SOIL SURVEY OF THE ASHEVILLE AREA, NORTH CAROLINA.

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LOCATION AND BOUNDARIES OF THE AREA.

The area surveyed is the southern half of the Asheville quadrangle, United States Geological Survey, and comprises about 500 square miles. It is situated between 82° 30′ and 83° west longitude and 35° 30′ and 35° 45′ north latitude. Of this area Buncombe County constitutes about one-half, about 40 square miles lie in the southern part of Madison County, and the remainder in Haywood County. The northwestern edge of the map approaches to within 2 or 3 miles of the Tennessee line. Asheville is in about the same latitude as Mem-

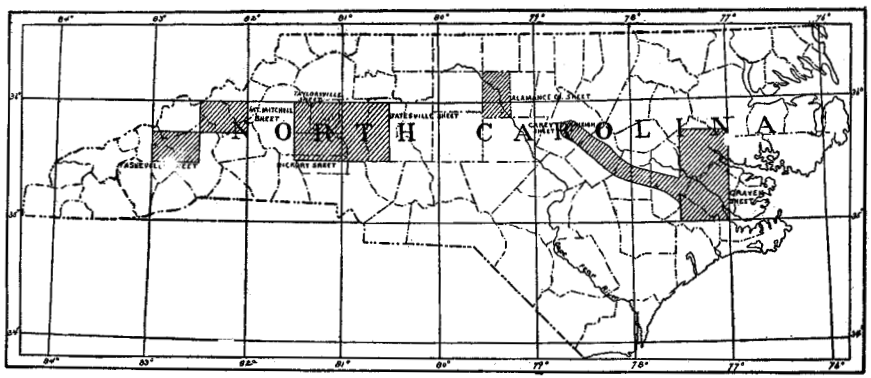

FIG. 10.—Sketch map showing location of the Asheville area, North Carolina.

phis, Tenn., and is nearly due south of Cleveland. It is about 400 miles inland from the Atlantic Ocean and about 270 miles by rail from Raleigh, the capital of the State.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The first settlements in the Asheville area were made about one hundred and twenty years ago, the country having been previously occupied by the Cherokee Indians. Though a little corn, tobacco, and a few pumpkins were grown here and there by the Indians, they lived mainly upon fish and game, supplemented by the native nuts, wild

fruits, and berries, which grew abundantly in this region. Save for occasional outbreaks they were on fairly friendly terms with the white settlers.

The earliest pioneers settled along the creeks and rivers and began tilling the richer and more easily cultivated bottom lands. Rye and oats were the first grain crops sown; afterwards wheat was more important, and later corn became the principal product. The virgin soils produced well, game was then abundant, and the simple needs of the settlers comparatively easily supplied. Except for their isolation and the difficulties of transportation and communication with the outside world, their hardships were less than those suffered by pioneers in some of the more northern latitudes.

These pioneers were mainly from Virginia, and the settlement of this part of the country was of slow growth. North Carolina was early divided into three counties—Albemarle, Bath, and Clarendon—and each county subdivided into precincts. Clarendon consisted of only one precinct—New Hanover—and comprised all of the western part of the State, including Tennessee. In 1738 this division into precincts was abolished and the precincts called counties. Buncombe County was formed in 1791 from Burke and Rutherford counties, formerly a part of Rowan County; and from Buncombe County, Haywood, and Madison counties were formed in 1808 and 1850, respectively.

The population and crop production increased, and in 1850 Buncombe and Haywood counties contained about 20,000 inhabitants and grew 363,611 bushels of corn, 38,462 bushels of wheat, 104,807 bushels of oats, and 25,247 pounds of tobacco. After the war of 1861 the growing of tobacco became quite an important industry. A part of the product was marketed at Asheville, though many of the larger growers sold on the Richmond and Lynchburg, Va., markets and at Greensboro and Durham, N. C. The height of this industry was reached in 1870, when the prices began to decline and the cultivation to fall off, until at the present time the acreage devoted to this crop is relatively small.

CLIMATE.

The following climatological data are drawn from the records of the Weather Bureau. The official weather observatory has only been established at Asheville within the last two years, and the tables and summaries are mainly made up from records of voluntary observers. These records were quite continuous from 1868 to 1879 and from 1889 to 1897.

The climate of the area is characterized by light annual precipitation compared with the remainder of the mountain portion of North Carolina. There is a large proportion of bright days and a compara-

tive absence of disagreeable or destructive winds. The mean annual precipitation for the western portion of the State is 53 inches, while that for the vicinity of Asheville is but 43 inches, 41 per cent of which occurs in the months of March, June, July, and August. The average annual precipitation at Waynesville, situated just outside the southwest corner of the area, is somewhat greater.

The mean annual temperature is 54.6° F., the warmest month being July, with a mean of 72° F., and the coldest January, with 37.9° F.

The three winter months are nearly alike in temperature. The highest monthly mean temperature ever recorded at Asheville was 76.8, in June, 1876, and the lowest mean was 27.2, in January, 1897. * * * The highest temperature observed was 95°F., on September 15, 1897, and the lowest —9°F., January 16, 1893. * * * Below zero temperature may occur in January, February, and December, but generally only during severe cold winters.[a]

A five-year record gives the annual snowfall as 16.4 inches, which is stated to be much above the normal. The average date of the last killing frost of spring is April 21, and the first killing frost of autumn October 16.

