

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE MARYLAND GEOLOGICAL SURVEY, EDWARD  
BENNETT MATHEWS, STATE GEOLOGIST; MARYLAND AGRICULTURAL  
EXPERIMENT STATION, H. J. PATTERSON, DIRECTOR.

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SOIL SURVEY OF CARROLL COUNTY,  
MARYLAND.

BY

R. T. AVON BURKE.

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W. EDWARD HEARN, INSPECTOR, SOUTHERN DIVISION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1919.]



WASHINGTON:  
GOVERNMENT PRINTING OFFICE,  
1922.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., December 30, 1921.*

SIR: I have the honor to transmit herewith the manuscript and map covering the soil survey of Carroll County, Maryland, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1919, as authorized by law. This work was done in cooperation with the Maryland Geological Survey and the Maryland Agricultural Experiment Station.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. H. C. WALLACE,  
*Secretary of Agriculture.*

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### MAP.

Soil map, Carroll County sheet, Maryland.



# SOIL SURVEY OF CARROLL COUNTY, MARYLAND.

By R. T. AVON BURKE.—Area Inspected by W. EDWARD HEARN.

## DESCRIPTION OF THE AREA.

Carroll County is situated in the northern part of the State of Maryland, and borders on the State of Pennsylvania. It is somewhat irregular in outline. Its greatest dimensions, both north and south and east and west, are about 27 miles. It comprises an area of 447 square miles, or 286,080 acres. Westminster, the county seat, is 28 miles northwest of Baltimore.

Physiographically Carroll County is a plateau dissected by numerous streams flowing in comparatively narrow valleys. There is considerable variation in the surface features of different parts of the county. The topography of the greater part is gently rolling to strongly rolling and even hilly. Along the rivers and larger streams the country is decidedly hilly, and many of the slopes, while comparatively smooth, are rather steep, as these streams have cut deep channels. The northwestern corner of the county, or all of that part underlain by the red sandstone and shale formation, has a smoother surface than the rest of the county, and consists mainly of undulating to gently rolling areas, which only become hilly near the streams. Along the streams there are narrow strips of first-bottom land, lying only a few feet above their normal water level and having a flat, smooth surface. Parrs Ridge, beginning at Mount Airy, extends in a northeasterly direction through Westminster and connects with Dug Hill Ridge. These ridges constitute what is termed the "backbone" of the county and form the divide between the drainage systems. Practically all the country to the east and south of Parrs Ridge slopes to the south, southeast, and east. The principal drainage ways of this section are the North Branch and South Branch of the Patapsco River and Morgan Run. The country to the north and west of this ridge is drained by the

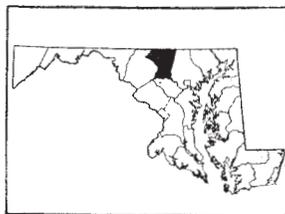


FIG. 1.—Sketch map showing location of the Carroll County area, Maryland.

Monocacy River, which forms the western boundary of the county and finally empties into the Potomac. The tributaries of the Monocacy and the streams which drain the western part of the county are Piney Creek, Silver Run, Bear Branch, Meadow Branch, and Double Pipe and Big Pipe Creeks. In general the county has excellent natural drainage, and all parts of it are well watered.

The elevation of the county ranges from about 300 feet in the southeastern corner to about 1,000 feet on Dug Hill Ridge in the northern part. The general elevation of the upland ridges is around 700 to 850 feet, except in the northwestern corner, where the elevation ranges from 310 feet on the Monocacy River to 575 feet in the northern part on the Pennsylvania line north of Piney Creek, this general region having an average elevation of 400 to 500 feet. The elevation at Mount Airy is 810 feet, at Sykesville 383, at Hampstead 913, at Westminster 774, at New Windsor 452, at Taneytown 524, at Silver Run 707, and at Melrose 795 feet.

The streams in the eastern part of the county are much swifter than those in the northwestern part and are actively engaged in deepening their channels. Comparatively little bottom land lies along their courses. Many flour and grist mills use the water power in these streams, but much remains to be developed.

Carroll County was created in 1838. Many of the early settlers were of German extraction. The present population consists of descendants of these, together with others of English, Irish, and Scotch descent. The census of 1920 gives the population of the county as 34,245, 89.7 per cent of which is classed as rural, there being only one town of more than 2,500 inhabitants. The population is remarkably stable, having increased only 10.4 per cent in 40 years. The population is well distributed, although slightly more dense in the eastern and southern parts of the county. The rural population averages about 68.7 persons per square mile.

Westminster, the county seat, is situated in the central part of the county and has a population of 3,521. Other important towns are Taneytown, with a population of 800, New Windsor, with a population of 512, and Mount Airy (partly in Frederick County), with a population of 754. Numerous other villages are scattered over the county.

Three important railroads serve Carroll County, the Western Maryland, the Baltimore & Ohio, and the Pennsylvania. The main line of the Western Maryland Railway traverses the central part of the county in a general east-west direction, passing through Westminster, New Windsor, Union Bridge, and Keymar. The main line of the Baltimore & Ohio follows the South Branch Patapsco River, along the greater part of the southern boundary of the county. Mount Airy and Sykesville are important stations on this line. The Harrisburg

division of the Western Maryland Railway traverses the northeastern part of the county in a north and south direction, passing through Hampstead, Greenmount, Millers, and Lineboro. A short branch of this road, known as the Bachman Valley Branch, extends southwest through Melrose to Ebbvale. The Frederick Branch of the Pennsylvania Railroad crosses the northwestern part of the county, passing through Keymar, Taneytown, and Galt. No part of the county is over 10 miles from a railroad.

An excellent system of public roads has been developed throughout this county. The road from Baltimore to Bridgeport is a first-class State road, which passes through Finksburg, Westminster, and Taneytown. Another is the Washington Road, which extends from Westminster to Sykesville. In addition there are other short stretches of State roads. The other roads of the county are generally good, so that it is easy for the farmers to get their products to shipping points and markets. Considerable milk and other freight is hauled in trucks to Baltimore.

Churches and schoolhouses are conveniently located. Nearly every farm is connected with a telephone system.

Baltimore constitutes the principal market for the products of Carroll County. Washington furnishes a market for a part of the poultry products, beef, pork, and general farm crops. Westminster and the other towns, together with the numerous canning plants, consume a considerable proportion of the farm products.

#### CLIMATE.

There are no Weather Bureau stations within the limits of Carroll County, but the tables prepared from records of the stations at Baltimore and Emmitsburg (located just outside of the county) give a good idea of climatic conditions. The records for Baltimore may be considered applicable to the eastern part of the county, and those for Emmitsburg to the western part of the county.

The winters are generally open, and there is usually little cold weather until January, which is given at both stations as the coldest month, with a mean of 30.9° F. at Emmitsburg and 33.4° F. at Baltimore. The mean annual temperatures for the winter season at Emmitsburg and Baltimore, respectively, are 31.9° F. and 35° F. The range of temperature in the winter months is from -23° F. to 75° F. at Emmitsburg, and from -7° F. to 78° F. at Baltimore. The average date of the latest killing frost in spring at Emmitsburg is April 6, and at Baltimore April 4, and the average dates of the first in fall are November 10 and November 3, respectively. The latest frosts in spring occurred on April 19 and May 12, and the earliest in

fall on October 26 and October 6, respectively. The average growing season is thus somewhat over 200 days. The summers in Carroll County are mild and pleasant. The days are rarely hot and oppressive, and the nights are generally cool. The mean temperature for July, the hottest month, is 75.4° F. at Emmitsburg and 77.3° F. at Baltimore, and the absolute maximum temperatures are 102° F. and 104° F., respectively.

The precipitation is well distributed throughout the year and is sufficient for the production of a wide range of crops. At Emmitsburg the yearly mean is 44.22 inches, at Baltimore it is 43.18 inches. The total amounts for the driest years recorded for Emmitsburg and Baltimore are 31.83 inches and 31.57 inches, and for the wettest years 61.37 inches and 62.35 inches, respectively. The following tables present the data in some detail:

*Normal monthly, seasonal, and annual temperature and precipitation at Emmitsburg, Frederick County, Md.*

(Elevation, 720 feet.)

