

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE WEST VIRGINIA GEOLOGICAL SURVEY;
I. C. WHITE, STATE GEOLOGIST.

SOIL SURVEY OF NICHOLAS COUNTY,
WEST VIRGINIA.

BY

S. W. PHILLIPS.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1920.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1922.

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ALBERT G. RICE, *Assistant to Chief.*

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., November 22, 1921.

SIR: I have the honor to transmit herewith the manuscript report and map covering the soil survey of Nicholas County, West Virginia, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1920, as authorized by law. This work was done in cooperation with the West Virginia Geological Survey.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. H. C. WALLACE,
Secretary of Agriculture.

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SOIL SURVEY OF NICHOLAS COUNTY, WEST VIRGINIA.

By S. W. PHILLIPS.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Nicholas County, West Virginia, is situated in the south-central part of the State, about 30 miles from the Virginia State line. Gauley River and its tributary, Meadow River, form the line between Nicholas and Fayette Counties on the southwest. All other boundaries follow survey lines. Summersville, the county seat, is about 80 miles southwest of Clarksburg and 60 miles due east of Charleston. The county is in the shape of an irregular diamond, with its longer axis, 43.3 miles, extending east and west, and the shorter, 33 miles, extending north and south. It has an area of 657 square miles or 420,480 acres.

Nicholas County lies in the Cumberland Plateau or Western Division of the Appalachian Province. The surface is that of a dissected elevated plain or plateau, the lower hills and ridges being remnants of an old peneplain formed during the Carboniferous period of geological history. This was gradually elevated, and subsequent erosion has cut out deep valleys and left ridges and peaks. The original elevation was not uniform, but was greatest in the southeast, where the ridges now attain heights of 3,000 to 3,500 feet, with a few peaks along the Webster County line reaching 3,850 feet. The general level dips to the northwest, the general height of the ridge crests which overlook Birch River and Strange Creek along the Clay and Braxton County line, reaching 1,700 to 1,800 feet. The old peneplain, which did not reach a mature stage, contained a number of outliers or monadnocks, among which, in the area north of Gauley River, were Cottle and Corren Knobs and Powell Mountain, remnants of a more ancient land surface. South of Gauley River were Fowler Knob, Mount Nebo, Pine Ridge, Bearhole Ridge, Coggins Knob, and Shawver Ridge, all remnants of the pre-Cretaceous period. The hard underlying sandstones have kept the streams

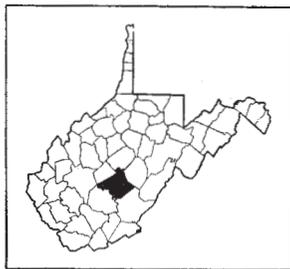


FIG. 1.—Sketch map showing location of the Nicholas County area, West Virginia.

from cutting back, so that the old peneplain is well preserved from Cottle Glades to Keslers Crosslanes, and is also seen around Nettie, Canvas, Mount Lookout, and Runa. This former base level is evidenced by meanders of streams which must have been started in the Cretaceous peneplain and continued during the uplift.

The northwestern part of the county, which is drained by Twenty-mile Creek, is characterized by narrow stony ridge tops, steep, precipitous stony slopes, and narrow V-shaped valleys whose floors are 800 to 1,000 feet below the ridge crests. To the north and east in Hamilton District the ridge tops are broader and more rolling, though stony, with steep precipitous slopes. In the central part of the county the hills and ridges are smoother, the slopes less steep, and the valleys U-shaped, the floors being 500 to 600 feet below the crests. Near Gauley River the streams have cut narrow, deep, often gorge-like valleys into the sandstone in making the abrupt descent. South of Gauley River the valleys are generally V-shaped, with steep stony slopes, but the mountain tops are broad and smooth.

Indistinct remnants of old terraces are found, but they are so thin and so obscured by erosion, and their material is so intermingled with soil materials brought down from adjacent slopes, that they have lost their character as terraces and are included with the upland soils.

The area is free from faults. The rocks rise to the southeast, and as a result several of the coal-bearing strata and the Eagle coal "overshoot" the ridges southeast of Summersville, and the Sewell coal and the New River group are brought "above drainage."

Several slight anticlines and thin shallow synclines cross the western part of the county in a general north-south direction. The first extends from the head of Leatherwood Creek near the Clay County line southwest across Twentymile Creek, passing west of Lockwood and across Gauley River southwest of the mouth of Peters Creek. The Clifftop syncline originates 3 miles northwest of Summersville at the head of Pine Run and passes just east of Keslers Crosslanes and Carnifex Ferry into Fayette County. Several other minor anticlines parallel these two. The Webster Springs anticline enters the county in the extreme eastern end from Webster County, about one mile north of Hanging Rock, and passes in a southwesterly direction into Greenbrier County north of the North Fork of Cherry River.

The highest point in the county is at Hanging Rock, where Nicholas, Webster, and Greenbrier Counties corner, with an elevation of 3,850 feet. Other knobs and ridges along the Webster and Greenbrier County lines attain heights of 3,000 to 3,800 feet above the sea. The extreme range in elevation in the county is nearly 3,200 feet.

All of Nicholas County is drained into the Kanawha River. The Gauley River drains about 80 per cent of the county, the central and

southern parts, and empties into the Kanawha at Gauley Bridge. In the north, Birch River with its tributaries, and Strange Creek and several tributaries of Buffalo Creek, carry the drainage waters into Elk River, which empties into the Kanawha near Charleston.

With the exception of Beaver and Muddlety Creeks, all of the streams in Nicholas County are clear, swiftly flowing mountain streams with rocky or gravelly beds. Many of them have small waterfalls, cascades, and rapids. With the cutting of the forests the run-off is practically unchecked, and rapid rises in the streams are of common occurrence. As a result considerable damage is done to crops along those streams that have agriculturally important bottom lands. Beaver and Muddlety Creeks meander sluggishly through their wide bottoms. The fall is not sufficient to keep their channels cleared, and poorly drained areas are numerous along their courses. This is also true of streams in the glade district in the eastern part of the county near Allingdale. Where they descend into Gauley River, however, their valleys narrow abruptly, and their currents become swift and powerful. None of the streams have reached base level, and although Beaver and Muddlety Creeks have attained an approximate base level along the central part of their courses, in their upper courses all of the branches and streamlets are actively cutting down their beds.

A network of small drainage ways radiates to nearly every section of the county. Springs are numerous on the hillsides and at the base of hills, and practically every farm is traversed by one or more streams, which simplifies the problem of a supply of water for stock. Many of the small streams go dry during part of the year.

Enough water power is developed from Muddlety Creek to furnish electric power and light for Summersville as well as for a grist mill and flouring mill. Although subject to a wide fluctuation in water level, Gauley River and its larger tributaries offer great opportunities for the development of water power for local use.

Nicholas County was formed from Greenbrier County by an act of the Virginia Assembly in 1818. The first permanent settlement was made near Lockwood, about 1802, by settlers from eastern Virginia. Later immigrants from Virginia and western Kentucky, seeking new hunting grounds, came in, and settlements sprang up along Peters Creek and Strouds Creek. Summersville was established in 1820 by the Virginia Assembly, but was not incorporated till 1860. Parts of Nicholas County were cut off when Webster, Braxton, and Clay Counties were formed.

The present inhabitants are largely descendants of the early settlers, though the lumber camps and mills and coal mines have at-

tracted considerable outside labor, much of which is from foreign countries. The negroes are comparatively few in the county.

The population of Nicholas County, according to the 1920 census, is 20,717. It has increased 17 per cent since 1910.

The population in the county as a whole is sparse, settlement being confined chiefly to the creek and river valleys and rolling plateau land through the central part. Large areas in the rough, hilly sections along the Clay County line and in the northern part in which Muddlety, Powell, Anthony, and Poplar Creeks rise, have very few inhabitants. The same is true of the broken, mountainous country in the southern and southeastern sections from which the timber has been removed. Cherry River valley, which includes Richwood, and the smoother high plateau land around Summersville are the most densely populated areas.

Richwood is the largest town in the county, with a population of 4,331. It was incorporated in 1901 and has grown rapidly with the construction of large lumber and paper mills and other industries dependent upon the forests in the neighboring mountains. It has a large tannery, a paper mill, several lumber mills, and a clothespin factory. It is the terminus of the Richwood Branch of the Baltimore & Ohio Railroad.

Summersville, the county seat, is the oldest town, having been established in 1820. It has a population of 279. Some fifteen other villages are situated in various parts of the county.