The relative humidity is somewhat high, due mainly to the early morning fogs, which are quite prevalent during the summer season. These do not occur to any considerable extent away from the river valleys, and are generally dissipated early in the day.

The prevailing direction of the wind in the summer is southwest, and in winter northeast.

Normal monthly and annual temperature and precipitation.

Month.	Asheville, N. C.		Month.	Asheville, N. C.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	37.9	3.04	August	70.6	4.63
February	39.7	3.57	September	64.9	2.95
March	45.9	4.14	October	53.6	2.61
April	54.6	3.35	November	45.5	2.76
May	62.6	3.62	December	38.9	3.13
June	69.6	4.08	Year	54.6	42.72
July	72.0	4.84			

PHYSIOGRAPHY AND GEOLOGY.

For convenience of reference the area mapped may be placed in two physiographic divisions, mountain and intermountain, the areas of the two divisions being about equal. In a general way the western half of the sheet will fall into the former division and the eastern portion into the latter. The northern two-thirds of the western half of the

[a] Climatology of Asheville. C. F. von Hermann.

sheet is wholly mountainous. It consists of the Newfound Mountain, a range extending in a northwest-southeast direction, and approximately transverse to the axis of the Smoky Mountains and the Appalachian system. The average elevation of its base above sea level is about 2,500 feet, from which principal peaks of this range reach to heights of from 4,000 to 5,000 feet above sea level. This range forms the watershed between Hurricane, Fines, and Crabtree creeks on the west, and Spring, Sandy Mush, and Turkey creeks on the east. The western branch of Hominy Creek, however, breaks through the southern end of the range at Turnpike. The Newfound Range is intersected by four parallel mountain ridges trending N. 55° E. to their termination in the French Broad Valley. The axes of these ridges are about 5 miles apart, and the most prominent peaks are a little over 4,000 feet high. The highest mountain in the sheet is Crabtree Bald, which reaches an elevation of 5,280 feet. Sandymush Bald, which is connected with it by one of these transverse ridges, is only a little lower, and is situated on the axis of the Newfound Range.

There are many sharp peaks and long, narrow knifelike ridges among these mountains, yet there is nearly always a covering of soil and comparatively few bare rock exposures. Before its settlement practically the whole of this mountain was clothed with a thick growth of deciduous and evergreen trees. Many of the smaller mountains are now cultivated to the top, while some of the loftier ones bear crops for a considerable distance up their sides. The slopes seldom exceed 35°, while, of course, the angle of the cultivated land is usually a much more moderate one.

The higher of these mountain ridges form natural boundary lines between the different mountain communities, and there is comparatively little travel from one neighborhood to another over the higher gaps, to pass some of which ascents of 1,000 feet have to be made.

The French Broad and Hominy Creek valleys cover most of the eastern half of the map, while the valleys of Big Pigeon River and Richland Creek occupy the greater proportion of the southern one-third of the western half of the sheet. These valleys taken together constitute about 50 per cent of the entire area, or 260 square miles, and seen from the elevated peaks surrounding them have the appearance of a nearly level basin. The general contour of these basins is only a little more rugged than some of the Piedmont Plateau, the hills ranging from 50 to 250 feet in height above the streams. These hills are rounded into singularly even and graceful curves, and the long, sweeping shadows cast by a declining afternoon sun across smooth hillsides and interspersed patches of woodland creates a very pleasing picture. Whole hillsides are seen to be covered with a short, thickly set growth of conical, old-field pine, through the dark green of which is seen the vivid red of the sloping soil washes and gullies, while in

the coves and valleys and on other hillsides deciduous trees vary the coloring.

The adjacent mountain ranges form quite abrupt margins to this intermountain or valley land, the boundaries being slightly obscured in some instances by outlying knobs and larger hills and ridges from 400 to 700 feet high. There is little really level land in these big valleys, the rolling topography being quite continuous, and as the descent of one hill is made the ascent of another is begun. A strip of level or only slightly sloping bottom land of from 50 to 100 yards wide borders many of the smaller streams. In some instances along the French Broad, Swannanoa, and Big Pigeon rivers and Hominy Creek these bottoms broaden to one-fourth mile and extend for a short distance along the streams. North of Asheville the French Broad River has almost no bottom land along it, the hills rising quite abruptly to a height of 200 or 300 feet for most of the distance to the northern edge of the map.

In its course of 25 miles through the area the French Broad River falls about 300 feet, and thus develops considerable water power, to utilize a part of which an electric power plant is at present being installed about 5 miles below Asheville. The current is quite rapid below Asheville and flows over a rough, rocky bed. Many of these rocks are loose, while others are in place and show a nearly vertical dip. The stream is from 80 to 120 yards in width.

The Swannanoa River is one of the principal tributaries of the French Broad, and its waters are discharged just below Biltmore. Big Pigeon River, third in point of size, flows in a general northwesterly direction across the southwestern corner of the sheet, its length within the area being about 20 miles. On it are situated the towns of Canton and Clyde. It flows through a comparatively smooth and fertile, though narrow, agricultural valley to a point about 2 miles below Clyde, where it becomes hemmed in between precipitous hills and mountains. Hominy Creek rises in the eastern edge of Haywood County, and after breaking through the Newfound Range flows the remaining 10 or 12 miles of its length to the French Broad River through a broad intermountain valley coalescing with that of the French Broad. The other important streams—Crabtree, Fines, Spring, Sandy Mush, and Turkey creeks—all have their sources in the higher mountains, and throughout the greater part of their lengths their valleys are narrow and belong to the truly mountainous type of country. The average elevation of these valleys is about 2,500 feet.

