U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.
IN COOPERATION WITH THE KENTUCKY AGRICULTURAL EXPERIMENT STATION.

SOIL SURVEY OF MUHLENBERG COUNTY, KENTUCKY.

BY

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

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[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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SOIL SURVEY OF MUHLENBERG COUNTY, KENTUCKY.

By J. A. KERR, in Charge, GROVE B. JONES, and S. W. PHILLIPS, of the U. S. Department of Agriculture, and P. E. KARRAKER, of the Kentucky Agricultural Experiment Station.

DESCRIPTION OF THE AREA.

Muhlenberg County is situated in the west-central part of Kentucky, in the western Kentucky coal fields region. It is about 25 miles long north and south and 20 miles east and west, and comprises an area of 472 square miles, or 302,080 acres.

The county lies within the Appalachian Plateau region, and has a prevailingly rolling to hilly topography. The elevations of the higher ridges, which represent the surface of the former plateau, range from approximately 550 feet above sea level in the northern part of the county, to 700 feet or more along the southern border. The main streams, flowing to the north, have carved valleys 150 to 200 feet below the higher levels, and their numerous branches carry this depth of dissection well up to their headwaters.

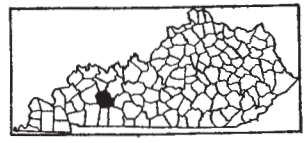

FIG. 29.—Sketch map showing location of the Muhlenberg County area, Kentucky.

Along the southern boundary the topography is typical of a dissected plateau, with some rather large areas of high plains cut through by deep, steep-sided valleys. Farther north the height of the old plain is reached only in occasional narrow ridges or isolated hills. These ridges are short and broken, and the stream courses are very irregular. A large basin in the central part of the county is drained by Pond Creek, with branches extending in all directions. Most of the country is hilly, but in many places there has been some development of secondary levels and gradual slopes. A section containing a large proportion of gently rolling land extends east and west through Greenville, Depoy, and Graham Station, another lies south of Millport, and a third, in the eastern part of the county, extends through Knightsburg, Ennis, and Belton. In nearly all sections there are some farms which lie very well.

The largest area of land with topography uniformly favorable for agriculture includes some 20 square miles in the extreme northern part of the county. This area is composed of a high terrace of Green River and the adjacent gently rolling upland.

The county lies in the drainage basin of Green River, which forms the northeast boundary of the county. The main branches of this river, which flow in a general northerly direction, are Mud River, on the eastern boundary; Pond Creek, in the east-central part of the

county; Cypress Creek, in the north-central part; and Pond River, on the western boundary. The southern part of the county is drained by Rocky Creek, which flows northeast to Mud River, and by Long Creek, which flows north and west to Pond River.

Through the central and northern parts of the county the flood plains of the rivers and larger creeks are rather wide, in many places exceeding a mile, and numerous irregular extensions on very small branches run well back into the hills. This condition becomes more marked on the northern border, where the bottoms of Green and Pond Rivers become 6 to 8 miles wide, and is apparently the result of subsidence of the area and consequent drowning of valleys, judging from the depth of the deposits.

Muhlenberg County was organized in 1798. Most of the settlers were of English, Scotch, or Irish descent and came from Virginia and the Carolinas. A German settlement was established in the northern part of the county. The present population consists principally of descendants of these settlers, though there is a foreign element in many mining towns. There is a small proportion of negroes, but not many of them are engaged in farming. The total population of the county in 1920 was 33,353, of which over 90 per cent was classed as rural by the census, there being only one town with more than 2,500 inhabitants. Over half the population is engaged in agriculture. Coal mining also is an important industry in the county.

Greenville, the county seat, is located in the central part of the county on the Illinois Central Railroad. It is the principal market of the county, and has several tobacco factories and storage houses. The population in 1920 numbered 1,917. Central City, situated in the north-central part of the county at the junction of the Illinois Central and the Louisville & Nashville Railroads, is the largest town in the county, with a population of 3,108, and is an important mining center. There are about 15 mining towns through the central and eastern parts of the county, which afford good local markets.

The county is well supplied with railroad facilities. The Memphis & Louisville branch of the Illinois Central Railroad passes east and west through the northern part of the county, and a branch of the Louisville & Nashville Railroad runs near the northern boundary; the Owensboro branch of the same system passes north and south through the eastern part of the county. The Kentucky Midland Railroad extends from Central City to Midland. Green River is an important waterway, with regular service from the Ohio River to Bowling Green and other points. Stock is shipped to Louisville by rail and to Evansville by river. Tobacco is marketed mainly in Greenville. Other local markets are South Carrollton on Green River, and Penrod and Dunmor in the southeast part of the county. Some tobacco is marketed at Hopkinsville, Owensboro, and neighboring markets.

There are only a few surfaced highways in the county, and the earth roads are rather poor. On the levels and gentle slopes they lead through poorly drained material, and on the hills they are in many places cut deep into shale and soft sandstone. Nearly all the more thickly settled communities are served by rural free delivery routes.

CLIMATE.

The mean annual rainfall, 47.65 inches, according to the records of the Weather Bureau station at Earlington, in the adjoining county on the west, is favorably distributed. The mean annual temperature is 57.5° F. There are short periods of very warm weather in the summer and extremely cold spells occur in the winter months, making shelter for stock necessary. The average annual depth of snowfall is 14.7 inches.

The average growing season extends from the middle of April to the middle of October, a period of six months, but killing frosts have been recorded as late in the spring as May 11, and as early in the fall as September 28. The grazing season is from about June 1 to killing frost.

The following table, compiled from the records of the Weather Bureau station at Earlington, Hopkins County, is representative of climatic conditions in Muhlenberg County:

Normal monthly, seasonal, and annual temperature and precipitation at Earlington, Hopkins County.

[Elevation, 420 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1908).	Total amount for the wettest year (1900).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	39.2	74	−14	3.86	1.38	3.06
January	35.6	76	−16	4.13	2.73	4.00
February	36.4	79	−28	4.00	6.25	5.86
Winter	37.1	79	−28	11.99	10.36	12.92
March	47.5	90	5	5.51	3.91	2.33
April	57.2	93	22	4.32	5.95	1.52
May	66.8	105	32	5.01	3.64	6.19
Spring	57.2	105	5	14 84	13.50	10.04
June	75.6	107	40	3.53	2.99	8.76
July	77.9	107	48	4.30	2.09	7.34
August	76.6	108	42	3.32	4.37	2.67
Summer	76.7	108	40	11.15	9.45	18.77
September	71.1	106	32	3.05	1.33	2.09
October	59 0	97	24	2.24	T.	3.82
November	47.7	85	7	4.38	2 10	8.60
Fall	59.3	106	7	9.67	3.43	14.51
Year	57.5	108	−28	47.65	36.74	56.24

AGRICULTURE.

Muhlenberg County was originally covered with a forest of oak, hickory, and beech, and the early settlers made only small clearings, in which they grew corn, wheat, flax, and cotton, all for home consumption as food and clothing. They also kept livestock, which grazed in the open forests. Tobacco was soon grown as a cash crop

and has continued to hold an important place in the agriculture to this day.

While much of the land was at first held in large grants, the operation of large plantations was never common, and, as the population increased, these holdings were sold in rather small tracts. The farmers generally have owned their farm lands and run their stock on the open range. The custom of ranging stock in this way has, however, fallen off with increase in population, and the practice is being discontinued. The southern districts have within recent years adopted stock laws abolishing the right of free range, and it is stated that the farmers throughout the county favor such laws.

Tobacco has generally proved satisfactory as a cash crop. In some seasons it is quite profitable, and in others it gives a return at least comparable to the cost of production. There have been periods of overproduction, but efforts to limit the tobacco acreage by agreement have not been successful.

Agricultural development was not greatly affected by the Civil War, as there were few slaves in the county. In the following decade the county incurred a heavy debt by issuing bonds for the construction of a railroad. The promoting company failed, leaving the county with a debt which finally amounted to $1,000,000—about 50 per cent of the assessed valuation of property. The debt burden had the effect of retarding development, since it discouraged all farm improvements. Undoubtedly the development of the coal industry was also delayed. A compromise settlement was made about 1900, and the county is now practically free of debt.

Until the last 20 or 30 years very little use was made of the low bottom lands of the county, but at present they are quite generally cultivated. This change is due in part to reduced yields on the worn fields of the upland and in part to the introduction of improved machinery, such as disk harrows, corn planters, sulky cultivators, and, more recently, tractors, with which the land may be quickly prepared late in the season. The extension of cultivation onto these larger bottoms apparently has caused little change in the general farming practice, as creek bottoms, having somewhat similar soils, occur on many farms throughout the county. Apparently there has been a slight reduction of the acreage in corn on hill farms, in some cases not enough being produced for home needs. On the farms in the larger valleys corn is the principal crop; some corn is sold, hogs are raised in considerable numbers, and thin cattle and hogs, bought in the hills, are fattened for market.

