

Issued February 15, 1909.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

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

SOIL SURVEY OF THE MIDDLEBOURNE AREA,
WEST VIRGINIA.

BY

THOMAS A. CAINE, E. R. ALLEN, H. JENNINGS,
AND G. W. TAILBY, Jr.

[Advance Sheets—Field Operations of the Bureau of Soils, 1907.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

[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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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., May 19, 1908.

SIR: A soil survey of the Middlebourne area, West Virginia, was carried on during the summer of 1907 for the purpose of classifying and mapping the soils and learning their agricultural capabilities. This work was done at the request of and in cooperation with the West Virginia geological survey, Dr. I. C. White, State geologist, part of the expense being borne by that institution. I have the honor to transmit herewith the report and map covering these investigations and to recommend their publication as advance sheets of the Field Operations of the Bureau of Soils for 1907, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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MAP.

Soil map, Middlebourne sheet, West Virginia.

SOIL SURVEY OF THE MIDDLEBOURNE AREA, WEST VIRGINIA.

By THOMAS A. CAINE, E. R. ALLEN, H. JENNINGS, and G. W. TAILBY, Jr.

DESCRIPTION OF THE AREA.

The Middlebourne area is located in the northwestern part of West Virginia and includes Tyler, Wetzel, and Marshall counties, the last-named being the extreme southern county of the Panhandle. The area is bounded on the north by the Ohio River and Ohio County, on the east by Pennsylvania, and Monongalia and Marion counties, on the south by Harrison, Doddridge, Ritchie, and Pleasants counties, and on

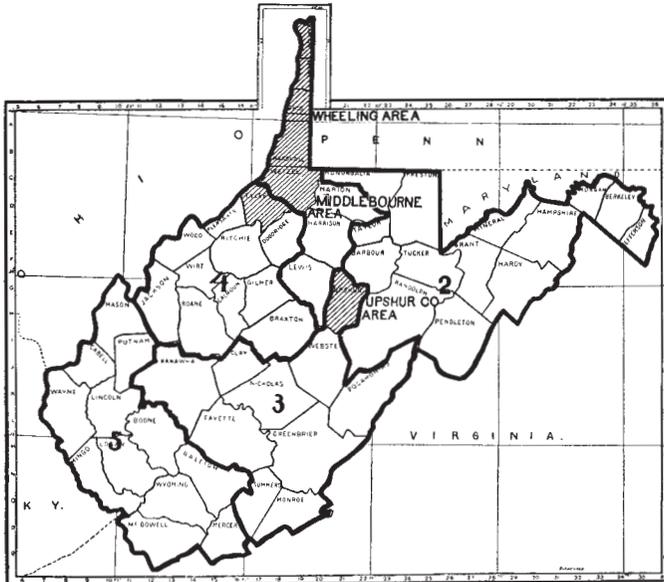


FIG. 1.—Sketch map showing location of the Middlebourne area, West Virginia.

the west by Pleasants County and the Ohio River. In a north and south direction it has a length of about 45 miles, while east and west its width varies from about 12 to 32 miles. Parallel $39^{\circ} 20'$ crosses the southern part of the area and 40° the northern part and meridians $80^{\circ} 25'$ and $81^{\circ} 10'$ west of Greenwich form the eastern and western limits, respectively. There are 609,536 acres or about 952 square miles in the area.^a

^a About 22 square miles of this was surveyed in the Wheeling area, but is included in the present map to complete Marshall County.

The most conspicuous topographic feature of the area is the narrow, meandering, gorgelike valley of the Ohio River, which extends in a northeast-southwest direction along the entire western border. The elevation of the river varies from 581 feet at the southern boundary to 610 feet at the northern boundary. The alluvial and terrace lands along the river are seldom over a mile wide, and as the river meanders back and forth the bottoms are found first on one side and then upon the other side of the stream. The hills bordering the river are steep and abrupt, and at those points where the channel runs close to the valley wall they are usually precipitous, often rising to an elevation of 400 to 600 feet in a distance of from one-fourth to three-fourths mile from the river.

Viewed from the hilltops the whole region presents a picturesque appearance, resembling a mountainous country in miniature. A close inspection, however, will show that as far as can be seen in all directions the highest points are all on about the same general level; and looking from one of the highest points, a mile or so back from the river across into Ohio, the deep, gorgelike, intervening valley is hardly perceptible. These nearly horizontal hilltops are the remnants of an ancient upland plain which has been reduced to its present highly dissected form by centuries of weathering and erosion.