Geologically, the area surveyed is entirely underlain by the older rocks, and from the gneisses, mica-schists, talcose-schists, and massive hornblendic rocks, together with numerous quartz veins, all of the soils are derived. Little granite is found within the area, and gneiss constitutes the greater proportion of the rock. From this, especially

from the coarser-grained and more feldspathic varieties, most of the sandy soils are derived. The micaceous schists weather into the heavier loams and clays. These heavy soils also, of course, ultimately result from the weathering of the gneiss and granite, but the mica-schists, even in their earlier stages of decomposition, yield materials having at least many of the characteristics of clay. The quartz veins vary from one-fourth inch to 6 feet or more in width. Many of the irregular rocks strewn about on the surface of the fields come from these quartz veins. Except on some of the sides and occasionally on the tops of precipitous mountain ridges, there is not, as a rule, sufficient loose rock present to interfere seriously with cultivation. The general dip of the rocks being to the south-southeast, the mountains are usually the most precipitous on the north and west sides, so that the improved and cultivable land is more often seen on the southern and eastern slopes.

SOILS.

Five types of soil have been recognized in the area, exclusive of the alluvial soil or bottom land along the streams. They are described in the order of their areal importance.

The extent of each of these soils is shown in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Porters loam	180,416	56.7	Meadow	7,808	2.4
Porters clay	49,152	15.5	Rock outcrop	1,856	6
Porters sandy loam	41,792	13.1	Total	318,144	.....
Porters black loam	24,064	7.6			
Porters sand	13,056	4.1			

PORTERS SAND.

The soil of the Porters sand to an average depth of 9 inches is a yellowish-brown to grayish-yellow sand. The texture is of a heterogeneous character, the grains varying from quite fine through medium and coarse into small gravel. There is also nearly always present more or less silt and clay, giving to the soil greater coherence than in the case of sandy soils of sedimentary formation. Though some broken rock is sometimes present at the surface, the percentage is small—seldom high enough to interfere with cultivation. The subsoil consists of grayish-yellow sand in which regularity as to size and arrangement of grains is lacking. Where the weathering is deepest the subsoil is generally finer in texture than the soil, but as the parent rock is reached the weathering is less complete, and coarser, more incoherent particles of rock are encountered. The depth of the subsoil varies greatly, ranging from 20 to 30 inches or more.

Porters sand is almost exclusively confined to the northwestern part of the area, where it is found on the mountain ridges. It generally occupies only the tops of these ridges, and usually where the slope is not steep. It occurs typically developed upon the long, gently sloping buttresses and spurs of some of the larger mountains. The drainage is always good.

The soil is principally derived from the coarse-grained gneisses, especially those containing considerable quartz and feldspar.

The principal crops are corn, oats, and tobacco. Probably four-fifths of the tobacco grown in this section is raised on Porters sand. The yield is about 500 pounds to the acre. The commonest trees seen are white and red oak and chestnut.

It is not a very strong or productive soil, and this fact, combined with its elevated and difficultly accessible position, renders it of limited agricultural value.

The following table gives mechanical analyses of typical samples of fine earth of this soil:

Mechanical analyses of Porters sand.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9755	2½ miles NE. of Canto.	Gray medium sand, 0 to 8 inches.	0.38	6.68	13.56	10.60	28.06	19.76	15.66	5.58
9757	1¾ miles N. of Crabtree.	Gray medium sand, 0 to 9 inches.	.86	5.20	12.10	6.92	20.84	19.64	26.80	8.48
9756	Subsoil of 9755....	Yellow sand, 8 to 30 inches.	.13	4.44	24.02	16.62	28.46	13.54	7.70	4.90
9758	Subsoil of 9757....	Yellow sand, 9 to 20 inches.	.33	4.80	12.80	8.80	23.72	17.60	23.82	8.40

PORTERS SANDY LOAM.

The soil of the Porters sandy loam is a light gray to grayish-yellow sandy loam of a minimum depth of 7 inches and varying from that to 12 inches. The sand grains are irregular in shape and variable in size, and mixed with them is more or less silt and clay. Much of the sand in this type of soil is highly micaceous, and if persistently rubbed between the fingers a great deal of the grit disappears. Notwithstanding this and notwithstanding the fact, too, that a physical analysis shows the texture to be rather fine, the soil in the field has decidedly the appearance and tilling properties of a sandy loam. There is frequently from 5 to 20 per cent of irregular fragments of rock present

in the soil, and it is not uncommon to see, especially on the grayer hillsides along the French Broad, in the vicinity of Alexander, quantities of somewhat cubical, sharply angular gravel from $\frac{1}{8}$ to 1 inch in diameter thinly strewn over the surface. The subsoil consists of a yellowish-brown or yellowish-red loam, which usually grades into heavy red clay at 30 inches or more. In some instances, however, the subsoil is quite sandy and grades into disintegrated but not wholly weathered rock at from 24 to 30 inches.

A considerable proportion of the Porters sandy loam mapped in the French Broad Valley, especially west of the river, near Owenby, and again south of Biltmore, is a light gray at the surface, the sand being more loose, incoherent, and rounded, like the sand of a sedimentary soil.