In 1880 three-fourths of the area of the county was in farms. On the average farm there were about 19 acres in corn, 4 acres in oats, 5 acres in wheat, 1½ acres in hay, and 2 acres in tobacco. From 1880 to 1920 the number of farms increased from 1,913 to 2,836, without any material change in the proportion of the land under cultivation in the average farm. During these years the production of oats and wheat steadily decreased, and at present (1920) many farmers do not grow either crop. On the other hand the average acreage in hay and forage crops increased to more than 6 acres per farm within the same period.

In 1909 the total area in all crops was 60,756 acres. The acreage of the principal crops was as follows: Corn, 39,970; wheat, 2,857;

tame hay, 9,035; grains cut green, 2,732; oats, 623; tobacco, 3,770; and vegetables, 1,588.

In 1919 corn occupied 34,887 acres, or 28 per cent of the improved land in farms. The total production was 637,180 bushels. Corn is the most extensive crop on all types of soil. It is often grown for two or more years in succession, both on bottoms and uplands. The varieties include the Boone County White and Hickory King. In late seasons the more quickly maturing types are planted on bottom land. Only a little of the fodder is saved; a small part of the acreage is cut, and possibly one-fifth of it is topped. Stock is allowed to run in the stalk fields through the fall and early winter. A few silos are in use on the larger farms.

The census reports 6,748 acres in wheat, in 1919, with a production of 86,994 bushels, or 12.8 bushels per acre. This is considerably more than the average yield for the county. Ordinarily wheat is not regarded as a very profitable crop.

Tame hay was cut from 11,378 acres in 1919. The hay crop is principally redtop. Ordinarily timothy does not thrive on the worn upland soils, although it is said to outyield redtop on some of the better farms, apparently where larger amounts of acid phosphate are used. It is not commonly grown in the bottoms. A stand of redtop is easily obtained, and it is more persistent than timothy, enduring for four or five years. Clover is not generally grown, though some clover seed may be mixed with the grass seed. There were only 744 acres in mixed timothy and clover in 1919, and 2,476 acres in timothy alone.

The acreage sown to oats is variable. Early oats do best, and when weather conditions in February and March allow, a larger acreage is sown. The method of harvesting the crop varies with the season and yield, but it is usually fed in the straw. The average yield per acre in 1919, as reported in the census, is 11.3 bushels. This is generally regarded as a useful crop on both uplands and bottoms, as the work falls in a convenient season, and fair yields of hay are obtained at a time when supplies of grain are low.

The acreage in tobacco varies somewhat with market conditions. The variance is indicated by an acreage of 6,025 in 1899, 3,770 in 1909, and 6,397 in 1919. A small acreage is grown on nearly every farm. The production for the county in 1919 was 4,726,873 pounds.

The tobacco of this general section is known as the dark export type, little or no Burley being grown. Standard varieties are One-sucker and Pryor. Differences in the quality of tobacco grown on well-drained and poorly drained soils are scarcely recognized. The crop from the limestone soils in the southwestern part of the county is marketed at Hopkinsville, but the same varieties are grown, and the product is regarded as of the same general type. The old Greenville brands of chewing and smoking tobacco have had a long period of popularity.

The tobacco is graded for market primarily according to the manner of curing. For export a heavily fired tobacco is preferred, as this can be safely kept in "higher condition," that is, with a larger moisture content, without heating. For local manufacture heavily "fired" tobacco is used for snuff, and lightly "fired" and air-cured tobacco is used for twist and smoking tobacco. The

principal use of fire-cured is the manufacture of plug tobacco. The price of fire-cured tobacco is normally somewhat higher than air-cured, to compensate for the additional labor. In all parts of the county some tobacco is fire-cured and some air-cured. In general, about half the crop is cured without artificial heat.

An average yield of 700 pounds per acre is shown in several census reports, but many farmers state that with moderate manuring and the application of 100 to 200 pounds of acid phosphate per acre yields of 1,000 pounds or more can be produced quite regularly. In view of the fact that so much manual labor is necessary in growing the crop, it seems remarkable that so little effort is made to have land devoted to it in a high state of productiveness. Tobacco usually follows corn, one year from sod, and is given moderate applications of manure and phosphate.

Very little provision is made for pasture, and only a small acreage is seeded to grass. The seeded areas are cut for hay for a few years, and, as yields decrease, are plowed for corn. Much of the farm land not in crops is lying out. Many of these fields rest only one year, but the more worn fields are left unplowed for longer periods, and grow up in weeds, greenbrier, and sassafras. In former years the vegetation on such fields must have been scanty, but in the last 20 or 30 years Japan clover (lespedeza) has spread through this country, thriving on both well-drained and poorly drained soils. Japan clover makes little growth until late in spring, and does not reach any great height. In meadows it is usually too short to be caught by the rake, and is often so thick as to make mowing difficult. In neglected fields it grows sparsely even on badly washed places, but in places it forms a thick mat. On account of its slow growth it does not afford a great deal of pasturage, but it is certainly a valuable plant, if only to protect the slopes from washing.

The common garden vegetables, such as sweet corn, tomatoes, cabbage, peas, and onions, produce well on all the well-drained soils of the county. Watermelons are easily grown, especially on the lighter soils. In 1919 there were 253 acres in potatoes, yielding 14,219 bushels; 175 acres in sweet potatoes, yielding 14,188 bushels; and 127 acres in other vegetables. There are very few truck farms in the county, the greater part of these crops being produced in garden patches in connection with general farming. There is a good demand for vegetables in the mining towns. The total value of vegetables produced in 1919 is $245,909.

Other crops which are grown in a small way on many farms are sorghum, cowpeas, soy beans, millet, and rye. In 1919, 591 acres of sorghum were grown for sirup, the production reaching 23,575 gallons. The yield per acre ranges from 80 to 200 gallons.

Cowpeas are rather commonly grown, especially on the bottom-land soils and on the more level areas of upland, giving a short rotation with corn and increasing the yield of the succeeding corn crop. Millet is grown mostly as a late crop on poorly drained alluvial soils, and is said to yield ordinarily more than a ton of hay per acre. Some of the more progressive farmers use rye as a cover and winter pasture crop and find it very satisfactory.

Small apple orchards are on nearly every farm. In 1919 there were 31,426 apple trees of bearing age in the county. They are not given much care and are seldom sprayed, so that much of the fruit

can not well be marketed. Many of the trees are of early varieties, which find a market in the mining towns. Although the county is not particularly adapted to apples, fairly good yields are obtained on some farms, especially at the higher elevations and on the river bluffs.

There were 19,283 peach trees in the county in 1919, but they are mostly unproductive, having suffered severe winter injury in 1917. It is said that they normally produce fairly well, though subject to damage from late frosts. Pears, plums, and cherries are also grown to a small extent, and give fair yields.

In January, 1920, there were 13,852 hogs, 4,798 beef cattle, and 5,665 dairy cattle in the county. The hogs marketed are mostly from bottom-land farms; the cattle are the increase of the dual-purpose and scrub cattle kept primarily for family use on nearly every farm. Small flocks of sheep or goats are kept on some farms, or run on the range.

Little or no attempt is made to supply the local markets with milk, and very little surplus butter is made through the winter. Dairy products in 1919 were valued at $241,432, but only about one-fourth of the total was sold. Poultry is kept on nearly every farm. The census gives the value of poultry and eggs produced in 1919 as $260,096, about 45 per cent of the products being sold.

The equipment of the small farms consists of implements of the simpler types, but good turning plows, disk harrows, and riding cultivators are quite common. Such implements as two-row planters, grain drills, and binders are in some cases owned by a few farmers and operated for hire on other farms. Tractors are coming into use on the bottom lands.

Throughout the county there is no definite rotation of crops. The available sod land is planted to corn. Tobacco is generally planted following corn. Wheat does well after tobacco, and is commonly followed by corn or grass. Corn is often grown for two or more years in succession. Where cowpeas or soy beans are grown, a three-year rotation of corn, cowpeas, or soy beans, and wheat is often used on part of the farm.

The usual plan is to "rest" the land at intervals, following corn. Land may thus lie fallow, growing up in weeds, sassafras, and Japan clover, from 1 to 3 or 4 years. The wide difference between the acreage of improved land and that in the various crops, as shown in the census reports, indicates that this practice has been very common. The proportion of land at rest, which varies in different localities and on different farms according to the acreage available for farming, is estimated at from 10 to 30 per cent. Of course there is little difference between this land and neglected pasture, following meadow, for even redtop tends to die out and Japan clover quickly appears. On the bottoms the practice is not often followed purposely, but in late seasons the acreage broken is reduced more or less.

In 1919 only one-fourth of the farmers reported an expenditure for labor, and the total outlay was only $57,835. At present there is rather a tendency on the less productive farms to give up farming for the time being for work at the mines.

The average size of farms in 1919 was 81.7 acres, of which 44.3 acres was improved. There are few farms operated on a large scale. Some holdings of 1,000 acres or more are owned by coal companies,

but these are divided into smaller tracts which are rented as separate farms. Twenty-five per cent of the farms were operated by tenants in 1919. Farms are nearly always rented on the share system, the rental being usually half the crop where the owner furnishes equipment, etc., or one-third without equipment.