The greater part of Nicholas County is rather distant from railroads. The eastern part depends upon the Richwood Branch of the Baltimore & Ohio Railroad, with a total of 18 miles of track in the county. The western part of the county is served by the branch of the Kanawha & West Virginia Railroad. The Chesapeake & Ohio Railway from Gauley Bridge crosses Gauley River at Belva and passes up Twentymile Creek to Vaughan and Bintree. In addition to these there are several lumber and coal roads, some of which carry passengers and freight and are a great convenience to the farmers in the various sections of the county.

Mail hacks and taxi lines operate between Summersville and Camden on Gauley, on the Baltimore & Ohio, and Belva, on the Chesapeake & Ohio. Most of the mail for the county is redistributed from Summersville by rural free deliveries and mail riders.

The roads are generally rough, and with a few exceptions do not receive much attention. A comprehensive plan for intercounty roads has been laid out, and first-class roads will be built as rapidly as money becomes available. County roads form a network over the county, except in the mountains and unsettled sections. Some of the roads built in creek bottoms are practically washed out with each flood. The most important road which was traveled before the ad-

vent of the railroads was the Weston and Gauley Bridge road, surveyed in 1851, which enters the county from Braxton County, north of Birch River village, crosses Powell Mountain, passes down Muddlety Creek to Summersville, into Peters Creek Valley, and down along Gauley River from Swiss to Gauley Bridge. Other important roads still in use are the Summersville and Slavins Cabin road or Webster road from Summersville, via Nile, Beaver, and Camden on Gauley, across into Pocahontas County; the Nicholas road which enters at the extreme southern point near Bamboo, from Greenbrier County; the Clay Courthouse road from Muddlety Valley near Muddlety Creek to Dade into Clay County; and the Greenbrier road which runs south from Richwood across the mountains into Greenbrier County.

Near the railroads the telephone service is well established, but throughout the county local telephone companies supply a very limited service.

Richwood, Summersville, Camden on Gauley, Tioga, Swiss, and Vaughan are the principal local markets. The lumber camps and coal mines also draw heavily on local produce, and farmers favorably located have a ready market for all surplus meats and vegetables. Cattle and sheep gathered from Muddlety and Beaver Valleys, the chief cattle districts of the county, are shipped from Camden to Pittsburgh and Baltimore, the most important outside markets. Practically no grain, hay, or other farm produce, except live stock, is shipped out of the county.

CLIMATE.

Nicholas County has a temperate climate. The summers are pleasant, with cool nights and only occasional hot spells of short duration. At Holcomb, in Cherry River Valley, at an elevation of 2,042 feet above sea level, the mean annual temperature, as recorded at the Weather Bureau station, is 51° F. The maximum temperature recorded during a period of 8 years is 101° F. in August. The mean temperature for June, July, and August is 68.4° F.

The winters are long and cold, with considerable snow, but usually are not as severe as those in the higher sections of the eastern and northern parts of the State. The lowest recorded temperature is -22° F., in December, and the mean for the winter season is 31.9° F. February, with a mean temperature of 31.1° F., is the coldest month of the year.

The average annual precipitation is 53.31 inches, rather evenly distributed throughout the year. The heaviest rainfall occurs during the spring and summer seasons when most needed by growing crops and pastures. In 1914, the driest year since the establishment of the station at Holcomb, the precipitation was 45.34 inches, the

greatest deficiency in rainfall occurring in the months of May and June, with a total of 6.16 inches less than the average for these two months.

Autumn is the driest season of the year, but there is usually sufficient precipitation to keep pastures green until frost. Floods generally occur during the winter and spring, with the melting of the snow in the mountains. The average annual snowfall is 70.5 inches, of which 59.7 inches falls during December, January, February, and March, the heaviest average fall being recorded for March.

The average date of the last killing frost in the spring is May 15, and that of the first in the fall, September 25, giving an average growing season of about $4\frac{1}{2}$ months. Killing frosts have occurred as late as June 11 and as early as September 12, and the growing season has varied from 103 to 175 days.

The climate of this region is favorable for general farming, stock raising, and the production of orchard fruits, especially apples.

The following table contains data taken from the records of the Weather Bureau station at Holcomb:

Normal monthly, seasonal, and annual temperature and precipitation at Holcomb.

(Elevation, 2,042 feet.)

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1914).	Total amount for the wettest year (1918).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	32.3	74	-22	3.61	5.21	5.34	15.4
January.....	32.2	78	-12	5.39	4.38	5.13	14.7
February.....	31.1	77	-7	3.49	2.66	3.00	13.3
Winter.....	31.9	78	-22	12.49	12.25	13.47	43.4
March.....	37.0	81	-2	5.76	4.48	9.37	16.0
April.....	49.8	91	17	4.23	6.66	5.68	3.7
May.....	59.7	92	25	4.66	1.75	4.96	0
Spring.....	48.8	92	-2	14.65	12.89	20.01	19.7
June.....	66.0	95	33	4.30	1.05	6.39	0
July.....	69.9	95	40	6.12	4.45	4.65	0
August.....	69.3	101	40	4.79	7.51	5.00	0
Summer.....	68.4	101	33	15.21	13.01	16.04	0
September.....	62.3	92	29	4.21	2.62	4.10	0
October.....	53.4	88	18	3.99	3.51	4.95	1.6
November.....	40.8	76	4	2.76	1.06	2.38	5.8
Fall.....	52.2	92	4	10.96	7.19	11.43	7.4
Year.....	51.0	101	-22	53.31	45.34	60.95	70.5

AGRICULTURE.

The first settlers came into Nicholas County early in the nineteenth century and located near the present village of Lockwood. Wild game was abundant, and hunting and trapping constituted the chief pursuit of the pioneers. Markets were remote and transportation difficult, so that the settlers were, of necessity, self-dependent for subsistence. Corn, small grains, and vegetables were grown, chiefly in the cleared areas in the bottoms about their homes. A few cattle and sheep were kept. Furs and skins formed an important means of exchange for the few necessities which were brought in once or twice a year from Gauley Bridge and Charleston. These conditions continued without great change until the advent of the railroads about 30 years ago, when the development of the timber resources of this part of the State began. Then the lumber and railroad camps afforded markets for surplus produce, which was gathered up by itinerant peddlers or local storekeepers and hauled to Gauley River points and even to coal-mine towns and camps as far as the New River. Lumber roads were built up the valleys as feeders to the lumber mills located on the Baltimore & Ohio and the Chesapeake & Ohio Railroads. Large tracts of forest have been cut over, but lumbering still constitutes the most important industry in the county. Pulpwood for the paper mills and staves and ties are also taken out in large quantities. Some coal is mined in the county along Bells and Twentymile Creeks. This is hauled by the Chesapeake & Ohio Railroad. Other commercial mines are in operation at Tioga in the northeastern part of the county, and at Saxman and other points on Cherry River and its tributaries near the Baltimore & Ohio Railroad. Local needs for coal throughout the county are served by mines that depend upon wagons to transport their product.

The present agriculture consists of general farming combined with some stock raising. The county is not agriculturally self-sustaining, and many of the mines and lumber camps ship in the greater part of their food supplies.

Corn is the principal cultivated crop, but production is usually insufficient for all home needs. In 1919 it was grown on 8,657 acres and produced 227,052 bushels, or an average of 26.23 bushels per acre.

Oats occupied 4,802 acres in 1919, and yielded an average of 16.9 bushels per acre. Much of the oats is cut green and fed in the sheaf. The area in wheat was 4,612 acres and the yield $10\frac{3}{4}$ bushels per acre. In the same year there were 995 acres in buckwheat, 104 acres in barley, and 167 acres in beans.

Tame grasses were grown on 11,966 acres in 1919, and yielded 10,982 tons of hay. A little more than half of this consisted of

timothy and clover mixed. Wild hay was cut on 933 acres, yielding 724 tons. Silage crops were grown on 175 acres, producing 1,040 tons of ensilage. Corn cut for forage occupied 833 acres.

The acreage in potatoes in 1919 amounted to 530 acres, and the average yield was 100 bushels per acre. Sweet potatoes were grown on 30 acres, and other vegetables occupied 61 acres.

Sorghum is grown on many farms for the production of sirup for home needs. Tobacco was a very important crop before the Civil War, but its cultivation was discontinued later, and it is now seen only in small patches grown for home use.

Tree fruits, especially apples, are grown in all sections of the county, but not commercially, except in a small way in the vicinity of Richwood. Apples of excellent color and flavor can be produced where proper care is given to the orchards. Peaches and cherries are also grown in the home orchards, as well as some grapes and berries.

Cattle and sheep raising are the most important live-stock industries. Beef cattle are fed in some numbers, especially in the Mud-dlety and Beaver Valleys, where hay and excellent pasturage are abundant. The stock consists chiefly of grades, with a few Short-horn, Hereford, and Angus sires. As the winters are severe, it is not customary to winter large numbers of cattle, and only a few for local use are fattened. The animals are shipped to Harrison County and other more northern counties, which have bluegrass pastures and are heavier corn producers, where they are prepared for market. Calves, however, are shipped direct to the Pittsburgh and Baltimore markets. Dairying is not important, being carried on principally to produce milk for family use, any surplus finding ready sale in the shape of butter in the near-by villages and towns.