The main body of the type is located in the northwestern part of the area, where it is usually found on the middle and steeper slopes of the mountains. The lower edge of the zone generally commences 200 or 300 feet above the streams and from there continues to the top, unless, as sometimes happens, it meets the boundary of the black loam near the summit or gives way to the coarser Porters sand. On the mountain sides the slopes are often quite steep, inclined at an angle of 35° or even 50° in some instances. Thirty-five degrees is about as steep a slope as it is practicable to cultivate, and even this is unprofitable unless the land is very cheap. The greater proportion of the cultivated soil has a slope of from 10° to 30°.

Free drainage is afforded both by the slope and by the porous nature of the subsoil, and comparatively little washing or gullying takes place. This is probably because much of the rain water passes downward into the porous soil and subsoil instead of running off in rivulets on the surface, as from the heavier, more compact soils.

The soil is derived principally from gneisses of the coarser, more siliceous varieties, though it also results from the weathering of the coarser-grained mica schists.

The principal crops grown upon the Porters sandy loam are corn and oats. Tobacco is also grown to some extent upon the sandier phases of the type. It yields on an average about 500 pounds to the acre. Twenty bushels of corn and from 30 to 35 bushels of oats to the acre are considered fair yields. Upon some of the mountain slopes, at the higher elevations, a good deal of grass is grown for grazing.

The natural forest covering consists mainly of hardwoods, red, white, and chestnut oak, and chestnut predominating. The only white pine and hemlock observed growing in the area were usually found upon Porters sandy loam. Upon some of the mountain sides, and especially near outcropping rocks, a thick undergrowth of rhododendron and laurel is occasionally seen.

The use of Porters sandy loam for pasturage is due not so much to its especial adaptability for grass as to its elevated situation and difficulty of access, rendering it of less value for cultivated crops. Timothy, bluegrass, and redtop do fairly well upon this type, and in the highest, most shaded situations, where early spring growth would be retarded until after all danger from late frosts, peaches ought to be successfully grown. Grapes should also do fairly well on this type.

The following table shows the texture of typical samples of the fine earth of this soil:

Mechanical analyses of Porters sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9749	¾ mile NW. of Alexander.	Gray sandy loam, 0 to 10 inches.	1.56	8.50	13.84	7.98	26.88	19.56	15.10	7.60
9751	3¾ miles SW. of Leicester.	Brown sandy loam, 0 to 7 inches.	1.48	6.08	12.86	9.34	26.56	18.14	13.60	13.30
9753	1¾ miles NW. of Canto.	Sandy loam, 0 to 8 inches.	1.74	7.52	13.26	8.02	19.02	13.08	22.30	16.54
9750	Subsoil of 9749....	Brown fine sand, 10 to 30 inches.	.90	7.80	12.42	7.48	31.56	17.26	16.10	7.04
9752	Subsoil of 9751....	Fine sandy loam, 7 to 20 inches.	.26	5.60	17.90	9.82	27.32	14.66	12.30	12.50
9754	Subsoil of 9753....	Brown sandy loam, 8 to 26 inches.	1.06	6.50	11.92	8.62	18.02	11.64	19.98	23.28

PORTERS BLACK LOAM.

The soil of the Porters black loam is a rich, loose loam, averaging about 8 inches in depth. It varies in color from a dark reddish-brown, where the top soil is thinnest, to almost black in deep sheltered coves. The loam contains so much organic matter that in the hands it feels not unlike muck. It is soft and mellow and very easily worked. The subsoil is a fine-grained brownish-yellow loam, rather compact, and a good conservator of moisture, yet easily penetrated by the roots of trees and growing crops. There is an almost entire absence of rock fragments in the soil and subsoil.

The areas of Porters black loam are for the most part confined to the western half of the area, the largest single body being found on the high ridge leading northeast from Crabtree Bald. Other smaller and less important areas exist in some of the mountains on the southern and eastern edge of the area.

The Porters black loam is strictly a mountain soil, and is generally found only upon the highest peaks on the north slopes and in the most

densely shaded coves. It almost never occurs upon the southern slopes, except in a few instances where it has crept over from the north side of the highest ridges and extends for a short distance down upon the other side. In a few instances, in densely wooded coves, small local spots of it have been encountered upon the southern and eastern slopes, but these are never more than a few feet or rods in extent and have not been mapped. Though the lower boundary of the soil is usually found up the side of a mountain, in some instances it extends down nearly to the trough of the valley, where the angle of the slopes is sometimes not over 10°. It ranges from this to 40° in the highest positions. Good drainage is thus always afforded. Only rarely have instances of soil washing been observed on this type.

The Porters black loam is derived from various classes of the metamorphic rocks, and there seems to be no particular kind to which may be traced a preponderating influence either in the origin of its physical characteristics or color. The color is due to the large amount of organic matter present, and it is in nowise influenced by the character of the rock from which the soil is derived—that is to say, a black hornblendic rock, for instance, is no more likely to yield Porters black loam than is a light gray gneiss. The only explanation which can be offered for the confinement of this black soil to the north side of a mountain is that upon that side, where there is more shade and less evaporation, vegetation is more rank and there is more vegetable débris. This decays more rapidly and completely than upon a slope exposed directly to the sunlight and yields a greater amount of the rich black vegetable mold. With the cutting off of the forest and the removal of the shady conditions under which the soil had its formation it might be expected that a change would gradually take place, the organic matter be used up, and the soil grow lighter in color. Available evidence, however, goes to show that these changes are very gradual, and probably a good many years might elapse without appreciable diminution of the productiveness of the soil.