The prevailing price for average farm land appears to be from $30 to $60 an acre. Location is a very important factor in determining the price of land. Productive bottom lands in the southwestern part of the county, valued by the owners, and undoubtedly conservatively, at $100 an acre, have apparently a market value of only half that amount. In some communities farm lands convenient to market are valued at $100 to $125 an acre.

SOILS.[1]

The soils of Muhlenberg County are light in color and the region in which the county lies is one in which the maturely developed or normal soil, from whatever source or parent rock, has a profile, or section, made up of three principal members, consisting of a relatively light textured layer at top, a heavier textured layer below this, and still deeper a layer consisting of the disintegrated and partially oxidized parent rock or the undecomposed and undisintegrated parent rock itself. In the virgin or uncultivated soil the surface layer consists of two members, a surface member of darkish color, due to the presence of partially decomposed organic matter, derived from leaves and other plant remains that have been worked into the soil by earthworms and in other ways, and a lower member of pale-yellowish, yellowish, or yellowish-brown color. The upper or dark-colored member is thin, rarely more than 2 inches, while the second member ranges up to 12 or 15 inches, the thickness varying with several factors, one important one being the soil texture. These two members constitute what have been designated by European soil investigators as the A horizon, the dark-colored one as the A1 horizon, and the light-colored as the A2 horizon.

The heavier textured layer, beginning below horizon A2, is usually brown or yellowish brown, yellow, or reddish in color and ranges in thickness in the latitude of Muhlenberg County up to 24 inches, being usually a little thinner. This is usually designated as the B horizon, and when it consists of more than one part as B1, B2 horizon, etc. Below the B horizon lies the parent rock or its disintegrated product, usually the latter, and in most cases it is more friable and lighter in texture than the B horizon. It is designated as the C horizon.

[1] In general the soils along the boundary between Muhlenberg and Logan Counties, Ky., join very well. A small area of Hanceville silt loam in Muhlenberg County abuts upon Tilsit silt loam in Logan County about one-half mile west of Dunmor. Also three small areas of Tilsit silt loam in Logan County lie against Hanceville stony loam in Muhlenberg County east of Dunmor, and a narrow strip of Hanceville very fine sandy loam in Logan County is opposed by Hanceville stony loam near the bottoms of Mud River. In the last locality, also, a narrow strip of Christian stony loam in Logan County abuts upon Hanceville stony loam in Muhlenberg County. These rather unimportant failures to join appear to be due to more detailed mapping having been done within some small areas than in others, such variation in detail that is sometimes difficult to avoid in strongly rolling wooded areas, or such as might result from differences in opinion on the part of soil men as to the degree of detail it may be advisable to attempt in such a section. Naturally some disagreements also will creep in as a result of the grading of one soil into another in such a way that sharp boundaries can not everywhere be drawn.

The region in the United States in which this character of profile, or section, prevails in the normal or mature soil extends from the Atlantic coast, between northern Virginia and central New England, westward to the prairie region of Illinois, Missouri, and Oklahoma.

Throughout this region the soil that lies on undulating to gently rolling surfaces is characterized by this profile. The soil on the slopes, especially the steep slopes in this region has a section or profile in which the B or heavy horizon is lacking or is imperfectly developed (thin or barely different in texture from the A horizon), while the soils on the flat lands have still a different section. The alluvial soils, those that have been recently deposited, do not have a B horizon in the profile. If heavy layers be found in them they are due to conditions of deposition rather than to the processes of soil development. In such cases there may be several heavy layers and they may be of any thickness.

In Muhlenberg County the soils with a normal section are the Hanceville silt loam and some of the Hanceville stony loam, the Christian stony loam, and the Elk silt loam.

The soils with imperfectly developed profiles, in which the heavier B horizon is lacking or only faintly developed, are the Cincinnati stony clay, the Huntington loam, and usually the Huntington silt loam, both types of the Holly series, and the Pope silt loam.

The Robertsville and Atkins soils have developed as wet-land soils and belong therefore in a class by themselves, though they have the A, B, and C horizons in their profile. The A2 horizon in the Robertsville and to a less extent in the Atkins soils is gray to nearly white and the B horizon immediately below it is heavy, especially in the Robertsville.

The Tilsit silt loam, the most important soil in the county from point of area covered, is different in its profile from any of the others. The A horizons are normal except that the A2 horizon is usually lighter or paler in color than in the other soils, excluding those of the Robertsville and possibly of the Atkins series. The feature which characterizes the Tilsit soil, however, and differentiates it from all the others is the B horizon. The upper part of this horizon, or the B1 horizon, is normal in all respects, but just beneath it and just above the C horizon the B2 horizon has been developed into a dense layer that where well developed is so compact that boring through it is difficult. It is little or no heavier in texture than the B1 horizon and when dug up or brought up on the auger is friable. It is usually highly mottled and contains spots of incipient iron concretions.

This soil is developed on the smooth upland surfaces and the development is most perfect on the flat areas. It develops on all smooth areas, whether upland or lowland, that are not underlain by gravel. It is a characteristic feature of smooth land in this latitude and has a number of relatives, so to speak, developed on the flat lands of other parts of the country. The most conspicuous cases are the Lebanon soils of Missouri and Tennessee, the Leonardtown soils of Maryland and Virginia, the Rittman soils of Ohio, and the Nappanee soils of Indiana. They develop on limestone material, sandstone material, unconsolidated silts and clays, glacial deposits, and loessial deposits.

The soils of the county have been differentiated partly on the basis of the soil section and partly on the basis of the geological formations. The geological formations in the county include sandstone and shale, interbedded limestone, shale, and sandstone, terrace material, and alluvium. The Christian and Cincinnati soils have been developed from material accumulated by the disintegration and decomposition of interbedded limestone, shale, and sandstone, the Hanceville and Tilsit soils from sandstone and shale material accumulated by disintegration and decomposition in place, the Elk and Robertsville soils from terrace materials supposed to be made up in part of material of limestone origin, the Huntington, Pope, Atkins, and Holly soils from sandstone alluvium, containing in the case of the Holly soils a small amount of limestone material.

For the purpose of soil mapping, the soils are classified into series and types. The series consists of soils that are similar in origin, color, and structural characteristics. Each series is divided into soil types, which differ from one another in the texture or the relative coarseness or fineness of the materials in the surface soil. The type is the unit of soil mapping. Sixteen types, representing ten series, and one miscellaneous soil, Rough stony land, were mapped in this survey.

The following table gives the names and the actual and relative extent of the several soils mapped in Muhlenberg County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Tilsit silt loam	94,016	31.1	Huntington loam	2,048	0.7
Hanceville silt loam	77,504	25.7	Rough stony land	1,344	.4
Atkins silt loam	39,552	13.1	Cincinnati stony clay	1,152	.4
Hanceville stony loam	31,872	10.6	Huntington silt loam	1,152	.4
Holly silt loam	17,728	5.9	Christian silt loam	896	.3
Holly silty clay loam	11,328	3.7	Elk gravelly loam	704	.2
Elk silt loam	9,152	3.0	Robertsville silt loam	640	.2
Pope silt loam	8,064	2.7			
Christian stony loam	2,688	.9	Total	302,080	
Atkins silty clay loam	2,240	.7			

TILSIT SILT LOAM.

The surface soil of the Tilsit silt loam is a gray silt loam, 2 to 4 inches deep, grading into a yellowish-gray to faintly reddish yellow or reddish-brown silt loam. This passes at 6 to 8 inches into a reddish-yellow moderately friable silty clay loam containing appreciable quantities of very fine sand. The color is solid, with very little or no tinging or streaking of gray. At 24 to 30 inches gray appears in numerous streaks and veins, and the lower subsoil is mottled light gray and yellow. The texture becomes very little heavier with depth, but the structure of the lower subsoil is somewhat compact.

The subsoil varies somewhat with the topography. In the more level areas the upper subsoil has a pale-reddish cast, and may be strongly mottled at a depth of 2 feet. On slopes and on the narrower ridges the red is more pronounced and extends to greater depth, and the gray mottling of the lower part is not so strong and

in places is not present within the 3-foot section. These variations occur in detail throughout the type, and are closely related to the local topography. Some cultivated land has a clear reddish-brown to reddish-yellow color, especially when moist. This is due in part to the turning up of the lower soil, and in part doubtless to wash.

The type occurs extensively throughout the county in areas of undulating to gently rolling topography. It is the predominant agricultural upland soil. There is little difference between the soil of the old plateau in the southern part of the county and that of the low areas along the large streams in the northern part, except that the material of these northern areas is in part colluvial, as near Graham, and the soil is generally considered a little more productive.

The type has good surface drainage, even the larger undulating areas containing very little poorly drained land. The internal drainage is retarded in the lower subsoil to some extent, but, as indicated by the color of the upper subsoil, not seriously.

Probably three-fourths of the type is in cultivation. The forest growth consists of white oak, post oak, hickory, dogwood, sassafras, and numerous other species. On farms there are many walnut and persimmon trees, and some cedars.