Considerable numbers of sheep are kept in the county, the forested and the rough and cut-over lands affording excellent grazing areas. The sheep are of the coarse-wool, mutton types.

Most farms have a few hogs. In the past the chestnut forests have usually afforded sufficient mast in the fall, so that little corn was required to fatten them, but the cutting of the timber has greatly reduced this source of feed. Poultry and eggs provide a considerable part of the farm income.

Topography influences the agriculture of the area much more than does the soil. Many steep slopes are cultivated or used for pasture. Some of these are entirely too steep, and erosion eventually will do serious damage to many. There are numerous precipitous slopes where tillage is impossible or impracticable. Some of these are not particularly stony; others are so stony as to preclude profitable utilization except for forestry or grazing, even if the surface were less sloping. Land which is topographically suited to tillage is used

for all crops grown in the region without much regard to crop adaptation. As a matter of fact, a very large proportion of the agricultural land consists of soils having the same general characteristics with a narrow range in texture or from loam to silt loam. What difference exists in value is largely determined by the degree of slope and the greater or less abundance of rock fragments.

The Muddlety and Beaver bottoms are recognized as best suited to hay on account of the imperfect drainage of much of the alluvial soil. In other parts of the county the bottom soils are more extensively used for the general crops, because of their ease of cultivation and accessibility, although the crops are likely to be injured by unseasonable frosts and floods. Stacks of hay are a characteristic feature of the landscape during fall and winter in the cleared valleys.

The smoother slopes, gently rolling uplands, and hill crests in the central and southwestern parts of the county are the most desirable locations for corn and small grains, because horse-drawn and power farm implements can be used. In the rougher, more broken sections the steep and stony slopes preclude the use of improved farm machinery. Here cultivation is done with light shovel plows and hoes, seeding and planting are done by hand, and grain crops are harvested with scythes and cradles.

No regular crop rotation is followed. Corn or the small grains are grown successively in the same field for several years before a change is made. Grass is usually seeded in buckwheat, which is cut early in the fall, thus allowing the grass to make a vigorous growth before winter. It is a common practice to delay haying until the seed becomes ripe and falls in order to reseed the meadows, and the resulting hay is more woody and less nutritious and palatable than if it were cut earlier. Bushes, weeds, and close grazing apparently have caused considerable deterioration in many pastures. Much improvement could be brought about by removing the bushes and by taking the stock off at intervals to allow the sod to recuperate. No information is available as to what profit might accrue from the use of fertilizers on sod.

Work stock consists chiefly of horses of light to medium weight. Some mules and oxen are also in use.

Since the stock is not confined, very little barnyard manure is accumulated on the farms. The available manure is generally applied on the corn land or on bare spots in the mowings. Fertilizers, chiefly of acid phosphate, are in general use throughout the county. They are applied at the rate of about 400 pounds per acre on corn and 200 on oats, wheat, and other small grains. Expenditure for fertilizers in 1919 amounted to \$62,828, for 1,162 farms reporting. Lime has produced excellent results where applied, but because of the long hauls its use has not been considerable.

Most of the farm work is done by the farmer and his family, and little hired help is used except at harvest time. The lumber camps and public works compete for the available labor, so that farm help is scarce and costly. Less than 30 per cent of the total number of farms report an expenditure for labor in 1919, the total spent amounting to \$35,721.

Large tracts of land are held by lumber and coal companies, and development of these is slow on account of the lack of railroad transportation. About 35 per cent of the entire area of the county is included in farms. There are 1,670 farms, with an average size of 92 acres, about 55 per cent of which is classed as improved land.

Over 88 per cent of the farms are operated by their owners. Of the farms leased, more than half are rented for cash.

Farm land ranges in value from \$20 to \$100 an acre, depending upon its location with reference to towns, the topography and character of the land, and the value of the timber on it and the coal seams under it. The highest prices are obtained for farms located in the smooth plateau section in the center of the county.

SOILS.

Nicholas County lies wholly within the Cumberland Plateau division of the Appalachian province. Its soils are residual and alluvial. Excluding Rough stony land, 11 types and 1 phase are mapped, four of which are alluvial and the others residual; that is, derived from the breaking down of consolidated rocks in place. The upland or residual soils have been derived from the weathering of interbedded sandstones and shales, the alluvial soils from materials washed from the uplands.

The principal geological formations which have given rise to the residual soils are the Conemaugh, Allegheny, Pottsville, and Mauch Chunk. The Conemaugh consists of alternate layers of gray sandstone and red shales, interbedded with gray shales. This formation outcrops, entirely above drainage, in the extreme northern part of the county. The materials coming from this formation form the Upshur and Meigs soils where the rock consists of red shale, and the Dekalb soils where the shale is gray. The Allegheny occupies the lower slopes of the hills capped by the Conemaugh. It is composed of gray sandstone and shale, which attain a thickness of about 300 feet in the county, the proportion of sandstone being larger than in the Conemaugh. It occupies more than half the area of the county and gives rise principally to silty soils, including most of the soils north of Gauley River. The Pottsville formation, composed of two divisions—the Kanawha and New River groups—is exposed below the Allegheny. It consists largely of sandstone and gives rise to Dekalb soils of

loam and silt loam texture. It occupies practically all of the county south of Gauley River and also includes some of the stony eroded areas along the northern side of the river. The valleys are V-shaped, with rough stony slopes. The Mauch Chunk formation, consisting mostly of red shale and sandstone, lies below the Pottsville. It outcrops for only a short distance along the lower slopes of the South Fork of Cherry River, in the southeastern part of the county. It is covered with detritus from the Pottsville formation above, and its extent in the county is so limited that it has very little influence on the soils.

The character of the underlying rocks has a direct influence upon the topography of the country as well as upon the soils. Where shale predominates, the slopes are smooth, though they may be steep, and the soils are largely silt loam; and in flattish areas the subsoil may be rather heavy and the underdrainage somewhat deficient. On the other hand, where sandstone constitutes the chief source of material, steep to broken topography results, the surface is commonly strewn with stony fragments and rock outcrops and areas of Rough stony land are encountered, the soils ranging from small spots of sandy or stony sandy loam to silt loam.

Erosion has caused considerable damage to many slopes that have been under cultivation and to some slopes which have been used chiefly for pasture, by gradually washing away the soil—in some instances down to the bedrock. A great many slopes are entirely too steep for cultivation and should either be left in forest or be kept well grassed for pasture by clearing off the brush at intervals and taking off the stock long enough to give the grass opportunity to reestablish a good sod. Other slopes less steep could be protected by terracing. On the whole, however, erosion has not as yet produced as much gulying as in many parts of the United States, even where the surface slope is less gradual. This may be due partly to protection of the land by winter freezing and partly to the capacity of the soil to absorb rainfall, owing to porosity resulting from the presence of rock fragments.

Although soils derived from sandstone are usually coarser than those derived from shale, the soil material in this county is predominantly high in silt. In places silt loam is found above sandstone, and there is usually considerable silt, even in the loam type, in places where the parent rock contains more sandstone than shale. This high silt content is due to the fact that there is so much shale interbedded with the sandstone that very little of the soil material is derived from pure sandstone.

Soils are grouped into series on the basis of origin, color, topography, and structural characteristics. The series are divided into soil types on the basis of texture.

The upland soils are grouped into four series, the Dekalb, Lickdale, Upshur, and Meigs.

The soils of the Dekalb series have been derived from gray sandstone and shale and are characterized by gray to light-brown surface soils and a brownish-yellow to yellow subsoil. They are generally well drained, as they vary from steep precipitous mountain slopes to gently rolling or flat and shelflike surfaces. They are moderately productive. Four types and one phase occur in the county; the stony loam, stony silt loam, loam, and silt loam, and the smooth phase of the silt loam. The silt loam, including its smooth phase, comprises the most important and extensive agricultural soil.

The Lickdale series, closely allied with the Dekalb and derived from the same materials, consists of types characterized by grayish to yellow or yellowish-brown surface soils and a yellow mottled subsoil. It occupies benchlike or gently sloping positions at the base of slopes adjacent to bottom soil of the Atkins series and flattish areas on the divides between streams or around stream heads. The series is represented in this county by the silt loam.

The Upshur series is characterized by dark-red to Indian-red surface soils and subsoil. Red shale and sandstone of the Conemaugh formation give rise to the silty clay loam type, the only member of this series that occurs in Nicholas County. It occupies knobs, ridge crests, and mountain tops in the extreme northern part of the county along the Strange Creek and Birch River valleys.