Comparatively little Porters black loam is at present in cultivation. Large areas of it are still in forest and a considerable proportion is devoted to pasture. After deadening the trees and harvesting two or three crops of corn these mountain pastures have been seeded to timothy, bluegrass, and redtop. These grasses grow luxuriantly, and where sheep are not allowed to run furnish grazing for cattle for a number of years without renewal. Corn without any fertilization yields from 40 to 50 bushels to the acre. In some of the coves near the highest mountains, and where the soil extends well down into the valleys, apples are grown successfully, though not extensively.

Red, white, and chestnut oak grow abundantly, together with many large chestnut trees. On Spring Creek are seen a number of fine specimens of buckeye, some of them exceeding a foot in diameter.

Upon no type of soil in the area have apples been so successfully grown as upon this black loam. Its peculiar adaptability to this fruit is not confined to this section, but is known and recognized in other localities in the State, and in the Valley of Virginia apple growing is successfully carried on upon the same soil, which the Bureau of Soils has recognized and mapped there. It is particularly suited to the Albemarle pippin in sheltered coves at not too great elevation. Besides apples, the soil is well adapted to most of the ordinary farm crops, and especially to corn and Irish potatoes.

The following table gives the mechanical analyses of typical samples of this soil:

Mechanical analyses of Porters black loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9745	1½ miles SW. of Turnpike.	Dark brown loam, 0 to 7 inches.	2.66	6.14	10.80	6.06	16.70	14.68	20.70	24.96
9747	3 miles NW. of Canto.	Black fine loam, 0 to 8 inches.	10.18	7.32	8.38	4.46	10.38	11.34	22.70	34.60
9746	Subsoil of 9745.....	Brown loam, 7 to 30 inches.	1.16	5.40	10.26	6.32	16.92	15.20	21.70	24.10
9748	Subsoil of 9747.....	Brown loam, 8 to 30 inches.	2.46	3.08	7.26	4.70	11.20	13.10	26.10	33.90

NOTE.—Sample No. 9747 contained a large amount of woody or but partially decomposed material, which would account for the high organic matter content as compared with other samples.

PORTERS LOAM.

The soil of the Porters loam averages about 8 inches in depth and consists of a yellowish-gray loam containing varying amounts of fine sand and silt. While there is enough clay present in the first 6 inches to give moderate coherence to the soil, it nevertheless feels quite gritty between the fingers and is friable. In areas where the soil is deepest it sometimes has a gray appearance at the surface, but as a rule the surface soil has a characteristic yellowish cast, with reddish-yellow spots where the soil has been partially washed away and the subsoil exposed. A few small rock fragments are sometimes seen scattered about on the surface, but are not usually plentiful enough to be a serious hindrance to cultivation. The upper few inches of the subsoil is a coherent yellowish clay loam, with a small percentage of fine sand intermixed. This usually grades at 18 inches into the heavy, adhesive red clay which is so characteristic of the area, and which underlies also the Porters clay. In the more mountainous parts of the area, however, this red clay is usually found at a greater depth, and sometimes the

yellow loam persists to a depth of 30 inches or more. By reason of its coarser texture this type of soil yields more readily to cultivation than the Porters clay, and a mellow seed bed is prepared with less difficulty.

Along the streams in the upper end of some of these mountain valleys are small, narrow areas of soil made up of a combination of the detrital material of the talus slope and the small amounts of sediment deposited by the streams themselves. These areas have been mapped as a phase of Porters loam, it being considered undesirable to include them with the meadow type. They usually have a slope of from 5° to 15°, and the subsoil contains numerous irregular rock fragments. Such areas are all more or less subirrigated.

Porters loam is found in all parts of the sheet, but is developed in larger and more continuous areas over the rolling valley lands of the intermountain part of the country. It usually also marks a strip on each side of the stream bottoms of the mountain valleys. Here it is sometimes found well up on the sides of the mountains, and in some instances even persists clear up to the top. It has a steeper slope on the mountains than in the rolling lands of the valleys of the French Broad River and Hominy Creek, where it occupies hillsides and hilltops alike.

The drainage is always sufficient, and often there is considerable washing and gullying of the soil, leaving exposed the underlying red clay and rendering necessary the abandonment of occasional fields.

The soil is derived from the weathering of the underlying gneisses and schists, the finer particles resulting from the decomposition of the feldspars, hornblende, etc., the more resistant siliceous minerals yielding the sand grains, the arrangement of the component materials then being effected by gravitation and the assorting power of percolating waters.

Corn, wheat, and oats are the principal crops grown upon Porters loam. Wheat gives an average yield of 10 or 15 bushels to the acre, and corn about 25 bushels. On the heavier phases of the type grass does fairly well. Fruit is grown to some extent, and with fairly good success in favored locations. The principal forest growth is shortleaf and loblolly pine, white oak, and red oak, together with some maple and chestnut. The chinquapin forms a thick undergrowth in some localities.