Corn and tobacco are the most important crops. Corn is grown on a large acreage, and yields from 15 to 25 bushels per acre. A small field of tobacco is grown on nearly every farm. The yield averages about 700 pounds. Redtop yields up to a ton of hay per acre, and the mowing lands ordinarily last from three to five years. Timothy is grown to only a small extent. When grown mixed with redtop on fairly new land it forms a considerable part of the crop for one or two cuttings. Very little clover is grown. Wheat yields 10 to 15 bushels per acre. Some oats are grown, the crop usually being fed in the sheaf. Cowpeas and soy beans are grown by a number of farmers.

Stock raising is on a very small scale, mainly because of the lack of good pasture. The low yield of tobacco on many farms is a result of the lack of sufficient stock to maintain productiveness. It appears evident that the seeding of a larger acreage to grass and a shorter period of cutting and pasturing before breaking would improve conditions. Orchard grass and fescue have also been recommended as pasture grasses.

There has been a good deal of surface washing on the slopes, owing to shallow plowing. It is said that this can largely be prevented by plowing 6 or 7 inches deep. Fall plowing is practiced on a few farms. Rye is grown occasionally and provides a very satisfactory cover crop and winter pasturage. The usual degree of washing has only temporarily reduced yields, and it has been found in experimental work that such places are rather better suited to alfalfa than the original surface, probably owing in part to the greater slope and better drainage and in part to the increased heaviness of the soil. These places are not hard to plow in good weather, for the subsurface layer contains sufficient very fine sand to give it friability, and when mixed with the floury surface soil the latter becomes fairly mellow, but where the organic matter content is very low, it is difficult to keep the plow point down in washed patches. On land receiving applications of ground limestone and acid phosphate on the State experiment field

near Greenville, sweet clover and red clover give good yields. Good alfalfa stands have been attained in various places by the application of 3 to 4 tons of ground limestone and 200 to 400 pounds of acid phosphate per acre. This soil may be quickly and profitably built up by these means, and greatly increased yields of all crops obtained.

HANCEVILLE STONY LOAM.

The Hanceville stony loam is typically a pale-yellow silt loam, containing appreciable quantities of fine sand, grading at 6 to 8 inches into reddish-yellow silty clay loam or clay subsoil. Partly weathered sandstone or shale occurs intermittently at shallow depths, and bedrock is reached in many places within the 3-foot section. The type lacks uniformity, including areas of very stony fine sandy loam along numerous outcrops, areas of Hanceville silt loam strewn with rock fragments from higher lying areas, and many strips of more or less shaly silt loam, silty clay loam, or clay, all of low agricultural value. The content of shale in the surface soil in the shaly areas is variable, but nowhere sufficient to provide any protection from erosion. Some included areas have a yellow subsoil, representing Dekalb or Tilsit material.

The type occupies considerable areas of breaks and steep hilly land throughout the southern part of the county, and occasional small areas in the hilly country along the larger streams to the north. It is nearly all in forest, the growth consisting largely of white oak, post oak, black oak, blackjack oak, hickory, and dogwood. There is very little chestnut or chestnut oak. The land washes badly on cultivation, can be worked only with difficulty, and is not very productive. Lespedeza does well on new land, and makes some growth on eroded land. Redtop does fairly well, but usually is of little value for pasture.

HANCEVILLE SILT LOAM.

The surface soil of the Hanceville silt loam consists of a surface layer of 1 or 2 inches of gray to grayish-yellow silt loam, passing into pale-yellow to reddish-yellow silt loam, which contains appreciable quantities of very fine sand. This grades at 6 to 8 inches into reddish-yellow, salmon, or reddish-brown friable silty clay loam. Weathering is not altogether complete in the lower subsoil over much of the type.

The Hanceville silt loam is extensively developed throughout the uplands, occupying much of the rolling to hilly country throughout the central part of the county. The drainage is good.

The type is derived in large measure from two kinds of rock immediately underlying it, consequently it is made up of successive belts of soil, some derived from sandstone and others from shale. The variations are not so apparent in the surface soil, although loam soil occurs intermittently over the softer sandstone. The texture of the upper subsoil is fairly uniform. Over sandstone and arenaceous shale the red color is usually well developed, and the lower subsoil is a reddish-yellow sandy clay, in many places grading into partly weathered rock. Over the heavier shales the subsoil is yellow to reddish yellow, and unweathered shale is encountered in many

places, generally embedded in clay. Where the underlying material is of denser structure, some mottling occurs in the lower subsoil, but this is not nearly so marked as in the Tilsit silt loam.

With continued clean cultivation and shallow plowing the soil washes considerably. The cleared land includes a good deal of silty clay loam, representing washed areas, and in many places there are patches and strips of badly eroded land. Over the softer sandstone, where the sandy, porous lower subsoil is exposed, gullies extend for some distance even through the heavier material.

Three-fourths of the type, comprising mainly the steeper hills, is in forest including oak, hickory, and dogwood. Cedar grows over the softer and steeper sandstone belts, and walnut, locust, persimmon, sassafras, elm, beech, and other trees are fairly common. On the gentler slopes there are numerous farms, on which, with care, washing may be controlled. These are considered fair farm land. Corn yields 10 to 25 bushels, tobacco 700 to 1,000 pounds, and redtop 1 ton per acre. Many of the gentler slopes occurring in association with more level lands represent old worn fields used mainly for pasture. With care in checking gullies and grubbing sprouts and briers, fair summer pasture may be had. New clearings are occasionally made on rather steep land, for the new ground produces well, but most of the steeper land remains in forest and is recognized as unsuited for farming.

In the vicinity of Midland some of the slopes are severely eroded. The sandstone bed underlying the most severely eroded belt is much softer than is common. This bed is high in the Pennsylvania formation and does not appear farther south in the county. Many of the eroded fields in this section, and some whole farms, have been abandoned.

CHRISTIAN STONY LOAM.

The Christian stony loam consists of a grayish-brown or brown to reddish-brown silt loam, underlain at about 5 to 10 inches by a reddish-yellow, yellowish-red, or buff, to brick-red, brittle silty clay or rather stiff clay. It is derived from interbedded red sandstone, bluish-gray pure limestone, and impure yellow clayey limestone, and is rather variable in places. Outcrops of sandstone and limestone and fragments of these rocks are numerous.

The type is not extensive, chiefly occupying the steep hillsides along Pond River and its branches in the southwestern part of the county. Some small areas occur in corresponding locations on Mud River, near the Logan County line.

Nearly all the type is in forest, consisting chiefly of red oak, white oak, post oak, hickory, beech, walnut, and dogwood. Small patches are farmed mostly to corn, which yields well, but most of the type is altogether too steep and stony for cultivation.

CHRISTIAN SILT LOAM.

The surface soil of the Christian silt loam is a light yellowish brown to brown mellow silt loam, 6 to 10 inches in depth. The subsoil is usually a yellowish-brown to red friable silty clay loam, which quickly grades into a yellowish-red to reddish-brown compact but

brittle clay. The soil is residual from interbedded sandstone and pure bluish-gray limestone, the material from each producing a friable soil, and being generally so mixed that the soil is uniformly productive. There are, however, some included beds of clay or impure clayey limestone which give rise to heavy, plastic soil.

The type is inextensive, occurring in a few small areas in the southwestern part of the county at lower levels on Pond River, Caney Creek, and Long Creek, occupying benchlike positions or gentle slopes. Most of the type is friable, well drained, and easily tilled. On Pond River and Caney Creek there are some patches of shallow soil with plastic, red and greenish-yellow mottled subsoils. However, all of the type has good surface drainage, and fair to very good underdrainage.

Nearly all of the Christian silt loam is in cultivation and is productive. Corn yields 40 to 50 bushels per acre; tobacco, 1,000 pounds or more; redtop and timothy, 1 to 1½ tons; clover, up to 2 tons; and wheat, 15 to 30 bushels per acre.

CINCINNATI STONY CLAY.

The soil of the Cincinnati stony clay typically consists of a plastic, dark-yellow heavy clay. Outcrops of limestone and large and small fragments are common. The type is somewhat variable, the dark-yellow clay alternating locally with strips derived from pure limestone, having a predominantly red cast and less plastic structure than typical. In places the soil is modified by material fallen or washed from the higher slopes.

The type occurs inextensively on the lower slopes of hills along Pond River and Caney Creek, in the extreme southwestern part of the county. Practically all of it is forested with hickory, dogwood, cedar, maple, and various species of oak. A part of the type which was formerly farmed and produced quite well, appears to have been abandoned on account of the difficulty of working the heavy soil and the exposure of shallow bedrock in places by washing. It is said that bluegrass has grown to some extent on the type, but does not form a good sod.

ELK GRAVELLY LOAM.

The Elk gravelly loam is an irregular type representing breaks in the terrace formation in which gravel is exposed to a considerable extent. The type is inextensive, occupying narrow slopes to streams, benches, and, in a few places, fragmentary eroded areas of terrace.

A variation consisting mostly of brown loam to fine sandy loam 8 to 12 inches in depth, overlying yellow or yellowish-brown fine sandy loam, loam, or silty clay loam, occurs as a long narrow gravel bed bordering the first bottom of Pond River near Millport and occupying the terrace bluff to the north. Small waterworn gravel are abundant in the soil and subsoil. Most of this area is gently sloping and is in cultivation. It is well drained and productive. Corn yields up to 40 bushels per acre; and tobacco, 700 to 1,000 pounds. Potatoes and other garden crops mature early and produce well.