The drainage of the area is all into the Ohio River, principally through Wheeling, Grave, Fish, Fishing, and Middle Island creeks. These creeks all pursue roughly parallel northwestern courses, but make a sharp bend to the southwest just before entering the river. They are very crooked and wind back and forth, often making loops of a half mile or so across. These creeks are still deepening their channels to the level of the Ohio River. In an air-line direction they have average falls varying from 15 to 30 feet per mile. In places their channels rest upon bare rock. On the inner bends of the loops there are often narrow strips of rich alluvial land and the hills back of these are less precipitous than on the outer bend, where erosion is more active. Here the hills are steep and precipitous, and whenever there happens to be a heavy, massive stratum of sandstone high up in the hills, it usually breaks off in huge, angular blocks, with which the hillside and the creek bottoms below are strewn.

Frequently within the loops of these large streams and a hundred feet or more above their present channels the same heavy, massive sandstone stratum, because of its resistance to weathering, forms a distinct table land, and gives rise to a peculiar character of soil. These larger creeks all have high valley walls with steep, sloping sides, and are, if anything, more gorgelike than the Ohio Valley. The hills rise abruptly from 200 to 400 feet a short distance back from the streams.

The drainage basins of the large streams are made up of an irregular network of smaller streams, which usually flow on bedrock through

straight, deeply-carved V-shaped channels. The depth of these valleys varies from 100 to 300 feet, and the fall per mile of the streams is often greater than 100 feet. The streams are rapidly cutting their channels deeper, hence there is seldom any bottom land along their courses. The main roads often lie in these valleys. In some places the valley floors are so narrow that the stream beds are utilized as the road, and where the stream ends the road winds up to the top of the divide only to descend immediately into the next valley. In the central portion of the area the divides between the main drainage basins are narrow and winding, the streams on both sides having cut back so far as to interlock, resulting in the formation of a series of long, narrow, detached hills and knobs along the top of the divide. In this same portion of the area the ridges between the smaller creeks and branches are long, narrow, and angular. In the northern and southern portions of the area, however, the divide between the main drainage basins and the ridges between the smaller streams are broader, the knobs and hills are less conspicuous, and the region is much better adapted to general farming. One of the highest points in the area is Honsocker Knob, which has an altitude of about 1,625 feet, so that within the area there is a total range in elevation of over 1,000 feet.

The first permanent settlers in the area came from Virginia, Maryland, and North Carolina about 1775, and located at different points along the Ohio River, principally near the present sites of Moundsville and New Martinsville. For the first fifty years following 1775 many more came from the same States, being attracted by the rich lands and the transportation advantages afforded by the Ohio River. The present farming population, comprising about 60 per cent of that of the whole area, is mainly descended from the original settlers, with a sprinkling of those of German and Irish extraction. The remainder of the population are those who, being attracted by the good wages paid in the oil, gas, coal, glass, pottery, and iron industries along the river, have come in recent years from various parts of this country and of the Old World.

When the original thirteen States were organized the area fell within the territory of Virginia and remained a part of that State until the formation of West Virginia in 1863. The whole area was originally within the limits of Ohio County, which was organized in 1785 and at that time included not only all of the Panhandle, but extended indefinitely westward and for a considerable distance to the south. After the formation of the State of Ohio the westward extension of Ohio County, Virginia, became fixed by the Ohio River. In 1814 Tyler County, named in honor of President Tyler's father, was formed from a part of Ohio County and included what is now Tyler and Wetzel counties. In 1835 Marshall County, named in honor of John Marshall, was organized from the southern portion of Ohio County. In 1846 Wetzel County was formed from a part

of Tyler County by act of the Virginia assembly. All three of these counties have an excellent frontage on the Ohio River, and thus even before the advent of railroads they were favored with the best means of transportation that the time afforded.

Until about twenty years ago little had been done to develop the natural resources of the area. Since then petroleum and natural gas have been found in vast quantities and are being extensively developed in the southeastern part of the area, while in the northern part along the Ohio River the iron, steel, and glass industries are yearly becoming more important. There are immense quantities of coal and considerable fire clay under the whole area, and these await development. In recent years the growth of the towns along the Ohio River has been rapid, and some new towns have sprung up, this being especially true in the vicinity of the iron, steel, and glass plants. The original forest growth of the area has practically all been removed, though in the central portion, where much of the land is too steep, broken, and rough even for profitable use as pasture, the landowners have very wisely permitted large areas to become reforested.

