum.....		427	508	774	665	122	
	<i>Trees</i>						
Apples.....		62,601	107,688	101,437	79,503	75,076	61,253
Peaches.....		17,767	19,460	17,364	8,253	9,410	4,706
Cherries.....		238	1,028	1,628	2,717	4,997	4,475
	<i>Vines</i>						
Grapes.....			889	1,496	2,017	3,162	4,215

Corn dominates the present agriculture. Wheat, hay, and tobacco follow successively in acreage. Tobacco, potatoes, and cabbage are the principal cash crops. Most of the farmers derive their chief income from the sale of tobacco and beef cattle, and they produce feed for livestock and food for the farm family. This type of agriculture is followed particularly on the better farms or where the soils are well suited to it. Every well-established farm has a few fruit trees, a garden plot, a few hogs, one or two milk cows, and a flock of chickens. A few farmers keep sheep. Dairy and poultry products are minor sources of income. Considerable income is derived from the sale of lumber, cross ties, poles, tanbark, galax leaves, and other forest products. Some apples, peaches, grapes, and cherries are sold.

Table 3 lists the value of certain agricultural products in 1929 and gives some indication of the relative importance of the several sources of farm income.

TABLE 3.—Value of certain agricultural products, by classes, in Madison County, N. C., in 1929

Crops	Value	Livestock products	Value
Cereals.....	\$432, 957	Dairy products sold.....	\$64, 433
Other grains and seeds.....	646	Poultry and eggs produced.....	333, 864
Hay and forage.....	111, 365	Wool produced.....	4, 521
Vegetables (including all potatoes and sweetpotatoes).....	68, 251	Honey produced.....	3, 008
Fruit and nuts.....	44, 516	Total.....	405, 826
All other field crops (mainly tobacco).....	533, 181	Total value of all products listed.....	1, 901, 618
Farm garden vegetables (excluding potatoes and sweetpotatoes) for home use.....	126, 716		
Forest products for home use and for sale.....	178, 160		
Total.....	1, 495, 792		

Because beef cattle are so important in the farm economy and the census does not report their value among the items listed in table 3, perhaps a better idea of the relative importance of different sources of agricultural income may be gained from the following tabulation of the value of farm products sold, traded, or used by the operator's family in 1929.

Product:	Value
Crops sold or traded (mainly tobacco).....	\$648, 433
Livestock sold or traded.....	280, 554
Livestock products sold or traded.....	186, 610
Forest products sold.....	77, 150
Farm products used by operator's family.....	759, 564
Total.....	1, 952, 311

Corn is grown on every arable soil in the county. Yields vary according to the soil, content of organic matter and mineral plant nutrients, and amount of fertilizer applied. Many farmers do not apply fertilizer on cornland. Practically all of the corn produced is used to feed work animals and cattle, to fatten hogs, and to grind into meal for domestic use. The quantity produced, however, is not sufficient to meet local requirements.

Wheat, second to corn in acreage, returns a comparatively low acre yield. The grain produced does not supply the local demand, and much flour and grain are purchased outside the county. Generally, a light application of fertilizer is made on wheatland, unless the land has been devoted to tobacco the preceding season, in which case no fertilizer is used.

Only a small acreage is used for the production of oats. Winter oats generally freeze, and spring oats do not yield well. Most of the farmers depend on some other crop, such as rye or barley, for hay and grain.

Tobacco, the most important cash crop, contributes to the income of almost every farmer. Prior to 1917 the flue-cured type was most commonly grown, but about that time the farmers shifted to burley, because it was worth about 10 cents a pound more than the flue-cured. Other reasons for this change are that the burley type requires less work to produce and harvest than the flue-cured and it can be sold in the markets in east Tennessee, which are much nearer and more convenient than the flue-cured tobacco markets of central North Carolina. In addition, the climate and the dominantly heavy-textured soils of

Madison County are better suited to the production of burley tobacco than to the production of flue-cured tobacco. All the tobacco produced is air-cured. A higher grade and larger quantity of fertilizer is applied for tobacco than for any other crop.

Only a small acreage is devoted to potatoes and market vegetables, because of the distance from markets.

Wild or tame hay is used by most of the farmers to feed beef cattle and farm animals through the winter. During a severe winter practically all of the farmers who keep cattle through the winter run short of hay and have to buy it outside the county. If late fall and early spring grazing can be procured, however, most of the farmers have enough hay for their cattle and work animals but none to sell.

The use of home-mixed or commercial fertilizers, necessitated by depletion of the available mineral plant nutrients in the soil, as well as selection of better varieties, strains, and seed, has maintained the acre yield of crops at about the same level throughout the period covered by the census. This is especially true of corn, oats, potatoes, and hay. Wheat returns a larger acre yield now than formerly, owing possibly to better seed and the use of fertilizer. The acre yield of tobacco for this period of time has gradually increased. This is due to two factors, (1) change from flue-cured tobacco to the burley type and (2) better management practices—heavier applications of commercial fertilizer, improved varieties, and more careful selection of tobacco fields and preparation of the soil.

Although the acreage of land from which crops were harvested was about 7,000 acres greater in 1934 than in 1929, the average acreage per farm was about 15 percent less. During this period corn increased in acreage from 16,074 to 21,011 acres, including that used for silage and fodder, and the production of grain rose more than 121,000 bushels. Wheat more than doubled its acreage in this period, increasing from 2,839 acres, from which 22,351 bushels were harvested, to 6,950 acres, from which 54,411 bushels were harvested. Tobacco was reduced from 3,167 acres, producing 2,282,171 pounds, to 2,650 acres, producing 2,152,900 pounds. The acreage in potatoes increased from 644 to 940 acres, and that in sweetpotatoes from 157 to 306 acres.

Many of the dairy cattle are grade and scrub cattle, but the beef cattle generally are purebred or grade Hereford. According to the census there were 14,973 cattle on farms in 1935. Of this number 7,132, or almost 50 percent, were cows, and 6,565 cows were milked during 1934. Between 1930 and 1935 cattle increased about 3,600 head and cows about 2,000 head.

Both mules and horses are used as work animals. Many purebred horses are kept. In 1935, 1,328 horses and colts and 1,724 mules and mule colts were reported on farms. This represented 9 percent fewer horses and only 6 percent more mules than were reported in 1930, although there were 928 more farms in 1934 than in 1929; in fact, the number of mules and horses combined was much less than the number of farms. Other livestock on farms in 1935 included 2,802 sheep, 4,703 hogs, and 117,933 chickens.

According to the 1930 census, the use of commercial and home-mixed fertilizer was reported on 1,859 farms, or 56.9 percent of the farms of

the county. The total expenditure was \$36,389, or an average of \$19.57 a farm. The fertilizer consists of 3-8-3,⁴ 4-8-4, 4-8-6, 4-10-4, and 4-10-6 ready-mixed fertilizer or home-mixed fertilizer analyzing about the same as the commercial mixtures. In addition to these fertilizers, many farmers apply nitrate of soda or sulfate of ammonia as a top dressing. All available barnyard manure is applied to the land. On some farms soil fertility is increased by growing and turning under leguminous crops.

Farm labor is plentiful, and wages are reasonable. Most of the laborers are white, as there are very few Negroes in the county. The number of farms on which labor is hired is comparatively small. In 1929, 704 farms, or 21.5 percent of all farms, reported the hire of labor. The total wages amounted to \$32,946, or an average of \$46.80 a farm reporting. Most of the laborers are hired by the day.

There were 1,624 farmers who reported buying feed in 1929, at a total cost of \$155,046, or an average of \$95.47 a farm reporting. The large quantity of feed purchased is due to the large number of cattle that are carried through the winter. The acreage of suitable land available for growing hay and corn is insufficient to produce the feed required.

The 1935 census reported a total of 4,195 farms in the county, with an average size of 52.8 acres. The farms in general range in size from 20 to 400 acres, but some are larger and others are smaller. The average value of land and buildings was \$1,245 a farm, or \$23.58 an acre. Of the 4,195 farms in the county in 1934, full owners operated 2,141, part owners 403, managers 4, tenants 1,647, and sharecroppers 581. Practically all of the tenant farms were operated on the share-crop basis, by which the landlord receives one-third or one-half of the crop, according to the amount of materials furnished by him.

On the owner-operated farms most of the houses are substantial buildings without electric lights or running water and in general are in a fair state of repair. Most of the tenant houses are small and in need of repair. Many of the farmhouses in the more isolated mountainous sections are small log cabins and in need of repair; in fact many of them are not fit for human habitation. The barns on nearly all of the farms are small but are large enough to care for most of the livestock and to house the greater part of the grain and tobacco. Generally, feed is allowed to stay in the field in stacks until needed for use.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are

⁴ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

noted. The reaction of the soil ⁵ and its content of lime and salts are determined by simple tests.⁶ Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis on those features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as coastal beach or bare rocky mountainsides, that have no true soil, are called (4) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics, the same natural drainage conditions, and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Hayesville, Porter, and Holston are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Hayesville loam and Hayesville clay loam are soil types within the Hayesville series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, certain areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

⁵ The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

⁶ The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strong alkaline reaction.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape.

SOILS

The soils of Madison County are varied in color, texture, structure, and consistence in both the surface soil and the subsoil. Bodies of soils range in extent from small and scattered ones of only a few acres to large and continuous ones of several square miles. The surface soils range in color from red and gray to black and in texture from loam to clay loam; the subsoils range from red rather heavy clay to yellow and brown friable clay and clay loam. Several distinct rock formations, which differ in their mineral composition, occur in the county. Most of the soils are developed directly from the decomposed material of the underlying rock formations, and the diversity of the soils is due to some extent to differences in these soil-forming materials.

Many of the soils, particularly the Porters and Ashe soils, are inherently fertile, as compared with many soils in North Carolina, and they have excellent physical properties; but their steep slope bars them from general use. They are much better suited to the growing of bluegrass, timothy, and clover than are the Hayesville and Halewood soils in the intermountain areas.

Geologically, Madison County is divided into two areas.

The larger and more important area comprises the eastern, northern, and southern parts of the county. This area is composed of Carolina and Roan gneisses and Cranberry and Max Patch granites. Through the soil-forming processes, materials of these formations have been converted into a large area of soils characterized by the development of profiles nearly normal for the region. These rocks have a high content of potash; and, as would be expected, the subsoils are relatively high in potash, in contrast to the subsoils of the Ramsey and Muskingum soils, which are developed from slates, shales, and sandstones. The soils derived from these granites and gneisses have been classed in the Hayesville, Halewood, Porters, and Ashe series, based on the color, texture, and consistence of the soil as a whole but more particularly of the subsoil.

The Hayesville soils have dominantly light-brown or reddish-brown surface soils and red rather heavy but moderately friable clay subsoils.

The Halewood soils differ from the Hayesville in having lighter colored surface soils and yellowish-brown or brownish-yellow friable clay or heavy sandy clay subsoils. These soils are developed mainly in the intermountain areas and on the lower slopes.

The characteristic features of the Porters soils are the dominantly brown color of the surface soils and the yellowish-brown or reddish-brown color and friable consistence of the subsoils. They occupy large areas and generally occur at an elevation ranging from 2,000 to 4,000 feet above sea level, although in some places they are at higher elevations.

The Ashe soils differ from the Porters in having lighter colored surface soils and subsoils, the latter being yellow or brownish yellow. Generally, in forested areas a rather thick mat of leafmold covers the surface. These soils occur on the highest positions in the county, ranging in elevation from 3,000 to 6,000 feet above sea level. The climate is cooler, the growing season is shorter, and locally the rainfall is heavier on the Ashe soils than on any other soils in the county. These conditions may account for the fact that the Ashe soils are especially well suited to pasture grasses.

The rock formations in the west-central part, or second geological area, of the county consist of shales, slates, and quartzites, with lenses of limestone. The soil-forming processes have given rise to a group of soils different in color, texture, and mineral content from those soils derived from gneiss, schist, and granites. These soils have not developed a profile approximating in any respect the normal profile of the region. They are relatively infertile. The rocks that gave rise to these soils represent reworked material deposited by water. This material later was metamorphosed and formed the existing rocks. At the time these rocks were being reworked by water, most of the plant nutrients were lost by leaching and other processes; therefore the rocks form soils low in plant nutrients. From the weathered products of these geological formations the Ramsey, Muskingum, and Lehew soils have been formed.

The Ramsey soils are characterized by their shallowness and the absence of the second layer or subsoil. In other words, the light-yellow or grayish-yellow surface layer rests directly on the parent rock. The Muskingum soils have brown or grayish-brown friable loam surface soils and brown or grayish-brown sandy clay or clay loam subsoils. The soil profile is very shallow. Indian-red or purplish-brown silty clay subsoils, grading into the purplish-brown shales below, distinguish the Lehew soils.

Small areas of soils have developed on terraces along Sandymush, Walnut, California, and Spring Creeks and the French Broad River. These soils have been formed from material brought down by the streams and deposited at times of their overflow. They include members of the State series, which have a brown sandy clay subsoil, and members of the Holston series, which have a yellow slightly compact fine sandy clay subsoil.

Soils of the Congaree and Toxaway series and alluvial soils, undifferentiated, are developed from recent deposits of alluvium on first bottoms along the streams. The Pope series is similar to the Congaree except that the soil material has been washed from soils of the uplands, derived from shales and quartzites. The Congaree soils are composed of brown soils containing large quantities of silt and sand. Black surface soils and bluish-black silty clay subsoils are distinctive features of the Toxaway soils.

All the soils of the uplands except the Porters and Ashe are deficient in organic matter. These soils are developed at high elevations, which affect the climate, and under a forest cover where conditions favored the accumulation of a large quantity of decaying vegetable matter. In forested areas a small quantity of organic matter is present in the topmost 1 or 2 inches of surface soil, and a thin covering of leafmold is on the surface; but this material has

not become incorporated with the soil. When the land is cleared and farmed, the supply of organic matter soon disappears.

Sheet erosion and gullying have been active since the soils were first cleared of their virgin forest and farmed. Many areas of once tillable soil became so severely eroded and gullied, through mismanagement, that they had to be taken out of cultivation; and at present a large acreage of such land is covered with pine and small locust trees. When these fields became unfit for crops, new fields were brought under cultivation and the old ones abandoned to erosion. Before natural reforestation could make headway, gullies had mutilated or practically destroyed many of these areas. Severely gullied land has been lost to the farmer indefinitely, even for forest purposes, as the trees that generally come in on such land are stunted and of very poor quality. Much of this eroded land was of such character, either steeply sloping, unproductive, or both, that it should never have been cleared. Although erosion following clearing has injured it, the land was not good agricultural land in the first place.

Erosion is still very active on sloping soils under clean cultivation in the eastern part of the county, especially near Walnut, Marshall, and Mars Hill. Overgrazed areas also have suffered considerable erosion. Erosion is most noticeable on the Hayesville and Halewood soils and is least noticeable on the Porters and Ashe soils on similar slope and under the same cultural treatment. The latter soils are friable throughout, readily absorb the rainfall, and thus suffer less run-off and erosion than do the former soils.

Owing to loss of fertility in the surface soil through leaching, acid condition, lack of permanent supply of organic matter, and losses through erosion, the farmer is constantly confronted with the problem of managing his land so as to achieve not only the maintenance of soil productivity but also soil improvement. Erosion has been greatly stimulated in many places by decreases in fertility and consequently weaker plant growth.

A more or less close relationship is evident between the soil type and the crops grown. Particularly is this applicable to potatoes and cabbage, as these crops are grown mainly on the Ashe soils. Although tobacco is grown on almost every soil type, different yields and different grades are obtained on the different soil types. Corn, wheat, tobacco, and hay—the leading crops in acreage—are produced in the eastern part of the county, where the relief, or lay of the land, and the soils are most favorable. Halewood loam, Hayesville loam, Hayesville clay loam, Porters loam, State loam, Holston fine sandy loam, Congaree silt loam, Congaree loamy fine sand, and alluvial soils, undifferentiated, which dominate the agriculture of the county, produce the greater part of these crops.

Intertilled crops are grown on the fertile soils where the relief is suitable. The steeper lands are generally used for pasture. Where the farm consists of both steep and smooth land, this usage will prove very satisfactory, and soil erosion will be checked to some extent. Many of the more prosperous farmers own two farms—one in the mountains, for pasture, and the other in the eastern part of the county, where they produce the corn and hay and keep the cattle during the winter. Many others, who are not able to own two farms,

lease pasture in the mountains and pay a cash rental per head of livestock to keep the livestock in that section.

Corn is grown on every arable soil type in the county. The soils that produce the highest yields of corn are inextensive, and a large part of the crop is produced on such extensive but less adapted soils as Porters loam and Halewood loam, which occur in the mountains. These soils have a comparatively high content of organic matter, have a favorable moisture content, and generally produce fair yields of corn without fertilizer. Nevertheless an application of fertilizer increases the acre yields and also lowers the cost of production per bushel; and the steep slope necessitates careful management to prevent loss of soil.

A large part of the wheat produced is grown on Halewood loam; Hayesville clay loam; alluvial soils, undifferentiated; State loam; and Holston fine sandy loam. These are the heavier textured soils with the smoothest surfaces, and they are, therefore, best suited for the production of wheat.

As all soils and land characteristics do not bear equal relationships to productivity, workability, and adapted use of the land, the soils of this county are grouped, for convenience in discussion, largely on the basis of characteristics most significant to plant production. These characteristics are moisture conditions, texture, extent of erosion, slope, color, natural fertility (including the quantity and character of organic matter), stoniness, consistence, and permeability. It is worthy of emphasis in this connection that however significant the mere presence or absence of one or more of these characteristics may be, the degree of their development is even more significant. Also, the significance of a difference in any one characteristic depends on the other characteristics of the soil.

The soils of the county are grouped into six groups as follows: (1) First-class soils, (2) Second-class soils, (3) Third-class soils, (4) Fourth-class soils, (5) Fifth-class soils, and (6) miscellaneous land types, not suited for crops or pasture and of limited use for forest. The first three classes may, perhaps, be considered three classes of cropland. It is conceded, however, that if the first three classes are called cropland, they are also adapted to both pasture and forest purposes so far as the soil itself is concerned. Similarly, the Fourth-class soils may be considered essentially as land best adapted, under existing conditions, to pasture, and the Fifth-class soils to be best used for forest, although the Fourth-class soils are productive of trees as well as grasses. It is to be realized, of course, that exceptions exist.