As mapped elsewhere throughout the county, the soil is in general rather heavy, as gravel comprises only a small proportion of the

deposit, and occurs mostly in beds 1 or 2 feet thick. On rather steep slopes the scattered gravel is firmly embedded in soil, but on cultivation the soil washes a good deal, in places very badly. Most of the type is in forest of oak, hickory, and beech, or is used for pasture.

ELK SILT LOAM.

The surface soil of the Elk silt loam is a grayish-yellow silt loam, grading at 2 to 4 inches into a slightly reddish yellow silt loam, 6 to 8 inches deep. The subsoil is a reddish-yellow or yellow silty clay loam, which, at 18 to 24 inches, becomes veined and mottled with light gray; the lower part of the 3-foot section is strongly mottled, and in places contains small iron concretions. The substratum is a gray silty clay containing iron concretions, beds of loose rounded or subangular gravel of chert, and beds of sand, or sandstone cemented with limonite and containing some bedded gravel.

The type occupies a high terrace of Green and Pond Rivers which extends across the northern part of the county and includes an area of some 20 square miles. As developed in Muhlenberg County, this soil represents a variation of the Elk silt loam. It differs from the typical soil in the lighter color of the surface soil and in the mottling of the lower subsoil, and is less productive. The lower, more recent deposits, such as are found on the island at Black Lake, more nearly resemble the typical soil.

The topography of the main area is undulating, but as a whole it has been considerably modified by long periods of erosion. The streams occupy small valleys well below the general level, and have in many places cut clear through the deposit. There are also apparently two or more levels, the bench drop being obscured by creep. That part of the deposit occupying the narrow ridge at Gishton is high above the adjoining level. The steep break is littered with débris from the higher level.

The surface drainage is fair over the typical undulating areas. Underdrainage is somewhat retarded in the lower subsoil, but not to any great extent. On slopes the lower subsoil is less mottled, indicating that the underdrainage is good.

The type is nearly all in cultivation, and is farmed in small tracts. Corn is the most important crop, the yields ranging from 15 to 25 bushels per acre. Tobacco yields 700 to 1,000 pounds per acre. Timothy is grown to some extent, but redtop is the common hay crop, yielding about 1 ton per acre. This soil was formerly regarded as more productive than the uplands to the south, but yields have been reduced through years of cropping.

ROBERTSVILLE SILT LOAM.

The surface soil of the Robertsville silt loam is a gray to yellowish-gray silt loam 6 to 8 inches deep. This grades into a mottled yellow and gray silt loam to silty clay loam.

The type is inextensive, occurring in a few small areas within the terrace formation in the northern part of the county, typically in flat locations at the heads of streams, and to some extent on flatter parts of the general surface.

The type is poorly drained, but the greater part is under cultivation. Oak, hickory, and gum constitute the typical forest growth. Corn yields 15 to 30 bushels per acre. Redtop yields about 1 ton of hay per acre. Oats are grown to some extent for hay. Cowpeas do well, yielding a ton or more of hay per acre. A good growth of tobacco was observed in one field on this soil, with shallow ditches for drainage. The type would undoubtedly be greatly improved by tiling, for it is productive in seasons when the rainfall is not heavy.

HUNTINGTON LOAM.

The Huntington loam is typically a brown very fine sandy loam or loam underlain at depths of 10 to 20 inches by a yellow to brownish-yellow silty clay loam. Near the river it grades into a deep very fine sandy loam, fine sandy loam, or fine sand, and on the side toward the upland into a brown loam to very fine sandy loam, which is underlain at 6 to 10 inches by yellow or mottled yellow and gray silty clay loam. The variations, however, are not uniform.

The type occupies a strip 100 to 200 yards wide along Green River. It is in the highest part of the bottom, above normal overflow, and it is seldom necessary to abandon farm houses and buildings located there. Drainage is well established. Planting is not delayed as on the lower bottoms, and the type is rarely overflowed during the crop season.

The Huntington loam is all in cultivation, except a narrow stretch of forest of honey locust, sycamore, and beech along the river. Corn is the predominant crop, with an average yield of 40 to 50 bushels per acre. Tobacco yields well, but is not grown to any large extent. Red clover thrives, yielding up to 2 tons per acre. Timothy yields over a ton per acre, and cowpeas up to 2 tons. Garden vegetables are early and yield well. Nearly every farm has an orchard. Damage from frost is uncommon, the conditions comparing favorably with those in the higher hill country. The type is farmed in connection with the larger acreage of lower bottoms. Land in these farms generally has a value of $75 to $150 an acre.

HUNTINGTON SILT LOAM.

The soil of the Huntington silt loam is typically a brown, mellow silt loam, grading at 8 to 12 inches into a yellowish-brown silty clay loam to silty clay. The type occurs in a small strip along Pond River, in the southwestern part of the county, and in a few small areas along Green River. In its occurrence in this county, the type is not so well drained as is typical, being rather a variation intermediate between the Huntington silt loam and the Holly silt loam, with considerable gray mottling in the subsoil.

The type is subject to overflow but is seldom flooded during the growing season. The soil is productive. Corn yields 40 to 60 bushels; timothy is grown to some extent, yielding in average years over a ton and in good years up to 2 tons per acre. Redtop, more commonly grown than timothy, yields a ton or more per acre. Clover does well but little is seeded. Some tobacco is grown, yielding 1,000 to 1,500 pounds per acre.

HOLLY SILT LOAM.

The Holly silt loam consists of a yellow silt loam, slightly tinged and mottled with gray, grading at 8 to 12 inches into a subsoil of mottled yellow and gray silty clay loam. This is the predominant soil of the bottoms of Green River. It also occupies the bottoms of Long Creek and other smaller streams in the southwestern part of the county and occurs to some extent on Pond River.

The type is subject to overflow, but this is less likely to occur as the season advances, and with late planting it is seldom that crops are damaged. The topography is almost flat; in general, the land rises slightly to the stream, but it is seldom marked by swampy conditions adjacent to the upland. In many places there is apparently a slight rise near the upland, and the soil may be so predominantly of wash from the hills as to represent more nearly the Atkins silt loam. The land dries out slowly in the spring, both surface drainage and underdrainage being somewhat deficient, but with the advent of warmer weather the soil usually becomes mellow and friable, and scours well from the plow.

It is stated that little use was made of these bottoms until within the last 20 years. About two-thirds of the type is now under cultivation, and it is regarded as a valuable soil. Corn is the leading crop, and may be grown for years in succession, although this results in reduced yields. About 30 bushels per acre is considered a fair yield and 50 bushels a very good yield. Cowpeas thrive on this soil, yielding over a ton of hay per acre. It is a very useful crop in late seasons. Both timothy and redtop are grown, yielding up to 1½ tons per acre. The stand in typical situations is little damaged by winter overflows. During the course of the survey good stands were observed following a season of exceptionally high water. These grasses, however, probably would not do well on the lower parts of the bottoms. A few good stands of clover were seen on unditched and unfertilized land. Some millet is grown, yielding up to 1½ tons per acre. Oats and sorghum are grown to some extent.

Tractors are used to good advantage on the larger farms, proving especially valuable in late seasons when the work must be rushed. Corn is generally planted in May or early in June, but planting even as late as the latter part of June generally gives sound corn. On many farms some upland or better drained bottom land is farmed in connection with this type, extending the work over a longer season.

Most of the corn is pulled, and little use is made of the stalk fields, as they are likely to be injured by the trampling of stock. Some of the grain is sold at the mines or to upland farmers, but most of it is fed to hogs or to young cattle bought in the uplands.

This land is valued at $40 to $80 an acre, depending on the location with reference to towns, and also on the character of the adjoining upland soils. Farms containing both upland and bottom land are most desirable.

Ditching and tiling of these bottoms has proved profitable; the delay of planting or poor stands from early planting has been greatly reduced, the soil can be kept in better tilth, work can be done more on schedule, and yields are considerably increased. Only a few places, however, have been thus improved. A ditch has re-

cently been made along the road north and east of Kinchloe Ferry. The walls of the ditch stand up well. There has been some caving near the mouth of the ditch, as it is high above the ordinary stage of water, and spillways may be necessary. Otherwise there is no apparent difficulty to be encountered in drainage on a large scale.

HOLLY SILTY CLAY LOAM.

The surface soil of the Holly silty clay loam is a mottled yellow and gray, or dark-gray, heavy silt loam to silty clay loam. This grades at 6 to 8 inches into heavy, but not plastic, mottled clay loam to clay.

The type is extensively developed in the bottoms of Pond River and occupies the narrow bottom of Mud River. It also occurs on Green River at the mouth of Nelson Creek.

These bottoms, like those of the silt loam of the series, are subject to overflow, in many seasons delaying the planting of crops, but are nevertheless well adapted to agricultural use. The bottoms of Mud River and Nelson Creek are mostly under cultivation. The larger areas of the type on Pond River are nearly all in forest of oak, beech, and gum, with occasional honey locust, pawpaw, and other trees. The channel of Pond River is apparently as deep as those of the other streams, and these lands are locally regarded as well adapted to farming when ditched.