The superior shipping facilities afforded by the Ohio River have been and always will be an important factor in the development of the region, and at present there are several steamboat landings within the area. There are also many desirable sites along the river for the location of steel, iron, glass, and pottery plants or factories. The Ohio River division of the Baltimore and Ohio Railroad runs the full length of the area on the West Virginia side of the river and connects the towns of Moundsville, New Martinsville, and Sistersville with Wheeling on the north and Parkersburg on the south. The West Virginia Short Line of the Baltimore and Ohio system crosses the southern part of Wetzel County and connects New Martinsville with Clarksburg, and the Wheeling Short Line, which crosses Marshall County and a part of Wetzel County, connects Moundsville with Fairmont. There are also two trolley lines in the area, one extending from Moundsville to Wheeling and the other from Sistersville to New Martinsville.

The chief towns of the area are McMechen, Moundsville, New Martinsville, and Sistersville, all of which are located on the Ohio River. There are also several other thriving little towns, the largest of which are Cameron, Hundred, Middlebourne, Pinegrove, Jacksonburg, and Smithfield. These towns and Wheeling furnish a greater demand for general farm and dairy products and truck crops than is at present being supplied by the agricultural population of the area.

CLIMATE.

The climate of the Middlebourne area is well suited to the carrying on of general farming. The winter weather is cold and there is

often considerable snow, but it can not be said that the climate is severe. It is seldom that the temperature goes below zero, and the average for the three coldest months—December, January, and February—is about 32° F. The other extreme is rarely higher than 100° F.

The average length of the growing season is between six and one-half and seven months, and not infrequently stock may be pastured for eight months of the year.

According to the data given in the accompanying table for New Martinsville, the average annual precipitation is about 39 inches, and during October and November the average monthly rainfall is about 2.7 inches. This is sufficient to germinate wheat and rye and get them well started and rooted before the winter sets in. The table shows also that the average monthly precipitation for December, January, and February is about 3 inches. A considerable part of this is in the form of snow, which protects the ground from much hard freezing and thawing. April has an average rainfall of 3.4 inches, and May is usually warm and pleasant, with an average rainfall of 3.5 inches, which is sufficient to germinate the corn and oats. It is seen also that in June, July, and August the average monthly temperature is about 74° F. and that the average monthly precipitation is about 4 inches. This is ample warmth and moisture for the growing and maturing of oats, wheat, rye, and hay. The least precipitation occurs in the fall after the close of the growing season, while the greatest occurs when the growing crops need it most. A failure of the staple crops on account of drought is very rare, and it is likewise very seldom that the rains are so excessive during the spring and summer months as to prevent the completion of plowing and sowing or seriously to damage hay and grain during harvest.

Normal monthly and annual temperature and precipitation.

Month.	New Martinsville.		Central Station. ^a		Bens Run. ^a	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	° F.	Inches.	° F.	Inches.	° F.	Inches.
January.....	32.0	3.12	37.0	3.60	38.3	3.42
February.....	30.7	2.96	30.6	1.40	32.0	2.10
March.....	42.7	3.32	35.7	3.98	37.2	5.06
April.....	52.9	3.44	52.6	3.18	54.6	3.62
May.....	63.6	3.54	61.9	2.00	64.0	6.89
June.....	72.1	3.85	70.1	4.58	72.4	5.82
July.....	75.8	5.42	71.6	3.32	74.7	3.27
August.....	74.9	2.93	75.2	4.72	77.7	8.62
September.....	68.0	2.42	69.0	2.76	72.0	1.64
October.....	56.0	2.09	54.3	1.86	55.8	3.22
November.....	44.1	3.35	42.5	2.34	44.7	2.52
December.....	34.8	3.19	35.0	4.51	35.8	5.60
Year.....	54.0	39.63	53.0	38.25	54.9	51.78

^aThe figures given for Central Station and Bens Run represent the temperature and precipitation for the year 1906, without departures from the normal.

Dates of first and last killing frosts.^a

Year.	New Martinsville.		Wheeling.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1898.....	May 9	Oct. 24	Apr. 8	Oct. 28
1899.....	Apr. 10	Oct. 1	Apr. 5	Oct. 1
1900.....	May 4	Oct. 17	Apr. 10	Nov. 14
1902.....	Apr. 15	Oct. 15	Apr. 8	Oct. 22
1903.....	Apr. 24	Oct. 25	Apr. 5	Oct. 25
1904.....	Apr. 22	Oct. 7	Apr. 21	Oct. 28
1906.....	May 10	Oct. 12	May 7	.....
Average.....	Apr. 26	Oct. 14	Apr. 13	Oct. 25

^a Data of frost occurrence at Central Station and Bens Run were too fragmentary to have any significance and are therefore omitted from above table.