The Meigs series, represented by the clay loam type, consists of undifferentiated Upshur and Dekalb materials in areas occupying positions similar to those of the Upshur. The types usually have brown or yellowish-brown surface soils underlain by the typical red Upshur subsoil.

Besides these series distinctions in the uplands, a classification designated Rough stony land includes areas so stony in character as to render impossible their use for agriculture.

The alluvial or bottom soils are grouped in the Pope and Atkins series. These soils are derived from alluvial deposits washed from the same upland soils, differences in drainage being chiefly responsible for differences in the soils necessitating their separation into two series. The Upshur and Meigs soils are so limited in extent that wash from them has had little or no effect on the adjacent bottom land soils.

The soils of the Pope series are characterized by brown surface soils and a yellowish subsoil. They are subject to overflow, but are well drained between periods of high water. The types of the Pope series mapped in Nicholas County are the loam, silt loam, and sandy loam, the sandy loam being the most extensive.

The soils of the Atkins series are characterized by light-gray to brownish-gray surface soils and a mottled gray and yellow, rather heavy subsoil. The soils occupy bottom lands with poor drainage, to which fact the color is due. Only one type, the silt loam, is mapped.

The following table gives the actual and relative extent of the different soil types mapped in this county :

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dekalb stony silt loam.....	165,248	39.3	Lickdale silt loam.....	1,216	0.3
Dekalb silt loam.....	114,112	31.4	Pope loam.....	1,024	.2
Smooth phase.....	17,920		Upshur silty clay loam.....	704	.2
Dekalb stony loam.....	73,984	17.6	Pope silt loam.....	384	.1
Dekalb loam.....	18,752	4.4	Meigs clay loam.....	256	.1
Rough stony land.....	14,208	3.4			
Pope sandy loam.....	9,408	2.2	Total.....	420,480
Atkins silt loam.....	3,264	.8			

DEKALB STONY LOAM.

The Dekalb stony loam consists of stony areas of Dekalb loam. The soil to a depth of 4 to 6 inches is a brown or yellowish-brown mellow loam, and the subsoil is a yellow to yellowish-brown friable sandy clay loam, silty clay loam, or sandy clay. Fragments of sandstone of all sizes are distributed over the surface and are mixed in the soil and subsoil in quantities sufficient to interfere with cultivation. The depth to bedrock usually ranges from 5 or 6 inches to 15 or 20 inches, the depth averaging less than in the case of the Dekalb loam. The topography in most places is steeper than that of the loam, and much of the type occurs on sharp slopes below the gentler upper slopes and ridge crests occupied by the loam. There are occasional outcropping ledges of sandstone, and fragments of shale are frequently present in both the soil and subsoil. Where the surface is not too steep, the land can be utilized after removing the larger stones. In the broken, severely dissected parts of the county the stony loam in places occupies the upper slopes and caps of the ridges, while the slopes lower down, being derived largely from shales, are occupied by Dekalb stony silt loam.

The type is found in all parts of the county, the most extensive areas being in Wilderness District and in Hamilton District. In the former section the areas occupy slopes below the Dekalb loam and in the latter, tops and parts of the slopes of ridges bordering Birch River.

The texture varies considerably, and the type includes patches of stony sandy loam, gravelly loam, stony silt loam, and areas of Rough stony land too small and unimportant to be mapped separately. The run-off is rapid, erosion is usually active in cultivated fields, and crops suffer during dry seasons for want of moisture.

A large part of this type still remains in forest, though much of it represents cut-over land that has grown up with thickets of young hardwood saplings, rhododendron, and mountain laurel.

The greater part of this type is too steep and stony for profitable cultivation. On areas that are farmed only the lightest of farm implements can be used, and most of the work must be done by hand. By allowing the land to revert to forest another timber crop can be cut off in 25 or 30 years, if care is taken to protect it against forest fires. Much of the type in the southeastern and southern parts of the county and in the north along Birch River and Twentymile Creek is included in the large holdings of lumber and coal companies and probably never will be permanently cleared, at least not until the development of mining begins. The forest growth includes chestnut, several varieties of oak, some pine, holly, hemlock, maple, dogwood, mountain laurel, rhododendron, beech, tulip poplar, black gum, elm, ironwood, basswood, cucumber tree, hickory, paw paw, buckeye, and on the lower slopes an occasional birch.

When cleared this soil affords good pasture for cattle and sheep, although erosion often limits such use to a few years. Corn, oats, and buckwheat are the principal crops cultivated, and yields of 15 to 30 bushels of corn and 12 to 20 bushels of oats per acre are obtained. Practically no manure or other fertilizer is used. The air drainage is excellent. Apples and peaches could be grown in the more favorable locations, and grapes would succeed, even on the steeper slopes.

DEKALB STONY SILT LOAM.

The soil material of the Dekalb stony silt loam is essentially identical with that of the Dekalb silt loam, differing only in the quantity of rock fragments present. The stony silt loam consists of brown to yellowish-brown stony silt loam, grading at depths of about 2 to 5 inches into a yellow or pale-yellow silty clay which is usually friable, owing to the presence of partly decomposed shale and sandstone fragments. In many places the surface material also is yellow silt loam. Bedrock, consisting of shale and sandstone, is encountered at depths ranging from 4 to 5 inches to about 20 inches. There are occasional outcrops of these rocks, and slabby fragments of sandstone and smaller fragments of shale are abundant over the surface and throughout the soil and subsoil. On the steep slopes, such as are usually occupied by this type, narrow belts and small patches of

loam, fine sandy loam, or sandy loam, and the stony variants of these are encountered, but they are not mapped on account of their small size.

There are some included small areas of soil consisting of dark-gray or dark-brown to black mellow loam 3 or 4 inches deep, overlying a brownish-yellow subsoil. An area of probably 15 or 20 acres near the top of the high mountain on the west side of the highway near Swiss consists of dark-brown to black mellow loam of high organic matter content (6.68 per cent carbon), overlying, at 6 to 12 inches, brown very friable loam. The dark color of these areas, which occur in shelf positions upon the gentler slopes and in mountainside drainage ways or coves, is due to the presence of a large quantity of decomposing vegetable matter derived from the mantle of leaf mold under moist conditions. In some of the areas this color may be partly due to material washed from coal seams outcropping at higher elevations, but this is not the case in areas like that near Swiss. Seepage, or whatever causes the moist condition, seems to account for the dark color. This soil would have been mapped as a distinct type if it had been of sufficient extent. Where accessible, this soil has been cleared of trees and stones and is highly valued for growing potatoes and corn.

The type characteristically occupies very steep slopes flanking the sharp, narrow ridges occupied by the Dekalb stony loam and the relatively flat-topped ridges of silt loam. In places it occupies both the slopes and crests of ridges and mountains. The greater part of it is too steep for cultivation and also too stony, and occasional included areas that could not be satisfactorily separated approach in character the Rough stony land, with here and there sheer rock cliffs.

The Dekalb stony silt loam is the most extensive type in Nicholas County. It occurs in large areas in every district, but especially in the rough broken section in the northern and northwestern parts along the Clay and Braxton County lines, and in the southern and southeastern parts along the Greenbrier and Webster County lines. It is very largely forested with a growth like that on the stony loam. Mountain laurel and rhododendron are abundant, and in the cut-over areas they form a dense, almost impenetrable thicket.

The type has good surface and internal drainage. It washes readily, and, after clearing, the top soil is rapidly removed. Only a small proportion of this type has been cleared and placed under cultivation. The steepness and stoniness of the land prohibit the use of machinery. Most of the cultivation is done by hand and small grains are harvested with a cradle. The largest part of the cleared area is in permanent pasture. Corn is the leading tilled

crop. It yields 15 to 35 bushels per acre. Some small grains, oats, wheat, and buckwheat are grown, but yields of these are small. Timothy, redtop, and orchard grass are the principal sources of hay.

Practically no manure or other fertilizer is used on this type, because of the difficulty of hauling and spreading it and because the farmers consider that it is not profitable, since a large part of such added material is soon leached away in the drainage waters. After a few years of cultivation the type is seeded to grass and used for grazing, for which it is better suited than for anything else except forestry. Where fields are farmed longer than a few years, or severely grazed, they often become so eroded that they are practically valueless for agriculture and are abandoned and allowed to revert to forest. The forest growth should never have been removed entirely from much of the type that has been cleared.

Land of the Dekalb stony silt loam ranges in value from \$10 to \$50 an acre, depending on the topography, the timber growth, and the prospects of coal.

DEKALB LOAM.