This is one of the best soils in the area for general agricultural purposes. Soils of this nature are suited to a wider variety of crops than are either the heavier clay soils or the sands and sandy loams. Porters loam can not be as highly recommended for wheat or grass as Porters clay, but for corn, oats, Irish potatoes, etc., the soil is fairly well adapted. It is believed that alfalfa would do well on some of the mountain creek bottom phase already referred to, where the subsoil is very porous and where the roots can penetrate to water.

The following table gives mechanical analyses of fine earth of the soil and subsoil of this type:

Mechanical analyses of Porters loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9739	2½ miles N. 75° W. of Clyde.	Gray loam, 0 to 9 inches.	1.84	6.92	14.64	9.52	21.84	9.62	15.74	21.12
9743	2½ miles NE. of Sandymush.	Brown loam, 0 to 9 inches.	1.06	1.80	6.20	6.80	13.90	14.38	31.32	25.56
9741	1½ miles SE. of Leicester.	Red loam, 0 to 9 inches.	2.00	3.20	8.98	6.78	17.38	10.96	25.20	27.44
9740	Subsoil of 9739.....	Brown clay loam, 9 to 24 inches.	1.02	3.76	12.02	7.24	15.78	7.10	12.14	41.74
9742	Subsoil of 9741.....	Clay loam to clay, 9 to 30 inches.	1.16	2.18	6.36	5.52	14.88	6.98	21.52	42.40
9744	Subsoil of 9743.....	Red clay loam, 9 to 30 inches.	.66	1.56	4.66	4.90	10.10	6.64	25.70	46.88

PORTERS CLAY.

The soil of the Porters clay consists of a brownish-red to red clay loam from 6 to 9 inches in depth. In its virgin state this soil has a covering of 2 or 3 inches of sandy loam, which in cultivation becomes intimately mixed with the heavier underlying clay. This sandy material is not in sufficient quantity to destroy the coherence of the clay, and yet the soil is more mellow and scours better on implements than would otherwise be the case. There are few rock fragments on the surface, except on the sites of quartz veins.

The subsoil to a depth of 30 inches or more consists of heavy, tenacious red clay, and is comparatively free from stone. This clay, though quite intractable, retains a good supply of moisture for crop needs, and will withstand a good deal of drought.

Considerable difficulty was experienced in determining the boundaries between Porters clay and Porters loam in the country lying immediately north of Leicester, because of the fact that the two types graded so imperceptibly into each other. Over quite a wide zone there seemed to be a great lack of uniformity on the part of both types. The same trouble was experienced to some extent in parts of the area in the vicinity of Clyde. In these cases of doubt, where the color and local physical characteristics seemed to be at variance with the main bodies of the types, averages had to be struck and the soils classified according to their general agricultural value; nor was it

deemed practicable in these areas always to recognize and to map separately the smaller disconnected spots showing even well-defined type characteristics.

Porters clay is found irregularly distributed over different parts of the area, but is more extensively developed in the French Broad Valley. There is also a quite large representation of it in the Big Pigeon River Valley and in the southwestern part of the sheet.

The greater proportion of the type is characterized by the rolling topography of the valley or intermountain country. In the rougher, more deeply eroded hill country, in the vicinity of Alexander, Porters clay is generally confined to the tops of the ridges, which are in many cases 300 or 400 feet above the bed of the French Broad River. About Asheville, Leicester, and in the southwestern part of the area the hills occupied by this type are not so high, and the red soil is not confined altogether to their tops, but extends down to the streams. This type of soil is seldom found on mountains, though a few exceptions have appeared, notably on the Elk Mountains, near Asheville, and Tobacco Mountain, southeast of Clyde. The slope of the hills is generally gentle enough to make cultivation practicable, though with heavy rains the run-off is so rapid as often to result in soil washes.

There is seldom any want of drainage on this type of soil. There is rather a too free and rapid drainage, which in some instances might be profitably checked by the terrace system of cultivation.

Porters clay, like the type previously described, owes its origin to the decomposition of gneiss and the schists. It is probable that the red clay results more generally from the weathering of a mica schist than from a rock containing more siliceous material. In two instances, south and southeast of Blackwell Springs, an abundance of quite pure black hornblende has given rise to small areas of Porters clay ranging from an ocherous brown to a dark ferruginous red color. The subsoil is here a little less tenacious and the top soil is a little more sandy than in typical localities.

Nearly all of the ordinary farm crops, except tobacco, are grown upon this soil. With the present methods of shallow cultivation the yields, especially in dry seasons, are sometimes a little below the average for Porters loam, but one year taken against another it is believed there is little difference in the productiveness of the two types.

An abundant, oftentimes dense, growth of short-leaf and loblolly pine springs up on abandoned fields. The original forest contained a larger proportion of the hardwoods—white, post, and red oak and chestnut being prominent species.

Porters clay, like its prototype, the Cecil clay of the Piedmont belt of the South Atlantic States, requires for its highest efficiency thorough and deep cultivation. It should be deeply plowed and the subsoil well broken up with a subsoil plow. It readily produces clover

and cowpeas. Green crops of these should be turned under, both for the purpose of supplying more plant food and for the equally beneficial effect upon the physical character of the soil. Crops like corn should be well and frequently cultivated, and especially as soon as practicable after rains, to prevent caking. Three times the care and attention usually given to the cultivation of this type of soil would more than treble its productiveness, and tilled in this manner no fear need be felt for the deterioration of the soil. Wornout and abandoned fields will be a thing of the past. Little, if any, commercial fertilizer need be applied; rather, as much barnyard manure as can be secured, and plenty of soiling crops. Tillage will do the rest. Porters clay properly handled is capable of producing almost any of the ordinary farm crops. The soil is well adapted to apples, especially the Winesap and similar varieties.