AGRICULTURE.

The early settlers confined themselves largely to the Ohio bottoms and to the easily tillable land for a few miles back from the river. They found the soils very well adapted to wheat, corn, and rye, and the growing of these crops constituted the main type of farming for the first fifty years following 1775. Over the larger portion of Wetzell and Tyler counties, however, there are large areas, especially within the drainage basin of Fishing Creek, where the hills are so steep and the ridges so narrow that the land has remained in the original forest or the areas once cleared have been reforested. It is within this poorest agricultural portion of the area that great bodies of oil and gas have been exploited in recent years.

During the first quarter of the last century the production of wheat, corn, and rye outgrew the local demands, but with the establishment of river transportation with the older colonies of the lower Mississippi a large flour and whisky trade was built up.

About 1840 grain growing is said to have become unprofitable because of the constant improvident cropping of the soils. The wheat yields had fallen off year after year from 35 bushels to about 10 bushels per acre, and other grain crops had decreased in like proportion. Considerable land was abandoned as "worn out" and allowed to grow up to weeds and brush, and for a time the production of grain scarcely sufficed to supply the local demands.

About this time (1835) a number of Merino and Saxony sheep were introduced, and the industry was so profitable that it spread in all directions and became very important in Virginia, Pennsylvania, and Ohio. Nearly every farmer kept some sheep and a number of those who owned large flocks became comparatively wealthy. Wool answered the commercial requirements of the time, since it was not exceedingly bulky, could be handled easily, was nonperishable, and in great demand. The wool or the manufactured woolen products

were readily exchanged in the southern markets for sugar, molasses, and cotton. Some of the area has always been considered a little too steep and broken for heavy stock, but admirably well adapted to sheep raising, which for a number of years was the most important industry, little attention being paid to other lines of agriculture. It was found that after being pastured to sheep a number of years the "worn-out" soils were greatly benefited, and some claim that they became more productive than ever. By this time the whole region had made marked progress in settlement and in industrial enterprises, and with the increase in population there arose a great demand for all kinds of farm produce, especially dairy products, fruit, and truck crops. A reduction in the price of wool caused sheep raising to become less popular and the wool industry no longer constitutes the principal pursuit. However, it is still an important auxiliary to general farming, especially among the most progressive and prosperous farmers, who use this means of maintaining the productivity of their soils.

Taking the area as a whole, there has been no increase in the acreage of wheat, corn, and oats during the last twenty years, and in fact the acreage seems to have been reduced within the last ten years, notwithstanding the ruling higher prices of these products. In the vicinity of Wheeling, Moundsville, New Martinsville, and some of the other towns a few of the farmers are striving to supply the increasing local demand for milk and butter, fruit of all kinds, and truck crops. There are no commercial orchards within the area, but judging from the few scattering, poorly kept orchards, and also from the similarity of climate and soils to those in the northern end of the Wheeling area, where there are several successful commercial orchards, there can be no doubt that the soils along the Ohio River, as well as most of the soils found in the hill sections of the area, are well adapted to the production of such varieties of apples as the Stark, Ben Davis, and Rome Beauty. It is also recognized that a considerable part of the upland areas is well adapted to dairying, but owing largely to the confining nature of the occupation, lack of intelligent labor to handle the stock, and the steep, rough roads to market, this industry is limited to the farms convenient to towns. The more level upland soils are fairly well and the terrace soils along the Ohio River admirably adapted to truck and berry crops, as well as to general farming. At present, however, very little attention is being paid to trucking in either of these localities, and most of the fruit and vegetables sold in the larger towns along the river is shipped in from outside points.

On the upland farms the more level part is usually fenced off from the steeper hillsides and used for general farm crops. The steeper hillsides are usually seeded down to grass and used for pasture or the

production of hay. Some of these hillsides have been furnishing excellent pasturage for over twenty-five years. Below these pasture fields and adjacent to the streams on both sides there is usually considerable Rough stony land which affords scant pasture and which is often permitted to grow up to locust and other trees or to remain covered with its original forest growth. In the central portion of the area most of the steep slopes and narrow ridges remain in timber.