Soils constituting the cropland of the first three classes may be characterized by injurious features, such as stoniness, erosion, slope, shallowness to consolidated bedrock, natural poverty in plant nutrients, impaired moisture conditions, and a slowly pervious subsoil, and still be a member of the cropland group, provided none of these injurious characteristics is developed to the extreme. On the other hand, the soil may be characterized by only one of these unfavorable features and be disqualified for cropland, provided the unfavorable feature is developed to the extreme.

Although there are limits beyond which development of injurious soil and land features cannot be allowed in soils classed as cropland,

nevertheless considerable range in the degree of their development must be allowed. Furthermore, the number of such injurious features characterizing one of the cropland soils may be none or any number up to seven or eight. The use capabilities of each soil are limited by the number, kind, and degree of development of such injurious features. There is, therefore, a considerable variation between the soils making up the cropland, or first, second, and third class; pasture land, or fourth class; and forest land, or fifth class.

The class or group into which any soil is placed is determined by the degree of its productivity and its adaptation to the important prevailing staple crops of the general region.

In the following pages the soils are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Madison County, N. C.*

Soil type	Acres	Per- cent	Soil type	Acres	Per- cent
Congaree silt loam.....	448	0.2	Hayesville clay loam, gullied steep phase.....	5,056	1.8
Porters loam, slope phase.....	320	.1	Porters loam, very steep phase.....	24,064	8.4
State loam.....	576	.2	Porters stony loam.....	1,216	.4
State loam, slope phase.....	256	.1	Porters stony loam, very steep phase.....	1,344	.5
Hayesville loam.....	448	.2	Muskingum loam.....	2,368	.8
Hayesville clay loam.....	256	.1	Muskingum loam, very steep phase.....	1,344	.5
Holston fine sandy loam.....	704	.2	Muskingum fine sandy loam.....	1,152	.4
Toxaway silt loam.....	128	(¹)	Ramsey loam.....	5,056	1.8
Pope fine sandy loam.....	256	.1	Ramsey loam, very steep phase.....	2,816	1.0
Alluvial soils, undifferentiated.....	3,840	1.3	Halewood loam, very steep phase.....	11,584	4.0
Halewood loam, slope phase.....	3,776	1.3	Ashe loam, very steep phase.....	6,656	2.3
Congaree loamy fine sand.....	768	.3	Ashe stony loam.....	960	.3
Porters loam, hill phase.....	2,112	.7	Ashe stony loam, very steep phase.....	1,216	.4
Holston fine sandy loam, slope phase.....	1,152	.4	Lehew silt loam.....	448	.2
Ashe loam, hill phase.....	1,844	.5	Rough gullied land (Hayesville soil material).....	64	(¹)
Halewood loam, hill phase.....	7,936	2.8	Rough stony land (Porters soil material).....	27,072	9.4
Hayesville clay loam, hilly phase.....	4,672	1.6	Rough stony land (Ramsey soil material).....	43,456	15.1
Hayesville clay loam, eroded steep phase.....	3,200	1.1	Rock outcrop.....	64	(¹)
Porters loam.....	24,064	8.4	Riverwash.....	64	(¹)
Halewood loam.....	76,416	26.5	Total.....	288,000	-----
Ashe loam.....	16,704	5.8			
Stony colluvium (Porters soil material).....	1,920	.6			
Ramsey loam, hill phase.....	384	.1			
Muskingum loam, hill phase.....	320	.1			

¹ Less than 0.1 percent.

FIRST-CLASS SOILS

First-class soils include Congaree silt loam; Porters loam, slope phase; State loam; State loam, slope phase; and Hayesville loam. These soils occur in almost level to gently sloping areas not exceeding a 15-percent slope. They are naturally well drained, although the Congaree soils are subject to occasional overflow.

These soils are dominantly brown loams and silt loams and have a mellow, friable consistence. The subsoils are mainly friable clay loams or heavy silt loams of a brown, red-brown, yellowish-brown, or gray color. They constitute the best agricultural lands and are the most productive soils in the county. As they occupy the smoothest areas, erosion has affected them very little or not at all. Practically

any type of farm machinery can be used advantageously, but, owing to the fact that only a small area of any of these soils occurs on any one farm, expensive machinery is not warranted.

The soils in this group, with the exception of some areas of Hayesville loam, are developed in small widely scattered areas in various parts of the county. Their total area is only 2,048 acres, or less than 1 percent of the total area of the county. Practically all of these soils are under cultivation, and the remaining parts are in pasture and forest. The principal crop is corn, and some tobacco and wheat are grown. Excellent yields are obtained.

Congaree silt loam.—The 10- to 15-inch surface soil of Congaree silt loam is brown or dark-brown silt loam. The subsoil to a depth of 24 to 40 inches is yellowish-brown silt loam or silty clay loam containing a large quantity of mica flakes. In places the surface soil contains enough organic matter to give it a dark grayish-brown color. Roots can easily penetrate this soil to a depth of several feet. The soil is acid in reaction throughout. The land is level. Included with areas of Congaree silt loam on the map are small areas of Congaree fine sandy loam, Congaree sandy loam, Toxaway silt loam, and some colluvial material, too small to indicate separately.

Small areas of this soil occur along Ivy Creek and some of its tributaries, especially southwest of Paint Fork. Still smaller ones border Bull, Shelton Laurel, and Walnut Creeks. Some small fields bordering minor streams have been practically destroyed by the stream cutting newer, wider channels (pl. 1, A). Like the other soils of this class, Congaree silt loam is inextensive.

This soil is very productive, and it is all under cultivation. About 60 percent is devoted to the production of corn, 3 percent to tobacco, 15 percent to wheat, and 22 percent to other crops. Corn yields from 30 to 60 bushels an acre when the land is fertilized with 200 pounds of superphosphate. Tobacco yields from 800 to 1,400 pounds an acre (pl. 1, B) when the land is fertilized with a mixture of 3-8-5 at the rate of 400 to 600 pounds an acre. Wheat yields from 8 to 20 bushels without fertilizer.

Where this soil is well developed it is probably the most fertile of the first-bottom soils in the mountains. It is well suited to the production of all crops generally grown in this area and produces large yields with the addition of small quantities of fertilizer. Applications of lime every 3 years are beneficial. The general agricultural value of this soil is about the same as that of Porters loam, slope phase; State loam; State loam, slope phase; and Hayesville loam. The presence of small areas of Congaree silt loam on a farm may make possible the use of less productive soils for pasture. The surface of this soil is flat, but, because of the fall of the streams, most of the land is fairly well drained.

Porters loam, slope phase.—The soil profile of Porters loam, slope phase, differs from Porters loam mainly in that the subsoil is deeper over bedrock and slightly heavier textured. The essential difference, however, is that the gradient of the slope phase is from 7 to 15 percent, whereas that of the typical soil is from 40 to 60 percent. The surface soil is brown or dark-brown mellow loam from 8 to 15 inches

thick, and the subsoil is yellowish-brown or reddish-brown friable clay, which extends to a depth ranging from 1 to 4 feet.

This soil occurs at the foot of the slopes in close association with Porters loam and with Porters loam, hill phase. Only a very small area is mapped, chiefly along Paint and Terris Forks in the extreme southeastern part of the county. About one-half of this soil is in cultivation, and the other half is in pasture. Of the cultivated land, 80 percent is devoted to corn, 10 percent to tobacco, and 10 percent to other crops. Corn yields from 40 to 50 bushels an acre without the use of fertilizers. Tobacco yields from 800 to 1,400 pounds when the land receives from 300 to 500 pounds of 3-8-5, 4-8-6, 4-10-4, or 4-10-6 fertilizer. All this soil can be tilled easily, and it is naturally well drained.

This soil is as productive as any in the county. Owing to the smoother surface and less erodibility, this soil has a greater agricultural value than Porters loam or Porters loam, hill phase. Good yields usually are obtained when small quantities of fertilizer are applied. Under proper management, cultivation can be continued for a long period without serious loss of surface soil. The general agricultural rating is the same as that of State loam; State loam, slope phase; Congaree silt loam; and Hayesville loam. Both external and internal drainage are good.

State loam.—The 8- to 16-inch surface soil of State loam is brown mellow loam. The subsoil is yellowish-brown friable silty clay loam or friable clay, which extends to a depth ranging from 30 to 45 inches. The subsoil is underlain by yellowish-brown, mottled with rust brown and specked with black, friable micaceous clay. This soil is acid throughout. Roots readily penetrate the entire soil. A few areas of State sandy loam are included with this soil in mapping.

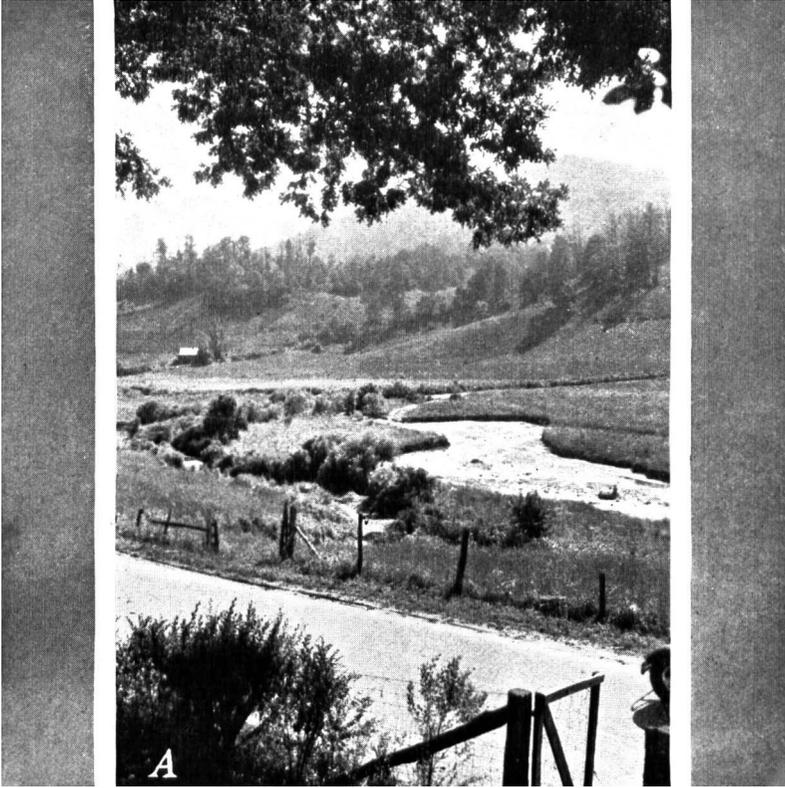
The principal bodies occur along Spring Creek near Meadows Store and at Hot Springs. Smaller ones border Little Sandymush Creek, Middle Fork of Little Ivy Creek, and Shelton Laurel Creek. A body lies along a short unnamed stream in the vicinity of Chestnut Hill Church south of Big Laurel. Their total area is small.

All this land is under cultivation. About 65 percent is devoted to the production of corn, 5 percent to tobacco, 10 percent to wheat, and 20 percent to other crops. Corn yields from 30 to 70 bushels an acre with light applications of fertilizer. Tobacco yields from 800 to 1,600 pounds when the land is fertilized with 200 to 600 pounds to the acre of 3-8-5, 4-8-6, or 4-10-6 fertilizer. Following tobacco, wheat yields from 15 to 30 bushels an acre without the use of fertilizer.

As this is considered the best farming land in the county, its agricultural value is high. Both internal and external drainage are good. The surface is smooth and the land is not subject to serious erosion. The slope ranges from $2\frac{1}{2}$ to 7 percent. Good yields of all the crops commonly grown are obtained without the use of large quantities of fertilizer. This soil is easy to manage and is free of stones.

State loam, slope phase.—The slope phase differs from typical State loam mainly in relief, as the gradient of the latter ranges from $2\frac{1}{2}$ to $7\frac{1}{2}$ percent and the gradient of the former from about $7\frac{1}{2}$ to 15 percent. A few very small areas are slightly steeper.

This soil occurs in close association with State loam and the Congaree soils. Fair-sized isolated bodies also border Walnut, Bull, and



A, Congaree silt loam in a field of originally good bottom land, now practically destroyed because the stream has left its former deep, narrow channel and cut a new, wide, shallow channel. *B*, Tobacco on Congaree silt loam.

California Creeks and their short tributaries. Its total area is even smaller than that of the typical soil. Practically all of this land is cultivated, and the same crops are grown, the same fertilizers used, and the same yields obtained as on the typical soil.

Compared with the typical soil the slightly steeper slope of this soil increases its susceptibility to erosion, but the general agricultural values of these two soils are about the same. Drainage is good throughout the soil. Some care must be exercised in managing it in order to prevent sheet erosion.

Hayesville loam.—Although the acreage of Hayesville loam is comparatively small, this soil is considered very important agriculturally. It occupies favorable relief for farming, with a slope ranging from $7\frac{1}{2}$ to about 15 percent, and is among the most productive soils in the intermountain areas.

In virgin areas the 4- to 6-inch surface soil of Hayesville loam is light-gray loam or fine sandy loam. A very thin layer of leafmold covers the surface. A layer of reddish-yellow clay loam, about 2 inches thick, intervenes between the surface soil and the subsoil. This layer generally disappears in cultivated fields, as it mixes with the surface soil, making it yellowish gray or grayish brown. The subsoil is red, light-red, or brownish-red stiff but brittle clay that crushes between the fingers into a granular friable mass and extends to a depth of about 30 inches. Generally between depths of 30 and 40 inches the material is mottled light-red or yellow friable clay or clay loam. The parent material is disintegrated and partly decomposed Carolina gneiss, Roan gneiss, Cranberry granite, or Max Patch granite. Owing to its heavy texture and its property of swelling when wet, the subsoil does not allow free penetration of rain water.

In some places a few stones occur on the surface and are mixed with the soil. The reaction is acid throughout. In most places roots penetrate the surface soil readily, but the subsoil is not so easily penetrated. In places where some erosion has taken place, the surface soil is shallower than that described above and has a brown or light-red color and a heavier texture.

Practically all of this soil is in the vicinity of Mars Hill, but very small bodies are scattered throughout the eastern part of the county. Their total area is very small.

About 80 percent of this soil is under cultivation; 30 percent of the cultivated land is devoted to tobacco, 40 percent to corn, 20 percent to wheat, and 10 percent to other crops. Cornland is generally fertilized with 100 to 300 pounds of 3-8-3 or 4-8-4 or with superphosphate, and it returns from 15 to 30 bushels of corn an acre. Where leguminous crops have been turned into the soil as green-manure crops, yields are generally higher. Wheat usually follows tobacco, and the land does not receive additional fertilizer. Yields range from 6 to 15 bushels an acre. Tobacco yields from 600 to 1,200 pounds an acre when the land is fertilized with 400 to 600 pounds to the acre of 4-8-4 or 3-8-5 fertilizer.

This land has favorable relief for farming and is considered good land for the production of all the crops commonly grown in this county. It is subject to serious loss of surface soil, however, when devoted to clean-cultivated crops without proper precautions. Such

precautions include the addition of organic matter, carefully planned rotations, and terraces, supplemented with properly fertilized strips of close-growing crops above and below the terraces. Both internal and external drainage are good. Hayesville loam can be built up to a fairly high state of productivity and this easily maintained by the growing and turning under of leguminous crops and by the application of lime and superphosphate.

SECOND-CLASS SOILS

Hayesville clay loam; Holston fine sandy loam; Toxaway silt loam; Pope fine sandy loam; alluvial soils, undifferentiated; and Halewood loam, slope phase, are all Second-class soils. Their total area is 8,960 acres, or 3 percent of the area of the county. About 50 percent of the land is under cultivation, 30 percent in pasture, and 20 percent in forest.

The soils in this group differ widely in color and structure because of differences in origin. They range from black soils and soils of variable texture in the first bottoms to soils with gray or brown loam surface soils and red clay loam or clay subsoils on the sloping areas. They all are naturally well drained, except Toxaway silt loam and alluvial soils, undifferentiated. Considered as a whole, they do not have so smooth a surface as the soils of the first class, and some sheet erosion and a very few shallow gullies are noticeable. Care must be given in the cultural practices on the soils on the slopes, in order to check erosion and to hold the surface soil.

Most of these soils occur in the intermountain areas, where the individual bodies range in size from a few to several acres. They are not quite so productive or desirable for general farming as the soils of the first class. A large proportion of them can be cultivated, and practically all of the rest could be used advantageously for pasture grasses if limed, given a liberal application of superphosphate every year, and properly seeded.

Hayesville clay loam.—The surface soil of Hayesville clay loam is reddish-brown or red clay loam, from 4 to 7 inches thick. The subsoil, which extends to a depth ranging from 24 to 35 inches, is red or reddish-brown heavy stiff brittle clay that can be crushed into a friable mass by pressure between the fingers. Underlying the subsoil are soft disintegrated and partly decomposed acid igneous rocks, from which it is developed. Included with this soil are small areas of Rabun clay loam. This inclusion has a reddish-brown clay loam surface soil and a dark-red clay subsoil. It is developed from parent material derived from dark-colored igneous rocks, chiefly diorite and gabbro. The subsoil of Hayesville clay loam has a large content of finely divided mica flakes. In places a few pieces of quartz gravel are mixed with the soil. The surface soil is easily penetrated by roots, but the subsoil is more compact. The reaction is acid throughout. Before this soil was cleared and put into cultivation, it probably had a surface similar to that of Hayesville loam. Accelerated erosion has removed part of the surface soil, and cultivation has mixed the rest with some subsoil material, giving it a clay loam texture.

This soil occurs in the vicinity of Mars Hill and on slopes to streams and on low ridges elsewhere in the eastern part of the county. Only a small total area is mapped.

Practically all of this land is in cultivation, about 50 percent being devoted to the production of corn, 15 percent to wheat, 20 percent to tobacco, and 15 percent to other crops. Corn yields from 15 to 35 bushels an acre when the land is fertilized with 100 to 300 pounds to the acre of 3-8-3 or with superphosphate. Wheat generally follows tobacco and yields from 7 to 17 bushels an acre without the use of fertilizer. Tobacco yields from 600 to 1,000 pounds an acre when the land receives from 200 to 600 pounds to the acre of 3-8-3, 4-8-6, or 4-10-6 fertilizer.