The following table of mechanical analyses shows the texture of fine earth samples of soil and subsoil of this type:

Mechanical analyses of Porters clay.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
9735	3 miles NW. of Clyde.	Red clay loam, 0 to 7 inches.	0.64	2.70	7.18	6.32	23.68	18.16	16.66	24.50
9733	3¼ miles NW. of Alexander.	Yellow loam, 0 to 9 inches.	2.02	2.96	6.88	5.38	14.98	12.02	32.22	25.38
9737	3 miles NE. of Leicester.	Red clay loam, 0 to 9 inches.	1.86	2.40	6.80	5.18	11.92	9.52	31.94	31.74
9738	Subsoil of 9737.....	Red clay, 9 to 28 inches.	1.70	2.00	5.40	4.08	9.84	9.38	28.70	40.32
9736	Subsoil of 9735.....	Red clay, 7 to 30 inches.	.45	1.60	4.84	4.84	16.44	11.10	20.46	40.70
9734	Subsoil of 9733.....	Red clay, 9 to 30 inches.	1.49	1.70	4.24	3.16	9.18	7.66	23.00	50.96

MEADOW

The soil of the Meadow consists for the most part of rather loose, incoherent brown sand of medium texture, which in many localities is quite micaceous. The soil, which averages about 10 inches deep, grades insensibly into the subsoil, and to the depth of 30 inches or more about the only difference noticeable is that from about 18 inches downward the subsoil is lighter in color. Variations in texture, affecting the soil and subsoil as a whole, however, occur. The material is in some cases quite fine and compact and more clayey than sandy in nature, the subsoil of this phase being at times mottled brown and yellow. These areas are few and small.

The Meadow is found in all parts of the area as a level strip bordering both the large and small streams. Its continuity along the streams is oftentimes interrupted, the hills closing in and the valleys becoming so narrow that no room is left for sedimentary deposition. Its average width along the smaller streams is less than 100 yards, though in a few instances in the wider valleys it broadens out to a quarter of a mile in width. A great part of the type is subject to overflow, and the drainage is deficient in many places.

The soil is sedimentary in origin, the particles being washed down from the hills and mountains and deposited where the streams are broadest and the currents most sluggish.

Corn and hay are the principal crops grown, the former yielding on an average about 30 bushels and the latter about 1½ tons to the acre. The soil is held in high esteem, as well for its convenient physiographic position and ease of cultivation as for the natural renewal of its fertility by sedimentation. Prices out of all proportion to its agricultural value are sometimes paid for land of this character. Vegetables are grown upon it to some extent, and it is also used for pasture land.

ROCK OUTCROP.

Certain areas, amounting in all to less than 1 per cent of the areas surveyed, are classed as Rock outcrop and shown in the map by suitable symbol. These embrace ledges of bare rock, areas of scant soil covering, or areas so covered with stones and bowlders as to be unsuited to cultivated crops.

AGRICULTURAL METHODS.

Considering the isolation of many of the farming communities, it is not surprising that more improvements in agricultural methods have not been adopted. Some excuse, too, for the primitive implements and practices may be offered by reason of the rough and oftentimes stony character of much of the mountain land. The steep slopes and uneven surfaces which prevail in much of the mountain country are prohibitive of the use of grain drills, wheeled double cultivators, harvesters, and other implements which contribute so much to the easy and economical prosecution of the work on more level farms. A few reversible disk sulky plows are being used in some localities in the rolling intermountain country. They give very good results, and, with the same draft needed for the old-style walking plow, cut a deeper furrow. No instances are known where they have been tried upon the steep mountain slopes. It is likely that much of the plowing on the steepest slopes will for a long time continue to be done with the small plows drawn by one horse or an ox. These plows have reversible moldboards, so that they can be drawn back and forth along the lower edge of a field and the furrows always turned downhill.

Many of the farms are so steep that the crops are taken off on sleds, and, in fact, the ox sled is the only vehicle which some of the mountain farmers possess.

The cultivated areas on the mountain farms are often quite limited in extent, and the crops correspondingly small in quantity. In thrashing seasons it is frequently necessary for a crew to haul their machine (a small, light one, the motive power to run which is furnished by horses—no portable engines being used) up rough and stony mountain roads for only two or three hours' work.

The method of harvesting corn is to cut the top off the stalks above the ears, and, with the leaves left on, put them in shocks. The leaves left on the standing stalks are then stripped off, tied into small bundles, and hung over one of the standing stalks to cure. After a few days these leaves and top stalks are removed to shelter, and the butt stalks with the attached ears left standing in the field until the grain is thoroughly dried out. It sometimes stands in this way for a month or six weeks, when the ears are pulled and carried to the crib, the husks being left on in many instances and removed only as the corn is wanted for feeding. While by the use of this method nearly the whole of the waste part of the stalk is left in the field and the edible portion preserved in more convenient form for feeding, the process appears tedious and expensive and its economy seems very doubtful.

Little attention has been paid to crop rotation or fertilization in the mountain section, though these have been practiced to some extent by the more progressive farmers in the lower hill country, where the soils have been longer in cultivation. Heretofore the land has always been so cheap that when the soil became exhausted the field was left to grow up to pine and additional land cleared.