Corn is the principal crop grown, with yields ranging to 50 bushels per acre in good seasons. Redtop is grown to some extent, and yields more than a ton per acre. Cowpeas also produce a ton or more of hay per acre.

The soil is fairly friable, though requiring heavier draft than the lighter soils. Tiling is very beneficial, the soil draining to working condition more quickly after rain than the lighter soil. Draining reduces the delay in breaking the land in spring and insures larger and better matured crops.

ATKINS SILT LOAM.

The Atkins silt loam typically consists of a gray, friable silt loam, grading at 8 to 12 inches into mottled yellow and gray silty clay loam. As occurring in this area, the type is more generally intermediate between the typical soil and the Pope silt loam, which is somewhat more brownish in color and slightly better drained.

With the clearing and cultivation of the uplands, washing has been quite common and large deposits have been made in the valleys. This material does not consist in any large measure of unweathered material from deep gullies, but rather of the surface soil. Farmers have remarked that they farmed the hills until they built up the valleys, and then began farming the latter. This saying does not exaggerate the amount of washing, but indicates the worn condition of the upland and the recent and irregular deposition of the material in the stream bottoms. Twenty or thirty years ago these bottoms were not extensively farmed, and probably they are at present more productive and more easily worked, although the typical gray surface soil under good drainage conditions appears to be equally productive. These recent deposits, which are widely distributed, are quite deep at the mouth of branches and along their channels, ex-

tending to the depth of plowing over at least half of the type, and forming a soil of mellow, brown silt loam.

The Atkins silt loam occurs quite extensively along most of the smaller streams throughout the county. The surface is almost flat; typically, it appears to rise slightly to the stream, but on some wider bottoms, as along Cypress Creek and the embayments of Caney Creek, there is a rise to the hills in the outer part of the bottom, where the material probably represents wash to a considerable extent. On the branches of Pond River, in the vicinity of Earles, some narrow lower bottoms have developed within the main areas.

The larger creeks are winding and are obstructed in places with brush from lumbering and a rank growth of lilies. However, the type does not approach swamp conditions, except as indicated along Pond Creek and in occasional swales on the smaller streams. The typical tree growth consists of oak, hickory, gum, and beech.

The Atkins silt loam is extensively farmed, probably three-fourths of it being under cultivation. The ground is cold and damp in the early spring, but as the season advances conditions improve greatly. The type is similar to the Holly silt loam in crop adaptation and crop yields, and requires the same methods of farming.

Many farmers use from 100 to 200 pounds of acid phosphate per acre on corn, especially in late seasons. This gives opportunity for earlier cultivation, and may be expected to increase the yield from 5 to 10 bushels per acre, besides giving sounder corn.

The channels of small streams in this type have been straightened in a number of places. Considerable interest is shown in ditching the areas along larger streams, which are especially subject to overflow and not so much used on that account. Such projects may be carried out at present under laws providing for the organization of districts on petition. The upper part of Cypress Creek has been ditched, the assessments amounting to about $10 per acre. Overflow is not altogether prevented, but seldom occurs and is of short duration. Land values are reported to have increased from about $25 to $50 an acre to a present value of $75 to $100.

The following table gives the average results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Atkins silt loam:

Mechanical analyses of Atkins silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
391228, 391230...	Soil	0.0	0.3	0.2	4.1	19.4	57.6	18.2
391229, 391231...	Subsoil	.0	.1	.5	3.3	14.8	58.9	22.3
391232...	Lower subsoil	.0	.0	.5	2.5	10.4	59.2	27.4

ATKINS SILTY CLAY LOAM.

The Atkins silty clay loam is rather heavy, varying from silty clay loam to silty clay, in both surface soil and subsoil. Throughout the 3-foot section the soil is mottled, mostly yellow and gray. This soil occurs as a large area in the bottoms of Cypress Creek, extending from Central City to the river bottom. The tree growth consists of gum, oak, willow, cypress, and other trees.

POPE SILT LOAM.

The surface soil of the Pope silt loam is typically a light-brown to yellowish-brown friable silt loam, containing a relatively high proportion of fine and very fine sand. This grades at 8 to 12 inches into yellow to brownish-yellow silty clay loam to silty clay. There is in places some mottling of gray within the 3-foot section. Considerable areas of friable loam soil occupying the upper, narrower bottoms of these streams are included with the type as mapped.

The type is most extensive in the upper courses of Rocky Creek and Long Creek, in the southern part of the county. It also occurs in many small areas near the heads of streams and in narrow strips along stream channels through much of the county.

Rocky and Long Creeks, in their course through the breaks near the southern border and for some distance below this rough, hilly country, flow through comparatively deep channels and have sufficient fall to give very good drainage to the bottom lands. The type is well drained, except for small areas near the upland in the wider bottoms, and nearly all of it is in cultivation.

The Pope silt loam is a productive soil. Corn is the principal crop, yielding in normal seasons up to 50 bushels per acre. Both redtop and timothy hay are grown, yielding a ton or more per acre. Cowpeas also are grown to some extent, and yields of a ton or more of hay per acre are obtained. Acid phosphate is commonly applied on tobacco at the rate of 75 pounds or more per acre, and yields of 1,000 to 1,500 pounds per acre are obtained. There is some possibility of damage to the crop from overflow.

ROUGH STONY LAND.

The creek bottoms in the southern part of the county are inclosed by steep valley walls, which in places are precipitous, with cliffs of sandstone and limestone 100 feet high. The upper course of Rocky Creek is bordered by cliffs for 5 or 6 miles. Such areas are mapped as Rough stony land.

CHEMICAL ANALYSES OF SOILS.[2]

INTRODUCTION.

This chapter deals principally with the chemical analyses of samples of soil and subsoil representing the different soil types in the county. In addition to the tables, brief interpretations and references are given in order that the report may meet the needs of the agricultural public.

Muhlenberg County lies wholly within the western coal field, an area embracing more than one-tenth of the State (4,500 square miles), and the predominating types of soil mapped in this county occur in other parts of this region, so that much of the information in this report should be applicable in other counties of this part of the State.

The incorporation of fertilizers, limestone, and organic matter with the soil is limited by the depth of plowing, which is ordinarily

[2] This chapter prepared by S. D. Averitt, of the Kentucky Agricultural Experiment Station.

about 7 inches, and the feeding roots of most plants function mainly within this depth; therefore the analysis of the surface soil is considered more significant, as a rule, than that of the subsoil in connection with crop production.

The analyses reported herein are stated as parts per million of the dry sifted soil, exclusive of whatever material has been removed by the 2-millimeter (about one-twelfth inch) sieve in the preparation of the samples for analysis. If the amount removed is large, it should be considered in computing the quantities in the original soil or the pounds per acre of the substances determined.

When it is desired to convert parts per million to pounds per acre we assume that the weight of dry soil on an acre to the depth of 7 inches is 2,000,000 pounds, and that the subsoil from 7 to 20 inches over the same area weighs 4,000,000 pounds. These assumed values, though not exact, are near enough to the true weight of the soil to involve no practical error. Therefore, to convert parts per million to pounds per acre, multiply by 2 for the first 7 inches or surface soil and by 4 for the next 13 inches or subsoil.

The following table shows the plant food contained in the main crops grown in the State calculated for yields which may be considered attainable at a profit. A more extensive table of such values and a detailed discussion of them with reference to soil analyses and maintenance of fertility will be found in Part II, Bulletin No. 228, of the Kentucky Agricultural Experiment Station.

Average amounts of nitrogen, phosphorus, and potassium contained in various crops.

Crop.	Nitrogen.	Phosphorus.	Potassium.
	Pounds.	*Pounds.*	*Pounds.*
Corn, 50 bushels per acre, contains	50	9	10
Stalks, 1½ tons	25	3	26
Total	75	12	36
Wheat, 25 bushels per acre, contains	36	6	6
Straw, 1½ tons	12	2	23
Total	48	8	29
Oats, 40 bushels per acre, contains	26	5	6.5
Straw, 1 ton	13	3	21
Total	39	8	27.5
Tobacco, 1,000 pounds of leaf, contains	40	2.2	50
Stalks, 300 pounds	10	.8	10
Total	50	3	60
Red clover hay, 1 ton per acre, contains	40	5	30

METHODS OF SAMPLING AND ANALYSIS.

The sampling was done uniformly as follows: On a representative area of the type or phase, selected after mapping, composite samples of surface soil, 0 to 6 inches, and of subsoil, 6 to 18 inches, were taken by means of a soil auger such as is used by the Bureau of Soils. The samples of surface soil usually consisted of the earth from 12 borings. The subsoil was taken from about half of the holes made for the surface soil. After these samples had been air dried they were rubbed up in a wedgwood mortar, being careful not to crush the

gravel. and sifted with a sieve having circular openings 2 millimeters in diameter. If gravel or stones were obtained, the amount was determined as percentage of the air-dry sample, and the percentages are given in footnotes attached to the table of type analyses for all samples containing one-half of 1 per cent or more. The earth which passed the sieve, after thorough mixing, constituted the sample for analysis. A part was ground finer for determination of total potassium, phosphorus, and nitrogen, but the portion used for digestion in one-tenth normal nitric acid was not ground. Portions were weighed out equivalent to the desired amount of moisture-free soil, so the findings are expressed on the moisture-free basis.