This is very productive land, which, with proper fertilization, is capable of producing large yields of most crops commonly grown. Because of its smooth surface, it is not so erodible as the Hayesville soils that have a steeper slope. If this soil is adequately terraced and strip cropped, clean-cultivated crops can be grown for a long time without further serious loss of surface soil. This soil clods readily if not plowed under the proper moisture conditions. The addition of lime should prove beneficial in most places. Plowing under leguminous crops not only adds much-needed humus to the soil but also increases the water-holding capacity. Both internal and external drainage are good.

Holston fine sandy loam.—The 6-inch surface soil of Holston fine sandy loam is light-gray or grayish-yellow fine sandy loam. Below this is a layer, about 5 inches thick, of pale-yellow friable fine sandy loam. The subsoil, extending to a depth ranging from 22 to 34 inches, is a yellow friable but slightly compact fine sandy clay. Below this is reddish-brown, mottled with yellow and in some places gray, compact but brittle fine sandy clay. The surface soil is very low in organic matter and is thoroughly leached. Some areas have a large number of rounded pieces of gravel and rounded stones on the surface and mixed throughout the soil. The entire soil is acid in reaction. Roots do not readily penetrate the subsoil.

Included with this soil are bodies that would be mapped as Warne silt loam, Altavista fine sandy loam, and Jefferson fine sandy loam if their area were larger. Warne silt loam has a gray or grayish-brown silt loam surface soil, a yellow stiff brittle clay or sandy clay subsoil, and a hardpan layer from 24 to 30 inches below the surface. The soil occurs at Beech Glen on Little Ivy Creek, at Spring Creek School, and at Hot Springs. The surface soil of the included Altavista fine sandy loam is gray or grayish yellow, and the subsoil is yellow heavy fine sandy clay. The one area mapped occurs near Crossrock Church on Little Sandymush Creek. Jefferson fine sandy loam has a light-gray or brown surface soil and a grayish-yellow or pale-yellow friable fine sandy clay subsoil containing many fragments of sandstone and shale. This soil is colluvial material from the surrounding slopes of shale and sandstone soils. It occurs southwest of Hot Springs where Bear and Little Bottom Branches flow into Spring Creek, and along the French Broad River about 1 mile northwest of Hot Springs.

Typical Holston fine sandy loam lies chiefly between Hot Springs and Paint Rock on both sides of the French Broad River. It is not extensive.

About 150 acres of this land are cultivated. Of the cultivated land, about 60 percent is devoted to the production of corn, 5 percent to tobacco, 10 percent to wheat, and 25 percent to other crops. Corn yields from 7 to 12 bushels an acre without fertilizer and from 20 to

35 bushels where the land is fertilized. Tobacco yields from 500 to 1,000 pounds an acre where the land receives from 200 to 600 pounds to the acre of 3-8-3, 4-8-6, or 4-10-6 fertilizer. Wheat following tobacco yields from 6 to 15 bushels without additional fertilizer.

Holston fine sandy loam is developed on old terraces, some of which lie from 100 to 200 feet above stream level. With a slope ranging from 2½ to 7½ percent, this soil has favorable relief for farming, although it is subject to serious loss of surface soil unless it is carefully managed. Practically all of this land is low in organic matter, but this material can be supplied by turning under leguminous crops. The addition of organic matter increases the water-holding capacity and thus helps check further loss of surface soil. Despite its low inherent fertility, this soil produces good yields under proper management, as it responds readily to fertilization and incorporation of organic matter. Its agricultural value is the same as that of Halewood loam, slope phase, and other soils in the second class. Both internal and external drainage are good.

Toxaway silt loam.—The surface soil of Toxaway silt loam to a depth of 10 to 15 inches is dark-gray or black mellow silt loam containing a large quantity of organic matter. This grades into black or bluish-black, specked with brown, silt loam or silty clay loam, which continues to a depth of about 3 feet. Below this is yellowish-gray or mottled gray and brown sticky silty clay. Finely divided mica flakes occur in the subsoil. This soil is strongly acid in reaction. Roots penetrate to the water table.

This soil occurs in the first bottom along some of the streams and is subject to overflow. Only a very small total area is mapped. The land is used for the production of corn and for pasturage. Corn generally is not fertilized and produces from 40 to 70 bushels an acre in dry seasons, but in undrained areas or in wet seasons yields become almost negligible.

Where well drained, this is a good soil for the production of corn and soybeans. As it is very acid in reaction, applications of lime prove beneficial. The well-drained areas have nearly the same agricultural value as Congaree silt loam; Porters loam, slope phase; State loam; State loam, slope phase, and Hayesville loam; and the poorly drained areas are generally used for pasture land. This soil for the most part is poorly drained, and drainage ditches are necessary in most places where it is to be cultivated. Toxaway silt loam is suited to the growing of corn, hay crops, potatoes, cabbage, and celery.

Pope fine sandy loam.—The 8- to 14-inch surface soil of Pope fine sandy loam is light-gray or brown friable fine sandy loam. The subsoil is brown or yellowish-brown fine sandy loam or fine sandy clay to a depth of 30 to 40 inches. Underlying this is mottled light-brown and gray sandy or gravelly material. Many sandstone fragments rounded by stream action are on the surface and mixed with the soil. The reaction is acid throughout. Roots penetrate to great depths. This soil is formed from material washed from the Muskingum and Ramsey soils and deposited as first bottoms along the streams.

Only a very small area is mapped, chiefly along small tributaries of the French Broad River between Hot Springs and Paint Rock, and

along other small streams of the sandstone and shale area. This first-bottom land is flat to undulating. Practically all of it is cultivated to corn or is in pasture. The difference between this soil and Congaree silt loam is that the Pope soil is formed from material washed from soils on slopes underlain by shale and sandstone, and the Congaree soil is formed from material washed from soils underlain by crystalline rocks. The former material, being low in plant nutrients, gives rise to a soil of only moderate productivity; whereas the Congaree material, being washed from more fertile soils, gives rise to a more productive soil. Nevertheless, Pope fine sandy loam is a desirable agricultural soil. It has good drainage for a soil developed in the first bottoms, and good yields of corn are obtained when a small quantity of fertilizer is used.

Alluvial soils, undifferentiated.—This classification represents a soil complex rather than a soil type. The color of the surface soil is gray, dark gray, brown, or black; and the texture is loam, fine sand, sand, or sandy loam. Brown, grayish-brown, or black sandy clay, sand, or silt loam makes up the subsoil. The thickness of both the surface soil and the subsoil varies considerably. Most of this land consists of Congaree soil material, but a few small areas of poorly developed Toxaway soils are included. The surface soil may change several times within a year, owing to the deposition or removal of material at each inundation. This soil is acid in reaction throughout. In places rounded pieces of quartz gravel are on the surface and mixed with the soil.

A fairly large area of this soil is mapped in the first bottoms of streams throughout the county. Drainage is good to fair for its position on the first bottoms, but it is everywhere subject to overflow during freshets.

Practically all of this land is under cultivation. About 75 percent is devoted to the production of corn, 5 percent to wheat, and 20 percent to other crops. Corn yields from 30 to 40 bushels an acre with the use of a small quantity of fertilizer. Wheat following tobacco yields about 15 bushels an acre without additional fertilizer. A small acreage is used for the production of tobacco; and, when the land receives 400 pounds to the acre of 3-8-5 fertilizer, tobacco yields from 700 to 1,400 pounds an acre. Cabbage, potatoes, beans, corn, and root crops give good yields.

Most of this land is deficient in organic matter, and this can be supplied by turning under leguminous crops. The addition of lime, where it has not been used for the last 3 years, proves very beneficial. The general agricultural value of this soil is about the same as that of the other soils in this class.

Halewood loam, slope phase.—Halewood loam, slope phase, consists of light-brown, grayish-brown, or grayish-yellow loam to a depth of 5 or 7 inches. It is mellow, friable, and easy to till. The subsoil, which extends to a depth ranging from 30 to 40 inches, is brownish-yellow or yellowish-brown friable clay or heavy sandy clay. This material grades into yellow, red, or brown and gray partly disintegrated soft gneiss, schist, or granite. In wooded areas a shallow layer of leafmold covers the surface, and the first 2 or 3 inches of the soil contain enough organic matter to give it a dark-brown color.

Small areas of a soil mapped as Iredell gravelly loam in other counties of North Carolina are included with Halewood loam, slope

phase, in this county. The Iredell soil has a brownish-gray surface soil and yellowish-brown or brownish-yellow heavy plastic impervious clay subsoil. Below the subsoil is green or greenish-yellow partly decomposed diorite or other basic igneous rock, which grades into the solid bedrock. This inclusion occurs near Pleasant Gap and Beech Glen in the southeastern part of the county.

Halewood loam, slope phase, occurs in close association with Halewood loam, hill phase; Hayesville loam; Hayesville clay loam; and Hayesville clay loam, hilly phase.

Practically all of this land is under cultivation. About 50 percent is devoted to the production of corn, 20 percent to wheat, 15 percent to tobacco, and 15 percent to other crops. Corn yields from 20 to 35 bushels an acre where the land is fertilized with 200 to 300 pounds of a 3-8-3 or 4-8-4 mixture. Wheat usually follows tobacco and yields from 10 to 20 bushels without fertilizer, but a top dressing of 100 pounds of nitrate of soda is applied in spring. Tobacco yields from 600 to 1,100 pounds an acre where the land receives from 400 to 600 pounds to the acre of a 3-8-5, 4-8-6, or 4-10-6 mixture. Garden vegetables do well. This soil would produce good pasture grasses, but it is needed for the production of the staple crops.

Halewood loam, slope phase, has a range in relief of from 7 to 15 percent. It is naturally productive, and the relief is favorable for the production of clean-cultivated crops. As mapped in this county, the degree of erosion ranges from slight to severe. With proper management, however, the less eroded areas can be farmed to all the crops commonly grown, without further serious loss of surface soil. The severely eroded areas can be utilized for the production of close-growing crops. Surface erosion can be controlled by terraces, supplemented with strips of properly fertilized close-growing crops above and below the terraces. The plowing under of leguminous crops improves the water-holding capacity of the soil and thus helps to check further loss of surface soil. The addition of lime is beneficial. The general agricultural value of this soil is the same as that of Hayesville clay loam.

THIRD-CLASS SOILS

The group of Third-class soils includes Congaree loamy fine sand; Porters loam, hill phase; Holston fine sandy loam, slope phase; Ashe loam, hill phase; and Halewood loam, hill phase. These soils comprise an area of 13,312 acres, or 4.7 percent of the total area of the county.

All these soils occur on slopes ranging from about 7 to 30 percent, with the exception of Congaree loamy fine sand, which occupies almost level or undulating land in the first bottoms. All the soils are naturally well drained, and in places run-off is rapid. Where clean cultivation has been practiced continuously, sheet erosion is pronounced, and in places gullies have developed.

Agricultural operations are restricted on the soils of this group, and extreme care as regards terracing, strip cropping, or seeding to pasture grasses in a regular rotation must be exercised if they are to be continued in cultivation without injury to the soil. They are generally less productive, more difficult to handle because of steep slope, more subject to leaching and erosion, and cultivated to less

extent than the soils of the first and second classes. Where the soils are properly managed, however, fair to good yields are obtained, as some of the soils are inherently fertile. More of the steeper areas should be seeded and devoted to pasture. These soils are scattered throughout the intermountain areas. The principal crops are corn, wheat, tobacco, and hay.

Congaree loamy fine sand.—Congaree loamy fine sand to a depth of 24 to 40 inches is brown loose loamy fine sand. This is underlain by light loamy sand or fine sandy clay, generally mottled gray, yellow, and rust brown. This soil is acid in reaction throughout. Roots penetrate to a reasonable depth. Some areas are only a few feet above the level of streams and are subject to frequent inundation, whereas other areas are several feet above the normal water level of streams and are subject to inundation only when the streams are at high flood stage.

This soil occurs as narrow strips along the French Broad River and as small islands in the river. Its total area is small. About 300 acres are under cultivation, of which about 85 percent is devoted to the production of corn and 15 percent to other crops. Cornland fertilized with 100 to 300 pounds to the acre of 3-8-3 or with superphosphate produces from 20 to 35 bushels of corn an acre. Garden vegetables and truck crops do well.

Despite the low inherent fertility and the marked deficiency of organic matter of this soil, good yields of the crops most commonly grown can be obtained by plowing under leguminous crops and adding fertilizer. The land is level to slightly undulating. External drainage is good, and internal drainage is good to excessive where the water table is low. This soil warms early and is very easy to till.

Porters loam, hill phase.—Porters loam, hill phase, differs from Porters loam, slope phase, mainly in relief. The slope ranges from 15 to 40 percent, which is greater than the slope of Halewood loam, hill phase, which ranges from 15 to 30 percent. The friable surface soil and subsoil of the Porters soil, however, allow ready absorption of rain water and thus reduce erodibility.

This soil occurs at the foot of the slopes and on the top of the ridges, in close association with Porters loam and Halewood loam.

Of the 2,112 acres of this soil in the county, about 600 acres are in pasture and 300 in forest. The rest is under cultivation. Probably 80 percent of the cultivated land is devoted to the production of corn, 5 percent to tobacco, and 15 percent to other crops. Cornland generally is not fertilized, and it produces from 20 to 40 bushels of corn an acre. Tobacco yields from 700 to 1,200 pounds an acre when the land is fertilized with 300 to 500 pounds to the acre of a 3-8-5, 4-8-6, or 4-10-6 mixture.

This soil has a less steep slope than typical Porters loam and is, therefore, less susceptible to erosion and more valuable agriculturally than the typical soil. It is capable of producing large yields of crops without the addition of large quantities of fertilizer, but if it is continued in cultivation extreme care must be taken to prevent serious loss of surface soil. Close-growing crops should be included in the rotation. This is good land for the production of grasses.

Holston fine sandy loam, slope phase.—This soil differs from typical Holston fine sandy loam mainly in relief, as the gradient ranges

from 7½ percent to 30 percent. Included with this soil are a few areas of Warne silt loam, Altavista fine sandy loam, and Jefferson fine sandy loam located down and across the river from Hot Springs. Several areas occur along Spring Creek. The descriptions of these included soils are given under the description of Holston fine sandy loam (page 21).

Areas of this soil occur chiefly between Hot Springs and the North Carolina-Tennessee State line, west of Antioch Church, and between Hot Springs and Paint Rock. Smaller areas border Shelton Laurel Creek and its tributaries. The total area is not large.

Surface and internal drainage are good. The soil warms early in spring and is easy to manage under a wide range of moisture conditions. The more gently sloping areas can be handled easily with improved machinery. Although this soil responds to the incorporation of organic matter and to the addition of commercial fertilizer, it is difficult to maintain in a high state of productivity.

The crops grown and the fertilizer used are practically the same as for Holston fine sandy loam, but yields are slightly less. Owing to the sloping and hilly relief, this soil is more susceptible to erosion than typical Holston fine sandy loam; and if the soil is cultivated the rotation should include close-growing crops, as these would help to check further loss of surface soil. The addition of organic matter would prove very beneficial.

Ashe loam, hill phase.—Ashe loam, hill phase, has a 6- to 10-inch surface soil of yellowish-gray or light-gray mellow loam. The subsoil of deep-yellow or brownish-yellow friable crumbly clay continues to a depth ranging from 24 to 36 inches. It grades into very light or almost white soft partly decomposed granite, which in places extends downward several feet before the solid bedrock is reached. In wooded areas a mat of organic matter covers the surface, and enough finely divided organic matter occurs in the first 2 to 4 inches of the soil to give the material a dark-gray color. A few fragments of granite or gneiss are present on the surface in some places, and here and there soft granite lies near the surface. Both the surface soil and the subsoil are strongly acid.

Areas occur in the southwestern part of the county on Max Patch Mountain and Mikes Knob and in the northeastern part along the Madison-Unicoi County line. They do not cover a large total area.

About 400 acres of this land are under cultivation, and the rest is in pasture. About 75 percent of the cultivated land is devoted to the production of corn and about 25 percent to truck and other crops. Corn yields from 20 to 40 bushels an acre without the use of fertilizer. The chief truck crops are potatoes, beans, and cabbage. Its high elevation limits the agricultural use of this soil, although it has greater agricultural value than typical Ashe loam. It is especially suited to the production of potatoes, cabbage, beans, and grasses, but, because of its hilly relief, it should not be farmed continuously to clean-cultivated crops, as serious loss of surface soil through sheet erosion will result. It is probably suited to close-growing crops. Excellent pasture grasses can be obtained by the addition of lime and superphosphate. Both external and internal drainage are good to excessive.

Halewood loam, hill phase.—Halewood loam, hill phase, differs from Halewood loam mainly in having a more gentle relief. Its slope ranges from 15 to 30 percent, whereas that of the typical soil ranges from 30 to 60 percent. Soil profile characteristics are practically the same for both soils. Small areas of soil, mapped as Iredell gravelly loam in other counties, are included on the map. This inclusion has a brownish-gray surface soil and yellowish-brown or brownish-yellow heavy plastic impervious clay subsoil. Below the subsoil is green or greenish-yellow partly decomposed diorite or other dark basic rock, which grades into the solid bedrock. Areas of this included soil are near Pleasant Gap and Beech Glen.

Halewood loam, hill phase, occurs in close association with Halewood loam; Halewood loam, slope phase; and Hayesville clay loam, hilly phase. A fairly large area is mapped, chiefly in the southeastern part of the county and in the northwestern part on both sides of Shelton Laurel Creek.

About 60 percent of this land is under cultivation. Of the cultivated land 50 percent is devoted to the production of corn, 20 percent to wheat, 15 percent to tobacco, and 15 percent to other crops. Corn yields from 20 to 35 bushels an acre when the land is fertilized with 200 to 400 pounds to the acre of 3-8-3 or 4-8-4 fertilizer. Wheat usually follows tobacco and yields from 7 to 20 bushels an acre without additional fertilizer. Tobacco yields from 600 to 1,100 pounds an acre when the land receives from 200 to 600 pounds to the acre of 3-8-5, 4-8-6, or 4-10-6 fertilizer.