AGRICULTURAL CONDITIONS.

The average mountain farmer produces little more than enough for home consumption. As the result of long years of isolation, the scarcity of money, and the difficulty of reaching the towns, he has learned to grow or manufacture at home things which the farmer in more accessible districts finds it more economical and convenient to purchase. A part of his clothing is made at home from the wool grown, carded, spun, and woven there; he manufactures brooms from home-grown broom corn; he raises sorghum and makes his own sirup; weaves his own baskets; substitutes gourds for tin dippers; and grows tobacco for his own use. The wants of the mountain farmer are simple. Many of the things which people living in the more advanced and progressive sections regard as necessities, he looks upon as luxuries, and neither indulges in nor desires. The mountain farmer is fairly prosperous, judged by his own standards, and is generally contented with his lot. His intellectual enjoyments are few. He cares

little for art or literature, reads few books, subscribes to few newspapers, and concerns himself little with events which are transpiring outside of his own community or State. Illiteracy is not uncommon. Lack of interest in educational matters is too often displayed, and the school generally occupies a place second in importance to the church.

A great many of the farms, especially in the mountain districts, are operated on shares. According to the last census the farms in Buncombe, Haywood, and Madison counties operated by their owners were 49 per cent of the total number, those leased for a cash rental, 3 per cent, and those worked on shares, 42 per cent. The usual arrangement is for the owner to furnish stock (work horses or oxen) and tools, receiving one-half of whatever crop is grown.

The average size of the farms in the three counties is about 85 acres. A tract of something over 10,000 acres, belonging to the Vanderbilt estate, lies within the area surveyed, and in Haywood County about 3,000 acres are held in one block. With these two exceptions, farms of over 200 acres are rare. Only about 3 per cent of the farms are operated by colored persons.

By far the greater part of the farm labor is performed by the immediate members of the farmer's family. The women and girls, especially in the mountain sections, are often seen at work in the fields alongside the men and boys, and give assistance in the hand cultivation of crops, in the corn and wheat harvest, and in other work of like nature. Very little colored labor is employed on the farms anywhere in the area, and in the mountain districts none.

Not much variety is observed in the character of the agricultural products of this section of the country, and these are of such quantity and nature that, with the exception of a small amount of tobacco and a few apples, scarcely anything is shipped beyond Asheville and Waynesville. Corn, wheat, oats, hay, beef and pork, dairy products, and honey, Irish and sweet potatoes, cabbage, tomatoes, and other vegetables are nearly all consumed within a few miles of where they are produced.

The only notable recognition of the adaptation of soils to crops is the selection in some instances of the coves and mountain slopes of Porters black loam for apple orchards. Tobacco is nearly always grown upon the sandier soils of the mountains and hills—either the Porters sand or Porters sandy loam. A sandier soil is usually selected for oats than for wheat. Corn is grown both on the mountain tops and on the alluvial soils along the streams, and the same is true of grass.

The Southern Railway owns and operates the only railroads within the area surveyed. The Knoxville division, running between Washington and Knoxville, intersects the French Broad River near Biltmore, 2 miles above Asheville, and skirts the windings of this beautiful

stream from there out of the area and out of the State into Tennessee. Its total length in the area is about 23 miles. The Murphy branch has a mileage of about 27 miles in the area, running nearly west from Asheville, through Hominy Creek, Canton, and Clyde. The Asheville, Spartanburg and Columbia branch leaves the area about 5 miles south of Biltmore.

The main wagon roads leading out of Asheville in different directions, to Leicester and Sandy Mush Creek, through Canton and Clyde to Waynesville, along French Broad River to Alexander, across Beaverdam Creek to Weaverville, and south and east from Biltmore, all have easy grades and well-drained, hard roadbeds. The most of the roads in the more mountainous sections are also well engineered and constructed, though in a few instances, across some of the mountain gaps, considerable improvement might be effected by changing the location of the roads so as to secure easier grades. Some of the smaller, less important roads leading up to the heads of the narrower mountain valleys are so rough and stony as almost to preclude the use of wheeled vehicles altogether. The natural and accepted method of travel, when no loads are to be hauled, is by horseback.

A large number of summer and winter tourists and health seekers are attracted to western North Carolina, and the population of the mountain towns along the line of the railroad is considerably increased during the greater part of the year. With the influx of this transient population the supply of vegetables, dairy products, eggs, and poultry, which is always limited, is entirely inadequate to the demand, and the very best prices are obtained. During the past summer (1903) young chickens have brought fancy prices, and the supply has been entirely insufficient.

There is a good demand for milk and butter, and dairying might easily be made a profitable industry. There is an abundance of cheap mountain pasture and farming land, well watered by pure, cold, spring-fed streams, relatively near the cities and towns. Many of the mountain streams would furnish abundant power for dairy and other farm machinery.

Though the soil and climatic conditions are especially favorable for the growth of grass, the greater part of the hay used in Asheville is shipped into the State from outside sources. For baled hay of the best quality as high as $25 a ton was paid during the summer of 1903. There seems to be no reason why this hay should not be grown at home at a handsome profit.

Opportunities exist for the establishment of several truck gardens, which, rightly carried on, can not help but prove highly remunerative. The rich bottom lands offer a soil excellently adapted to a great variety of vegetables.

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