The methods of analysis used are as follows: Total N, Kjeldahl method, 5 hours' digestion. Total P, magnesium-nitrate method (Methods of Analysis, A. O. A. C., pp. 314 and 318). Total K, the modified J. L. Smith method, as adopted by the A. O. A. C. in 1909 (see Bureau of Chemistry Bulletin No. 132 and Bulletin No. 122, p. 116). N/10 HNO_3 digestion for easily soluble K, P, and Ca. A weight equivalent to 75 grams of water-free soil was digested in 1,500 cubic centimeters of N/10 HNO_3 for one-half hour at room temperature and filtered through a dry paper filter. One thousand cubic centimeters of the clear filtrate was evaporated to dryness and treated twice with HCl to get rid of HNO_3, taken up with HCl and water, and the silica filtered out and washed and the filtrate made to 100 cubic centimeters. Aliquots of 10, 50, and 32.2 cubic centimeters were taken for Ca, P, and K, respectively. Determinations of acidity in terms of CaO necessary to neutralize. The method is essentially that given in the Journal of the A. O. A. C. (vol 1, No. 4, p. 25). One cubic centimeter standard KOH=0.004 gram $CaCO_3$ or 0.01 per cent, instead of 0.001 per cent, as stated in the text.

In the tabulations each sample has a number, and the subsoil in each case is designated by the number following the number representing the surface soil; thus sample 61240 is a sample of the first 6 inches of Atkins silt loam, and No. 61241 is the corresponding subsoil, 6 to 18 inches. The locations from which the samples were taken are given at the end of this chapter.

Chemical analyses.

[Parts per million of the moisture-free fine earth]

Depth and sample number.	Total nitrogen (N).	Total phosphorus (P).	Phosphorus (P) dissolved by N/10 HNO_3.	Total potassium (K).	Potassium (K) dissolved by N/10 HNO_3.	Calcium (Ca) dissolved by N/10 HNO_3.	Acidity as lime (CaO) to neutralize.
Atkins silt loam:							
0 to 6 inches—							
61240	1,480	600	11	16,100	93	720	500
61249	1,320	610	14	16,800	200	1,360	30
61251	2,220	735	13	17,100	146	580	2,010
Average	1,673	648	13	16,667	146	887	847
6 to 18 inches—							
61241	580	430	9	15,900	66	280	1,360
61250	480	610	9	15,900	76	360	1,080
61252	780	615	8	15,000	84	280	3,020
Average	613	552	9	15,600	75	307	1,820

Chemical analyses—Continued.

Depth and sample number.	Total nitrogen (N).	Total phosphorus (P).	Phosphorus (P) dissolved by N/10 HNO_3.	Total potassium (K).	Potassium (K) dissolved by N/10 HNO_3.	Calcium (Ca) dissolved by N/10 HNO_3.	Acidity as lime (CaO) to neutralize.
Tilsit silt loam:							
0 to 6 inches—							
43504	890	330	10	12,300	70	420	30
61242	820	400	12	12,600	93	540	330
61247	640	590	14	9,700	56	420	120
61273	980	530	10	12,700	88	680	100
61283[a]	980	435	8	11,300	121	700	50
Average	862	457	11	11,720	86	552	126
Maximum	980	590	14	12,700	121	700	330
Minimum	640	330	8	9,700	56	420	30
6 to 18 inches—							
43505	560	280	8	13,300	71	440	340
61243	440	330	11	14,100	83	380	1,560
61248	320	335	9	11,500	72	240	780
61274	540	535	10	16,100	71	440	785
61284[a]	660	345	9	11,800	98	600	300
Average	504	365	9	13,360	79	420	753
Maximum	660	535	11	16,100	98	600	1,560
Minimum	320	280	8	11,500	71	240	300
Tilsit silt loam, rolling areas:							
0 to 6 inches—							
61253	660	445	10	14,900	158	400	260
61255[b]	640	435	10	13,600	98	160	710
61265	720	375	11	13,700	82	880	30
61267[b]	780	400	10	12,300	118	380	400
61269	720	295	9	12,100	138	480	160
Average	704	390	10	13,320	119	460	312
Maximum	780	445	11	14,900	158	880	710
Minimum	640	295	9	12,100	82	160	30
6 to 18 inches—							
61254	440	435	9	16,200	142	360	920
61256[b]	500	350	5	15,100	104	220	780
61266	420	585	9	14,500	77	520	630
61268[b]	430	345	9	14,100	98	200	1,280
61270	520	425	7	14,200	131	780	560
Average	462	428	8	14,820	110	416	834
Maximum	520	585	9	16,200	142	780	1,280
Minimum	420	345	5	14,100	77	200	560
Hanceville silt loam:							
0 to 6 inches—							
61257	780	470	7	14,900	81	800	10
61271	740	355	10	14,800	101	460	170
Average	760	412	9	14,850	91	630	90
6 to 18 inches—							
61258	340	300	7	16,100	85	360	1,200
61272	460	395	7	16,200	120	640	305
Average	400	348	7	16,150	103	500	753
Hanceville stony loam:							
0 to 6 inches—							
61244	820	400	11	10,800	128	720	15
61246[b c]	1,040	505	14	10,100	120	260	170
Average	930	452	13	10,450	124	490	92
6 to 18 inches, 61245	420	555	8	12,600	85	460	540
Atkins silty clay loam:							
0 to 6 inches, 61279	1,640	550	14	17,400	171	1,480	270
6 to 18 inches, 61280	1,500	540	12	18,600	175	860	(d)
Huntington silt loam:							
0 to 6 inches, 61261	820	675	14	6,800	52	840	50
6 to 18 inches, 61262	460	670	12	6,900	46	820	20

[a] Gravel removed by the 2-millimeter sieve as per cent of the air-dry sample; No. 61283, 1.2; No. 61284, 0.9.
[b] Virgin soil.
[c] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample; No. 61246, 24.3.
[d] Alkaline.

Chemical analyses—Continued.

Depth and sample number.	Total nitrogen (N).	Total phosphorus (P).	Phosphorus (P) dissolved by N/10 HNO_3.	Total potassium (K).	Potassium (K) dissolved by N/10 HNO_3.	Calcium (Ca) dissolved by N/10 HNO_3.	Acidity as lime (CaO) to neutralize.
Holly silt loam:							
0 to 6 inches, 61259	860	600	6	12,600	49	1,040	130
6 to 18 inches, 61260	460	455	7	12,100	49	820	530
Holly silty clay loam:							
0 to 6 inches, 61263 [e]	1,660	680	11	14,200	101	2,400	140
6 to 18 inches, 61264	820	665	14	14,200	100	1,560	1,520
Elk silt loam:							
0 to 6 inches 61275 [f]	620	495	10	9,400	41	420	130
6 to 18 inches, 61276 [f]	420	445	10	12,100	61	460	840
Elk gravelly loam:							
0 to 6 inches, 61277 [g]	880	470	12	11,200	68	640	100
6 to 18 inches, 61278 [g]	680	495	7	10,100	55	460	670
Huntington loam:							
0 to 6 inches, 61281	840	345	18	15,300	162	4,180	100
6 to 18 inches, 61282 [h]	800	285	10	13,000	101	580	100
Pope silt loam:							
0 to 6 inches, 61285	960	310	9	13,700	175	1,200	20
6 to 18 inches, 61286	880	560	8	13,300	117	1,160	80

[e] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample; No. 61263, 0.7.
[f] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample; No. 61275, 1.6; No. 61276, 0.5.
[g] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample; No. 61277, 0.8; No. 61278, 0.5.
[h] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample; No. 61282, 0.6.

Inspection of the foregoing table shows that some of the bottom soils contain a fairly good supply of nitrogen. The upland soils, however, are all deficient in this element. One or two of the bottom types show a moderate amount of total phosphorus, about 1,200 to 1,300 pounds per acre in the surface soil. The others are low in this element, containing in many cases much less than 1,000 pounds in the surface soil. The easily soluble phosphorus is low in all types, ranging in the surface soil from 12 to 36 pounds per acre, with an average of about 22 pounds. Total potassium in the Atkins silty clay loam is rather large, especially in the subsoil. In all other cases it is fair to medium as compared with the average of the State. In the surface soil of the Atkins silt loam, in the surface soil and subsoil of the Atkins silty clay loam, in the surface soil of the Huntington loam, and in the Pope silt loam the content of easily soluble potassium is large. In all other cases it is from medium to low. If, however, the organic matter content of the soil is increased and maintained, lack of potassium probably will not limit the production of profitable crops, especially on the well-drained types. With the exception of the surface soil of the Pope silt loam and Holly silty clay loam, the easily soluble calcium is low and there is a decided tendency to acidity. This is marked in the case of the Atkins silt loam, both in surface soil and subsoil.