This soil ranges from virgin to slightly or even severely eroded. The degree of erosion is shown on the map with the proper symbol. The less eroded areas can be used for the production of close-growing crops, and the severely eroded areas should be used for pasture. This is a fairly good soil, but, owing to its hilly relief and susceptibility to erosion, it should not be farmed to clean-cultivated crops. Serious loss of surface soil marks many areas that have been farmed to clean-cultivated crops. The general agricultural value of this soil is the same as that of Porters loam, hill phase. Both internal and external drainage are good.

FOURTH-CLASS SOILS

The Fourth-class soils include Hayesville clay loam, hilly phase; Hayesville clay loam, eroded steep phase; Porters loam; Halewood loam; Ashe loam; stony colluvium (Porters soil material); Ramsey loam, hill phase; and Muskingum loam, hill phase. These soils occupy 127,680 acres, or 44 percent of the total area of the county. They are distributed over all parts.

The hilly phases range in slope from 15 to 30 percent, whereas the typical soils and other phases have a range in slope from 30 to 60 percent. This gives a steep, broken relief, accompanied by a rapid run-off of rain water. Where clean cultivation has been practiced for several years, particularly on the Hayesville soils, much sheet erosion has taken place, and, in addition, many gullies have formed. Owing to the steep slope, only light farming implements can be used. The surface soils are dominantly friable and mellow loam or clay loam, and the subsoils are friable to fairly stiff clay loam or clay. Many of the soils in this group are naturally fertile, whereas others are low in the mineral plant nutrients. Most of these soils

are low in organic matter, especially those areas under cultivation. The reaction is acid.

This land is used in places for general farming, mainly because smoother land is not available. Many of the farmers have no First-, Second-, or Third-class soils and therefore feel the necessity of cultivating these Fourth-class soils on steep slopes and mountainsides despite the difficulties (pl. 2, *A*). Although a considerable acreage of this land is under cultivation, most of it is in either pasture or forest. It is recognized that most of these soils are not suited to clean-cultivated crops but are best adapted to pasture grasses. Where the farmers have enough of the first three classes for their clean-cultivated crops, the soils in this class are used for pasture or are left in forest. The use of lime and superphosphate is strongly recommended for the soils devoted to pasture grasses.

Hayesville clay loam, hilly phase.—Hayesville clay loam, hilly phase, differs from the typical soil mainly in its somewhat steeper slope, which ranges from 15 to 30 percent, whereas the slope of the typical soil ranges from 7½ to 15 percent. Included with this hilly soil are small areas of Rabun clay loam. This soil has a reddish-brown clay loam surface soil and a dark-red heavy clay subsoil. It is developed from dark igneous rocks, chiefly diorite and gabbro.

Hayesville clay loam, hilly phase, occurs in close association with Hayesville clay loam; Hayesville clay loam, eroded steep phase; and Halewood loam, hill phase. About 3,000 acres of the land are under cultivation, chiefly the lower slopes.

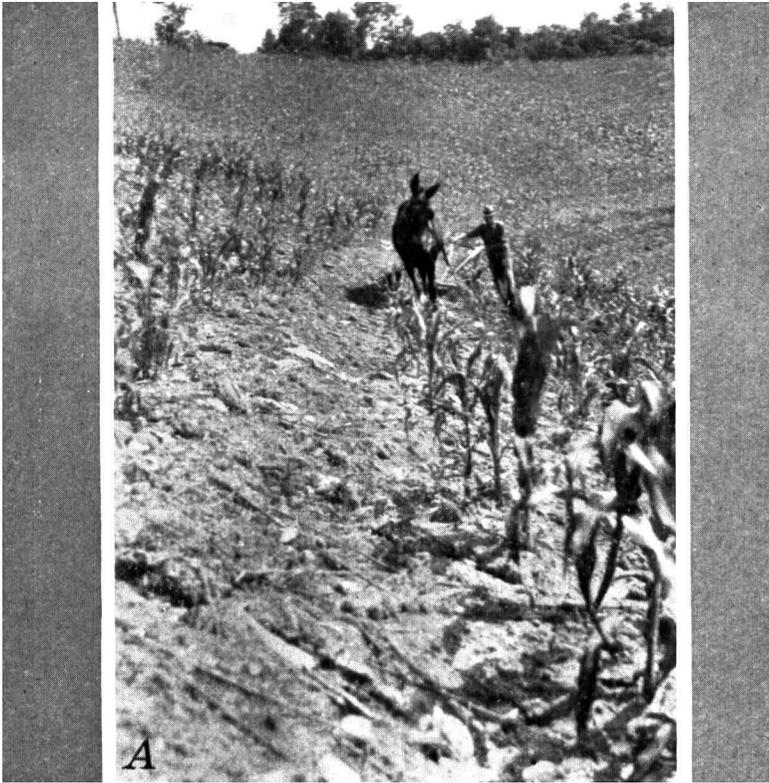
The crops grown and the fertilizer used are about the same as on Hayesville clay loam, but the yields are lower. This is productive land, but because of its hilly relief, serious loss of surface soil, and susceptibility to further erosion, it is probably best suited to pasture. The general agricultural value of this land is the same as that of Porters loam and Halewood loam. Both external and internal drainage are good.

Hayesville clay loam, eroded steep phase.—Hayesville clay loam, eroded steep phase, differs from the typical soil mainly in its considerably steeper slope, which ranges from 30 to 60 percent. Included with this soil are areas of Rabun clay loam, which has a reddish-brown clay loam surface soil and a dark-red heavy clay subsoil. It is formed from dark igneous rocks, chiefly diorite and gabbro.

This soil is closely associated with Hayesville clay loam, hilly phase; Hayesville clay loam, gullied steep phase; and Halewood loam, mainly in the south-central and southeastern parts of the county.

A small part of this soil is in cultivation, and a larger acreage is in pasture, whereas about 70 percent is in forest or is idle. Of the cultivated land, about 60 percent is devoted to the production of corn, 25 percent to wheat, and 15 percent to other crops. Corn yields from 5 to 20 bushels an acre without fertilizer and 15 to 30 bushels an acre when the land receives 100 to 300 pounds an acre of 3-8-3 fertilizer or an application of superphosphate. Wheatland generally receives 100 to 200 pounds of superphosphate to the acre and yields from 7 to 12 bushels of wheat an acre.

Steep relief, loss of most of the surface soil, and susceptibility to further erosion are reasons why this land should not be continued



A, View showing difficulty of contour cultivation on a 30- to 60-percent slope.
B, Strip cropping to hold Halewood loam. Note meadow in center; corn alternating with sod on slope to left; garden alternating with grass and fruit trees on slope to right.

in clean-cultivated crops. Probably the best use for the land is pasture. The general agricultural value of this soil is the same as that of Porters loam, Halewood loam, and Hayesville clay loam, hilly phase. Both internal and external drainage are good. Rain water runs off the eroded or bare surface rapidly. Many gullies have formed, and, unless erosion is checked by grasses or trees, much more soil will be lost.

Porters loam.—Porters loam is an extensive and important agricultural soil. The slope ranges from 40 to more than 60 percent. Although the relief is steep, a large acreage is under cultivation and in pasture. This is probably the most fertile soil in the mountains.

In forested areas either a thin layer of dark-brown highly organic loam or a 2- to 3-inch layer of black leafmold covers the surface. This is underlain to a depth of 6 to 8 inches by brown mellow friable loam containing some organic matter. The subsoil, to a depth ranging from 24 to 40 inches, is brown, yellowish-brown, or reddish-brown friable and crumbly clay loam. Below this is gray and yellow or, in some places, light brownish-yellow soft disintegrated and partly decomposed gneiss, schist, or granite rock. The light-colored soft disintegrated rock occurs in some places and the broken hard rock in others. Both the surface soil and the subsoil are acid in reaction. A few stones are on the surface and, in places, mixed with the soil, but they are not numerous enough to interfere with cultivation or pasture. Roots easily penetrate the surface soil and the subsoil.

Depth to underlying material, thickness of the subsoil, and the color of the soil vary noticeably throughout large areas of Porters loam. A common variation is a light-colored soil that grades into the Ashe soils, and another has a red subsoil resembling that of the Hayesville soils.

Porters loam is closely associated with Porters loam, very steep phase, in large areas in the northeastern part of the county. Smaller areas are on the mountains at the head of Spring Creek and its tributaries, on Doggett Knob, and in the southeastern part.

About 6,500 of the 24,064 acres mapped are in cultivation, 15,000 acres are in pasture, and the rest is in forest.

The principal crops are corn, wheat, and tobacco. Corn yields from 20 to 40 bushels an acre without any fertilizer for the first few years the land is in cultivation, after which the same yields are obtained only with the use of 100 to 300 pounds to the acre of 3-8-3 fertilizer or with superphosphate. No fertilizer is applied for wheat following tobacco, and yields of 5 to 15 bushels an acre are obtained. When wheat does not follow tobacco, a small quantity of fertilizer is applied, and yields are about the same. Tobacco yields from 800 to 1,400 pounds an acre when the land is fertilized with 200 to 600 pounds to the acre of 3-8-5, 4-8-6, or 4-10-6 mixture. About 50 percent of the cultivated land is devoted to corn, 15 percent to wheat, and 35 percent to all other crops.

Porters loam is a fertile soil, but its steep relief subjects it to serious loss of surface soil under continued cultivation. If this land must be cultivated, probably the best method is to have narrow strips of close-growing crops or hay crops intermixed with the cultivated area. This practice retards run-off and thus helps to check surface

erosion. Porters loam furnishes excellent pasture. Both external and internal drainage are good. The soil absorbs a large amount of rain water because of the mellow friable character of both the surface soil and the subsoil and also because the underlying rocks are broken and in places disintegrated to a depth of several feet. Erosion is noticeable in many places, and, if this soil on the steeper slopes is kept in cultivated crops, serious erosion will result and the soil now suited to pasture grasses will be less valuable.

Halewood loam.—The 4- to 7-inch surface soil of Halewood loam is light-brown, grayish-brown, or grayish-yellow loam. In wooded areas a thin layer of leafmold lies on the surface or a small amount of organic matter is mixed with the first few inches of the surface soil. The subsoil, which extends to a depth of 20 to 40 inches, is brownish-yellow or brown clay or heavy sandy clay. Under normal moisture conditions this material is friable and brittle, and when wet it is somewhat plastic. The underlying parent material consists of disintegrated and partly decomposed light- and dark-colored gneisses, schist, and granites, mostly Carolina and Roan gneisses and Cranberry and Max Patch granites. These rocks range in color from light gray to dark gray and are acid igneous rocks. In places a few pieces of quartz gravel are on the surface and mixed with the soil. Roots penetrate readily. This soil is acid in reaction throughout.

Halewood loam occupies interstream areas throughout the eastern part of the county, especially near Marshall, Mars Hill, and Walnut. It is by far the most extensive soil in the county.

About 19,000 acres of this land are under cultivation, and 30,000 acres are in pasture. Perhaps 45 percent of the cultivated land is devoted to corn, 4 percent to tobacco, 16 percent to wheat, and 35 percent to other crops. Corn yields from 15 to 30 bushels an acre when the land receives 100 to 400 pounds to the acre of 3-8-3 fertilizer or an application of superphosphate. From 200 to 600 pounds to the acre of 3-8-3, 3-8-5, 4-8-6, or 4-10-6 fertilizer is applied for tobacco, which yields from 600 to 1,200 pounds an acre. Wheat yields from 5 to 20 bushels an acre without fertilizer and following tobacco, or about the same amount when a light application of fertilizer is made. On farms where cattle are grazed, about 2 acres of pasture a head is allowed.

This soil occupies steep slopes. In some areas the soil remains in a virgin state; in others it has been practically destroyed by erosion. The degree of sheet and gully erosion is shown on the map with proper symbols. Although this is a good soil, the steep relief subjects the cleared and farmed areas to serious loss of surface soil, unless the utmost precautions are taken (pl. 2, B). Probably the best use for this land is pasture.

Ashe loam.—Ashe loam generally occurs at higher altitudes—in most places exceeding 3,500 feet—than does Porters loam. It is a very productive soil, but its high elevation limits its use for crops. In this county this soil is not so important agriculturally as Porters loam, and a much smaller acreage is cultivated.

The 6- to 8-inch surface soil of Ashe loam consists of gray or yellowish-gray loam. The subsoil, which continues to a depth ranging from 20 to 30 inches, is deep-yellow or brownish-yellow friable

crumbly clay or sandy clay. This material readily crushes to a loose granular mass. It is underlain by light-gray or mingled light-gray and yellow soft disintegrated and partly decomposed light-colored granitic rock. The surface soil is acid in reaction and low in organic matter. Many stones are scattered over the surface and throughout the soil. Roots penetrate to great depths. In wooded areas a shallow mantle of leafmold lies on the surface and enough organic matter occurs in the topmost 2 or 3 inches of soil to give it a grayish-brown color.

Large bodies of this soil occur in the southwestern part of the county along the North Carolina-Tennessee State line, on Spring Creek Mountain, and on Doggett Knob northward along Grass Land Ridge, and in the northeastern part, especially in the vicinity of English.

About 1,000 acres of this soil are under cultivation, and about 10,000 acres are in pasture. About 70 percent of the land under cultivation is devoted to corn and the rest to other crops. Corn yields from 25 to 50 bushels an acre when 200 to 300 pounds to the acre of 3-8-3 or 4-8-4 fertilizer is used. This land would be well suited to the production of potatoes, cabbage, and green beans if it were not so steep. Because of its slope, however, it should not be cultivated, as serious erosion results. It is, however, well suited for pasture. Both external and internal drainage are good. Run-off is rapid in areas under clean cultivation. Some erosion has already taken place, and further injury may be expected unless the surface is protected by a cover of grasses or leafmold. Pasture grasses do exceptionally well in these high mountain areas, where the temperature is cool, rainfall is abundant, and fogs are common.

Stony colluvium (Porters soil material).—The surface soil of stony colluvium (Porters soil material) is brown or dark-brown mellow friable porous loam, from 10 to 20 inches thick. The subsoil is yellowish-brown or brown friable mellow loam, which extends to a depth ranging from 15 to 40 inches. The soil profile represents an admixture of alluvial and colluvial soils. Many large and small stones occur on the surface and in the soil. Rock outcrops are not uncommon. The materials forming this soil have rolled or washed down from the steep mountainsides occupied by the Porters soils and, to less extent, the Ashe and Halewood soils.

Small bodies occur at the heads of streams throughout the county, but they cover only a small total area.

About 200 acres of this land are under cultivation, about 65 percent of which is devoted to the production of corn, 10 percent to tobacco, 5 percent to wheat, and 20 percent to truck and other crops. Cornland generally is not fertilized, and it yields from 15 to 30 bushels of grain an acre. From 200 to 400 pounds to the acre of 3-8-5, 4-8-6, or 4-10-6 fertilizer is applied for tobacco, which yields from 700 to 1,500 pounds an acre. Truck crops, garden vegetables, and apples do well in places where there is enough soil between the rocks to support the plants and trees.

This land has favorable relief and would be capable of producing good yields without the use of much fertilizer, except that its stoniness makes it difficult to carry on farming operations. It is probably best suited to pasture in its present condition. When most of the stones have been removed from the surface and surface soils, the land

is well suited to the production of cultivated crops. The general agricultural value of this land is the same as that of Porters loam and other Fourth-class soils. Both internal and external drainage are good.

Ramsey loam, hill phase.—The 4- to 6-inch surface soil of Ramsey loam, hill phase, is light-gray or yellowish-gray loose friable mellow loam. The underlying material is yellow or grayish-yellow loam or clay loam, which extends to a depth ranging from 12 to 30 inches. A large percentage of this layer represents small shale fragments. This material grades into the parent material, which is composed of shale or sandstone fragments. Some shale fragments are mixed with the surface soil and underlying material. Included with this soil are areas of fine sandy loam and silt loam. The reaction is acid throughout.

Most bodies border Spring Creek south of Hot Springs and the short tributaries of Shelton Laurel Creek that join it from the west. The soil is closely associated with Ramsey loam. Altogether these bodies aggregate only a very small area.

About 200 acres of this land are in cultivation, about 50 percent being occupied by corn, 15 percent by tobacco, 20 percent by wheat, and 15 percent by other crops. Corn yields from 10 to 20 bushels an acre when the land is fertilized with 200 to 400 pounds to the acre of 3-8-3 fertilizer or with superphosphate, and 2½ to 10 bushels when it is not fertilized. Wheat following tobacco yields from 2 to 10 bushels an acre without fertilizer, and about the same yields are obtained where it does not follow tobacco and the land is fertilized with 100 to 300 pounds to the acre of 3-8-3 or with superphosphate. Tobacco yields from 400 to 800 pounds an acre when the land receives from 200 to 600 pounds to the acre of 3-8-5, 4-8-6, or 4-10-6 fertilizer.

Having a steep slope (15 to 30 percent), decided susceptibility to erosion, and low fertility, this soil is best adapted to pasture or forest. Erosion is severe where this land is cleared and farmed, and only fair yields are obtained with the use of large quantities of fertilizer or manure. The agricultural value of this soil is lower than that of the Porters soils. Both external and internal drainage are good.

Muskingum loam, hill phase.—The 4- to 8-inch surface soil of Muskingum loam, hill phase, is brown mellow friable loam. The subsoil is brown, grayish-brown, or brownish-yellow friable loam, sandy loam, or, in places, silty clay loam, reaching to a depth of 12 to 24 inches. Underlying the subsoil is the parent material composed of sandstone, quartzite, or shale. This material is well weathered, and only fragments of rock remain, although in many places the constructional form of the rock still exists. No sharp line of demarcation can be detected between the surface soil and the subsoil. In some areas some sandstone fragments are on the surface and mixed with the soil, but there are not enough to interfere with cultivation. The material is acid in reaction throughout.

Included with this soil is a small area, near Antioch Church, of soil underlain by limestone. The surface soil is gray heavy plastic clay, 6 to 8 inches thick, and the subsoil is mottled blue, yellow, and brown heavy stiff plastic clay to a depth ranging from 15 to 30 inches, where it rests on solid rock. Numerous fragments of limestone and flint are scattered over the surface and throughout the soil mass.