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1879).	Total amount for the wettest year (1889).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	33.0	75	1	3.20	4.72	1.82	5.8
January.....	30.9	70	-23	3.28	1.77	4.84	9.5
February.....	31.7	64	-15	3.28	1.03	1.24	11.5
Winter.....	31.9	75	-23	9.76	8.12	7.90	26.8
March.....	39.8	89	2	4.16	3.08	6.04	7.0
April.....	51.8	92	20	3.22	2.88	4.17	.5
May.....	61.9	97	32	4.16	4.26	10.20	.0
Spring.....	51.1	97	2	11.54	10.22	20.41	7.5
June.....	70.3	97	42	4.34	2.16	5.10	.0
July.....	75.4	102	50	4.02	1.57	9.50	.0
August.....	72.6	99	50	4.08	4.39	2.00	.0
Summer.....	72.8	102	42	12.44	8.12	16.60	.0
September.....	65.7	96	36	3.60	2.17	6.45	.0
October.....	54.6	90	26	3.68	.77	3.38	T.
November.....	42.8	77	12	3.20	2.43	6.63	1.4
Fall.....	54.4	96	12	10.48	5.37	16.46	1.4
Year.....	52.5	102	-23	44.22	31.83	61.37	35.7

*Normal monthly, seasonal, and annual temperature and precipitation at Baltimore, Baltimore County, Md.*

[Elevation, 115 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1900).	Total amount for the wettest year (1889).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	36.9	73	-3	3.08	2.07	0.61	4.2
January.....	33.4	74	-6	3.22	2.11	4.22	6.1
February.....	34.6	78	-7	3.51	4.65	2.53	7.5
Winter.....	35.0	78	-7	9.81	8.83	7.36	17.8
March.....	41.9	86	5	3.88	3.17	5.71	4.5
April.....	53.0	94	12	3.27	2.06	8.70	.6
May.....	64.2	96	34	3.56	1.00	6.82	T.
Spring.....	53.0	96	5	10.71	6.23	21.28	5.1
June.....	73.0	99	46	3.84	4.34	6.17	.0
July.....	77.3	104	55	4.82	1.51	11.03	.0
August.....	74.7	100	51	4.21	2.91	1.40	.0
Summer.....	75.0	104	46	12.87	8.76	18.60	.0
September.....	68.6	101	39	3.85	4.26	4.59	.0
October.....	57.5	90	30	3.02	1.68	4.12	T.
November.....	45.8	79	15	2.92	1.81	6.45	1.0
Fall.....	57.3	101	15	9.79	7.75	15.16	1.0
Year.....	55.1	104	-7	43.18	31.57	62.35	23.9

AGRICULTURE.

Agriculture has been the chief industry of Carroll County since its settlement. Tobacco was the principal cash crop for many years, and much was shipped to Europe. Later wheat, corn, and hay became the standard crops of the county. Considerable quantities of wheat were manufactured into flour in mills using the water power afforded by many of the streams. Cattle, sheep, horses, and hogs were raised and were driven to markets in Maryland and neighboring States.

Improvement in the yields of crops and the methods of handling the soil has been noticeable since the Civil War, but has been most pronounced during the last 25 or 30 years. The general use of lime and commercial fertilizers, the keeping of dairy cattle and other stock, the application of barnyard manure, and the turning under of other organic matter, together with a rather definite crop rotation including grass and hay crops, have been the main factors in

building up the agriculture to its present position. At present the agriculture of the county consists of the production of wheat, corn, and hay for home use and for sale, dairy farming, market gardening, feeding of beef cattle, hog raising, and fruit growing. Many farmers produce, in addition to their home supply, considerable quantities of vegetables for sale.

The following table shows the acreage of the leading field crops, as given in the last five reports of the United States Census:

*Acreage of leading field crops in Carroll County.*

Year.	Wheat.	Hay.	Corn.	Oats.	Rye.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
1879	40,077	34,027	31,983	11,972	5,269
1889	44,704	39,272	33,624	10,695	6,752
1899	58,097	42,293	39,880	3,251	5,732
1909	57,189	42,759	41,618	4,144	7,185
1919	66,404	37,935	40,275	4,402	2,527

From this table it will be seen that wheat has been the leading crop during the last 40 years, and that hay and corn have maintained their position as important crops. The decrease in the acreage of hay since 1909 should be considered in connection with the large increase in recent years in the acreage devoted to silage crops and to corn cut for fodder.

Wheat is the dominant crop of Carroll County. It not only occupies the greatest acreage, but is the leading cash crop and is grown on nearly every farm. The wheat is sold to local mills or shipped to Baltimore.

Corn is the crop next in importance, on the basis of acreage. It is grown on all farms, and the most of it is used for feeding work stock, hogs, and steers on the farm, although a little is sold in Baltimore and at shipping points within the county. Some corn is grown for ensilage. Among the varieties of corn grown are the Boone County White, Johnson County White, Whitecap, and Reids Yellow Dent. There is very little white corn grown north of Westminster.

Hay is next in acreage to corn and is included in the cropping systems of nearly all farms. The 1920 census reports the acreage of tame grasses in 1919 as 37,391, of which 25,642 acres were in timothy and clover mixed, 7,294 acres in timothy alone, and 3,645 acres in clover alone. Some alfalfa is produced, but the growing of this crop is in the experimental stage, and the acreage is very small. Much of the hay is consumed on the farm; some of it, however, is shipped by rail or hauled by truck to Baltimore.

According to the census, 21,025 acres of corn were cut for fodder in 1919.

Rye is a minor crop and is used chiefly as a soiling crop or for green-manuring purposes. Oats is not a very important crop. It sometimes takes the place of wheat in rotations.

The canning industry is becoming very important in Carroll County, particularly in the eastern section, there being eight plants in the county. The crops handled include sweet corn, tomatoes, peas, string beans, and pumpkins. There is no fruit cannery in the county.

The corn is hauled to the plants and there husked by machinery. The price paid for it in 1919 was about \$25 a ton. Some farmers report a production of as much as 8 tons per acre. The peas are mowed and hauled to the plants. The peas are removed from the vines by machinery, and the vines are hauled back and used as feed. String beans are picked by hand, only the pods being delivered to the factory. Two crops of string beans are frequently grown on the same land in one season.

Many farmers in the southeastern part of the area have excellent gardens, the surplus vegetables being marketed in Baltimore. Irish potatoes are becoming an important crop. These are sold locally or in Baltimore. The crop occupied 2,830 acres in 1919.

About 500 acres, mostly on the Manor loam and gravelly loam, are devoted to the production of wormseed, and there are about half a dozen stills in the county engaged in the manufacture of the oil. This is considered a very profitable crop by many farmers. It is used in vermifuge and in patent medicines. The price obtained for the oil ranges from \$2 to \$8 a pound. From 40 to 60 pounds per acre is a good yield.

Dairying in Carroll County is concerned principally with the production and sale of whole milk, the daily output during the summer season amounting to 15,000 gallons. Most of this is shipped to Baltimore. There are no condenseries, creameries, or cheese factories in the county. Some butter is made on the farms for home use and to supply local markets. The cattle utilized for dairy purposes are Jersey, Holstein, and Guernsey, or grades of these breeds. The total value of dairy products in 1919, not including home use, is reported by the census as \$1,617,074.

The feeding of beef cattle, mostly Hereford and Shorthorn grades, is becoming important. About 3,500 are brought in each year, mainly from the Pittsburgh and Chicago markets. They are fed ensilage, in part the waste in canning sweet corn, and are finished on corn. Many of these cattle are sent to foreign markets.

Many horses are raised in Carroll County. They are mostly of draft type, principally of the Percheron breed. Some trotting stock

is produced at Middleburg, where a farm well equipped for this purpose is located.

Large quantities of pork and some mutton are produced in the county. The hogs are principally of the Berkshire, Poland-China, and Hampshire breeds. They are butchered locally when they weigh between 150 and 250 pounds. The greater part of the meat is shipped to Baltimore. Most of the sheep are of Shropshire, Hampshiredown, and Southdown breeds. They also go largely to the Baltimore market.

There are a few poultry farms in Carroll County, and nearly every farm has its flock of chickens, ducks, or geese. The total value of poultry and eggs for 1919 is given by the census as \$1,242,844. This is about three-fourths the value of dairy products.

The census of 1920 reports 144,314 fruit trees of bearing age and 8,606 grapevines. There are 101,464 apple trees, 24,956 peach, 7,453 pear, 3,912 plum and prune, and 6,523 cherry trees. The total value of the fruit and nuts for 1919 is given as \$158,958. Nearly every farmer has a few fruit trees and grapevines, and a cane-fruit or berry patch. In some sections there are commercial apple and peach orchards, most of the larger ones being in the northwestern part of the county. The principal varieties of apples are the York Imperial, Stayman Winesap, Grimes, Winesap, and Stark.

Of the peaches, the Elberta is the leading variety. Among the pears the Bartlett, Kieffer, and Le Conte are popular. The products of the larger orchards are shipped to Philadelphia, Boston, and New York, while the fruit of the smaller orchards is sold locally or in Baltimore.

The crop adaptations of the various soils in Carroll County are generally known, so far as the crops more commonly grown are concerned. The farmers recognize the value of the Chester loam, Montalto loam, Manor silt loam, Penn silt loam, and Hagerstown silt loam as good general farming types. They also recognize the limitations of the Bermudian and Congaree silt loams, and use them for grass and pasture. More corn is produced on the Bermudian silt loam than on the Congaree, as the former is better drained. The Manor loam and the Chester loam, shallow phase, are used for the production of general farm crops, but are not considered as productive for the purpose as the heavier types, and they are used largely for the production of canning crops and vegetables. The Manor slate loam, Lehigh gravelly loam, Manor gravelly loam, and Chester gravelly loam are recognized as fair soils for corn, wheat, and the clovers, and as excellent soils for fruits. The Manor loam, micaeous phase, is considered the best soil in the county for early truck, fruits, and potatoes. Despite the recognized adaptation of the vari-

ous soils and soil conditions, it is frequently necessary to produce crops not particularly suited to the soils of the particular farm.