The surface soil of the Dekalb loam consists of a brown to yellowish-brown loam which passes at depths of 5 to 8 inches into a yellow or pale-yellow friable sandy clay loam, silty clay loam, or sandy clay. In places the subsoil color is golden yellow, ranging here and there to slightly reddish yellow. The soil is in places a silty loam, but more commonly consists of a light loam ranging in occasional areas, particularly on ridge crests and hilltops, and the steeper slopes, to fine sandy loam or sandy loam with a yellow, friable sandy clay subsoil. In places the surface is light gray. In forest areas the yellow color is encountered nearer the surface than in cultivated areas, there being a few inches of brown loam over the characteristic pale-yellow to yellow sandy clay loam subsoil.¹

Small fragments of sandstone are usually present in the soil and subsoil, giving the material a more porous character than it would otherwise have, and this porosity probably accounts for the small amount of erosion that has taken place. Many quite steep slopes under cultivation show practically no erosion. In places sandstone fragments of about the size that would be classed as angular gravel are abundant on the surface, giving rise to patches of gravelly loam, but such areas are too small to be mapped, and under cultivation they give apparently just as good results as the areas without gravel.

The soil rests upon sandstone, which over most of the areas lies within 2 to 4 feet of the surface. It is much nearer, from 6 to 12 inches, near areas of the Dekalb stony loam, or Dekalb stony silt

¹ The difference between forest soils and cultivated soils is more fully discussed in the description of the Dekalb silt loam.

loam, with which the loam is closely associated, and on sharp ridge crests, where the soil material has been washed away. In such areas some stones are scattered over the surface. In places these have been removed and the land put under cultivation.

The Dekalb loam occurs in its largest development on the fairly smooth ridge tops south of Gauley River. In Wilderness and Kentucky Districts, and in the vicinity of Mount Lookout and Nettie it constitutes the most important agricultural soil. Other large areas lie in Beaver District, near Craigsville, on the ridge tops north of Richwood, and in Summersville District, between Summersville and Hughes Ferry Bridge. This type has been formed by the weathering of the rather porous rocks of the New River formation, in which sandstone predominates. It has for the most part a fairly level to rolling topography, although it is also found on rather steep slopes and sharp ridges.

Although the Dekalb loam is not naturally very productive, and in places contains a large proportion of medium and fine sand, it is regarded as one of the most desirable types in the county, because it is easy to handle, its topography allows the use of farming machinery, it warms up rather early in the spring, and it responds quickly to good cultural methods and the application of manure and fertilizers. Applications of the latter usually are light because of their high cost.

The greater part of this type has been cleared of its timber, which consisted chiefly of chestnut, oak, and other hardwoods, and put into cultivation. It is used principally for corn, oats, wheat, hay, and pasture.

Irish potatoes of excellent quality are produced, and if transportation facilities were better, they would be a very profitable crop upon this type. Buckwheat and rape do very well. Tobacco, which was once an important crop, is still grown in small patches by many farmers for their own use. Garden vegetables are usually considerably earlier than on the Dekalb silt loam. Fruits, especially apples, peaches, and cherries, do well in the home orchards and in some instances form a considerable source of income.

Corn yields from 25 to 50 bushels per acre, averaging around 40 bushels, with higher yields in favorable seasons. Wheat and buckwheat ordinarily produce from 12 to 15 bushels, and 20 to 22 bushels when heavily fertilized. Oats produce from 25 to 45 bushels. Some of the oats are fed in the sheaf. Timothy and redtop, with some orchard grass and red clover, comprise the grass mixture most commonly used, giving yields of one-half to 1 ton of hay per acre. No systematic rotation of crops is generally followed.

The price of land of this type depends upon the location with reference to principal roads and, as is the case in practically all soils

of the county, upon the value of the mineral rights. The more desirable farms can be bought for \$60 to \$75 an acre, while in the rougher sections the prices range from \$20 to \$40.

In undertaking the improvement of this soil the most important step is to increase the supply of organic matter. This can be brought about by the use of more manure, the turning under of green crops, such as rye or clover, and the growing of more legumes in rotations. The application of lime will probably show profitable results, although under present conditions it is very expensive. Even small quantities—400 to 500 pounds per acre—in some instances have given increased yields for a number of years following the application. Fertilizers, especially those high in phosphorus, have been found profitable. The sawdust piles and slab heaps left behind by the saw mills constitute a fairly important possible source of potash. If this material, now a waste, were burned, the ashes could very profitably be applied to the fields.

Vegetables, especially Irish potatoes, and fruits of good quality and flavor could be produced to advantage where land of this type is located near railroads.

DEKALB SILT LOAM.

The Dekalb silt loam consists of 1 to 3 inches of yellowish-brown to brownish-gray or light-brown silt loam grading into a yellow to pale-yellow silt loam, which quickly passes at about 6 to 10 inches into yellow or pale-yellow silty clay. In places the subsoil is somewhat compact, but when moderately moist it crumbles readily under pressure. In some places finely divided mica imparts a slightly greasy feel to the subsoil. In forested areas the yellow material lies nearer the surface, the soil in places beginning as yellow silt loam immediately beneath a covering of leaf mold an inch or so thick, or passing from yellowish-brown or brownish-gray silt loam to yellow or pale-yellow silt loam within an inch or two.

In the field it was noticed that the forested uplands had the appearance of having a lower content of organic matter than the cultivated soils, and samples of each were taken for laboratory investigation. Five representative samples were collected from forested areas and five from areas which had been in cultivation at least long enough for the large stumps to have completely disappeared, probably for at least 15 years, and perhaps for much longer periods. In the forest there is usually a covering of mold, seldom thicker than one-half to 1 or 2 inches and consisting chiefly of leaves partly decomposed in the under layer. In collecting the samples from forested areas the leaf mold was removed, but no part of the soil, so that the samples collected included all the true soil materials. The following table gives the results of organic-matter determinations.

Content of organic matter (determined as carbon) in virgin and cultivated up-land soils, Nicholas County, West Virginia, from surface six inches.

[All samples were in duplicate. Probable error about one-tenth of 1 per cent. Each sample was tested for carbonate and found to contain practically none.]

VIRGIN SOILS.

Type and sample.	Locality.	Description.	Per cent of carbon.
Dekalb silt loam, sample A.	Three-fourths mile west of Summersville, near top of Lonetree Mountain.	Gray to grayish-yellow silt loam; subsoil, yellow silty clay. Shale at 20 inches. Chestnut, oak, hickory, poplar, dogwood.	1.67
Dekalb silt loam, sample B.	Hill slope near Enon.	Pale-yellow silt loam; subsoil, yellow silty clay. Shale at 18 inches. Chestnut, oak, hickory, dogwood.	.69
Dekalb silt loam, smooth phase, sample D.	Flat near Mount Lookout.	Yellowish-brown silt loam; subsoil, yellow silty clay. Shale at 3 feet or more. Not so well drained as other samples. Oak and chestnut.	2.28
Dekalb loam, sample F.	Gentle slope 1 mile west of Bruce.	Brown loam, 2 inches over yellowish-brown loam; subsoil, yellow silty loam. Shale and sandstone at 24 inches. Oak, dogwood, hemlock.	2.08
Dekalb silt loam, sample H.	Steep slope at Spruce Grove School.	Brown silt loam, 1 inch over yellow silt loam; subsoil, yellow silty clay loam to silty clay. Many shale fragments. Shale at 12 inches. Beech, oak, maple, chestnut, black gum.	3.33

CULTIVATED SOILS.

Dekalb silt loam, sample C.	Near Enon, on slope below sample B.	Brown silt loam, 3 inches over yellowish-brown silt loam; subsoil, yellow silty clay loam to silty clay. Shale at 15 inches. Broomsedge pasture.	1.15
Dekalb loam, sample E.	Gentle slope 1 mile west of Bruce, across road from sample F.	Brown mellow loam; subsoil, yellow friable loam. Shale and sandstone at 20 inches. Wheat field.	1.57
Dekalb silt loam, sample G.	Slope one-half mile southwest of Spruce Grove School.	Light-brown silt loam; subsoil, yellow silty clay. Shale at 20 inches. Corn field.	2.38
Dekalb silt loam, sample I.	Ridge top one-half mile of Moore School.	Light-brown silt loam; subsoil, yellow silty clay loam to silty clay. Shale at 24 inches. Oat field.	3.19
Dekalb silt loam, sample J.	2 miles west of Hominy Falls.	Light-brown silt loam, 5 inches over yellow silt loam; subsoil, yellow silty clay, considerable sandstone fragments. Shale at 24 inches. Rape field.	3.05
Average carbon content of forest soils.....			2.01
Average carbon content of cultivated soils.....			2.27

The five samples of forest soil showed an average content of 2.01 per cent of carbon, while the five samples of cultivated soil (corresponding types) showed an average carbon content of 2.27 per cent. The sample of lowest carbon content as well as that of highest was

from a forested area, but, on the whole, the virgin and cultivated soils show no consistent difference as regards their carbon content.