Also included is an area northwest of Hot Springs. It has a brownish-red heavy clay surface soil and a maroon heavy stiff plastic but brittle clay subsoil. Possibly this is a remnant of an old terrace.

Muskingum loam, hill phase, occurs northeast of Hot Springs, in the vicinity of Hickeys Fork, north of Allegheny and Little Laurel Creeks, and west of Hot Springs. The total area is very small.

About 150 acres of this land are under cultivation, of which, about 60 percent is devoted to corn, 20 percent to wheat, 10 percent to tobacco, and 10 percent to other crops. Corn yields from 10 to 20 bushels an acre with a small application of 3-8-3 or 4-8-4 fertilizer. Wheat yields from 7 to 12 bushels an acre when it follows tobacco or when the land receives a 3-8-3 or 4-8-4 fertilizer or superphosphate. From 200 to 600 pounds of 3-8-5, 4-8-6, or 4-10-6 fertilizer to the acre is applied to tobacco, which yields from 400 to 1,000 pounds an acre.

Owing to its hilly relief, low fertility, and susceptibility to erosion, this land should be in pasture or, preferably, in forest. The soil was placed in this group because its slope is less steep than that of the other Muskingum soils.

FIFTH-CLASS SOILS

The group of Fifth-class soils comprises Hayesville clay loam, gullied steep phase; Porters loam, very steep phase; Porters stony loam; Porters stony loam, very steep phase; Muskingum loam; Muskingum loam, very steep phase; Muskingum fine sandy loam; Ramsey loam; Ramsey loam, very steep phase; Halewood loam, very steep phase; Ashe loam, very steep phase; Ashe stony loam; Ashe stony loam, very steep phase; and Lelew silt loam. The lands of this group cover 65,280 acres, or 23 percent of the total area of the county.

Developed on the mountains, these soils have the steepest slope of any soils in the county. The gradient of the types range from 30 to 60 or more percent, whereas the very steep phases, which are on the very steep sides of the mountains, have a slope that exceeds 60 percent and is as much as 90 percent in places. The soils are too steep for farming purposes, and most of them are too steep even for pasture. It is true that small areas or patches here and there are cultivated or are in pasture. Some of these soils, like the Porters and Ashe, are fertile and would produce good yields of staple crops but are barred from use on account of steep slope and extreme erodibility when cultivated.

A large area of these soils has been purchased by the United States Government and is now included in a national forest. In many places the soil is shallow over bedrock, in others stones are strewn over the surface, and in still others solid rock outcrops. The best use for these soils, under present economic conditions, is forest.

Hayesville clay loam, gullied steep phase.—This soil occupies steep areas where erosion has removed practically all of the surface soil and, in places, part of the subsoil. In most places the surface soil is clay loam, but where all the original surface soil has been removed the texture now is clay. Otherwise, the profile characteristics are the same as those of typical Hayesville clay loam, except that the subsoil is shallower or completely removed by erosion.

This soil is closely associated with Hayesville clay loam, eroded steep phase, and Halewood loam, mainly in the southeastern and south-central parts of the county. A very small percentage of the land is cultivated. Most of it is idle, in pasture, or has been abandoned and partly reforested to second-growth pines.

Steep slope, loss of practically all of the surface soil and some of the subsoil, and badly gullied condition disqualify this land for either cultivation or pasture. It is best suited to forest. Both internal and external drainage are excessive. Growing of kudzu and planting of locust are recommended to hold this soil. In some places brush dams would be very beneficial across some of the deeper and larger gullies.

Porters loam, very steep phase.—Porters loam, very steep phase, differs from the typical soil mainly in relief, which is very steep and mountainous. The slope ranges from 60 to 90 percent. A large area is mapped in close association with Porters loam.

About 500 acres of this land are cultivated, and about 5,000 acres are in pasture. The crops grown, fertilizer used, and yields are about the same as on Porters loam. This is a productive soil, but, owing to the very steep relief, it should not be cultivated or pastured. It is best suited to forest. Both external and internal drainage are good. Water runs off rapidly, and, unless the surface is protected by mulch or grasses, severe erosion will remove all the surface soil and subsoil to bedrock.

Porters stony loam.—In forested areas the surface soil of Porters stony loam consists of a thin covering of dark-brown or black leaf-mold underlain by brown mellow friable loam to a depth ranging from 6 to 10 inches. The subsoil is clay loam or friable clay that is reddish brown grading to yellowish brown. At a depth of 24 to 36 inches this material rests on gray and yellow soft disintegrated and partly decomposed gneiss, schist, or granite rock. Scattered over the surface and mixed with the soil are numerous angular rock fragments ranging in diameter from 6 inches to 2 feet or more. In places large boulders are present, and outcrops of solid rock are common. Root penetration is good unless impaired by stones. This soil is acid in reaction throughout.

Small areas of this soil are associated with areas of Porters loam. About 200 acres are in cultivation, and 200 acres are in pasture. Corn is the principal crop and yields from 20 to 45 bushels an acre without any fertilizer.

This land is too steep and rocky for the production of clean-cultivated crops. Steep slope, ranging from 25 to 60 percent, subjects it to serious erosion if cultivated. It is best suited to forest. Both external and internal drainage are good to excessive.

Porters stony loam, very steep phase.—Porters stony loam, very steep phase, differs from Porters stony loam mainly in relief. This soil occurs in close association with Porters loam; Porters loam, very steep phase; and Porters stony loam.

This is not an extensive soil, and it is all in forest, for which purpose it is best suited. Drainage is good throughout. The slope ranges from 60 to 90 percent. This land is less desirable than Porters stony loam and more inaccessible, as it occurs in many places near the tops of the highest mountains.

Muskingum loam.—Owing to the characteristics of the parent rock, this soil is very low in mineral plant nutrients. This fact, together with its steep slope—from 30 to 60 percent—naturally places it in the group of Fifth-class soils.

The 4- to 8-inch surface soil of Muskingum loam is brown mellow friable loam. The subsoil is brown, grayish-brown, or brownish-yellow friable loam, sandy loam, or, in places, silty clay loam, to a depth ranging from 12 to 24 inches. Underlying the subsoil is the well-weathered parent material, developed from sandstone, quartzite, and shale, of which only fragments exist. This soil is acid throughout. Included with this soil are a few areas northwest of Hot Springs, derived from the same rock but having red subsoils. The surface soil and the subsoil have the same texture and structure as Muskingum loam. Also included is an area northwest of Hot Springs that has a brown surface soil and a reddish-brown subsoil, the subsoil being slightly heavier than that of Muskingum loam.

Muskingum loam occurs northeast of Hot Springs at the headwaters of Hickeys Fork, Little Laurel, and other tributaries of Shelton Laurel Creek that join it from the west. Other areas lie between Paint Rock and Hot Springs. This is not an extensive soil.

About 200 acres of this land are under cultivation, of which corn occupies about 45 percent, tobacco 4 percent, wheat 15 percent, and other crops 36 percent. Corn yields from 10 to 25 bushels an acre when the land receives 100 to 300 pounds of 3-8-3 fertilizer or an application of superphosphate. Wheat yields from 5 to 15 bushels an acre if it follows tobacco; otherwise the land is fertilized with 100 to 300 pounds of 3-8-3 fertilizer or with superphosphate. Tobacco yields from 600 to 1,000 pounds when the land is fertilized with 200 to 600 pounds of 3-8-3, 4-8-4, 4-8-6, or 4-10-6 fertilizer.

Because of its steep relief and low fertility, this soil should not be cultivated or pastured. Where cleared and farmed for only a short time, serious loss of surface soil has resulted. The land is best suited to forest. The agricultural value of this soil is the same as that of Ramsey loam and is lower than that of the Porters, Halewood, or Hayesville soils on the same relief. Both external and internal drainage are good to excessive.

Muskingum loam, very steep phase.—Muskingum loam, very steep phase, differs from the typical soil mainly in having a steeper slope, which ranges from 60 to 80 or more percent. The soil profile characteristics are practically the same as for Muskingum loam, except that in many places bedrock lies nearer the surface.

This soil is closely associated with Muskingum loam south of Paint Fork and northwest of Bluff to the North Carolina-Tennessee State line. It is even less extensive than the typical soil. Practically all of this rugged land is in forest, to which it is best suited. In general agricultural value this soil ranks considerably lower than Muskingum loam, and the price of the land depends on the amount and quality of the timber growing on it. Both external and internal drainage are good to excessive.

Muskingum fine sandy loam.—The 4- to 8-inch surface soil of Muskingum fine sandy loam is light-gray or grayish-yellow mellow friable fine sandy loam. The subsoil is yellow friable fine sandy loam, which extends to a depth ranging from 12 to 30 inches. It is

underlain by angular fragments of sandstone and quartzite or the solid sandstone and quartzite rock. In wooded areas a small quantity of organic matter is on the surface or is mixed with the first 3 or 4 inches of soil. A few pieces of gravel and fragments of sandstone and quartzite are scattered over the surface and are mixed with the soil. This soil is acid in reaction throughout. Roots readily penetrate the soil in places where the depth to bedrock is greater.

This soil occurs chiefly south of Paint Rock and does not occupy a large total area. The slope ranges from 30 to 60 percent. This is not considered an agricultural soil in this county. Owing to its steep slope and low fertility, it is probably best suited to forest. Its general agricultural value is the same as that of Ramsey loam and Muskingum loam and is lower than that of Porters loam. Drainage is good throughout. If this soil were cleared and cultivated, erosion would soon remove all the surface soil and subsoil.

Ramsey loam.—Because of its shallowness and low fertility, Ramsey loam is classed as forest land, or a Fifth-class soil. This soil is developed from the weathered products of slate, shale, and sandstone. When cleared for farming or even cut over, this soil is very erodible on the prevailing slope of 30 to 60 percent.

The surface soil of Ramsey loam is light-gray or yellowish-gray mellow friable loam, from 4 to 6 inches thick. Below this is yellow or grayish-yellow loam or loamy clay, which continues to a depth ranging from 10 to 20 inches. This clay grades into the parent material composed of shale or sandstone fragments. Shale fragments make up a large part of the surface soil and subsoil, increasing in number with depth until the parent material is reached. The entire soil is acid in reaction. Small areas of Muskingum soils are included with this soil in mapping.

Fairly large areas of this soil lie between Walnut and Hot Springs along United States Highways Nos. 25 and 70, which are coextensive in this county, and along the French Broad River from Barnard to the North Carolina-Tennessee State line. Areas are mapped on Shelton Laurel, Little Laurel, and Spring Creeks.

About 1,000 acres of the 5,056 acres mapped are under cultivation, and 1,000 acres are in pasture. About 50 percent of the cultivated land is devoted to corn, 10 percent to tobacco, 15 percent to wheat, and 25 percent to all other crops. Corn yields from 5 to 10 bushels an acre when the land is not fertilized and 10 to 25 bushels when the land is fertilized with 100 to 300 pounds to the acre of 3-8-3 or with superphosphate. Tobacco generally yields from 500 to 900 pounds an acre, and the land receives from 200 to 600 pounds to the acre of 3-8-5, 4-8-6, or 4-10-6 fertilizer. Wheat yields from 4 to 8 bushels an acre without fertilizer. Slightly larger yields are obtained when wheat follows tobacco or when the wheatland is fertilized. Cultivation is difficult.

Because of its steep slope, shallowness, erodibility, and low fertility, this soil is best adapted to forest. The Federal Government has purchased several thousand acres of this land for the Pisgah National Forest. Both external and internal drainage are excessive.

Ramsey loam, very steep phase.—Ramsey loam, very steep phase, differs from the typical soil in that it has a steeper slope and is

shallower. There are more shale fragments on the surface and mixed with the surface soil than in the typical soil.

This soil occurs in close association with Ramsey loam and rough stony land (Ramsey soil material), and its total area is not large. It is all in forest, to which it is best suited. Both external and internal drainage are excessive, and the water-holding capacity of the soil is low.

Halewood loam, very steep phase.—The very steep phase of Halewood loam differs from the typical soil mainly in its steeper slope, which ranges from 60 to 80 percent or more.

This soil occurs in close association with Halewood loam, along the French Broad River, west of Apple Tree Ridge, along the Ivy River and Walnut, Laurel, and Shelton Laurel Creeks, and along other streams in the eastern part of the county. It covers a fairly large area. Only a patch here and there is cultivated, as most of the land is cut-over forest land or woodland pasture. This soil is too steep for cultivation or even pasture and should be left in forest. Its value depends on the growth of timber and its accessibility. Internal drainage is good, and external drainage is excessive. If the land were cleared, severe erosion would result and gullies would form.

Ashe loam, very steep phase.—This soil differs from typical Ashe loam mainly in relief. The soil profile characteristics are practically the same as those of Ashe loam, except that most of the soil is shallower over bedrock. It occurs in close association with Ashe loam, although it is not so extensive. This is inherently a good soil, but, owing to its steep relief, it should not be cultivated or pastured. It is best suited to forest. External and internal drainage are good to excessive. This very steep soil occupies mountainsides whose slopes range from 60 to 90 percent. Cultivation would be extremely difficult, and erosion on cleared land that is not in grasses would soon destroy the soil even for forest purposes.

Ashe stony loam.—In forested areas the 4- to 8-inch surface soil of Ashe stony loam is gray or almost black loam rich in organic matter. This layer is mellow and friable. The subsoil is brownish-yellow or deep-yellow friable crumbly clay or sandy clay, which extends to a depth ranging from 15 to 30 inches. Underlying the subsoil is light-gray and yellow soft disintegrated and partly decomposed granitic rock. Many stones, ranging in diameter from 1 to 6 feet, and large boulders occur on the surface and mixed with the soil, and in many places bedrock outcrops. The entire profile of this soil is acid in reaction. Roots penetrate readily except where stones interfere.

This soil occurs in small areas mainly in the southwestern part of the county. None of it is under cultivation; and of the total of 960 acres, about one-fifth is used for pasture. The land should be used for forest, as it is too steep and rocky to be cultivated or even pastured. This soil has a lower agricultural value than Ashe loam. External and internal drainage are good to excessive.

Ashe stony loam, very steep phase.—This soil differs from typical Ashe stony loam mainly in having steeper relief. It occurs chiefly in two fair-sized areas in the southwestern part of the county, where it lies on the mountaintops and ridges or on steep slopes near the mountaintops.

This land is steep, mountainous, stony, and rough. It is all in forest, for which purpose it is best suited. Surface drainage is good to excessive, and internal drainage is good.

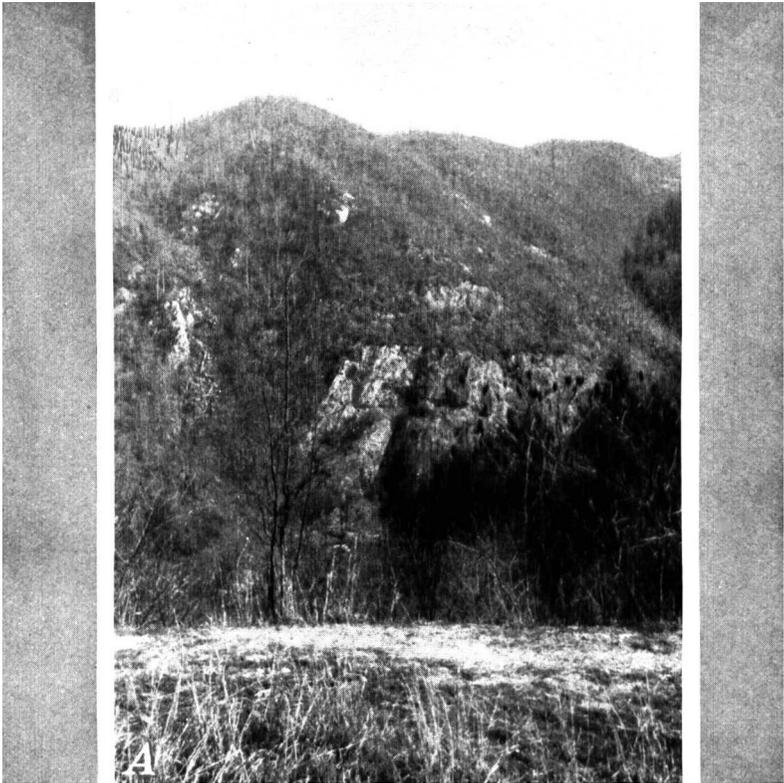
Lehew silt loam.—In forested areas the 4- to 7-inch surface soil of Lehew silt loam is purplish-brown silt loam. The subsoil is purple or Indian-red silty clay loam to a depth ranging from 15 to 35 inches. Below this is the parent material of soft or hard Indian-red shale fragments intermixed with some silty clay loam. A few shale fragments are present throughout the soil. This soil is derived from the Rome formation, formerly called Watauga shale. Roots penetrate well where the soil material is thickest over the rock. The reaction is acid throughout. In most places the slope ranges from 30 to 40 percent, although in some places it is only 15 percent and in others it is as much as 60 percent.

This soil occurs in small areas from 1 to 3½ miles northwest of Hot Springs. Although some of this land is cultivated to corn, wheat, and tobacco, it is not considered suitable for general farming. The inherent fertility is low, and crop yields are low even where the land is fertilized. Because of its steep slope and susceptibility to erosion, this soil should not be cultivated or even pastured. It is best adapted to forest. Its agricultural value is the same as that of the Ramsey and Muskingum soils; Porters loam, very steep phase; and Porters stony loam. Both internal and external drainage are good to excessive.

MISCELLANEOUS LAND TYPES

The group of miscellaneous land types includes rough gullied land (Hayesville soil material), rough stony land (Porters soil material), rough stony land (Ramsey soil material), rock outcrop, and river-wash. These land types comprise the steepest, roughest, and most stony parts of the mountainsides, crests of mountains, and knobs. In places the walls are precipitous, especially where the streams have cut narrow and deep gorges through the mountain ranges, and here and there are some expanses of bare rock with almost perpendicular walls or faces. The thickness of soil over bedrock in many places is very slight, and moisture conditions are not favorable. Only a small part of these land types is suitable for forest. It would be difficult and expensive to cut the trees and transport them to sawmills.