The methods of agriculture are usually good. Corn is generally checkrowed. The land may be plowed in the fall or spring; most of it in the spring. In preparing the seed bed it is thoroughly harrowed and dragged. The rows are spaced 4 feet 3 inches apart each way. Corn is cultivated usually three or four times, and is harvested with a corn harvester where the topography of the fields permits. Ensilage corn is harvested in the same manner.

Wheat is sown on corn land in the fall with a drill, the land first being harrowed or disked. It is harvested with binders when the surface permits, or is cut with a cradle. It is shocked in the field and when cured is stacked. Traveling thrashing outfits later separate the grain. Where small-grain stubble land is used, it is plowed and harrowed instead of simply disked before seeding. Timothy is generally sown with the wheat, and clover is sown in the wheat and grass the following spring. Hay is cut for one or two years succeeding that in which the wheat is harvested.

Soy beans are becoming important as a forage crop. They are also grown for seed. Some harvest the seed with a bean huller and some use a threshing machine after removing some of its parts. Cowpeas are also grown for forage or as a cover crop for the orchards. Oats are mostly sown in the spring, although some winter oats are sown in patches with winter vetch. Rye and winter vetch also are used as cover or forage crops. Some crimson clover is seeded in the orchards.

The farms in Carroll County are improved with good houses, barns, machinery, and stock. Many of the houses are of brick or stone. These are large and substantial structures, some of them built before the Civil War. Large barns, of the same permanent materials, are numerous. Silos are common on the farms. The newer houses are built largely of wood and many of them are very attractive. The farms are equipped with all kinds of labor-saving machinery. There is need of a few more corn harvesters and threshing outfits in the county.

Rotation of crops is a part of the farm practice of Carroll County. The rotation most commonly followed is corn, wheat, and grass. Sometimes more than one crop of wheat is grown before seeding to grass. Hay may be cut for two years and the land returned to corn or it may be kept in pasture for an indefinite period. Little trouble is experienced in getting stands of bluegrass, and the pasture sods last a long time. Some acreages have been in grass more than 40 years; they are practically permanent.

According to the census the expenditure for fertilizers in 1919 amounted to \$650,387. Most of the complete fertilizers are mixed locally. On wheat the farmers use from 250 to 400 pounds of a mixture analyzing about 1 per cent of nitrogen, 8 per cent of phosphoric acid, and 2 per cent of potash, applied at the time of seeding. Somewhat higher grades are used for potatoes and truck crops. Manure is used on corn land sometimes supplemented by 200 pounds of rock phosphate. Manure and rock phosphate are sometimes used as a top dressing for grass lands.

Lime is used on all lands every 3 to 8 years, with good results. Limekilns are scattered throughout the county, but few of them are in operation now. When quick lime is used it is applied at the rate of 10 to 50 bushels per acre. Hydrated or slaked lime is more commonly used. It is applied in quantities ranging from 1,000 to 2,000 pounds per acre.

The expenditure for labor in 1919, as given by the census, was \$384,012. Most of the labor employed consists of native whites. It is generally efficient but the supply is not large. The monthly wage ranges from \$25 to \$35, with board. Some farmers pay a bonus if the service has been very satisfactory. Day labor receives from \$2 to \$4 a day without board. Some of this work is done by contract. Many women and children are brought into the county during the canning season. These are usually paid on a quantity basis.

According to the 1920 census, 95 per cent of the area of the county is included in farms, and 75.8 per cent of the land in farms is classed as improved.

There are 3,518 farms in Carroll County, ranging in size from a few acres to 1,000 or more. In general they contain from 10 to 120 acres. The census report of 1920 gives the average size of farms as 77.8 acres. There has been little change in size within the last three decades.

Of the total number of farms, 74.4 per cent are operated by owners, 23.9 per cent by tenants, and 1.7 per cent by managers. When land is rented or leased it is generally on a share basis, one-half the crops going to the landlord. The tenant and landlord generally share the cost of seed and fertilizer, and the tenant usually supplies the work stock.

Land values vary considerably over the county, ranging from \$40 to \$150 an acre. The principal factors influencing prices are character of the soil, topography, distance to railroads, and location with respect to towns and good roads. The highest prices are asked for land in the southeastern part of the county along good highways and comparatively near Baltimore.

SOILS.<sup>1</sup>

Carroll County lies entirely within the Piedmont Plateau region, a belt of country lying some distance from the Atlantic and Gulf coasts and extending from the Hudson River to eastern Alabama. All the soils of the county, with the exception of narrow strips of first-bottom material, have been derived from the underlying rock formations. These formations comprise two classes of rocks—first, igneous and metamorphic rocks; second, sedimentary rocks. The igneous and metamorphic rocks are by far the most extensive and include gneiss, granite, schist, gabbro, diabase, and slates. Generally these have weathered to a depth of several feet, but in many instances the disintegrated rock lies near the surface or is reached within the 3-foot section. The sedimentary rocks consist of red and gray sandstone and shale and limestone. The two first mentioned, of Triassic age, are confined to the northwestern corner of the county, occupying an area of approximately 65 square miles. These rocks have not weathered as deeply as those of the first-mentioned group, and the soil material is not as deep as in the case of some of the soils from crystalline rocks. The limestone, consisting principally of Cockeysville marble, occurs in valleys in the west central part of the county. Though of small extent, it gives rise to a distinct type of soil.

Along the rivers and larger creeks are narrow strips of alluvial material. This material has been brought down from the adjacent uplands and deposited by the streams at times of high water. Fresh sediments are added with each overflow. There are two classes of alluvial material in the county—that coming from the areas of sandstone and shale found along the streams in the northwestern corner of the county, and that washed from the region of igneous and metamorphic rocks.

The various rocks of the county, differing in their chemical and mechanical composition, have disintegrated and decayed into different soil materials. The soils from these materials have been grouped into series according to color, structure, origin, and other common physical characteristics. The series are further divided into types, the unit of soil classification, on the basis of texture. The soils derived from the igneous and metamorphic rocks are classed in the Chester, Manor, Lehigh, and Montalto series; those from Triassic sandstones and shales in the Penn series; and those derived from the limestone or marble in the Hagerstown series.

The types of the Chester series have brown to yellowish-brown surface soils and a yellow to brownish-yellow or reddish-yellow

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<sup>1</sup> The soil areas of Carroll County, Md., do not in all cases join with those of Adams and York Counties, Pa., owing to the greater detail shown in the more recent survey and to adjustments in classification since the earlier areas were mapped.

friable subsoil. They are derived from the weathering of crystalline rocks, including the Wissahickon formation of gneiss and schist and some granite. The Chester stony loam, Chester gravelly loam, and the Chester loam, with a shallow phase, are mapped.

The types of the Manor series have light-brown to yellowish-brown surface soils and a yellow or brownish-yellow to reddish-yellow friable subsoil. These soils are characteristically micaceous, and in many places the lower subsoil is a micaceous loam or grades into the disintegrated schist. They are derived from a yellow schist or slate metamorphosed from the so-called complex of acid and basic volcanic and argillaceous sedimentaries. The series is represented in this county by the Manor slate loam, gravelly loam, loam with micaceous phase, and the silt loam. These soils cover about one-half the area of the county.

The Lehigh types are grayish to bluish in the surface soil and drab to yellowish or brownish in the subsoil. These are derived from the weathering of a blue or bluish-gray fine-grained slate. Only one type, the Lehigh gravelly loam, is mapped in this survey.

The Montalto series has types with brown to reddish-brown surface soils and a maroon-red to dark-red, smooth, compact, fairly friable subsoil. Only one type, the loam, is mapped. This is derived from gabbro or diabase, a dense, dark-colored rock.

The types of the Penn series are characterized by the Indian-red color of both soil and subsoil. These soils are derived from the weathering of red sandstones and shales of Triassic age. They are predominantly smooth and friable in structure. The Penn silt loam, with a mixed phase and a gravelly phase, is developed in Carroll County.

The Hagerstown series consists of types with brown to reddish-brown surface soils and a reddish-yellow to reddish-brown subsoil. Only one type, the silt loam, is mapped. It is derived from the Cocksவில் marble and impure limestone.

The alluvial soils have been classed in the Congaree and Bermudian series. The Congaree soils have brown to grayish-brown surface soils and a brown, friable, slightly micaceous subsoil. One type, the Congaree silt loam, is developed in this county. The Bermudian series consists of types having Indian-red to reddish surface soils and subsoil, the material being very similar in color and texture to the upland soils from which it is derived. The Bermudian silt loam is the only type mapped.

The following table gives the names and the actual and relative extent of the soil types of Carroll County:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Manor loam.....	44,288	19.5	Manor silt loam.....	17,792	6.2
Micaceous phase.....	11,584		Chester gravelly loam.....	13,824	4.8
Chester loam.....	29,696	17.6	Bermudian silt loam.....	4,288	1.5
Shallow phase.....	20,672		Chester stony loam.....	2,816	1.0
Penn silt loam.....	36,608	15.0	Lehigh gravelly loam.....	1,920	.7
Mixed phase.....	5,440		Montalto loam.....	1,024	.3
Gravelly phase.....	640		Hagerstown silt loam.....	1,024	.3
Manor slate loam.....	38,272	13.4	Total.....	286,080	.....
Manor gravelly loam.....	35,136	12.3			
Congaree silt loam.....	21,056	7.4			

PIEDMONT PLATEAU.