For information on the management of the soils of the county, including fertilizer practices, the reader is referred to Bulletin No. 228 and Extension Circulars Nos. 123 and 129, which may be obtained free upon application to the Kentucky Agricultural Experiment Station, Lexington, Ky.

In the table below, showing the locations from which the samples analyzed were taken, the numbers of the samples should be read as follows: 61240–41 means sample No. 61240, the surface soil, and sample No. 61241, the corresponding subsoil.

LOCATIONS FROM WHICH SAMPLES WERE TAKEN.

Laboratory numbers of samples.	
61240–41	5½ miles southeast of Greenville, on Bowling Green Road. Gray silt loam, of Atkins silt loam. Bottom. Field in pasture.
61242–43	4½ miles northwest of Dunmor, on Russellville Road. Tilsit silt loam. Field in corn.
61244–45	1 mile north of Nos. 61242–43. Hanceville stony loam.
61246	Virgin soil of Nos. 61244–45. Only surface soil collected.
61247–48	3 miles east of Greenville, on Rochester Road. Tilsit silt loam. Field in pasture. Flat area.
61249–50	1½ miles east of Greenville, on Rochester Road. Atkins silt loam. More clay than this type usually shows. Mottling to within 3 inches of surface.
61251–52	5 miles southeast of Central City. Atkins silt loam. Bottom.
61253–54	4 miles east of Central City. Tilsit silt loam. Rough, rolling land. Good deal of red in color.
61255–56	Virgin soil of Nos. 61253–54.
61257–58	1 mile south of Nelson, near Nelson Creek Church. Hanceville silt loam. Rolling, eroded country. Rough.
61259–60	2½ miles north of Nelson, on Green River. Gray silt loam, of Holly silt loam.
61261–62	2¾ miles north of Nelson, on Green River. Sandy variation of Huntington silt loam, near river. Subsoil a little lighter in color than the surface.
61263–64	8 miles southwest of Greenville, 2½ miles west of Greens Chapel. Pond River bottom. Gray silty clay loam, of Holly silty clay loam.
61265–66	One-fourth mile west of Greens Chapel. Tilsit silt loam. Rolling variation. Mottling deeper than usual.
61267–68	Same locality. Virgin soil of Nos. 61265–66.
61269–70	Same locality. Between Tilsit silt loam and the rolling variation in character.
61271–72	2½ miles north of Graham. Hanceville silt loam. Typical rough, rolling country.
61273–74	1 mile south of Millport. Tilsit silt loam. Best agricultural section of county. Upland.
61275–76	One-third mile northwest of Lynn City. Elk silt loam. Flat terrace.
61277–78	One-half mile west of Bevier. Elk gravelly loam. Small area not shown on map. Rolling terrace.
61279–80	1½ miles west of South Carrollton. Cypress Creek bottom. Atkins silty clay loam. Sample practically a clay loam. Very stiff. Swampy.
61281–82	3 miles south of Central City. Small bottom. Huntington loam. A gray, rather sandy loam.
61283–84	One-fourth mile north of Weatherford Store. Tilsit silt loam. Collected by J. A. Kerr.
61285–86	Long Creek, south of Weir. Pope silt loam. Collected by J. A. Kerr.

SUMMARY.

Muhlenberg County is situated in the coal district of western Kentucky. It comprises an area of 472 square miles. The physiography is that of a plateau dissected and reduced by streams flowing 150 to 200 feet below the higher levels. The surface is rolling to hilly, with numerous local developments of gradual slope and undulating areas. The extreme northern part of the county is occupied by a high terrace formation.

The upland is well drained through numerous streams. Green River forms the northeastern boundary, Mud River the eastern boundary, and Pond River the western boundary of the county. These streams have reached a low gradient. There are considerable developments of alluvial lands on large and small streams in all parts of the county.

According to the 1920 census, the population of the county is 33,353. Greenville, the county seat, and Central City, the mining center of the county, are the most important towns. There are numerous mining towns through the central and eastern parts of the county.

Good transportation facilities are furnished by through railroad lines, and by packets on Green River.

Corn and tobacco are the principal crops, corn occupying two-thirds of the acreage in farm crops. Other crops commonly grown are redtop, timothy, oats, wheat, cowpeas, and vegetables. Japan clover is the principal pasture growth, giving fair summer pasturage. Tobacco is the largest source of income, but considerable income is derived from the sale of livestock, dairy products, poultry, and truck crops. The farms are generally small and are operated usually without hired labor.

The upland soils are of the Appalachian Province. They are predominantly from interbedded shale and sandstone, with some development of limestone soils in the southwestern part of the county. The soils derived from shale and sandstone support a good growth of hardwoods, but in cultivation show only moderate productiveness. They are classified in the Tilsit and Hanceville soil series. The soils derived from limestone are classified in the Christian and Cincinnati series.

The Tilsit silt loam is the predominant agricultural soil of the upland. The topography is favorable for farming. The surface drainage is good, but the underdrainage is somewhat deficient. Corn and tobacco are the principal crops.

The Hanceville silt loam occupies rolling to hilly country and is not extensively farmed. The Hanceville stony loam is hilly and nearly all in forest.

The Christian silt loam is a productive soil. The Christian stony loam and the Cincinnati stony clay are hilly, and are not extensively farmed.

There is considerable development of alluvial soils through most of the county. The rivers of the county rise in limestone country; their terrace soils are classified in the Elk and Robertsville series; their first-bottom soils are classified in the Holly and Huntington series.

The Elk silt loam is a fairly well drained terrace soil, moderately productive of corn, redtop, tobacco, and other crops. The Robertsville silt loam is poorly drained.

The Holly silt loam and Holly silty clay loam are the most extensive first-bottom soils along the rivers. They are not well drained, but are productive and extensively farmed. The Huntington loam and Huntington silt loam are well drained and very productive soils.

The alluvial soils of the smaller streams are classified in the Atkins and Pope series. The Atkins silt loam is the most extensive of these. It is not well drained, but is a productive soil for corn and redtop. The Pope silt loam is a well-drained, productive soil.

Rough stony land includes the steep and stony valley walls along creeks in the southern part of the county.

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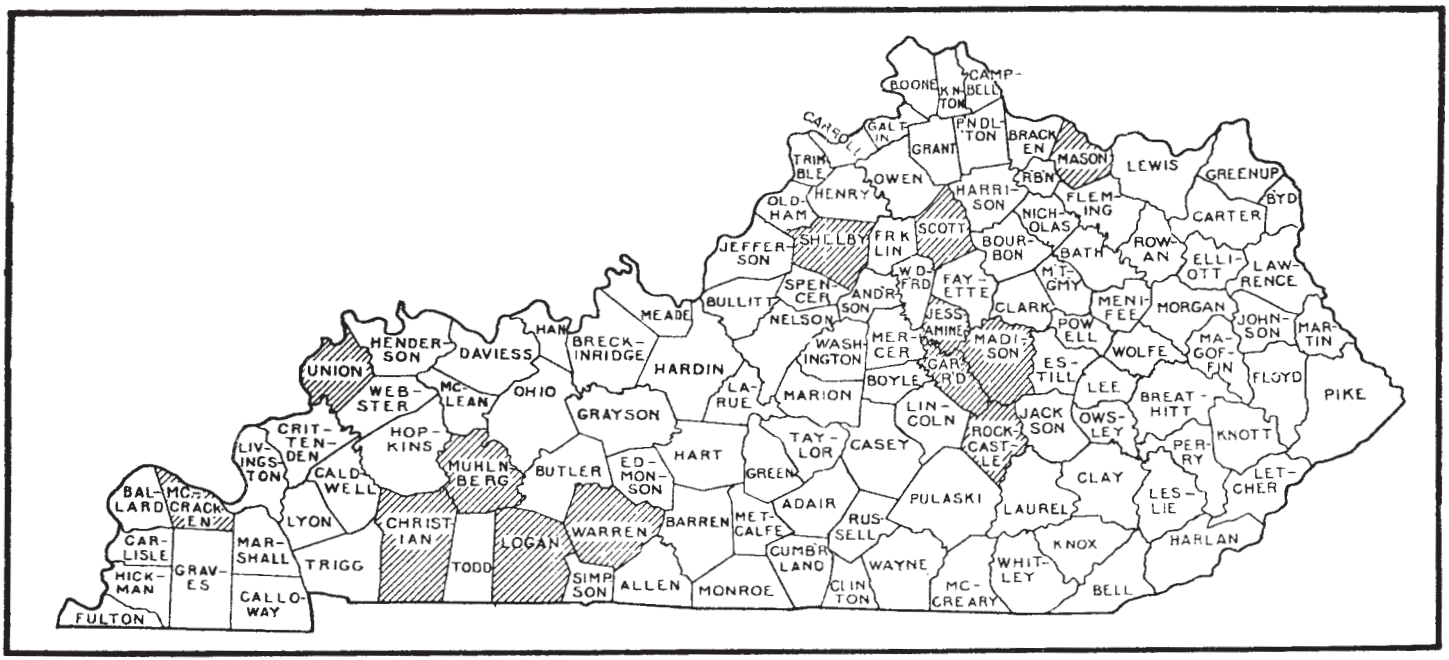

Areas surveyed in Kentucky, shown by shading.

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