Rough gullied land (Hayesville soil material).—Rough gullied land (Hayesville soil material) represents small areas on steep slopes, mountainsides, and knolls, scattered throughout the eastern part of the county, that are so severely sheet eroded and gullied that they are no longer considered suitable for agriculture and have been abandoned. These areas consist of a series of gullies and sharp intervening narrow ridges within areas of Hayesville loam and Hayesville clay loam. In some places the gullies have cut only into the subsoil, whereas in other places they have cut through the subsoil into the soft parent material and even down to bedrock. The ridges between some of the gullies have eroded only slightly, whereas others show cuts down to the subsoil or the parent material. Erosion is still active, and no measures are being taken to prevent further loss and removal of soil.



A, Rock outcrop in an area of rough stony land (Porters soil material). B, Gullied land. Such gullies are shown on the soil map by red jagged lines.

Some areas are reforesting naturally to second-growth pines and some yellow locust. A good and probably the cheapest way to check and control erosion on these areas is to plant kudzu and black locust. The kudzu makes a quick growth and will protect the soil to some extent while the locust trees are making a start. Fortunately, areas of this rough gullied land are very few and small. Nevertheless erosion should be checked to prevent silt from these areas from washing into reservoirs and to conserve what little soil remains.

Rough stony land (Porters soil material).—Rough stony land (Porters soil material) includes areas that have rough, steep, or precipitous relief. In many places large boulders and outcrops of bedrock (pl. 3, A) are numerous; in others the slope is very steep and the underlying bedrock is only a few inches below the surface. The soil material, where formed to an appreciable depth, is predominantly Porters loam or Ashe loam. The parent material of the soil is derived from the crystalline rocks.

This land occurs in close association with Porters stony loam; Porters stony loam, very steep phase; Porters loam; Porters loam, very steep phase; Ashe stony loam; Ashe stony loam, very steep phase; Ashe loam; Ashe loam, very steep phase; Halewood loam; and Halewood loam, very steep phase. It covers a large total area.

This land occupies steep slopes, sharp mountain ridges, and peaks. On account of the prevailing steep slope, run-off is excessive, and when cleared of forest the soil readily washes away. This land is considered nonagricultural, except for forestry. Practically all of it is in forest. The value of this land depends altogether on the timber growth and its accessibility.

Rough stony land (Ramsey soil material).—Rough stony land (Ramsey soil material) differs from rough stony land (Porters soil material) in the character of the soil and the underlying rock formations. The geological formations consist of shales, slates, and sandstones, and these rocks produce soils that are comparatively low in mineral plant nutrients.

This land occurs in close association with Ramsey loam; Ramsey loam, very steep phase; Muskingum loam; Muskingum loam, very steep phase; and Muskingum fine sandy loam. It is very extensive, covering over 15 percent of the total area of the county. Practically all of this land is in forest, to which it is best adapted. A large part of the land has been acquired by the Federal Government and is included in the Pisgah National Forest.

Owing to its low natural fertility, this land supports less timber and a poorer quality of trees than does rough stony land (Porters soil material); its value is correspondingly less. Both external and internal drainage are good to excessive. Only a thin mantle of soil covers the bedrock, and in places solid rock outcrops. Some areas have almost perpendicular walls.

Rock outcrop.—Rock outcrop includes bare exposures of solid rock having almost perpendicular walls or faces on mountainsides. A few scrub trees and bushes grow in the crevices where a scant covering of soil has formed, but the areas have no agricultural value. A few very small bodies occur along Laurel Creek and elsewhere.

Riverwash.—Areas of riverwash border the French Broad River at Hot Springs and Shelton Laurel Creek. This material is a mix-

ture of sand, gravel, and rock, and in no place does it resemble a soil. All the particles of material are rounded or semiangular, ranging in size from sand grains to boulders 2 feet in diameter. Typical riverwash, such as occurs at Hot Springs, supports practically no vegetation. The area on Shelton Laurel Creek contains more fine material than that at Hot Springs and supports a considerable growth of underbrush and scrub trees. Riverwash has no agricultural value and is subject to overflow during times of high water. The total area in this county is only 64 acres.

PRODUCTIVITY RATINGS

Table 5 lists the soils of Madison County in the approximate order of their general productivity for the common crops under the better soil-management practices. The most productive soils are at the head of the table, and the least productive are at the foot. The order is modified to some extent, to show the comparative desirability of the soils as influenced by their workability and erodibility.

TABLE 5.—Productivity ratings of the soils of Madison County, N. C.

Soil (soil types, phases, complexes, and land types) ¹	Crop productivity index ² for—													General productivity grade ⁴		Remarks including fertility, workability, and erodibility, if used for cultivated crops	Soil groups or general land classification ⁵	
	Corn		Wheat		Tobacco (burley)		Clover hay		Lespedeza		Potatoes		Vegetables ³					Pasture ³
	A	B	A	B	A	B	A	B	A	B	A	B		A	B			
State loam.....	60	100	60	90	40	80	50	100	---	110	---	80	Good	Good	5	1	Moderately fertile; easily worked; slightly erodible. Best farming land in county. Fertile; very easily worked; subject to overflow; slightly or not at all erodible. Comparatively fertile; easily worked; slightly erodible. Moderately fertile; easily worked; moderately erodible. Rather low in fertility, but responsive to management; easily worked; moderately erodible.	First-class soils (good cropland; also capable of supporting good pasture).
Congaree silt loam.....	70	95	40	70	50	70	70	100	---	90	---	80	do	Very good.	4	2		
Porters loam, slope phase	60	95	60	90	40	70	50	80	---	90	---	90	do	do	5	2		
State loam, slope phase..	55	95	55	95	35	75	45	95	---	100	---	75	do	Good	5	2		
Hayesville loam.....	40	70	50	80	40	80	55	80	---	105	---	60	do	do	5	3		
Alluvial soils, undifferentiated.	50	70	40	60	50	70	60	90	---	85	---	70	Good	Very good.	6	3	A complex of Congaree and Toxaway soils; fertile; easily worked; subject to overflow; slightly or not at all erodible; poorly drained in places. Moderately fertile; easily worked; slightly or not at all erodible; subject to overflow but well drained. Fertile; easily worked, but requires drainage; subject to overflow; slightly or not at all erodible. Rather low fertility, but responsive to management; easily worked; moderately erodible. Similar to Hayesville loam except that it is slightly difficult to work and has undergone more accelerated erosion. Low in fertility, but responsive to management; easily worked; slightly to moderately erodible.	Second-class soils (good to fair cropland; also capable of supporting fair to good pasture).
Pope fine sandy loam...	60	85	---	---	---	---	40	80	---	90	---	80	do	Good	6	2		
Toxaway silt loam ⁶	30	80	30	70	---	---	40	80	---	90	---	80	Fair	do	7	4		
Halewood loam, slope phase.	35	60	40	70	35	60	50	75	---	100	---	60	Good	do	7	4		
Hayesville clay loam...	30	70	30	70	30	60	40	80	---	105	---	50	Fair	do	7	5		
Holston fine sandy loam.	20	60	30	50	35	65	30	60	---	80	---	60	Good	Fair	8	4		

See footnotes at end of table.

TABLE 5.—Productivity ratings of the soils of Madison County, N. C.

Soil (soil types, phases, complexes, and land types)	Crop productivity index for—														General productivity grade	Remarks including fertility, workability, and erodibility, if used for cultivated crops	Soil groups or general land classification		
	Corn		Wheat		Tobacco (burley)		Clover hay		Lespedeza		Potatoes		Vegetables	Pasture				A	B
	A	B	A	B	A	B	A	B	A	B	A	B							
Porters loam, hill phase	40	70	30	60	35	65	50	80	---	80	---	90	Good..	Good..	7	4	Third-class soils (fair to poor cropland; good to fair pasture).		
Ashe loam, hill phase	30	60	30	60	---	---	50	80	---	80	---	90	Very good.	do	7	4			
Congaree loamy fine sand.	40	60	---	---	35	70	20	60	---	60	---	60	Good..	Fair..	7	4			
Halewood loam, hill phase.	40	60	35	70	30	70	45	70	---	70	---	50	do	do	7	4			
Holston fine sandy loam, slope phase.	20	60	35	75	30	60	20	60	---	80	---	50	do	do	8	4			
Stony colluvium (Porters soil material).	30	50	30	50	30	70	30	60	---	60	---	50	Good	Good..	7	5	Fourth-class soils (unsuited for extensive cropping, but potentially generally well suited for pasture).		
Porters loam	20	50	20	50	20	70	30	60	---	60	---	40	Fair..	do	8	5			
Ashe loam	20	50	20	50	10	40	30	60	---	60	---	50	Good..	do	8	5			
Hayesville clay loam, hilly phase.	20	40	20	40	20	40	20	50	---	50	---	30	Fair..	Fair..	8	6			
Halewood loam	20	40	20	40	20	60	20	50	---	50	---	30	do	do	8	6			
Hayesville clay loam, eroded steep phase.	10	30	10	30	10	30	10	40	---	40	---	20	Poor..	do	9	7			
Muskingum loam, hill phase.	20	40	10	30	20	50	10	30	---	40	---	20	Fair..	do	9	7			
Ramsey loam, hill phase	10	30	10	20	10	40	10	30	---	30	---	20	do	do	9	8			

The rating compares the productivity of each soil for each crop to a standard, namely, 100. This standard index represents the approximate average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions in which the crop is most commonly grown. An index of 50 indicates that the soil is about half as productive for the specified crop as are those with the standard index. Soils given amendments, such as lime and commercial fertilizers, and unusually productive soils of small extent may have productivity indexes of more than 100 for some crops.

The following tabulation sets forth some of the acre yields that have been set up as standards of 100. They represent long-time average yields of crops of satisfactory quality.

Crop:		
Corn	----- bushels--	50
Wheat	-----do----	25
Potatoes	-----do----	200
Burley tobacco	-----pounds--	1,500
Clover hay	-----tons--	2
Lespedeza hay	-----do----	1.5

The rating in the column headed A under each crop indicates yields obtained under the less careful and less intensive soil-management practices, which, on most of the soils, include the use of small quantities of commercial fertilizers. On more fertile soils, such as Congaree silt loam and Toxaway silt loam, little or no fertilizer is used. In the column headed B, yields under more careful and intensive recommended practices are given. These practices consist of regular crop rotations, including the growing of legumes, the use of barnyard and green manures, the application of liberal quantities of complete commercial fertilizers, the use of improved varieties and high-quality seed, and, in some areas, the use of mechanical measures, such as contour tillage, strip cropping, and terracing, for the control of erosion.

The principal factors affecting the productivity of land are climate, soil (this includes the many physical, chemical, and biological characteristics), slope, drainage, and management, including the use of amendments. No one of these factors operates separately from the others, although some one may dominate. Crop yields over a long period of years furnish the best available summation of the associated factors and therefore are used where available. In Madison County many of the indexes are based on estimated yields rather than on reported yields, as definite information is scarce. Interviews with farmers, combined with the observation of members of the soil survey party, are depended on for information upon which to base estimates of yields.

Because of limited information, no indexes are given for vegetables or pasture. Only general statements are used to indicate the productivity of the soils for these crops.

The soils are listed in the order of their general productivity under the more careful practices, and productivity grade numbers are assigned in the column "General productivity grade." The general productivity grade is based on a weighted average of the indexes for the various crops, the weighting depending on their relative acreage and value. If the weighted average is between 90 and 100, the soil

type is given a grade of 1; if it is between 80 and 90, a grade of 2 is given; and so on. Since it is difficult to measure or express mathematically either the exact significance of a crop in local agriculture or the importance and suitability of given soils for particular crops, the weightings are used only as guides, and in Madison County the general productivity grades were determined by inspection of the indexes rather than by mathematical calculations.

Under the column headed "Remarks including fertility, workability, and erodibility" are listed many of the factors that determine the suitability of the soil for growing crops, grasses, or trees. These include lay of the land, depth of soil, fertility, responsiveness to fertilization, drainage, susceptibility to overflow, and erodibility when used for the common crops.

In the column headed "Soil groups or general land classification" the soils are grouped according to their comparative desirability or physical suitability for crop growing, grazing, or forestry.

The best soils of the area, grouped as First-class soils, are considered good cropland; that is, they are, in general, capable of moderate to rather high production of the common crops of the area under good soil-management practices; they are rather easily worked; and it is not difficult to maintain productivity. In short, it is possible to farm these soils rather intensively and at the same time to conserve them without great difficulty. The land is so desirable for crops that comparatively little of it is devoted to pasture or wood lots, in spite of the fact that it will support a good growth of pasture grasses or trees. Some small areas of inferior soils, owing principally to steep slope and erosion, are included in the soil types grouped in this class.

Second-class soils are considered somewhat less desirable and are designated as good to fair cropland. They are generally somewhat less productive than the First-class soils, and, as a rule, they are somewhat harder to till or harder to conserve if tilled. They are capable of supporting fair to good pasture, and some areas are in timber.

Third-class soils are considered poor cropland or fair to good pasture land. They are of medium to low productivity and are generally rather hard to till or to protect from erosion.

Fourth-class soils are characterized by hilly and steep topography that makes them unsuitable for cropping by common farm machinery. Their susceptibility to accelerated erosion when cropped also limits their use for corn, tobacco, truck crops, and other crops requiring rather intensive tillage. The Porters and Ashe soils are especially productive of grasses, and this fact, together with the fact that considerable parts of the county are still rougher and more stony, has led to the designation of these soils as pasture land. Crop indexes are given for these soils because a considerable part of their total area is used for corn, tobacco, and other crops.

Fifth-class soils have still more rugged relief than Fourth-class soils and, as a result, are not well suited for pasture. Their best use over a long period appears to be growing trees, although small patches are worked by hand for corn, tobacco, truck crops, and other subsistence crops because of a shortage of better land. This use of such land emphasizes the influence of the distribution of soil types (soil

pattern) on land use and the need for adjustment of land resources to demands.

Miscellaneous land types are essentially too rough, stony, or eroded to have any appreciable value for forestry purposes and, accordingly, are grouped separately.

The productivity rating and land classification do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the country. They give a characterization to the productivity and use capabilities of the individual soil types, but they do not picture the total production of crops by soil types, as this depends also on the acreage of each type devoted to each crop.

Economic considerations play no part in determining the crop indexes and little part in determining the land classification; therefore, neither indexes nor soil classes can be interpreted into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. The association or the pattern of distribution of soil types in any particular locality or farm may have a very important influence on the use and value of the land. Such conditions are not adequately covered in this classification.

LAND USES AND AGRICULTURAL METHODS

Madison County has a typical mountainous terrain and includes several mountain ranges with peaks more than 4,000 feet high. Between the mountain ranges are more or less rugged hills or intermountain country, rolling land, and small areas of level to sloping land in the first bottoms and on the terraces along the streams. There are wide differences in the soil, relief, stoniness, consistence of subsoil, depth of profile over bedrock, and condition of erosion. Large areas of brown loams underlain by yellowish-brown or reddish-brown friable clay loam subsoils occur in the mountainous areas. Extensive areas of rough stony land are in the western, northwestern, and southwestern parts of the county.

About 56 percent of Madison County is in forest, and of the forest land outside of farms approximately 90 percent is held in large timber tracts. Considering that 44 percent of the total land acreage is devoted to the production of farm crops, is in pasture, or is idle, it is reasonable to assume that much of the actual farming is done on soils unsuited to cultivation. Some of the most severely eroded soils are in the intermountain areas where steep land was cleared, cultivated, eroded, and later abandoned. In places these soils are slowly reforested. Such land never should have been farmed, but, if cleared and immediately seeded, it would now afford valuable pasture.

The capabilities, conservation, and proper adaptation of the soils in Madison County have never been fully realized or appreciated by many farmers and landowners. Many of the soils are inherently fertile, compared with the soils in many parts of North Carolina, but are precluded from cultivation because of steepness of slope. Most of the soils on moderate slopes are capable of being built up to a fairly high state of improvement and their productivity easily maintained through proper treatment, including in the rotation a leguminous crop, and the application of lime and phosphate.

In any well-planned farm program, proper use of the soil is of fundamental importance. The uses of the land inevitably change, at least in some particulars, with changes in transient social and economical conditions. The agriculture of this county has been and is today a subsistence type; practically the same crops, with the exception of tobacco, have been grown without much modification for the last 50 years. Tobacco is the principal cash crop.

Some of the farmers are practicing more diversification and are giving more consideration to practices leading to control of run-off and conservation of soil than was given when the soil was freshly cleared from the forest. Deeper plowing on most of the soils, contour cultivation, strip farming, and seeding more land to grasses have proved beneficial and profitable.

The climate and much of the soil in the western part of North Carolina favor the production of bluegrass, timothy, clover, and lespedeza and make cattle raising more important than in many other sections of the State. The Ashe and Porters soils are naturally adapted to bluegrass, and a large plowable acreage of these soils is in pasture. Much of the land in cultivation on the steep slopes should be seeded to grasses in order to check erosion and to preserve the soil for posterity. The acreage devoted to corn should be decreased, and more small grain, lespedeza, and clovers should be substituted as a soil-improvement measure. The same amount of corn could be grown on a smaller acreage if a proper rotation, including a leguminous crop, were practiced. In many places near the bases of the slopes, in coves, on the smoother mountainsides, in the saddles, or on the flatter tops of the mountains, the soil is farmed in patches.

Many of the soils are adapted to certain crops. In the eastern part of the county several soils rank high in the production of particular crops. The Hayesville, Halewood, and Porters soils are exceptionally well suited to the production of lespedeza, where a small quantity of lime and fertilizer, particularly phosphate, is used to get the crop started. Hayesville loam, Halewood loam, State loam, Porters loam, and alluvial soils, undifferentiated, are well suited to the production of burley tobacco. The Hayesville, Halewood, State, Porters, all the Congaree soils, and alluvial soils, undifferentiated, are suited to the production of corn and wheat. At present the yields are moderately low, but these soils can be built up to a much higher state of productivity and made to produce good yields. The soils of this group are also suited to the production of truck crops, if proper rotations and methods of fertilization are practiced.

Ashe loam and Porters loam are especially well suited to the production of cabbage, potatoes, and sweet corn. Porters loam and Ashe loam are well suited for pasture. The very steep slopes of all the soils are suited only for forest and some amount of woodland pasture. When the forest is cleared on Ashe loam a good crop of bluegrass generally comes in without seeding or fertilizing. Good grazing grasses also come in naturally on the Porters soils. On the Halewood and Hayesville soils good pasture can be obtained by seeding the proper mixtures and making small applications of fertilizer and superphosphate.