CHESTER STONY LOAM.

The surface soil of the Chester stony loam consists of a brown to yellow loam or silty loam, 6 to 8 inches deep. The subsoil is a yellow or yellowish-brown loam to silty clay loam, which rarely exceeds a depth of 26 inches, where the more or less weathered bedrock is reached.

Over the surface and through the soil and subsoil are many rock fragments, ranging up to several inches in diameter, while outcropping ledges are rather numerous. The rock consists principally of schist and quartz, with some gneiss. Many local variations in depth, texture, and color occur throughout this type, but owing to their small extent they were not separated on the map.

The Chester stony loam is an inextensive type. It is restricted to the eastern part of the county, and is well developed along the North Branch Patapsco and its tributaries, and the headwaters of Gunpowder Falls. The type occupies the steeper slopes along the streams. It is unimportant in the agriculture of the county. An area here and there is used for permanent pasture, but most of it supports a forest of white oak, red oak, black oak, chestnut, some poplar, hickory, and other hardwoods. Land of this type is rarely sold alone, and then only as wood lots. The rough topography, together with the stones over the surface and the numerous outcrops, practically precludes the use of this type for general farming. It should remain forested, or, if cleared, should be seeded to pasture grasses.

CHESTER GRAVELLY LOAM.

The surface soil of the Chester gravelly loam is a brown or yellowish-brown loam, 6 to 10 inches deep. The subsoil consists of a yellow

or yellowish-brown silty clay or clay loam, which usually extends to 3 feet or more. Over the surface and throughout the soil and subsoil is an abundance of angular gravel consisting of quartz, quartzite, and schist fragments from 2 to 4 inches in diameter.

Included with this type are many small areas where the surface soil is brown or red and the subsoil is light red. These areas have the same texture, structure, and gravel content as the typical soil. A large area of this variation occurs along Gunpowder Falls, a smaller area lies on the east side of Cranberry Branch, west of Mexico, another is about one-fourth mile east of Mexico, and numerous small spots occur throughout the Chester loam.

In the southern areas of the Chester gravelly loam some difficulty was experienced in making the separation between the Chester gravelly loam and Manor gravelly loam, and boundaries in some cases were arbitrarily drawn. In general the Chester gravelly loam is restricted to the eastern and northeastern part of the county. It is well developed in the vicinity of Alesia, south and west of Manchester, between Manchester and Brummal, around Shiloh, and along West Branch. Many small spots occur throughout the Chester loam areas.

The Chester gravelly loam occupies ridges and slopes, and the topography is rolling to hilly. The elevation ranges from 500 to 1,000 feet above sea level. The type is exceptionally well drained and in many places the drainage is excessive. It is well watered; streams reach all parts of it, and springs are numerous.

Gravel on the surface and through the soil interferes to some extent with cultivation of crops and is especially hard on the farm tools. The gravel seems to aid in holding moisture in the soil and it tends to prevent erosion.

Probably not over 50 per cent of this soil is under cultivation; the rest supports a mixed growth of oak, chestnut, and other hardwoods. It is used principally for the production of general farm crops, corn, wheat, and hay. Occasional patches of rye are grown as a soiling or green-manuring crop. The yield of corn ranges from 20 to 40 bushels, of wheat 15 to 35 bushels, and of hay from 1 to 1½ tons per acre.

The Chester gravelly loam responds readily to fertilization and improved methods of handling. Productiveness can easily be maintained by good methods of cultivation, such as are employed by the best farmers. A systematic crop rotation consisting of corn, wheat, wheat, and timothy and clover is generally followed. About the same kind and amount of fertilizer and lime are used on the gravelly loam as upon the loam, and practically the same methods of culture are practiced. The larger stones have been removed from many of the fields.

Land of this type ranges in price from \$75 to \$100 an acre, depending on location and improvements.

## CHESTER LOAM.

The surface soil of the Chester loam is a grayish-brown, light-brown, or yellowish-brown friable loam 6 or 8 inches deep. It carries a relatively high percentage of silt, and in some places approximates a silt loam in texture. In forested areas the surface soil is yellow or brownish yellow; but, upon cultivation and the addition of organic matter, the soil acquires a brown color. The subsoil, extending to a depth of 3 feet or more, is a yellow to brownish-yellow, or slightly reddish-yellow, friable clay loam. The material in the lower part of the 3-foot section in places carries a noticeable amount of finely divided mica scales. Areas where this micaceous material is reached at about 24 inches are mapped as Chester loam, shallow phase.

In the vicinity of and north of Eldersburg, northwest of Gamber, along the county line 2 miles east of Lineboro, on the ridge west of Lineboro, and north of Cranberry Station, are small bodies that have a brown surface soil and a light-red friable subsoil. This material, which is closely associated with the Chester loam, differs from it only in color.

Included with this type are also spots of Manor loam, Chester gravelly loam, and Chester loam, shallow phase, which are too small to be indicated on a map of the scale used. In the southeastern part of the county, north and west of North Branch, the soil rests upon a shallow subsoil, which is underlain directly by the weathered gneiss or schist. East of the railroad, between Indian Run and Georges Run, the subsoil is less compact than typical, as it contains more mica. A few fragments of the parent rock, and even outcrops, occur here and there.

The Chester loam is one of the extensive and important soil types of the county. It is well developed along the eastern border and in the southeastern corner. Some of the larger and more typical areas are in the vicinity of Millers, Greenmount, Houcksville, and east and south of Eldersburg.

The surface of this type ranges from gently rolling to strongly rolling and in places hilly, and practically all of it lies favorably for agriculture. Its range in elevation is from about 400 to 800 feet above sea level. The type is naturally well drained. The surface is sufficiently rolling to allow the rain water to run off, and the subsoil is sufficiently porous to allow free circulation of water without being leachy. Crops seldom suffer from lack of moisture in ordinary droughts.

The greater part of the Chester loam has been cleared and is either under cultivation or in pasture. Small areas support a forest of chestnut, white oak, red oak, hickory, and occasional patches of pine.

The leading crops are corn, wheat, and hay. Oats, rye, barley, buckwheat, potatoes, and soy beans are also grown. In the dairying

sections, silage corn and other crops are grown for feed, and in many places a considerable acreage is devoted to the production of sweet corn, peas, string beans, and tomatoes for the canneries. There are no large commercial orchards on the type, but nearly every farm has a small orchard to supply home requirements.

Corn yields from 25 to 60 bushels per acre, wheat 15 to 30, and hay from 1 to 1½ tons. Sweet corn yields from 4 to 8 tons per acre. Irish potatoes and garden vegetables give good returns.

All the wheat is fertilized and most of the corn, either with commercial fertilizers or manure. Potatoes are heavily fertilized. The fertilizer used for wheat contains about 1 to 2 per cent of nitrogen, 8 to 10 per cent of phosphoric acid, and 1 to 2 per cent of potash, and is applied at the rate of about 300 to 500 pounds per acre. Most of the land is limed once in 4 or 5 years. Hydrated lime is usually used, the rate of application ranging from 1,000 to 2,000 pounds per acre. Large quantities of stable manure are used on corn land.

Well improved farms on the Chester loam near railroads and on important State highways sell for as much as \$100 to \$150 an acre. Good land, improved, but not so well situated, sells at \$60 to \$75 an acre.

The Chester loam is an easy soil to work, and a good tilth can readily be maintained. It is naturally a very productive soil if cultivated and fertilized properly, but if neglected it soon deteriorates. It should be limed every few years, and a good supply of organic matter should be maintained. It is one of the best soils in the Piedmont region of Maryland, and practically every crop suited to the climate can be successfully grown upon it.

*Chester loam, shallow phase.*—The surface soil of the Chester loam, shallow phase, consists of a yellow or yellowish-brown loam, 6 to 12 inches deep. The subsoil is a yellow to brownish-yellow or reddish-yellow friable silty clay or clay loam, which rarely exceeds a depth of 20 to 24 inches. Below this is a friable, soft, highly micaceous material which consists of the disintegrated but not fully weathered schist rock.

Local spots that have a brown soil and a reddish subsoil, also spots of Manor loam, micaceous phase, occur throughout the phase where erosion or soil wash has removed surface soil and upper subsoil. Most of these spots, however, are too small to show separately on the map. The Chester loam, shallow phase, is confined to the eastern half of the county. It occurs in a belt extending in a northeast-southwest direction from the vicinity of Morgan on the South Branch of Patapsco River toward the eastern boundary of the county east of Richards Mill. The belt is wider at the southern

end and narrow at the northern end, and is broken by other types of soil, especially of the Manor series, to the influence of which the phase owes some of its characteristics. The surface of the phase is gently rolling to hilly, and the range in elevation is from 450 to 800 feet above sea level.