Chips of shale and sandstone are of common occurrence in this soil and subsoil, making it more open and friable than it would otherwise be. Bedrock, consisting of sandstone and shale, is generally reached at depths less than 3 feet, and in many places of 20 to 24 inches, or even less. In places the upper part of the underlying rock is partly disintegrated, and the lower subsoil consists of silty clay containing decomposing fragments of shale and sandstone. The type in general is fairly free from stones, though where it merges into the Dekalb stony loam or stony silt loam stone fragments are common on the surface and occasional sandstone and shale outcrops occur. In places along the slopes soil material derived from sandstone gives rise to patches of loam and fine sandy loam and their stony variants, but such areas are so scattered and so small that they could not be mapped satisfactorily. In low mountain gaps, and in places on steep hillsides where shale outcrops, the surface consists of a silty clay loam. These also are too small to be shown on a map of the scale used.

The soil material is derived chiefly from shale, even where it is underlain by sandstone. In such places it would appear that shale strata, formerly overlying the sandstone, have supplied the soil material, the sandstone having undergone comparatively little decay. The type occupies positions varying greatly in topography. It is developed on smooth, gently rolling plateaus and shoulders or benches in the valleys, on flat to rolling mountain tops, and on steep broken mountain sides.

From the viewpoint of agriculture this is the most important soil in the county. Most of it has been cleared, although a large part of the cleared land is too steep for cultivation and is used for pasturing cattle and sheep. Probably more than 50 per cent of the cleared land is used chiefly for pasture. There are, nevertheless, some very steep hillsides in cultivation, the crops including corn, wheat, buckwheat, oats, and potatoes, and an occasional patch of rye or sorghum. Machinery can not be used on the steep hillsides, and plowing, cultivation, and harvesting are laborious and difficult operations. The small grains are seeded and harvested by hand. Corn is cultivated to some extent with 1-horse double-shovel plows, but the larger part of the tillage is done with hoes. After a few years of cultivation erosion generally damages the fields on the steep hillsides, the soil in places being removed to bedrock, and many fields that were cleared and farmed by the early settlers have been seeded in grass and maintained as permanent pastures or have been abandoned and allowed to revert to forest. The steepest slopes are usually well forested, and there is little doubt that timber is the best crop for such areas.

Erosion probably would follow the use of many of these slopes, even for pasture. The forest growth consists chiefly of chestnut, hickory, white oak and other oaks, dogwood, maple, tulip poplar, walnut, and cucumber trees. In places hemlock and pawpaw are found, also some sourwood and ironwood.

The Dekalb silt loam is widely distributed over the county, occurring in every district, but is relatively more important in Beaver, Hamilton, Summersville, and Grant Districts, in a broad belt extending across the center of the county.

The smoother areas on some of the ridge crests and mountain tops are practically inaccessible for farming on account of the expense of building and maintaining roads up the steep hillsides.

Corn is the principal cultivated crop, ranging in yield, according to the estimates of farmers, from about 20 to 60 bushels per acre. The average yield is probably nearer the lower than the higher figure, although in a corn-growing contest a maximum yield of 120 bushels per acre on this type is reported. In this case the land was heavily manured and fertilized and carefully cultivated. Oats are next to corn in importance, yielding 25 to 45 bushels per acre. Much of this crop is fed in the sheaf, especially in the rough hilly sections where thrashers can be operated only with great difficulty. On most farms sufficient wheat is produced for home needs, but there is little surplus. Yields of 10 to 20 bushels per acre are obtained. Buckwheat does well, especially on the higher elevations, and yields of 10 to 40 bushels per acre are reported. It is popular as a nurse crop in seeding to grass. No regular crop rotation is followed, a field being seeded to wheat or planted in corn for several years until it falls low in yields, when it is seeded to grass or allowed to remain idle for a period. This is not naturally a strong grass soil; it yields one-half to three-fourths ton of hay per acre. The most common grasses are redtop, timothy, and orchard grass, with an occasional patch of bluegrass sod and some clover. The last does well on this type when limed, and several patches of alfalfa seeded on limed soil have been profitable. In late summer the pasturage sometimes is scant on account of insufficient rainfall. The pastures would be better if reseeded more frequently.

Commercial fertilizers are in general use. They are applied to all grain crops. Distance of haul from the railroad is a factor influencing the quantities applied. Acid phosphate is the chief ingredient in most of the mixtures. The application most commonly used is 400 pounds on corn and 200 pounds on oats or wheat.

A potato of excellent quality is produced on this soil, but the yield is not large, ranging from 30 to 120 bushels per acre. Some sweet potatoes are grown, chiefly in home gardens. Apples, peaches, and cherries do well, especially on ridges and upper slopes, but the trees

are not given much attention. Wild blackberries and raspberries grow in abundance on cutover and other uncultivated areas.

Small grains are apt to winterkill on unprotected ridge tops as the wind removes the protective covering of snow, and such areas are best reserved for buckwheat or seeded to grass. Sorghum and tobacco, for home use only, are grown in patches on many farms.

The price of this land varies widely according to its location, topography, productiveness, and the value of the underlying coal. The surface rights bring \$40 to \$60 an acre.

This soil is deficient in organic matter and would be much improved by turning under stable manure and green-manure crops. Growing more legumes, such as cowpeas and soy beans, would do much to increase productiveness. Applications of lime, even though small in quantity, are reported to have given invariably good results, and farmers recognize its value, but the cost of transporting it from the railroad prevents its use on most farms. The type includes many good orchard sites, and commercial fruit growing should be profitable in sections where transportation facilities are convenient.

Dekalb silt loam, smooth phase.—The Dekalb silt loam, smooth phase, differs from the typical soil principally in having a smoother surface and greater average depth to bedrock. It includes relatively low hills and flattish benches or shoulders in the valleys, and flattish hilltops and ridge crests and the gentler slopes in the highland areas. It occurs principally in the valley of Muddlety Creek, near Summerville, in Beaver District from Delphi to Craigsville, around Keslers Crosslanes, and in Wilderness District near Mount Lookout.

The soil consists of a light-brown silt loam, 6 to 8 inches deep, overlying yellow silty clay which is moderately compact in its natural position when dry, though fairly friable when moist fragments are subjected to hand pressure. In places where sandstone underlies the phase there occurs a lower subsoil of friable yellow fine sandy clay, and in spots freshly decomposed sandstone imparts to it a faint reddish-yellow mottling. In places the bedrock, consisting of shale and sandstone, is reached within 36 inches of the surface, though as a rule it is deeper. In flattish and imperfectly drained areas the subsoil is slightly plastic. The soil of forested areas is yellow at or near the surface. Fragments of shale and of sandstone are of common occurrence, but not in areas large enough to be separated as a shale loam or gravelly loam soil.

The subsoil color of this phase as well as of the typical soil is of striking uniformity, being nearly everywhere pale yellow to yellow. The subsoil material has a well-defined closeness or density of structure, so that it can be readily distinguished from the more open structure of the subsoil of the loam or stony loam types. In places a little

gray mottling is present in the subsoil, owing apparently to the presence of whitish or gray material similar to fire clay.

Owing to a more favorable topography, a much larger proportion of the smooth phase than of the typical Dekalb silt loam is in cultivation. Machinery of all kinds is used to advantage, and the small grains have a more important place in the scheme of agriculture. About the same crops are grown as on the typical soil, although a larger percentage is in hay. The average yields are higher on the phase. The forest growth is the same as on the typical soil.

LICKDALE SILT LOAM.

The Lickdale silt loam consists of a yellowish-brown to grayish-brown silt loam, underlain at 6 to 8 inches by a yellow friable silty clay loam, grading at 18 to 20 inches into yellow, friable to slightly tough, silty clay which is mottled in the lower part with gray and in places with brown or rusty brown. In some areas the gray color predominates below 30 inches. This lower stratum is somewhat compact. Where the underlying rock lies near the surface the subsoil here and there is noticeably sandy.

This type occupies lower slopes and benchlike positions near stream bottoms, as well as some flat upland areas around the heads of streams. The drainage is poor, owing to the rather impervious character of the lower subsoil.

The Lickdale silt loam is not extensive. The principal areas of the type are in the eastern part of the county, in the vicinity of Beaver and Craigsville. Other small areas are mapped on lower slopes just above the Atkins silt loam in the valleys of Muddlety and Beaver Creeks.

Most of the type is cleared. It is devoted principally to grass, which yields three-fourths to $1\frac{1}{2}$ tons per acre of a rather low grade of hay, containing considerable broom sedge and other wild grasses. Some fairly good crops of corn, oats, and buckwheat are obtained, but in most areas the imperfect drainage lowers the yields.