The usual crop rotation upon the tillable uplands is one year each of corn, oats, and winter wheat. A limited acreage of potatoes is grown. Timothy is sown in the fall with the wheat, and clover is sown the following spring. The first year the meadow consists largely of clover, but the following year the timothy predominates and is left as long as it will yield a profitable crop, usually from three to five years. On the soils derived from calcareous shales, as the timothy thins out Kentucky bluegrass takes its place. The latter is never cut for hay, but makes excellent pasture, being much better than the Canadian bluegrass, which is also abundant in the area. The length of time a field remains in pasture depends upon the size of the farm, the amount of stock kept, and very much upon the location of the field and the character of the soil. The most successful farmers try to keep land seeded down as long as possible, and to keep enough stock to consume the greater part of the hay, straw, and grain.

There are a few custom flour mills in the area, but practically all of the farmers sell their wheat and buy flour imported from other States. This has led a few to abandon wheat growing and to substitute a yearly rotation of corn and oats. Timothy and clover are sown in front of the drill with the oats, and usually two excellent crops of clover are secured the next year. In the cultivation of the steeper slopes the farmers, as a rule, cultivate the upper half one year and the lower half the following year. This is done to keep washing and gulying in check, and whatever wash occurs from the upper half of the field the first year is caught in the grass and sod of the lower half of the field and adds to its fertility for the following year. When the steeper slopes are broken for corn the best farmers leave one and sometimes more narrow strips of sod about the middle of the field and following the contour of the hill; and where there are slight depressions, old gullies, or little runs they are likewise left in sod, and the brush and stones which accumulate in the field are usually disposed of by dumping into these depressions to aid in checking further gulying and erosion.

On many of the slopes of the Rough stony land the influence of the underlying more resistant shaly sandstone is quite marked, giving rise to a series of horizontal natural terraces. The level part of the terraces consists of a narrow strip of very productive

soil, while the part too steep for cultivation is kept in sod for the protection of the better lying strips.

Very little commercial fertilizer is used, but all of the farmers recognize the great value of stable manure in maintaining the productivity of the soils. Many admit that it would be better for their farms if they kept more stock. In the trucking areas no rotation is practiced, and the productivity of the soils is maintained by manure hauled from the towns. The level areas along the streams are not subject to serious erosion, and their productivity is maintained by occasional overflows and by frequent heavy applications of manure.

The adaptation of the methods to the present conditions on the rolling uplands is well illustrated in the case of the corn, practically the only clean-cultivated general farm crop in the area. The sod is broken to a depth of about 7 inches, and the corn is either drilled or dropped in rows running with the contour of the hills, so as to aid in checking erosion. During the first year the sod roots aid in binding and holding the soils, and recognizing this fact the farmers seldom plant corn two successive years upon the same field, because the sod roots would be thoroughly rotted the second year and washing and gulying would be serious.

The low prices paid for wool, the rapid industrial development of the region, and the increased demands for agricultural products have completely changed the agricultural conditions during the last quarter of a century. Landowners throughout the area are quite prosperous, as shown by the low percentage of mortgaged farms. Their dwellings and barns are usually quite substantial, the farms are well supplied with good draft horses, and there is an abundance of up-to-date farm machinery in use. In recent years returns from the sale of the underlying coal and the rentals and royalties from gas and oil have added to the income of the farmers, and their prosperous condition at present is due in part to this.

The great demand for laborers in the factories, mills, potteries, blast furnaces, and mines, and in the oil and gas industries has attracted many people from adjoining States and caused young men to leave the farms to engage in these various pursuits because of the shorter hours and better pay. The scarcity of good farm labor is one of the most serious drawbacks to farming. The wages paid farm hands range from \$20 to \$30 a month, with board, lodging, and washing, and often feed for a driving horse. The most successful farmers feel the necessity of arranging their farm practice in such a way as to hire as little labor as possible. About 75 per cent of the farms are operated by the owners, the remainder being rented for cash or on shares. Throughout the area, especially in the central part, there are considerable tracts of wooded land which

are too steep and broken for cultivation. The average size of the farms is about 100 acres. The size of the holdings, however, ranges from a few acres to over 1,000 acres.

There has been a great increase in the selling price of the farm lands within the last fifteen years. Improved farms are now selling for as much per acre without the coal, oil, or gas privileges as they did fifteen years ago with all of these privileges. Unimproved farm lands with the above-mentioned rights could have been purchased fifteen years ago for about \$15 an acre. With the coal, oil, and gas privileges these same lands now bring from \$50 to \$100 an acre, depending upon location. The whole area is underlain by the Pittsburg coal, and the coal rights on most of the farms have been sold. In the best farming sections of the area the average price per acre for improved farms without coal, oil, or gas rights is about \$50. The price, however, varies considerably, depending upon the kind of soil and the nearness of the farm to town.