The shallow phase is generally uniform in texture and color where the surface is gently rolling, but varies considerably in depth and texture and to some extent in color where the surface is steeper. It is naturally well drained. In the hilly areas the drainage is excessive, and the underlying rock is exposed in places as a result of erosion.

About 70 per cent of the phase is under cultivation; the rest supports a forest of oak, chestnut, and other hardwoods.

The soil is easy to work, and crops mature early on it. Some farmers report that it does not stand drought as well as the typical Chester loam. It is used for the same type of farming as the Chester loam, and the yields reported for crops are about the same or but slightly lower than on the latter type.

It is generally well farmed, and most of it is in excellent condition. Land of this phase is valued at \$100 to \$150 an acre, depending on location and improvements.

#### MANOR SLATE LOAM.

The surface soil of the Manor slate loam consists of a yellowish-brown or brown loam to silt loam, 5 to 8 inches deep. The subsoil is a yellow, yellowish-brown, or yellowish-red light silty clay loam which rarely extends to depths greater than 2 feet, where it rests upon partially decomposed shale, slate, or phyllite. A slick, greasy feel and friable structure characterizes the subsoil of the material. Over the surface and throughout the soil section is an abundance of yellow, brown, gray, or black chips of the parent rock, constituting from 20 to 60 per cent of the soil mass. The fragments are for the most part small, flat, and thin, and do not interfere with cultivation. On the tops of ridges and divides the color of the deeper substratum is in places a dull red or yellowish red streaked with red.

In many places on the steeper slopes the typical subsoil is wanting, the surface soil resting directly upon the partly decomposed shale or schist, and outcrops of these rocks are common.

The Manor slate loam is one of the extensive soils of the Manor series. It is well developed in the north-central part of the county, along the northern border, and west of Parris Ridge. Only a few small spots occur east of that ridge; one of these lies on the ridge east of Watersville, another southwest of Mexico, and others in the vicinity of Cranberry and near Maple Grove. It is well developed on top of Dug Hill Ridge in the northeastern part of the county.

The largest and most important areas are situated around Deep Run, Cherrytown, Union Mills, Silver Run, Pleasant Valley, Fountain Valley, Tyrone, Uniontown, and New Windsor.

The topography of the Manor slate loam is rolling to hilly. Its highest altitude above sea level is about 1,000 feet, on Dug Hill Ridge. Most of the hills are low, however, and have fairly smooth slopes.

The surface drainage is well developed and in many places is excessive, particularly on the steeper slopes, some of which are badly washed and eroded. The subdrainage is good in general. Shallow areas of the soil are said to be droughty.

Probably 70 per cent of this type is under cultivation; the rest supports a forest of various oaks, chestnut, some hickory, and poplar. The type is used principally for the production of such general farm crops as corn, wheat, and hay. Certain areas produce canning crops, and some of the type is in orchards. The yield of corn ranges from 20 to 60 bushels; of wheat, 12 to 35 bushels; and of hay, 1 to 1½ tons per acre. The canning crops consist of sweet corn, peas, string beans, and tomatoes. The yields are said to be lighter on this type than on the Manor loam or silt loam. The fruit produced includes apples, peaches, pears, and small fruits.

The Manor slate loam is handled in much the same way as the Manor loam and silt loam, although crops can not be as economically produced on all areas of the type because labor-saving machinery can not always be utilized. The selling price ranges from \$40 to \$125 an acre, depending on location and improvements.

Deep plowing and the incorporation of organic matter would do much to increase the water-holding capacity of the type and thus add materially to its productiveness.

#### MANOR GRAVELLY LOAM.

The surface soil of the Manor gravelly loam consists of a brown or yellowish-brown loam, 8 to 10 inches deep. The subsoil is a light-brown to reddish-brown silty clay loam, extending in most places to a depth of 3 feet, but in others grading into the disintegrated shale or schist rock at depths between 24 and 36 inches. In places there is an intermediate layer of brown to light-brown silty clay between the typical surface soil and typical subsoil. This layer may have a thickness of 6 inches, or again may be very thin. On the surface and throughout the soil section is an abundance of small angular schist and quartz fragments of various sizes.

Included with this type are many local spots of Manor stony loam too small to show on the map. They usually occur on some of the steeper slopes or at the heads of draws and ravines. Some of the largest of these lie along the slopes of Morgan Run and in the vicinity of Wentz. Also included with this type are spots that have a

distinct silt texture in both soil and subsoil. One of the most important of these lies near the headwaters of Little Morgan Run and is crossed by the Washington Road.

The Manor gravelly loam is one of the extensive soils of the county. It is developed largely in the south-central part and southern end of the county along or close to Parrs Ridge. One of the largest areas of this type is situated west and southwest of Smallwood, including Bird Hill, and extending toward Mount Airy. This area is interrupted in places by areas of Manor loam and Manor stony loam and by the bottoms of Morgan Run, Piney Run, and Gillis Falls. The type also occurs along the slopes of the South Branch of Patapsco River, south and east of Mount Airy, also south of Sams Creek, east and south of Weldon, and west of Wentz.

The Manor gravelly loam occupies rolling to hilly areas along the tops of the ridges and divides. In places there are small areas of flat land; in others the slopes are very steep. Drainage is well established over all the type, and is excessive in the more hilly areas. Here erosion may be active, especially on the redder areas. The typical soil in smoother areas generally does not wash. The gravel seems to protect it against erosion.

Although one of the main types in Carroll County, the Manor gravelly loam is not as largely used for agriculture as the Manor loam, and probably not over 30 per cent of it is under cultivation. The rest is utilized for pasture or supports a mixed forest growth, mainly oak, with some hickory and chestnut. Much of the merchantable timber has been removed, and most of the trees now are small.

The type is used for the production of corn, wheat, and hay, supplemented by fruit and some canning crops. Part of the wormseed crop of the county is grown on this type. Corn yields from 20 to 35 bushels, wheat from 10 to 25 bushels, and hay about 1 ton per acre. Tomatoes and sweet corn are said to do unusually well on the type, and the fruit produced is of excellent quality. Apples are the most important fruit crop. The leading varieties are the York Imperial, Stayman Winesap, Stark, and Winesap. The Elberta and a number of other varieties of peaches are grown.

The Manor gravelly loam is rather difficult to work on account of the gravel, and it is especially hard on tools. This land is handled in much the same way as the Manor loam. The same fertilizers are used and about the same amounts applied.

Land of this type sells for \$10 to \$100 an acre, depending on the location and improvements.

Fruit growing is profitable on this type, and the acreage devoted to it should be extended. The steeper slopes should be seeded for permanent pastures or utilized for forestry.

## MANOR LOAM.

The surface soil of the Manor loam consists of a brown, grayish-brown, or yellowish-brown mellow loam to silty loam, having a depth of 5 to 10 inches. The subsoil is a friable reddish-yellow or yellowish-red silty clay loam, which usually extends to a depth of 3 feet. In many places the change from soil to subsoil is gradual. Finely divided mica is a characteristic feature of the subsoil, and the surface soil in places also contains noticeable quantities of this mineral. The content of mica in the subsoil is large enough to give the material a slick, greasy feel and a friable structure. Areas in which the lower subsoil is highly micaceous are mapped as the Manor loam, micaceous phase.

In many places small quantities of fine schist fragments and quartz gravel are scattered over the surface and through the soil mass. Areas in which such coarse material occurs in sufficient quantities to affect the character of the surface soil are mapped as Manor slate loam or Manor gravelly loam. On some of the slopes and knolls the partly disintegrated shale or schist from which this soil is derived lies within the 3-foot section, and in places reaches into the surface soil. In the vicinity of Mount Airy, west of Day, north and west of Barrett, north of Sykesville, south of Wakefield Station, and south of Westminster are areas which have a brown surface soil and a reddish-yellow to red smooth, friable subsoil. The agricultural value of this variation is not materially different from the typical soil.

The Manor loam is one of the extensive and important soils of Carroll County. Its greatest development is in the southwest corner and in the central part along Parrs Ridge. It is well developed in the vicinity of Mount Airy, Taylorsville, Baile, around Westminster, southeast of Westminster toward Walnut Grove Mills, north of Westminster around Bixler and Bachman Mills, and northwest of Melrose. A fairly large area lies in the northwestern part of the county about 2 miles east of Galt. There are a number of isolated areas scattered throughout the county, particularly in the central and western parts.

The topography of the Manor loam is gently rolling to rolling and hilly. The type occupies some of the broad, gently rolling to rolling interstream areas and sloping hillsides. Even in the most hilly areas the slopes are generally smooth, although the numerous stream channels are in rather deep and narrow valleys. Most of this type lies favorable for general farming, and even the steeper areas may be used advantageously for pasture and for the production of fruit.

There is excellent natural surface drainage for all areas of the Manor loam. Erosion is active where the slopes are not protected by growing crops, permanent pasture sods, or forest. Both the soil and

subsoil are sufficiently open and friable to absorb and hold considerable quantities of water, and crops on this soil seldom suffer from drought.