Artificial drainage, either by means of tile or open ditches, the use of lime, and the incorporation of organic matter by plowing under stable manure or green manure crops should result in increased yields.

UPSHUR SILTY CLAY LOAM.

The Upshur silty clay loam is a reddish-brown to brownish-red silty clay loam, underlain at 5 to 7 inches by a dark Indian red, stiff, heavy clay which has a smooth, greasy feel when rubbed between the fingers. This soil is formed by the weathering of the red shales of the Conemaugh formation, which outcrops at or near the

summits of knolls and ridges in the northern part of the county. Its total area in the county is small, so that it is only locally important in the agriculture.

Small fragments of shale occur in the soil in many places, but not in sufficient quantities to produce a shale loam. The lower part of the subsoil normally contains varying quantities of disintegrating shale, and bedrock is encountered in places at depths of 20 to 24 inches.

This soil is very sticky when wet, and if plowed in that condition it forms clods that become very hard upon drying. Some small areas from which the surface silty loam has been eroded, exposing the heavy clay, are included with this type.

Practically all the Upshur silty clay loam is cleared of its forest growth, which comprised oak, chestnut, poplar, maple, and some hickory and walnut.

The superiority of this soil over the soils derived from the gray sandstones and shales is recognized by the farmers. It is an excellent soil for hay and pasture, and over half of it is devoted to these purposes. It produces good timothy and clover and holds a sod longer than do the Dekalb soils. Yields of 1 to 1½ tons per acre of hay are obtained. Bluegrass succeeds on this type in many parts of the State. Corn does very well, the yields ranging from 35 to 60 bushels per acre, but on account of the difficulty of cultivating this heavy soil, only a small proportion of the type is planted in this crop. Wheat and oats are important crops. Yields of 15 to 25 bushels of wheat and 30 to 50 bushels of oats are reported. Fall-sown small grains sometimes suffer from winter killing, as the soil has a tendency to heave.

Applications of lime should give profitable results, though phosphate and manure are more essential to the maintenance of the productivity of this soil. No very definite rotation is generally used. Most farmers put the ground in corn for 2 or 3 years, following this with a small grain and then seeding to grass. Where the surface is steep the soil washes badly, and care should be taken to keep the land covered with grass or in grain during the winter.

The surface rights to land of this type bring \$40 to \$80 an acre; the mineral rights sometimes bring as much as \$40 an acre.

MEIGS CLAY LOAM.

The Meigs clay loam consists of undifferentiated areas of Dekalb and Upshur soils, chiefly silty clay loam and clay loam, together with areas in which Upshur and Dekalb materials are mixed. It includes also patches of Upshur clay and Dekalb silt loam.

This type is not extensive. It occurs in the extreme northern part of Nicholas County in association with areas of the Upshur soils.

It occupies knobs and smooth ridge crests. Methods and crops used on the Upshur silty clay loam are followed on the Meigs clay loam. The yields vary, being better on the patches of Upshur than on patches of Dekalb soil. The land has a somewhat lower value than that of the Upshur types.

POPE SANDY LOAM.

The Pope sandy loam consists of a light-brown loamy sand or sandy loam, 2 to 4 inches deep, passing into a yellowish-brown to yellow sandy loam which at about 15 to 18 inches rests upon a yellowish-brown or yellow, friable heavy sandy loam or sandy clay. In places the texture approximates fine sandy loam. There are some included small areas of rather high bottoms, with positions similar to second bottoms, as in several narrow strips along Gauley and Cherry Rivers. These were not mapped separately, owing to their small extent.

The type occurs in the flood plains of streams rising in areas of Dekalb material. It is the most extensive bottom soil in the county, occurring along Birch River and its tributaries in the north, along Cherry River in the southeast, and as the principal soil along most of the creeks in the southern part of the county and Twentymile Creek in the northwest. Along the larger streams overflow is not frequent.

The surface of the Pope sandy loam in places is somewhat hummocky and the texture variable. Deposits of sand are common along the stream banks, and in many places beds of gravel are encountered, while back from the creek there are occasional small areas of silt loam. On some of the smaller streams areas of local wash, consisting of gravel, sand, and loam, are included with this type. Between overflows the drainage is excellent, owing to the porous nature of the soil and subsoil.

A large part of the type is cleared, but some still supports the original forest of tulip poplar, sycamore, beech, oak, and pine, with an undergrowth of rhododendron and laurel.

Grass and corn occupy the greater part of the cultivated area. Redtop and timothy and some native grasses constitute the main source of hay. Yields of one-half to $1\frac{1}{2}$ tons of hay per acre are obtained. The maximum yield of corn is about 45 bushels per acre. Occasional patches of sorghum and millet are grown. Irish and sweet potatoes, as well as garden vegetables and melons, do well.

Because of its favorable texture and ease of cultivation, light implements and light draft animals can be used. The soil appears to be rather low in organic matter, and the turning under of manure or an occasional green crop is recommended. It responds quickly

to applications of fertilizers and manure, and where favorably located with reference to roads and markets it can be profitably used for trucking.

The value of the Pope sandy loam varies considerably, though it can generally be purchased for \$25 to \$50 an acre.

POPE LOAM.

The Pope loam consists of a surface soil of yellowish-brown to dark-brown, mellow loam, 10 to 12 inches deep, underlain by yellow to brownish-yellow very friable sandy clay which in places passes into lighter yellow, friable sandy clay below 2 feet and includes sandy or gravelly layers at depths of 24 to 30 inches.

This type is not very important agriculturally, having a small total area. Its principal occurrence is in the Muddlety bottoms near Opal and along Phillips Run. It is commonly closely associated with the Pope sandy loam and includes small strips of that type along the stream banks. The loam is largely in grass, but small acreages are used in growing corn and oats. The small grains usually make a rank growth of straw and are apt to lodge badly. Hay consists of timothy, redtop, and some clover. Unless reseeded frequently, weeds and broom sedge or other wild grasses of inferior quality crowd out the tame grasses. The yield of hay is 1 to 2 tons and of corn 20 to 45 bushels per acre. The type is well adapted to trucking.

As is the case with the other bottom soils, no rotation is practiced, and little or no fertilizer, manure, or lime is used. Underdrainage, frequent reseeding of the meadows, an occasional intertilled crop, and applications of lime are recommended for improving the hay and pasture land on this type.

POPE SILT LOAM.

The Pope silt loam consists of a brown to dark yellowish brown mellow silt loam surface soil underlain at about 8 inches by a friable yellowish-brown to yellow silty clay loam subsoil which continues practically unchanged to a depth of 36 inches. In places the lower subsoil is somewhat plastic and shows slight rusty-brown or gray mottlings; in other places the texture is that of sandy clay. Along stream margins some narrow strips of loam or sandy loam occur which are not large enough to be shown separately on the map. Small tongues and patches of Atkins silt loam, which occur in swales or depressions, also are included for the same reason.

The Pope silt loam is a first-bottom soil, subject to overflow, lying along streams that drain and receive wash from the Dekalb silt loam uplands. The type is not very extensive. The principal areas are

in the upper Muddlety bottoms; others occur along the small streams tributary to the larger creeks.

The greater part of the type has been cleared of forest and is used chiefly as hay and pasture land. Hay yields well, especially in the areas along Muddlety Creek, where from three-fourths to 2 tons per acre of mixed timothy and redbtop, and sometimes clover, are obtained. Yields of 15 to 25 bushels of oats and 20 to 50 bushels of corn are reported. No systematic rotation is followed, and the fields are kept in grass for long periods. Land of this type is held at \$40 to \$100 an acre.

Improved drainage of the lower bottoms by means of ditches and by straightening the creek channels must be effected before crops other than hay can be safely grown. There is little need of applying manure or fertilizers, as the soil is subject to frequent overflows which serve to maintain productiveness through fresh deposits of soil materials, including organic matter, the content of which is naturally high. Applications of lime at the rate of about 1,000 pounds per acre would probably be beneficial. The mowings generally are infested with weeds, which could be controlled to some extent by more frequent reseeding and the occasional planting of an intertilled crop.

ATKINS SILT LOAM.

The surface soil of the Atkins silt loam consists of 8 to 10 inches of a dark grayish brown, gray, or brownish-gray heavy silt loam, showing some rusty-brown mottling. The subsoil is a mottled gray or bluish-gray and yellow or mottled brown and dark-gray silty clay loam which at 18 to 20 inches passes into gray or bluish-gray impervious plastic silty clay, usually mottled with rusty brown or yellow. Bluish gray usually dominates the subsoil color.