All the soils in this county originally produced good hardwood forest, but where such forests have been cleared and the land brought

under cultivation the soils under natural conditions reforest to pines (either white or scrub) and locust. Locust is probably one of the best trees available to start on eroded areas, as it will take hold and make a good root growth in a few years, thus checking erosion within a few years. Locust is a leguminous tree and aids in storing nitrogen in the soil, thus making it possible for other plants to grow on these eroded areas.

Organic matter is everywhere deficient, except in soils of the first bottoms and, in places, in the virgin Porters and Ashe soils. This material can best be supplied by growing and turning into the soil leguminous crops, such as soybeans, cowpeas, lespedeza, and clover. If the legumes are cut for hay, little if any residue can be added to the soil for soil improvement; but if the seed is harvested and the plants turned into the soil, considerable improvement in the organic-matter content of the soil should result. Where this is done, the quantity of nitrogen in the fertilizer may be reduced; and if the practice of growing leguminous crops is continued for a few years, the seed harvested, and the residue plowed under, it may not be necessary to supply nitrogen from commercial sources.

All the soils range from medium acid to very strongly acid. Table 6 gives the pH values of the extensive and important soil types. The hydrogen-electrode method of determination was used.

TABLE 6.—*pH* determinations of samples of eight soil profiles from Madison County, N. C.¹

Soil type and sample No.	Depth	pH	Soil type and sample No.	Depth	H
Halewood loam:	<i>Inches</i>		Ashe loam:	<i>Inches</i>	
239601.....	0- 6	6.1	239616.....	0- 3	4.9
239602.....	6- 9	4.9	239617.....	3-10	4.9
239603.....	9-37	4.9	239618.....	10-39	5.1
239604.....	37+	5.3	239619.....	39+	4.7
Hayesville loam:			Ramsey loam:		
239605.....	0- 1	3.7	239620.....	0-1½	4.8
239606.....	1- 7	5.0	239621.....	1½-12	4.5
239607.....	7-11	4.9	239622.....	12+	4.3
239608.....	11-38	4.7	Lehew silt loam:		
239609.....	38+	4.7	239623.....	0- 6	6.0
State loam:			239624.....	6-20	6.1
239610.....	0-11	4.7	239625.....	20+	5.7
239611.....	11-38	5.3	Muskingum fine sandy loam:		
239612.....	38+	5.7	239629.....	0- 6	4.7
Porters loam:			239630.....	6-30	4.7
239613.....	0- 4	5.6	239631.....	30+	4.2
239614.....	4-40	4.5			
239615.....	40+	4.7			

¹ Determinations made by E. H. Bailey in the laboratories of the Division of Soil Chemistry and Physics, Bureau of Plant Industry.

From table 6 it is evident that the soils are too acid to produce the best yields of the ordinary farm crops and, particularly, are too acid to grow most leguminous crops successfully. A liberal application of lime would prove beneficial and profitable, provided it can be obtained at a reasonable cost. The county agricultural agent or the North Carolina Agricultural Experiment Station can furnish data on the quantity necessary to apply to the acre for any particular crop.

Soil leaching and soil erosion are important factors in causing a shortage of plant nutrients in the soil. It has been estimated that these processes remove more plant nutrients than do many crops.

Leaching is more active in the lighter textured soils than in the heavy-textured soils; on the other hand, erosion is more active on the heavy-textured soils. Incorporating organic matter into the soil by growing and plowing under green-manure crops is one way of checking soil leaching and soil erosion. This practice also increases the water-holding capacity of the soil. The addition of organic matter to the soil not only conserves the soil and the plant nutrients but also conserves the moisture, thus making it possible for crops to survive droughts in much better condition. It also increases the productivity of the soil.

Depletion of fertility is one ill effect of growing the same crop year after year. A few farmers practice crop rotation in order to improve the fertility of the soil, and these rotations have proved beneficial. The North Carolina Agricultural Experiment Station recommends the following 4-year and 5-year rotations for the soils of the county for land with a slope of not more than 30 percent, except Porters loam, which may have a slope of as much as 40 percent.

The 5-year rotation is as follows: First year—corn (for grain or silage), with rye or oats in the fall for turning under; second year—tobacco, with wheat (for grain) in fall; third year—wheat with grass mixture, with clover or lespedeza in fall; fourth year—grass mixture for hay; and fifth year—grass mixture for pasture. If land is available, the latter grass mixture should be left on the land from 1 to 3 years longer.

The 4-year rotation with tobacco includes: First year—corn (for grain or silage), with rye or oats in fall for turning under; second year—tobacco, with wheat in fall; third year—wheat, with clover or lespedeza in fall; and fourth year—clover or lespedeza to be turned under the following spring.

If tobacco is not grown, the 4-year rotation for upland soils includes: First year—corn (for grain or silage), with soybeans (seed to be harvested and residue to be turned under), with wheat, or with other small grain in fall; second year—wheat or other small grain (for grain), with clover and grass mixture drilled in April; third year—clover and grass mixture (for hay); and fourth year—clover and grass mixture (for grazing and turning under).

If enough land is available, clover and grass may be left on the land from 1 to 3 years longer before turning under. If land steeper than 30 percent is cultivated—and at present much of it is—it is well to combine the crops listed in the rotations above and grow them in strips. In one section of the county this type of farming is followed with much success. The strips of close-growing crops, such as clover, lespedeza, and grass, should be laid out on the contour, and on land with a 50-percent slope the strips should be from 20 to 30 feet wide. On less steep slopes these strips might be made wider, and on steeper slopes they should be narrower. By rotation and strip cropping it is possible to farm the steeper areas without serious erosion. It must be remembered that it is not the strips that prevent erosion but the growing plants, and for this practice to be successful a good sod must be kept on the sod plots at all times.

Terracing is practiced in many places in this State, but generally it is not recommended for land having a slope of more than 15 percent. If terracing is to be done, it is advisable to consult the agricul-

tural agent about the length, width, and height of the terraces, the distance between them, and the contour interval for them. After this information has been obtained, and if the land is not too steep to be terraced, some type of level should be used to stake off the terraces before starting to build them. If not properly constructed and properly cared for, terraces frequently break or "overflow" and do considerable damage. On the steep areas where farming must be carried on, all practical methods for the control of erosion should be practiced.

In many places in this county, especially on some of the Hayesville soils, erosion has removed most of or all the surface soil and gullies have formed (pl. 3, *B*), thus making the land unfit for agriculture. Effective methods for the control of erosion include growing winter cover crops, contour plowing, terracing, and strip cropping. In strip cropping, rows of grass or other crops that will check erosion are employed instead of terraces. Terracing and strip cropping not only protect the soil from erosion but cause it to absorb more moisture and thus increase its moisture supply. Destructive soil erosion takes place on slopes and hilly areas as a result of using soil in ways to which it is not naturally adapted; and, in general, control of erosion is a matter of adapting management to the capabilities and deficiencies of each soil type.

The soils and climate in Madison County are well suited to the production of grasses and hay crops. As good markets are nearby, livestock raising could be followed on an even larger scale than at present. Much of the land not fitted for the production of the clean-cultivated crops because of steepness of slope could be used as pasture, and by the use of better seed and better grass mixtures more cattle could be grazed on areas already devoted to this use.

Recommendations for grass mixtures and their acre seedings for permanent pastures are made by the North Carolina Agricultural Experiment Station as follows: Kentucky bluegrass, 5 pounds; tall oatgrass, 8 pounds; redbud, 5 pounds; timothy, 5 pounds; orchard grass, 8 pounds; white clover, 2 pounds; alsike clover, 2 pounds; and lespedeza, 5 pounds. This mixture is suited to fairly fertile and well-drained soils of the uplands. The following mixture is best suited to moist, fairly fertile soils: Kentucky bluegrass, 5 pounds; redbud, 6 pounds; orchard grass, 8 pounds; timothy, 2 pounds; white clover, 3 pounds; and lespedeza, 6 pounds.

Carefully conducted field experiments have been made by the North Carolina station on many of the types of soil in the State to determine the best fertilizer treatments for the different crops. Table 7 gives the recommendations for the crops grown on the major soil types in the county. These recommendations are for the average soil. If the soil is above the average the quantity of nitrogen may be lowered, and if below the average it should be raised. Frequently it is more advantageous to use a more concentrated fertilizer, and correspondingly smaller quantities, since much of the cost includes freight and hauling charges. Thus, the same quantity of plant nutrients may be cheaper when purchased as 1 ton of 6-16-12 than as 2 tons of 3-8-6.

TABLE 7.—*Recommendations for the amount and kind of fertilizer for use on the leading crops on several soils of Madison County, N. C.*

Soil type	Fertilizer recommended for—						
	Corn	Small grain	Grasses	Potatoes	Legumes	Burley tobacco	Adapted vegetables
Ashe loam and Porters loam.	<i>Pounds</i> 200 to 400 of 4-10-4.	<i>Pounds</i> 200 to 300 of 4-10-4.	<i>Pounds</i> 200 to 300 of 4-10-4.	<i>Pounds</i> 800 to 1,000 of 3-8-6.	<i>Pounds</i> 200 to 300 of 2-10-4.	<i>Pounds</i> 800 to 1,000 of 3-10-6.	<i>Pounds</i> 800 of 5-8-6.
Hayesville loam.	300 to 400 of 4-10-4.	200 to 400 of 4-10-4.	200 to 400 of 4-10-4.	800 to 1,000 of 3-8-6.	200 to 400 of 2-10-4.	1,000 of 3-10-6.	600 of 5-8-6.
Hayesville clay loam.	300 to 400 of 4-10-4.	200 to 400 of 4-10-4.	200 to 400 of 4-10-4.	-----	200 to 300 of 2-10-4.	1,000 of 3-12-6.	-----
Halewood loam.	300 to 400 of 4-10-4.	200 to 300 of 4-10-4.	-----	-----	200 to 300 of 2-10-4.	1,000 to 1,200 of 3-10-6.	800 of 5-8-6.
Holston fine sandy loam.	300 to 400 of 4-10-4.	300 to 400 of 4-10-4.	-----	-----	200 to 300 of 2-10-4.	1,000 to 1,200 of 3-10-6.	-----
State loam.	300 to 400 of 4-10-4.	200 to 300 of 4-10-4.	200 to 300 of 3-10-4.	-----	200 to 300 of 0-10-4.	-----	-----
Alluvial soils, undifferentiated; Congaree loamy fine sand; and Congaree silt loam.	300 to 400 of 3-10-4.	200 to 300 of 3-10-4.	200 to 300 of 3-10-4.	800 of 3-8-6.	200 to 300 of 0-10-6.	-----	600 to 800 of 3-8-6.
Toxaway silt loam.	300 to 400 of 2-10-4.	200 to 300 of 2-10-4.	200 to 300 of 2-10-4.	-----	200 to 300 of 0-10-6.	-----	-----

Following is a list of the highest-yielding varieties of the crops recommended for the soils of Madison County: Corn—Holcombe Prolific, Southern Beauty, Biggs (Mountain Branch Station strain); wheat—Alabama Bluestem, Fulcaster, and Leap's Prolific; rye—common, Abruzzi; oats—Fulghum, Appler, Burt; burley tobacco—Kelley root-rot resistant, White Burley; grasses—orchard grass, red-top, Kentucky bluegrass, timothy, meadow fescue; clover—red, crimson, white, and sweetclover; soybeans for soil improvement—Herman, Southern Prolific, Virginia, Laredo; soybeans for hay—Herman, Laredo, Virginia; cowpeas for hay—Monetta, Iron, Brabham; and cowpeas for seed—Groit, Early Red, New Era.

Following is a list of bulletins and circulars that will give further information concerning crops and soil improvement. This list is furnished by the North Carolina State College, Raleigh, N. C.:

North Carolina Agricultural Experiment Station Agronomy Information Circulars 11, Results of Soil Building Demonstrations in North Carolina; 51, How the North Carolina Soil Survey is Being Used to Help Farmers; 68, The Part Legumes Play in Maintaining the Productiveness of North Carolina Soils; and 73, Crop Rotation as a Material Aid to Soil Productiveness.

North Carolina Agricultural Experiment Station Circular 9, Grass Mixtures for North Carolina Pastures.

North Carolina State College of Agriculture and Engineering Extension Circulars 127, Soybean Growing in North Carolina; 178, Winter Legumes for Soil Improvement; and 208, Agricultural Program for North Carolina.

Table 8 compares the value of different soils for certain crops.⁷

⁷ Based on the following publication: WILLIAMS, C. B., COBB, W. B., and MANN, H. B. AGRICULTURAL CLASSIFICATION AND EVALUATION OF NORTH CAROLINA SOILS. N. C. Agr. Expt. Sta. Bul. 293, 157 pp., illus. 1934.

TABLE 8.—*Comparative value of soils, mainly in Madison County, N. C., for different crops*

Crop	Best soils	Second-best soils	Third-best soils
Corn	{Toxaway loam ¹ {State loam	Congaree fine sandy loam ¹	{Porters loam. {Congaree silt loam.
Grasses	{Congaree fine sandy loam ¹ {Congaree silt loam {State loam	{Ashe stony loam {Ashe loam {Porters loam {Toxaway loam ¹	{Hayesville loam. {Halewood loam.
Potatoes	Porters loam	{Ashe loam {Porters stony loam {State loam	{Ashe stony loam. {Congaree fine sandy loam. ¹ {Toxaway silt loam. ¹ {Halewood loam. {Hayesville loam. {Hayesville clay loam. {Congaree silt loam. {Porters loam. {State loam.
Lespedeza		State loam	{Congaree loamy fine sand. ¹
Oats			{Congaree silt loam.
Tobacco	{Porters loam {State loam {Congaree fine sandy loam ¹	Halewood loam Ashe loam Hayesville loam	{Ashe stony loam. {Hayesville loam. {Porters stony loam. {Halewood loam. {Ashe loam. {Porters loam. {State loam.
Vegetables	{Ashe loam {Porters loam {State loam	{Toxaway silt loam	{Ashe stony loam. {Hayesville loam. {Porters stony loam. {Halewood loam.
Wheat		{Hayesville clay loam {Hayesville loam	{Ashe loam. {Porters loam. {State loam.

¹ Not mapped in Madison County.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of environment acting upon the soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent soil material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the relief, or lay of the land, which determines the local or internal climate of the soil, its drainage, moisture content, aeration, and susceptibility to erosion; (4) the biologic forces acting upon the soil material; that is, the plants and animals living upon and in it; and (5) the length of time the climatic and biologic forces have acted on the soil material.

Madison County is in the northwestern part of North Carolina and is a typical mountain county in the State, with regard to relief, drainage, and soils. It lies in the southern part of the Gray-Brown Podzolic soils region of the United States. The surface soils are predominantly brown, ranging in color from gray or grayish brown to reddish brown, and in texture from loam to clay loam. The soils may be divided into two broad groups, the brown soils of the mountains and the lighter colored heavier textured soils of the intermountain areas. The brown soils of the mountains occupy a little more than one-half of the county.

All the soils have developed under forest cover in a comparatively mild climate and with an abundant rainfall. The trees provide only a small amount of vegetable material, and very little organic matter has accumulated. The native forest growth consisted principally of deciduous trees, together with a few white and shortleaf pines. In the forested areas a thin covering of forest debris and leafmold lies on the surface, and in the topmost 2 to 4 inches of the surface soil a small amount of organic matter is mixed with the mineral particles.

All the soils range from medium acid to very strongly acid in reaction; that is, they have a pH value ranging from 4.2 to 6.1. (See table 6, p. 48.)

The effects of erosion, incurred through incorrect land use, are evident on the once fairly well developed profiles in practically all parts of the county where the land has been cleared and farmed. This is especially true of steeper areas of soil in the intermountain area. In many places the surface soil has been removed, exposing the subsoil, and in addition gullies have formed, extending to the soft parent material or even to bedrock. At present, normally developed soils occur only in some areas that have been protected by forest. Extensive wooded areas on steep and very steep slopes do not have a normal soil profile. This is particularly true of areas of the Ramsey and Muskingum soils and also of the areas of rough stony land.

All the upland soils have developed through the soil-forming processes from the weathered products of the underlying rocks. The geological formations of the county may be placed into two great divisions: (1) Crystalline rocks and (2) noncrystalline rocks. The crystalline rocks underlie about four-fifths of the land. The noncrystalline rocks occupy about one-fifth, and that area is in the west-central part of the county. The northern boundary of this rock formation crosses the Tennessee-North Carolina State line at a point one-half mile northwest of the corner of Madison County and Green and Unicoi Counties, Tenn. The boundary between the two groups of rock follows a southwest course to Belva, thence south to Hopewell Church, and from there south to a point near Walnut, where it turns west and north and crosses the French Broad River in the vicinity of Stackhouse. Thence it turns in a southwest direction along the Doe Branch to a point near the top of the mountain; then west to Puncheon Camp Branch, one-half mile south of Highland School; from there west and south, past Spring Creek, thence northward to a point one-fourth mile north of Bonnie Hill Church; and finally west to the State line. A few areas of crystalline rock occurs within areas of the noncrystalline rock formations.

In the group of crystalline rocks are Carolina gneiss, Roan gneiss, Max Patch granite, and Cranberry granite. In the group of noncrystalline rocks are the slates and shales of the Cambrian system.

Carolina and Roan gneisses occur in the vicinity of Marshall, up the French Broad River from Marshall, in the vicinity of Mars Hill, and east to the county line.

Max Patch and Cranberry granites are closely associated and border the Carolina and Roan gneisses on the east. The granites extend in a belt across the county from southwest to northeast from as far west as the State line northwest of Bluff and northeast to Stackhouse.

Slates and shales of the Cambrian period occupy the rest of the county, which is the northwestern part.

The Carolina gneiss formation³ consists of an immense series of interbedded mica schist, garnet schist, mica gneiss, and fine-grained granitoid layers. Most of them are light gray or dark gray, weathering to dull gray and greenish gray.