Probably 80 per cent of this type is farmed, the rest being in wood lots and pasture. The principal crops grown are corn, wheat, hay, and canning crops. Irish potatoes, oats, buckwheat, soy beans, garden truck, and fruits for home consumption and local markets also are produced.

Corn yields from 20 to 50 bushels per acre, with much higher returns on the better farms with highly manured fields, in seasons that are especially favorable. The yield of wheat is from 12 to 30 bushels per acre, and of hay, 1 to 1½ tons per acre. The canning crops consist of sweet corn, tomatoes, peas, a few string beans, and pumpkins. The yields of these crops vary considerably, but are slightly larger on this soil than on any other of the Manor types.

Practically all of the farmers on this type follow a rather definite rotation consisting of corn 1 year, wheat 1 or 2 years, and timothy and clover 2 years. Most farmers use lime, the application ranging from 1,000 to 3,000 pounds per acre. Lime is generally applied once in each rotation and at least in every other rotation. Practically all farmers use commercial fertilizers for wheat at the rate of 300 to 400 pounds per acre, the mixture consisting of about 1 to 2 per cent of nitrogen, 8 per cent of phosphoric acid and 1 or 2 per cent of potash. Recently ground phosphate rock, containing about 16 per cent of phosphoric acid, has been used, particularly for corn and the hay crops. Considerable barnyard manure is used, especially for corn, but the supply is inadequate, except on the dairy farms.

The Manor loam can be built up to a high state of productiveness, and this easily maintained, by proper crop rotation, the addition of organic matter, and liberal applications of lime. The subsoil is retentive and the effects of fertilization are lasting. The steeper slopes should be kept in permanent pasture as much of the time as possible, to prevent erosion. The soil is very easy to cultivate and, if plowed and harrowed under proper conditions of moisture, will not bake or clod. The turning under of green-manuring crops, such as cowpeas or crimson clover, will greatly improve the soil.

Farms on this type sell for \$60 to \$125 an acre, depending on the state of improvements and the location with respect to good roads and shipping points.

*Manor loam, micaceous phase.*—The surface soil of the Manor loam, micaceous phase, consists of a brown or yellowish-brown loam, from 8 to 10 inches deep. This is underlain by a brownish-yellow friable micaceous loam, which normally extends to a depth of 3 feet or more, but in places rests directly upon the rotten mica schist at depths between 20 and 36 inches. Both soil and subsoil contain

conspicuous quantities of finely divided mica. It is so abundant in the subsoil that it gives it a slick, greasy feel and causes it to be extremely friable and porous. Small fragments of quartz and schist are distributed over the surface and throughout the soil and subsoil. They are too small to interfere with cultivation.

Included with this type are many local spots of Louisa loam too small to show on a map of the scale used in this survey. These areas are characterized by a red micaceous subsoil, generally heavier in texture than that of the Manor loam, micaceous phase.

The Manor loam, micaceous phase, is restricted largely to the southeastern part of the county. One of the largest areas lies along the Baltimore and Carroll County line and along the North Branch Patapsco River, and includes Finksburg, and Louisville. Two small areas, separated by Georges Run, occur south of Manchester. The phase also is developed in the southern part of the county in the vicinity of Woodbine and Hoods Mills. Another body lies along the Liberty road, northwest of Freedom, and extends northeast to Morgan Run. Two small areas occur in the extreme southeastern corner of the county.

The phase occupies rolling to hilly country and may occur on the tops or on the slopes of ridges and hills. The surface, however, is usually smooth, and practically all the land can be cultivated.

Drainage is well established and in places is excessive, and parts of the phase wash badly during heavy rains. The light friable subsoil erodes easily, and the land should not be left bare.

The phase is an open, porous soil and absorbs light rains quickly. It is easy to work and warms up early in spring, but is inclined to be droughty during protracted dry spells.

The Manor loam, micaceous phase, is not one of the extensive soils of the county, but probably somewhat over 60 per cent of it is under cultivation. Wood lots and pasture lands compose the rest. It is used for general farming and dairying. Corn, wheat, and hay are the leading crops. Garden truck and fruit, and occasional crops of rye, barley, buckwheat, soy beans, and potatoes are grown. A few promising patches of alfalfa were noted. The yields reported range from 20 to 50 bushels of corn, 10 to 30 bushels of wheat, and about 1 ton of hay per acre. Vegetables are early and of good quality, and find a ready market in Baltimore.

This soil responds to good methods of cultivation and to fertilization. Most farmers use some definite system of rotation in general farming. All the available manure is used on corn land. Commercial fertilizer, usually with the formula 1-8-2, is used on wheat, at the rate of 300 to 350 pounds per acre. Ground rock phosphate is sometimes used on corn land with manure, and also as a top dressing

for grass lands. Hydrated lime is applied on stubble at intervals of 2 to 8 years.

Land of this phase is valued at \$50 to \$125 an acre, the price depending on location and improvements.

An effort should be made to increase the content of organic matter by turning under manure and green-manuring crops or by the more frequent growing of leguminous forage. The steeper slopes should be protected from washing by terraces or side-hill ditches, or put in bluegrass and maintained as pasture. It would seem that the acreage in truck and fruit crops could be profitably extended on this soil, as it is well located with regard to markets and produces earlier vegetables and small fruits than any other soil in the county.

#### MANOR SILT LOAM.

The surface soil of the Manor silt loam is a brown silt loam, 5 to 10 inches deep. The subsoil is a light-brown or yellowish-brown silty clay loam, commonly extending to a depth of 3 feet. The change in color and texture from the soil to the subsoil is generally gradual. A few fine schist or slate fragments are present on the surface and mixed with the soil and subsoil in many places. The soil and the subsoil have the slick, greasy feel characteristic of the Manor series, although the mica is not as conspicuous as in the coarser types.

Local spots of Manor loam, Manor slate loam, and Lehigh silt loam are included with this type. These are of such small extent and so closely associated that no separation could be made.

The Manor silt loam is the least extensive type of the Manor series and is confined largely to the west-central part and southwest corner of the county. It occupies flat to gently rolling uplands, or the lower benches of the uplands above the stream bottoms. In areas lying on tops of ridges and divides and on slopes surface drainage is generally adequate. Where the soil material is thin and the underlying mass of partially weathered phyllite and shale comes within the 3-foot section, the underdrainage is good, but where the partly weathered material lies at greater depths, especially on the flatter areas at the base of slopes, under drainage may be deficient.

The Manor silt loam is an important soil in Carroll County, and probably 90 per cent of it is under cultivation. It is used for the production of the general farm and canning crops. The general farm crops consist of corn, wheat, and hay. The reported yields of corn range from 25 to 60 bushels, wheat from 15 to 35 bushels, and hay 1 to 2 tons per acre. The yields of canning crops are heavy.

This type is handled and fertilized much like the Manor loam. It is one of the most productive soils for general farm crops in the county, and the surface features favor the use of all kinds of machinery and therefore the lowest production costs. The soil is easy to work and responds to good treatment. Crops, however, do not mature on it as early as on the other Manor types.

Land of this type is valued at \$60 to \$150 an acre, depending on drainage conditions and improvements.

Some effort should be made to protect the type from seepage in the lower lying areas, and the flat upland areas should be ditched or tiled. The use of lime and the turning under of leguminous crops would do much to improve the physical condition of the soil in these places and increase its productiveness.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Manor silt loam :

*Mechanical analyses of Manor silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
201430.....	Soil.....	1.7	4.1	1.4	4.8	22.5	46.2	19.0
201431.....	Subsoil.....	.7	3.7	1.4	5.6	16.9	51.4	20.2

LEHIGH GRAVELLY LOAM.

The Lehigh gravelly loam consists of a gray to bluish-gray loam or yellow silt loam, 8 to 10 inches deep. The subsoil is a grayish, bluish, or yellowish-brown silty clay, extending to a depth of 2 feet where it rests upon black slate or phyllite. Over the surface and throughout the soil section is an abundance of flat and angular gravel. The flat slaty fragments are principally phyllite or slate, and the angular gravel is quartz. On the steep slopes the massive bluish slate rock approaches the surface and sometimes outcrops.

Included with the Lehigh gravelly loam is some Lehigh silt loam, the two being mapped together because of their small extent.

The Lehigh gravelly loam occurs in the vicinity of Pleasant Grove School, 1 mile west of Bailes Mill, and on the ridge west of the village of Pipe Creek. The silt loam is developed in an area about 2 miles east of Mount Airy, and around Gosnell. Other spots too small to indicate on the map occur throughout the county. Even in the more gravelly areas the quantity of coarse fragments is too small to interfere with cultivation.

The type for the most part occupies ridges and slopes, but is not confined to any particular topographic position. Some of it is well

drained, but a part is subjected to seepage and is wet and cold. On the steep slopes the type washes and gullies badly. It is a difficult soil to handle when too dry or too wet.

Not more than 40 per cent of the Lehigh gravelly loam is under cultivation, most of it is forested with small trees, mainly scrub oak and chestnut, with some poplar, red oak, and white oak. When cultivated it is used for the same crops as the Manor gravelly loam, although it is not nearly so productive. Apples do well on the better drained areas.

Land of this type is valued at \$40 to \$75 an acre, depending on location and improvements.