The type occupies poorly drained first-bottom areas. It is most extensively developed along Muddlety and McMillion Creeks and in the meadows along Beaver and Little Beaver Creeks in the central and eastern parts of the county. Another important area lies along Meadow Creek in the vicinity of Keslers Crosslanes.

The material forming the Atkins silt loam has been washed from the Dekalb silt loam and stony silt loam of the uplands. Agriculturally it is the most important bottom soil in the area, for although its total area is not so great as that of the Pope sandy loam, it occurs in larger bodies, and it is on this type that the farmers of the central and eastern parts of the county depend largely for their hay. It is often called "crawfish land," and in many places it remains wet and swampy throughout the summer. The type is developed around the heads of streams, especially those which rise in areas of smooth to level topography.

This type includes a few areas of Atkins loam and fine sandy loam that were not large enough to be mapped as separate types. Such areas occur in the Beaver Creek bottoms at the point where Hannah Run empties into Beaver Creek, and just below the confluence of Beaver and Little Beaver Creeks, and along Arbuckle Branch below Summersville.

Along the streams there are occasional well-drained strips that are yellow to yellowish-brown and closely resemble the Pope silt loam, except that the subsoil is like the typical Atkins subsoil.

Nearly all of the type has been cleared and is now used as hay or pasture land. It originally supported a growth of oak, beech, poplar, sycamore, and willow.

Some areas, because of their poor drainage, have been almost abandoned or allowed to grow up in a dense tangle of willow, alder, bay-bush, and bullrushes. Much of the mowing and pasture land is covered with a growth of wild grasses and sedges. Where land is fairly well drained, redbud and timothy flourish with the wild grasses. The yield of hay in many seasons reaches 2 to 2½ tons per acre. Weeds and the less desirable wild grasses often become abundant in the older meadows. It is difficult to grow any clover or bluegrass on this type because of its poor drainage.

Little fertilizer or manure is applied, and lime is not used to any extent. Plow furrows or open ditches are the chief means used to improve the drainage, but the method is not sufficient. When these bottoms were first used some of the farmers cut lateral trenches 18 to 24 inches deep and installed wooden drains of plank 4 to 6 inches wide, placed edgewise on each side of the trench and covered with another plank. The soil was then thrown back upon this "wooden tile." This system was satisfactory for several years; but the passage gradually filled up with soil and roots, and the boards rotted, so that the drainage conditions are now the same as they originally were. In some cases the meandering channels of the creeks have been straightened, giving immediately beneficial results by increasing the flow of the stream.

Practically no small grains are grown, as the soil is usually too wet and tends to produce a rank growth of straw, causing the grain to lodge. Corn, while not extensively grown, produces fairly well on the better drained areas. However, very little of this type is ever broken, and most of it has been in grass and pasture with but very few reseedings since it was cleared by the first settlers.

This type is not as valuable for cultivated crops as is the Pope silt loam. It is held at prices ranging from \$40 to \$100 an acre, according to its location and drainage.

The most important factor in improving the Atkins silt loam is drainage. Before this type can be made to produce its maximum

in grass or grain it must be drained artificially. The main stream channels should be straightened and deepened, thus insuring a more rapid run-off and fewer overflows. Subsequently tile laterals should be laid through the fields. After thorough drainage, lime probably should be applied at the rate of about one-half to 1 ton of burnt lime per acre. Organic matter should be supplied by applying manure or by turning under a green crop or grass sod. At present this soil puddles if plowed or cultivated when too wet, and upon drying it becomes hard, forms clods, and is difficult to handle.

ROUGH STONY LAND.

Rough stony land includes very steep and very stony land and outcropping ledges of sandstone. The land is too steep or too stony for farming, and it would be entirely impracticable to attempt the removal of the stone fragments, owing to their abundance and large size. Land of this kind is valuable for forestry and pasture, and where chestnut trees are numerous it makes excellent fall range for hogs, which thrive on the mast.

Areas of this character are scattered, the largest including the cliffs along Gauley River, which extend almost unbroken from above Swiss to beyond Brocks Bridge. Other areas lie in the southeastern part of the county along Cherry River. In many places the areas consist chiefly of outcropping ledges of rock. There are some included patches which are less stony, and even some small bodies of Dekalb silt loam that were not separated, owing to their small extent.

The value of Rough stony land depends upon the kind and quality of the forest growth, the number and thickness of the coal seams that underlie it, and its value for grazing as determined by its steepness and the degree of stoniness.

SUMMARY.

Nicholas County lies in the south-central part of West Virginia. It has an area of 657 square miles, or 420,480 acres. Settlement of this county was begun early in the nineteenth century by immigrants from eastern Virginia. The population of Nicholas County in 1920 was 20,717, of which 79 per cent was classed as rural. Summersville is the county seat.

The county includes a part of the Cumberland Plateau or Western Division of the Appalachian Province. The topography is generally hilly to broken. The elevation ranges from 675 feet at Belva on Gauley River to about 3,850 feet at Hanging Rock in the extreme eastern end of the county, a total range in elevation of nearly 3,200 feet.

Gauley River and its tributaries drain about 80 per cent of the county, the remainder being drained into the Elk River through Birch River and Buffalo Creek. Lumbering and agriculture are the principal pursuits. Coal mining is a minor industry which will become important upon the construction of railroads.

Richwood, the largest town, is an important lumber center. It has several large sawmills, a paper mill, tannery, and clothespin factory. Standard railroad transportation facilities are available only in the eastern and western edges of the county. Log roads transport considerable of the freight to points in the interior.

Nicholas County has a cool, temperate climate well suited to the production of crops that do not require a long growing season. The mean annual temperature is 51° F., and the mean annual rainfall is about 53 inches.

Agriculture consists of general farming combined with stock raising. The farm products are not sufficient to meet the local demands.

Corn and hay are the principal crops, followed by the small grains, of which the oats crop is the most important. Potatoes and buckwheat are grown on most farms, and every farmer produces some garden vegetables.

Cattle and sheep raising are the principal live-stock interests. The cattle are of the beef type, and the sheep are raised for wool and mutton. Poultry is kept on the farms to supply home needs.

Farms occupy 35.3 per cent of the total area of Nicholas County, according to the 1920 census. The average size is 92.1 acres, of which 54.6 per cent is classed as improved. Large tracts of coal and timber lands are held by individuals and corporations.

The soils of Nicholas County fall into two classes, residual and alluvial. Exclusive of Rough stony land, 11 soil types and 1 phase are recognized. The residual soils, classed in the Dekalb, Lickdale, Upshur, and Meigs series, are derived from sandstone and shale of the Carboniferous. The alluvial soils are included in the Pope and Atkins series and are derived from sediments washed from the residual uplands.

The soils of the Dekalb series have yellowish-brown surface soils and a yellow subsoil. The silt loam is the second most extensive soil mapped and, including the smooth phase, comprises the greater part of the farm lands used for crop production. It occupies positions varying from steep slopes to rolling or nearly level benchlike areas. It is well suited to general farm crops and fruit. The stony silt loam is the most extensive type mapped. It occupies steep stony slopes and rough broken country. Little of it is farmed because of the large quantity of stone on the surface. Areas away from the railroads are devoted chiefly to grazing. The loam type is quite ex-

tensively developed south of Gauley River. It is well adapted to general farm crops, and because it is easy to handle and warms up rather early in the spring, it is well liked by the farmers. It occupies ridge tops and smooth upper slopes of hills. The stony loam, like the stony silt loam, is difficult to handle on account of the steep, broken topography and the stones on the surface. It is chiefly in forest or cut-over land and pasture.

In the Lickdale series only one type, the silt loam, is mapped. On account of its deficient drainage it is largely in pasture and mowings.

The Upshur silty clay loam has a reddish-brown to red surface soil and a red subsoil. It occurs to a very small extent in the extreme northern part of the area and occupies ridge tops and knolls. It is the strongest upland soil type in the county and is well adapted to hay, legumes, corn, wheat, and oats.

The Meigs clay loam consists of undifferentiated Upshur and Dekalb material. It is inextensive and occupies the summits of hills close to the Upshur silty clay loam. It is not as productive as the Upshur, and on account of its variable character it is not as highly prized.

The Pope soils, which include the sandy loam, loam, and silt loam, have brown to yellowish soils and a yellow to yellowish-brown subsoil. The sandy loam, which is the most extensive of the bottom soils, is widely distributed over the county. It is less productive than the silt loam or loam. These soils are devoted principally to grass and pasture, although fairly good crops of corn are obtained on them.

The Atkins silt loam is a poorly drained bottom soil most extensively developed in the flat bottoms of Muddlety and Beaver Creeks. It has a grayish-brown surface soil and a mottled gray, yellow, or rusty-brown, heavy plastic subsoil. It is devoted entirely to hay production and to pasture.



[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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