³ KEITH, ARTHUR. ASHEVILLE FOLIO, NORTH CAROLINA-TENNESSEE. U. S. Geol. Survey Folio 116, library ed., 10 pp., illus. 1904.

The Roan gneiss consists of a great series of beds of hornblende gneiss, hornblende schist, and diorite, with some interbedded mica schist and mica gneiss. The hornblendic beds are dark green or black, and the micaceous beds are dark gray. The mica schist and mica gneiss beds range in thickness from a few inches to as much as 80 feet. This formation is most common near the Carolina gneiss and represents a transition into that formation.

Max Patch granite consists almost entirely of coarse granites, in places porphyritic and in places of uniform grain. The minerals composing the rock are orthoclase feldspar, plagioclase feldspar, quartz, biotite, and a very little muscovite.

Max Patch granite is intrusive in the Cranberry granite and the older gneisses. In few places does it come in contact with the gneisses, as it is generally surrounded by the Cranberry granite.

Another variety is a coarse red granite. This appears to be a modification of the usual massive rock, from which it differs only in having much red or pink feldspar. These give a very marked red color to the whole rock. In the same regions where this red color characterizes the feldspar this mineral is often partly altered into epidote and saussurite.

Cranberry granite consists of variously textured and colored granites, as well as schist and granitoid gneisses derived from granite. The granite is an igneous rock composed of quartz and orthoclase feldspar and plagioclase feldspar, with biotite, muscovite, and, in places, hornblende as additional minerals. Minor accessory minerals are magnetite, pyrite, ilmenite, garnet, and epidote. The most notable variation is in the size of the feldspar crystals.

Slates and shales of the Cambrian system are divided into several formations, of which the Snowbird, Hiwassee slate, Nantahala slate, and Great Smoky conglomerate occur in this county.

The Snowbird formation is composed mainly of beds of white or gray fine and coarse quartzites. With this are interstratified beds of conglomerate and arkose, and subordinate layers of gray and black slate. Some of the quartzites contain much feldspar in small grains. When these beds are considerably weathered, oxidation of the iron gives the rock a rusty-brown or red color. The arkose beds, which lie at the base of the formation, are either light gray or somewhat red, varying with the color of the feldspar fragments that they contain.

Hiwassee slate consists almost entirely of slate, but some layers are almost unaltered bluish-gray or bluish-black shale. When the slate is weathered, the color becomes somewhat green, yellowish gray, and yellow. A noticeable constituent in some of the beds is mica in fine scales.

Nantahala slate is composed of black or gray mica schist and ottrelite schist. Mica schist is, as a rule, somewhat darker, owing to very minute grains of iron oxide. Many of the layers are composed of light-gray, dark-gray, and bluish-gray bands. Some of them are sprinkled with crystals of garnet. Ottrelite is a universal constituent of the formation.

Great Smoky conglomerate contains a considerable variety of strata, comprising conglomerate, quartzite, graywacke, mica schist, and slate. The original character of the beds is plainest in the conglomerate, which has layers from 1 to 50 feet thick. The pebbles are smaller than they are in Cochran conglomerate and in few places

exceed one-half inch in diameter. From this they grade into coarse and fine quartzites and graywacke. All these rocks are decidedly gray, becoming almost white on exposure, owing to the weathering of the feldspar.

Cochran conglomerate consists chiefly of coarse and fine conglomerates, sandstone, and quartzite. White or light-gray colors characterize the sandstones and quartzites, whereas the conglomerates are dark gray and bluish gray in many places.

The Rome formation (formerly called Watauga shale) consists of a series of interbedded red, brown, yellow, green, and varicolored shales, shaly sandstone, and impure limestones. The greater part of the formation is made up of highly colored Indian-red shales.

Nichols slate consists largely of fine-grained rocks that range from dark gray to bluish gray and from slates to shales, according to the degree of their metamorphism. The shales generally are micaceous, fine scales of mica having been deposited when the rock was formed.

Nebo quartzite is composed almost entirely of beds of fine-grained quartzites and sandstones that are light gray or white. Hesse quartzite is composed almost entirely of fine- or medium-grained white quartzite in which are included a few minor layers of argillaceous and sandy shale. The Shady dolomite formation consists almost entirely of limestone and dolomite of various kinds, more or less crystalline.

The noncrystalline formations comprise the Great Smoky conglomerate, Hiwassee slate, Rome formation, Snowbird formation, Cochran conglomerate, Nichols slate, Nebo quartzite, Hesse quartzite, and Shady dolomite. The Ramsey, Muskingum, and Lehew soils have developed from the weathered products of these rocks.

The crystalline formations are composed of Max Patch and Cranberry granites and Carolina and Roan gneisses, with areas of meta-diabase, metarhyolite, metagabbro, soapstone, and dunite included with the formations.

The crystalline rocks have given rise through weathering and soil-forming processes to the Halewood, Hayesville, Porters, and Ashe soils of the uplands.

The soils of the first and second bottoms along the streams are composed of reworked material brought down by the streams from the uplands and deposited in the valleys. The State and Holston soils occupy the low second bottoms and terraces, whereas the Toxaway, Pope, and Congaree soils occupy the first bottoms.

The main factors that have given rise to the soils of this section are vegetation, age, climate, relief, and parent material. Other soil-forming processes, however, have played an important part in their formation. All the soils have formed under a heavy growth of hardwood trees, an environment that favored the accumulation of only a small amount of organic matter and allowed thorough leaching and development of zones of eluviation and illuviation. Natural or geological erosion has prevented the formation of deep soils on the very steep slopes. This erosion has kept bringing new plant nutrients into use, and the weathering processes have kept just far enough ahead of the erosive process to develop a shallow soil, thus keeping the profile comparatively young at all times.

All the soils are more or less acid. Owing to the comparatively heavy rainfall, any lime in the form of calcium carbonate that may have formed in them from the parent material has been dissolved and carried away by water passing through the soil. Another common characteristic of the soils is their leached condition, especially in the eastern and western parts of the county. In the center, along the mountain ridges, this condition is not so noticeable. The heavy annual rainfall, mild temperature, and open friable consistence of the soils promote leaching. As the soils are frozen for only short periods during the winter, leaching continues throughout the greater part of the year. As a result of leaching, much of the soluble plant nutrients in the surface soil has been transferred to the subsoil or removed from the solum.

Relief is a very important factor in the formation of soils in this county. The steep to very steep slope induces both natural and accelerated erosion. Water runs off at a great velocity and carries with it large quantities of soil material. Good internal drainage has allowed oxidation and reduction to accomplish their parts in the soil-forming processes. This good drainage also gives the micro-organisms a good chance to do their work. These reactions and soil-forming processes have not yet come to a standstill but are still going on in a continuous soil cycle.

In the mountainous part of the county, where the typical normally developed mature soil occurs, Porters loam and Ashe loam most nearly represent the regional profile. Following is a description of a profile of Porters loam taken $2\frac{1}{4}$ miles north of California.

- 0 to 4 inches, dark-brown loam containing a large quantity of organic matter and many small roots.
- 4 to 40 inches, brown mellow friable porous clay loam containing numerous small roots. This material breaks down under slight pressure to a friable mass. There are no definite cleavage lines.
- 40 inches +, yellowish-brown friable clay loam with many fragments of rock and disintegrated rock and grading into hard broken rock with soil filling the interstitial spaces.

Table 9 gives a chemical analysis of a profile of Porters loam near Chimney Rock, Rutherford County, N. C.

TABLE 9.—*Chemical analyses of a profile of Porters loam near Chimney Rock, Rutherford County, N. C.*¹

Sample No.	Depth	Chemical analysis													Ignition loss	Total	N	CO ₂ from car- bonates	H ₂ O at 110° F.
		SiO ₂	TiO ₂	Fe ₂ O ₃	Al ₂ O ₃	MnO	CaO	MgO	K ₂ O	Na ₂ O	P ₂ O ₅	SO ₃							
236524	0-2	71.59	0.39	1.79	11.57	0.02	0.20	0.09	3.82	0.84	0.04	0.06	9.20	99.61	0.18	0.00	1.77		
236525	2-10	72.17	.45	2.61	14.68	.02	.16	.13	3.94	.74	.03	.04	4.81	99.78	.04	.00	1.43		
236526	10-36	60.83	.56	4.48	22.25	.05	(²)	.78	2.54	.35	.06	.03	7.69	99.62	.01	.00	1.43		
236527	36-54	65.46	.52	3.97	19.37	.06	(²)	.53	4.26	.44	.01	.05	5.42	100.09	.01	.00	1.11		
236528	54+	68.57	.46	3.21	17.35	.08	.09	.59	4.93	.62	(²)	.01	3.92	99.83	.00	.00	.72		

¹ Sample collected by R. C. Jurney and analyzed in the laboratories of the Division of Soil Chemistry and Physics, Bureau of Plant Industry, by G. Edgington.

² Trace.

The Ashe soils differ from the Porters in color and in elevation. The Ashe soils are light gray or grayish brown in the A horizon and yellow or brownish yellow in the B horizon; whereas the Porters are brown in the A horizon and yellowish brown or reddish brown in the B horizon. The Ashe soils generally occur on the higher mountaintops that are 3,500 feet or more above sea level, whereas the Porters soils occur at a lower elevation. The parent materials from which the soils of the two series are developed, however, are about the same.

The Halewood and Hayesville soils in the intermountain areas have normal soil profile development, except on some of the steepest slopes or in the most severely eroded areas. The Halewood soils differ from the Porters in that they occur at lower elevations, have a different soil profile, and have less fertility. The surface soil of the Halewood is grayish brown or gray, and the subsoil is yellowish brown or brownish yellow. They are not so friable or porous as the Porters. Susceptibility to erosion is greater and the productivity is less in the Halewood soil than in the Porters. The Hayesville soils have light-brown or grayish-brown surface soils in the loam and fine sandy loam types, with heavy brittle but friable red subsoils. In the clay loam type of the Hayesville series the surface soil is brownish red or red and the subsoil is the same as that under Hayesville loam. Like the Halewood soils, these soils are much more susceptible to erosion and are less productive, compared with the Porters. The Hayesville soil occurs at a lower elevation than the Porters. The Porters and Hayesville soils may be derived from the same type of parent material.

The Muskingum soils are derived from noncrystalline rocks, mostly slates, conglomerates, sandstones, quartzites, and shales. Muskingum fine sandy loam has a light-gray surface soil and a grayish-yellow or yellow friable loose subsoil. The Muskingum soils are less productive and more susceptible to erosion than the Porters and do not have normal development of a soil profile.

The surface soils of the Ramsey soils are light gray or yellowish gray and are underlain by yellow or grayish-yellow material. Below this is the parent material, which is composed of shale or sandstone fragments. This is a very shallow soil, the parent material in most places being within a few inches of the surface.

The Lebew soils are easily distinguished from the Porters and other soils, in that the surface soil is grayish-brown silt loam, from 2 to 5 inches thick, in forested areas and is underlain by purplish-red or Indian-red silt loam or silty clay loam with many shale fragments intermixed with the soil material. These shale fragments are the same color as the soil, which indicates that the soil inherited its color from the parent material rather than through the soil-forming processes. The Lebew soil is developed from the noncrystalline rock and from only one formation, the Rome. The Ramsey, Muskingum, and Lebew soils have very shallow solums, and the Ramsey and Muskingum may be considered AC soils so far as development of a profile is concerned.

Stony colluvium is a soil condition, and the material is derived from two different sources, residual and colluvial, or even alluvial. It represents material washed from Porters loam and has many angular and semiangular rock fragments on the surface and throughout the soil mass. In color it resembles the Porters soils. It occurs at the

bases of the slopes and contiguous to the heads of the small streams that rise within areas of the Porters soils.

The State and Holston soils have developed on low second bottoms and terraces. The State soils have brown surface soils and yellowish-brown friable silty clay loam subsoils. The materials from which the State soils have developed were brought down from the soils underlain by crystalline rocks. The Holston soils occur on the high terraces along the lower reaches of the French Broad River. They have developed from materials washed from the soils underlain by shales, slates, and conglomerates.

The soils in the first bottoms are the Toxaway, Congaree, and Pope soils, and alluvial soils, undifferentiated. The Toxaway soil has a black surface soil and a bluish-black subsoil, owing chiefly to poor internal and external drainage. The Congaree soils have brown surface soils and subsoils and contain considerable finely divided mica flakes. Alluvial soils, undifferentiated, have about the same color as the Congaree soils, but the texture is very mixed. Small areas contain the Toxaway soil or a Congaree surface soil and a Toxaway subsoil. The materials of the Congaree, Toxaway, and alluvial soils, undifferentiated, are derived from material washed from upland soils derived from crystalline rocks. The Pope soil is somewhat similar in color to the Congaree, but the material is derived from materials brought down and deposited by the streams, from areas of soil formed from the noncrystalline rocks. The Pope soils are not so fertile as the Congaree soils.

Rough stony land includes steep mountainous areas that are very stony and have numerous outcrops of solid rock. Most of the soil material included in this classification belongs to the Porters, Ashe, and Ramsey soils.

SUMMARY

Madison County is in the western part of North Carolina, bordering the Tennessee State line. Marshall, the county seat, is about 15 miles northwest of Asheville by air line. The county has an area of 450 square miles, or 288,000 acres.

This is considered one of the rough mountainous counties of the State. The relief ranges from hilly to steep for the intermountain area and steep and mountainous throughout the rest of the county. Some of the streams, particularly the French Broad River, have carved out very deep, narrow valleys, and the valley walls are in many places precipitous. All the upland area is naturally well to excessively drained, and even the soils developed in the first bottoms and on the terraces are, for the most part, well drained and suitable for agricultural purposes. The elevation of the county above sea level ranges from 1,259 to 5,168 feet.

The climate is healthful. The days are warm and the nights are cool throughout the summer. There is considerable difference, however, in the temperature and rainfall between the valley and intermountain areas and the highest mountains. Rainfall is fairly well distributed throughout the year, and the supply generally is abundant. The average annual snowfall is 18.2 inches.

The agriculture is mainly of a subsistence type. The chief sources of cash income are the sale of burley tobacco and beef cattle.

A comparatively large income is derived from the sale of poultry products and a smaller amount from dairy products. Some revenue is obtained also from the sale of lumber, cross ties, poles, tanbark, and other products of the forest. Many apples and a smaller quantity of peaches, grapes, and cherries are sold annually. Corn occupies the largest acreage of the crops commonly grown. Some wheat and a small quantity of oats are grown. Hay crops are important, because the hay is used for feeding cattle during the winter.

Much of the land now under cultivation is too steep to be cultivated and still maintain the soil. In many places, particularly in the intermountain area, both sheet and gully erosion are serious, and in some places the land has become so badly eroded as to be unfit even for pasture. The soils in general are low in organic matter. They range from medium to strongly acid in reaction. Throughout the greater part of the county the soils are dominantly loams underlain by friable clays or clay loams. Particularly is this true of the Porters and Ashe soils. Many other soils are inherently good but are barred from crop production because of steepness of slope.

The soils of Madison County have been placed in six groups: (1) First-class soils, (2) Second-class soils, (3) Third-class soils, (4) Fourth-class soils, (5) Fifth-class soils, and (6) miscellaneous land types.

Congaree silt loam; Porters loam, slope phase; State loam; State loam, slope phase; and Hayesville loam are members of the first class. These soils constitute the best agricultural lands and are generally the most fertile soils in the county. They occupy the smoothest relief; that is, they lie favorably for farming operations, although the Hayesville and Porters soils are on sloping relief. The principal crop is corn, and some tobacco and wheat are grown. These soils produce hay of good quality.

The second class comprises Hayesville clay loam; Holston fine sandy loam; Toxaway silt loam; Pope fine sandy loam; alluvial soils, undifferentiated; and Halewood loam, slope phase. Most areas of these soils are either under cultivation or in pasture. They are not considered quite so productive as the soils in the first class, but in some instances just as large yields have been obtained from some of these soils as from the soils in the first class, owing to proper management and fertilization. The Hayesville soils are sloping to hilly and are subject to serious erosion under clean cultivation.

The third class includes Congaree loamy fine sand; Porters loam, hill phase; Holston fine sandy loam, slope phase; Ashe loam, hill phase; and Halewood loam, hill phase. These soils, with the exception of Congaree loamy fine sand, occur on relief ranging from 7 to 30 percent slope. Agricultural operations on the soils of this group are restricted because of the steep slope and the susceptibility to erosion under clean cultivation. In general, the Third-class soils are less productive and more difficult to handle and are cultivated to less extent than soils of the first and second classes.

In the fourth class are Hayesville clay loam, hilly phase; Hayesville clay loam, eroded steep phase; Porters loam; Halewood loam; Ashe loam; stony colluvium (Porters soil material); Ramsey loam,

hill phase; and Muskingum loam, hill phase. The slope of the hilly phases ranges from 15 to 30 percent, whereas that of the other types and phases ranges from 30 to 60 percent. Where clean cultivation has been practiced for several years, particularly on the Hayesville soils, much sheet erosion and gulying have taken place. Although the soils in this group are used to some extent for general farming, it is generally thought that they are best suited for pasture grasses. Most of the soils in this group produce an excellent quality of pasture grass, especially where the soil has been given an application of lime and superphosphate.

The soils comprising the fifth class are Hayesville clay loam, gullied steep phase; Porters loam, very steep phase; Porters stony loam; Porters stony loam, very steep phase; Muskingum loam; Muskingum loam, very steep phase; Muskingum fine sandy loam; Ramsey loam; Ramsey loam, very steep phase; Halewood loam, very steep phase; Ashe loam, very steep phase; Ashe stony loam; Ashe stony loam, very steep phase; and Lehew silt loam. These soils are developed on the mountains and occur on the steepest relief in the county. The slope ranges from 30 to 90 percent or more. This land is too steep for farming purposes, and most of it is too steep for successful pastures; therefore the best use for these soils, under present economic conditions, is for forest.

Miscellaneous land types include rough gullied land (Hayesville soil material); rough stony land (Porters soil material); rough stony land (Ramsey soil material); rock outcrop; and riverwash. These classifications of material occur on the steepest, roughest, and most stony parts of the mountainsides, crests of mountains, and knobs. In places the walls are precipitous. Only a small part of these lands is suitable for forest, as there are large outcrops of solid rock, and in many places there is only a shallow covering of soil over rock.

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