Terracing of the slopes, deep plowing, and the incorporation of organic matter would do much to improve the tilth of the soil, and the more frequent turning under of leguminous crops would do much to increase its productiveness.

#### MONTALTO LOAM.

The surface soil of the Montalto loam is a mellow, friable, brown or reddish-brown loam, 8 to 15 inches deep. This passes gradually into a heavy, smooth, red clay subsoil, which becomes more compact with depth, and in places extends to a depth of several feet. The subsoil here and there is mottled or streaked with dark-red or brown stains. Distributed over the surface are occasional boulders or stones of diabase or gabbro, but only in a few spots are they sufficiently numerous to interfere with the proper cultivation of the soil.

The Montalto loam is so closely associated with the limestone soils in places as to make the separation very difficult. It is very small in extent and occurs only in a few isolated spots. It is developed in the eastern and southern part of the Wakefield Valley. It also occurs in a narrow strip near the headwaters of Sams Creek, about 1½ miles east of Weldon. This latter development is not typical; the rock fragments are more abundant, and the soil has been modified somewhat by contiguous formations, particularly in the southern part of the area. One other small area occurs about 1 mile south of Eldersburg; here, however, the type has been subjected to wash, and the surface soil is more nearly a clay loam. The Montalto loam occupies knolls and slopes and also occurs on the lower benches of the valleys.

At least 70 per cent of this type is under cultivation; the rest is used for pasture or supports a mixed growth of white oak, poplar, hickory, and chestnut, with an occasional cedar or pine. The farmed area is used in the production of general farm crops, corn, wheat, and hay being the most important. This is one of the strongest soils in the county for these crops. The yields of corn range from 30 to

60 bushels; wheat, 20 to 40 bushels; oats, 30 to 50 bushels; and hay,  $1\frac{1}{2}$  to 2 tons per acre.

The soil of the Montalto loam should be handled under proper conditions of moisture. If plowed when too dry, it breaks up in clods, and if too wet, it does not scour readily from the plow. The addition of organic matter and the application of lime would improve its physical condition. The same cultural methods are used on this type as on the Chester soils, and the same rotation and fertilization practices followed.

Land of this type sells for \$50 to \$150 an acre, depending on location and improvements.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Montalto loam:

*Mechanical analyses of Montalto loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
201411.....	Soil.....	2.6	4.0	1.8	9.8	13.0	39.9	28.9
201412.....	Subsoil.....	1.2	2.1	1.1	6.7	9.1	15.6	64.4

PENN SILT LOAM.

The surface soil of the Penn silt loam is an Indian-red to reddish-brown silt loam, 8 to 12 inches deep. The subsoil consists of an Indian-red silty clay loam, which in its typical development continues to a depth of 3 feet or more. In many places, however, the subsoil is underlain at 24 to 36 inches by the partly disintegrated Indian-red sandstone or shale from which the type is derived. Scattered over the surface locally and throughout the soil and subsoil are small, soft sandstone or shale fragments, but these do not occur in sufficient quantities to interfere with cultivation. During extremely dry periods the surface soil bleaches, the color ranging from brown to a grayish red, but when wet it is a deep Indian red. In a few places the soil is a fine sandy loam, and would have been mapped as Penn fine sandy loam had the areas been larger. In places on the slopes and bluffs the parent rock outcrops or lies very near the surface.

The Penn silt loam is confined to the northwestern corner of the county, where it occurs in one area, with an extent of about 57 square miles, broken only by narrow strips of bottom land and spots of the mixed phase or gravelly phase of the type. It borders the Pennsylvania State line for a distance of more than 6 miles and extends southward for about 10 miles. It is typically developed in the vicinity of Taneytown, Harney, Longville, Stumptown, Trevanion, Middleburg, and along the Monocacy River.

This type occupies a distinct physiographic position and has a much smoother surface than other sections of the county. The surface is dominantly undulating to gently rolling, with more rolling country and steeper slopes along the Monocacy River and some of its larger tributaries. Practically all this type has a surface favorable for farming with modern machinery. Natural surface drainage is for the most part well established, but there are local spots that are level and flat and need artificial drainage. Where the bedrock lies near the surface, the type does not withstand drought well. The elevation ranges from about 400 to 575 feet above sea level.

The Penn silt loam is one of the important soil types in Carroll County, and practically all of it is under cultivation. The small areas forested support a growth chiefly of white oak, red oak, and hickory. General farming is practiced upon this soil, together with some dairying. Corn, wheat, rye, barley, hay, and oats, garden vegetables, and fruits, the product of small orchards, constitute the principal crops. Corn, the leading crop, yields from 25 to 50 bushels per acre. Sweet corn, produced for canning, gives satisfactory yields. Wheat returns from 15 to 30 bushels, oats 25 to 40 bushels, and hay from 1 to 1½ tons per acre. Occasionally oats displace wheat in the rotation, and some buckwheat, barley, and rye are grown. It is said that crops on the Penn silt loam mature somewhat later than on the soils in the eastern part of the county. Commercial fertilizer, usually a 2-8-2 mixture, is used for wheat at the rate of 300 to 500 pounds per acre. Most of the land is limed, and barnyard manure is used quite extensively.

Farms on the Penn silt loam are held at \$50 to \$150 an acre, depending on improvements, and the location with respect to towns and State highways.

This soil is capable of being built up to a fairly high state of productivity. This can best be accomplished through the growing and turning under of cowpeas and crimson clover, and by the addition of barnyard manure. Where this is done less nitrogen is required in the commercial fertilizers, and more lime and phosphoric acid can be used profitably. The incorporation of vegetable matter in connection with deeper plowing will make the soil more drought resistant. The crops now grown are well suited to this land. While the soil is susceptible of improvement and can be maintained in a highly productive state, under inefficient methods it deteriorates rapidly. Some of the flatter and more poorly drained areas should be drained with open ditches or tile drains.

*Penn silt loam, mixed phase.*—The Penn silt loam, mixed phase, consists of two soils, which contrast in color and vary in texture and are so intimately associated that no type separation could be made.

It consists of typical Penn silt loam, with its characteristic Indian-red soil and subsoil, and spots having gray to light-brown loam or silt loam surface soils and a yellow, yellowish-brown, or reddish-yellow silty clay subsoil. Included with this phase are a few spots of Lansdale silt loam. These occur in depressions or flat areas, and consist of light-brown to gray silt loam underlain by yellow or mottled gray and yellow compact silty clay. One spot of this description occurs three-fourths mile east of Longville, and two others lie  $1\frac{1}{2}$  miles northwest of Galt. The Penn silt loam, mixed phase, is derived from interbedded white or yellow and Indian-red shale and sandstone. In many places only an arbitrary boundary can be drawn between the phase and the typical Penn silt loam.

The Penn silt loam, mixed phase, which is restricted to the northwestern part of the county, is surrounded entirely by the typical soil. The largest area is situated in the vicinity of Galt, a smaller area lies northwest of Mayberry, and another southeast of Crabster. Numerous spots occur throughout the region underlain by the Triassic rocks.

The Penn silt loam, mixed phase, has a gently rolling to rolling topography. The surface is such that all kinds of improved farm machinery can be economically used. Except in a few depressions, the natural drainage is good. Practically all of this type is under cultivation. It is used for the production of the same class of crops as the Penn silt loam, with similar yields on spots of typical soil, but somewhat smaller yields on the lighter colored spots. Land of this type is valued at \$75 to \$100 an acre.

*Penn silt loam, gravelly phase.*—The surface soil of the Penn silt loam, gravelly phase, consists of a brown or reddish-brown loam about 10 inches deep. The subsoil is a brown to Indian-red clay loam of variable depth. This rests upon the solid or partly disintegrated bedrock. Over the surface and through the soil section is an abundance of small rounded quartz and quartzite gravel and larger stones, some with a maximum diameter of 4 or 5 inches. In the subsoil there are lenses or balls of material resembling decomposed limestone.

This phase is far from uniform. It is generally shallow on the tops of ridges and deeper at the base of slopes. In places large boulders of the conglomerate from which the gravel is derived are embedded in the surface or are scattered over the surface.

The phase has a very small extent in the county. It is shown on the soil map by gravel symbols. A small area occurs north and northeast of Tyrone and another along the ridge between Weishaars Mill and Mayberry. There are also several small spots to the east of the village of Piney Creek.

The Penn silt loam, gravelly phase, generally occupies the tops and slopes of narrow ridges. These ridges no doubt were continuous at one time, but they have been so dissected that only remnants of the original material now remain. The type is well drained, but in places, particularly in the areas lying farther west, erosion has been so active as to expose the conglomerate bedrock, and large boulders are thickly strewn over the surface. Where the conglomerate has broken down, however, the slopes do not seem to erode badly.

This is an unimportant soil, and little of it is under cultivation. Most of it supports a mixed growth of hardwoods, mainly oak. It is used principally for woodlots and pastures. Corn occupies the greater part of the cultivated area. It is said to be quite productive and to withstand protracted spells of dry weather. The gravel interferes more or less with cultivation.

Land of this phase is usually sold with adjoining soil types. It would seem that orcharding would be a profitable use for this land where the surface is not too rough. The rougher spots should be used for growing forest trees.

#### LIMESTONE VALLEY.

##### HAGERSTOWN SILT LOAM.

The surface soil of the Hagerstown silt loam consists of a dark-brown silt loam, 10 to 15 inches deep. The subsoil is a brown or reddish-brown silty clay, which normally extends to a depth of 3 feet or more. The transition from soil to subsoil is generally gradual.

Included with this type and closely associated with it are patches of Hagerstown clay loam and clay. These usually occur in positions exposed to wash or erosion. Outcropping marble is common, and the soil near these outcrops is generally much shallower and redder. This type is also modified more or less by the overlapping of other soil materials.

The Hagerstown silt loam covers a very small area in Carroll County. It is developed in the western part of the Wakefield Valley and along Priestland Branch. It occurs in small areas south of Union Bridge and between New Windsor and Wakefield, but these are not so nearly typical as the others, being modified by admixture of material giving other types. Similar conditions occur along Copps Branch, southwest of Shrovers Mill and between Warfieldsburg and Spring Mills. Many small quarries and limekilns are located in the western part of the county, but limestone has not contributed material to the surface soil.

As typically developed the Hagerstown silt loam occupies slightly inclined or flat areas on the lower slopes or in valleys. The less

typically developed areas occupy ridges or slopes in places generally exposed to erosion. The drainage in the typical areas is fairly well established, although there are places on the hillsides where the soil is kept wet by seepage and ditches are essential, and others where the surface is so flat that drainage is inadequate.

Nearly all of this soil is under cultivation. The rest of it is used for pastures or orchards or supports a growth of oak, hickory, and other hardwoods. The pastures on the type are said to be very durable. The land is used for general farming or dairying and is considered very productive. Corn, wheat, and hay are the principal crops. Corn yields from 30 to 80 bushels per acre; wheat, 25 to 40 bushels; and hay, 1 to 2 tons per acre.

Land of this type is valued at \$50 to \$150 an acre, depending on location and improvements.

The steeper slopes should be protected from erosion by contour plowing and terracing. Most of these slopes should be seeded to grass and used for permanent pasture.

#### RIVER FLOOD PLAINS.

#### CONGAREE SILT LOAM.

The surface soil of the Congaree silt loam is a brown or grayish-brown mellow silt loam having a depth of about 8 to 15 inches. This passes gradually into a light-brown or brownish-yellow silt loam or silty clay loam, which normally extends to a depth of 3 feet or more. In places the lower subsoil is mottled with gray and rusty brown. Near the banks of the small streams the texture is nearly a loam, while adjacent to the uplands, in very narrow strips of low, wet land, the soil is a grayish silt loam underlain by a mottled gray or bluish-gray and yellow silty clay loam subsoil. Throughout the soil and subsoil there is usually a noticeable amount of finely divided mica. This occurs in greatest abundance in those areas where the Congaree silt loam has been washed directly from areas of Manor soils.

The Congaree silt loam occurs along streams throughout the county, except in the northwestern corner, where the Bermudian silt loam is developed. It occupies first-bottom lands varying in width from 100 to 400 feet. In most places this soil lies only 3 to 6 feet above the normal water level of the streams. The surface is nearly level or has a slight slope toward the stream course. In most areas drainage is fairly good except during times of high water, when all the type is subject to overflow. Some of the lower lying areas are naturally poorly drained, and some places remain marshy throughout the greater part of the year.

Only a small proportion of the Congaree silt loam is under cultivation. This is probably due to the danger of crop loss through floods. Some corn is grown, the yields ranging from 30 to 60 bushels per acre. Most of this land is cleared or partly cleared. The larger areas are devoted to pasture. The forest growth consists of white oak, pin oak, shingle oak, some poplar, and sycamore, together with a little ironwood.

The Congaree silt loam is naturally one of the most fertile soils of the county, but the likelihood of overflow precludes the use of it for general farming. If it were properly drained and protected from overflow, it would be a valuable soil for corn and forage crops. Much of this type can be reclaimed by simply ditching the land and straightening and deepening the stream channels. The soil is easy to cultivate and responds readily to applications of manure and lime.

#### BERMUDIAN SILT LOAM.

The surface soil of the Bermudian silt loam, as typically developed, consists of an Indian-red to reddish-brown, mellow silt loam, 8 to 15 inches deep. The subsoil is an Indian-red or reddish-brown compact silt loam or spongy silty clay loam, extending to a depth of 3 feet or more. The line of demarcation between soil and subsoil is not very distinct.

Many local variations occur throughout the type, which is generally more uniform where the bottoms are wide than where they are narrow. In places the typical subsoil is entirely lacking, being displaced by thin layers of clay, sand, and gravel of various colors. In other places the soil is underlain by a mottled gray and brown clay. These spots are generally poorly drained. Included with this type are areas along Piney and Big Pipe Creeks which have gray to grayish-brown surface soils and yellow, yellowish-brown, or reddish-brown subsoils. These were not considered of sufficient extent to map as a separate type. They probably owe their origin to material derived from wash coming from the mixed phase of the Penn silt loam.

The Bermudian silt loam occupies flat to very gently sloping areas of first-bottom land along water courses and lies from 2 to 5 feet above the normal water level of the streams. With the exception of some included areas of second-bottom material, the Bermudian silt loam is subject to frequent overflows. In places on the flatter areas the type is poorly drained between overflows, the run-off being very slow.

The Bermudian silt loam represents material washed from the Penn silt loam uplands and deposited along the streams during floods. It is naturally a very productive soil, and good results are obtained

where the land is well drained. It is used principally for grass and corn. Corn yields 30 to 60 bushels and hay  $1\frac{1}{2}$  to 2 tons per acre, without the use of fertilizers. The type is slightly more productive than the Congaree silt loam.

Land of this type is usually included in farms with upland soils and is rarely sold alone. Prices range from \$60 to \$100 an acre.

Drainage of this type could be improved in many places by deepening, straightening, and widening the stream channels and by cutting lateral ditches. The type is well suited to corn and forage crops.

#### SUMMARY.

Carroll County is situated in the northern part of the State, bordering on Pennsylvania. It comprises an area of 447 square miles, or 286,080 acres.

The county is included in the physiographic division known as the Piedmont Plateau. The topography ranges from level to gently rolling in the northwestern part to hilly and rolling in the eastern and southeastern parts. The range in elevation is from about 500 to 1,100 feet above sea level. A conspicuous ridge, known as Parris Ridge, extends from Mount Airy in a northeastern direction through the center of the county into Pennsylvania. This ridge is the divide between two well-developed drainage systems. The drainage on the east side flows into Chesapeake Bay and that on the west side into the Potomac River.

The population of Carroll County is 34,245, or 76.6 per square mile. The principal towns within the area are Westminster, Taneytown, Manchester, New Windsor, Union Bridge, Sykesville, and Mount Airy.

Transportation facilities are good throughout the entire section. Three main lines of railroad and two branches traverse the county. State highways or good roads connect all farms. Churches and schoolhouses are conveniently located.

The markets of the county are the railroad shipping points in the area, and more remote places like Baltimore, Philadelphia, New York, Washington, and Chicago.

The climate of this county is mild and temperate, lacking the extreme heat or cold of places farther south or farther north. It has a growing season of 216 days, which is ample for the production of a wide range of crops.

The agriculture consists of general farming and dairying, supplemented by the production of canning crops and fruit. The feeding of beef cattle is becoming important.

The farm buildings are large and substantial. The farms are well kept and fenced. Good work stock and all kinds of improved farm implements are used.

The practice of rotating crops is common, and the other farm practices are generally efficient. Lime and fertilizer are commonly used, and manure is saved and applied to the land.

Farms range in size from a few acres to 1,000 acres, but generally contain between 40 and 120 acres. Land values range from \$40 to \$150 an acre.

All the upland soils of the county are derived from the weathering of consolidated rocks in place. From schist, granite, gneiss, marble, diabase, and gabbro come soils of the Chester, Manor, Lehigh, Montalto, and Hagerstown series, and from the red and gray sandstone and shale in the northwestern part of the county, come soils of the Penn series. The bottom lands are classed in the Congaree series and the Bermudian series.

The Chester loam, Manor silt loam, Penn silt loam, Hagerstown silt loam, and Montalto loam are used for general farming or dairying. They are well suited to the production of corn, small grains, and hay. The surface in general on these types is such that labor-saving machinery can be utilized and crops economically produced.

The Manor loam and the shallow phase of the Chester loam are mainly used for the production of general farm crops. They are not quite as productive as the heavier soil types, but most of the canning crops and vegetables are grown on these and do unusually well.

The Manor slate loam, Lehigh gravelly loam, Manor gravelly loam, and Chester gravelly loam produce rather light crops, but seem to be well adapted to all kinds of fruit. The Manor loam, micaceous phase, is considered the best soil in the county for early truck and fruit.

The Congaree and Bermudian silt loams are used for growing corn and hay or as permanent pasture.

The soils of Carroll County are generally strong and productive, and respond to intelligent handling.



[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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