At present the live-stock interests of the area are not as important as formerly. Some cattle, sheep, and hogs are kept by every farmer, but on most farms the number could be profitably increased. The stock is usually of good quality, including the farm horses, which are well bred and well cared for.

Until about twenty-five years ago the production of sheep for wool or mutton was one of the most important industries. At present there are about one-third as many sheep in the area as formerly. Practically the only breeds raised are the Delaines and the Merinos. These give a good yield of wool, and the lambs, which are marketed in the fall, bring from \$2 to \$3 a head when six months old. It is believed that the number of sheep could be profitably increased where protection from dogs can be had, and also that goats would prove a good investment in the rougher parts of the survey.

The dairy interests are confined almost exclusively to the territory immediately surrounding the towns and villages. Not many blooded cows are kept. The dairymen usually live close to town and retail milk at 5 to 8 cents per quart, the price depending somewhat upon the season of the year. The present local supply of milk is barely sufficient to meet the demand in some of the towns, and it seems that this industry could be profitably extended.

Some farmers sell annually in the local markets a few fat steers and calves. Only a few hogs are raised, but in parts of the area where corn is grown in abundance more hogs could be raised with profit.

As a rule, the farmers understand how the different soils should be handled to maintain their productivity and to bring the largest returns. On the Meigs clay loam the fields should seldom if ever be plowed, and it would be better to keep them either in orchards or pasture. On the Rough stony land it is believed that the greatest profits are to be had by pursuing systematic forestry, and that growing

locust trees for posts would be especially profitable. Orcharding should receive more attention. Practically all of the farmers recognize that it would be better to keep more stock and feed their roughage at home instead of selling, even at high prices, all available hay, straw, and grain to the teamsters in the oil and gas fields.

SOILS.

The soils of the area fall naturally into three general divisions. The first and most important is that comprising the residual upland soils, which occupy fully 90 per cent of the area, and are found in all locations from the gently rolling hilltops to the steepest hillsides. Geologically, the uplands belong to the Coal Measures of the Carboniferous age, and that part of the Coal Measures here represented belongs to the Dunkard series (Permian). Several upland soil types were found, each differing from the others in texture, topography, and agricultural value, and each requiring different methods of treatment in the way of cultivation and fertilization in order to insure the best yields.

The Dunkard series is composed largely of a brown and a gray micaceous sandstone which is very easily disintegrated. In Marshall County these sandstones are interstratified with limy shales, which upon weathering result in soil of relatively high lime content, and for this reason, as also because of the more gentle topography, the soils are considered better for general farming than those farther south.

In Wetzel County, especially, the sandstone and sandy shales are interstratified with numerous beds of marly red shales, holding concretions of lime, and because of the easily eroded character of these formations they give a very rugged topography and are better suited to forestry, grazing, and fruit culture than to general farming. Large areas of this region are forested with second-growth timber, nearly all of the original timber having been removed. Occasionally small cleared spots may be seen even upon some of the steeper slopes, and for the first year or two the crop yields upon these are surprisingly large, but unless kept in pasture the soil soon washes off and exposes the underlying shales and sandstones.

In the region where the limy shales are most abundant the soils are best for wheat, corn, oats, hay, and pasture and support a permanent bluegrass sod. The soil derived from the marly red shales is also well adapted to these crops and supports an excellent bluegrass sod, but owing to rapid erosion it is found only in narrow areas, a rod or so wide, running horizontally around the hills. Very often the sandstone and sandy shale fragments from above have become so thoroughly mixed with this soil that it is difficult to recognize it. The soil derived solely from sandstone is limited in extent and occurs as isolated patches, principally in shelflike positions 100 feet or more above the main streams.

The second of the three general divisions of soils found in the area occurs in the form of terraces along the valleys of the Ohio River and its larger tributaries. Along the river the terrace material is composed largely of glacial sand, silt, and gravel brought down by the glacial floods. Along the tributary streams, however, the terrace material, though deposited at the same time as the river terraces, was not brought from a glaciated region, but was derived from the soft, easily weathered sandstones of the Dunkard series, and hence the difference in the resulting soils.

The terrace soils of the Ohio River are represented by the Wheeling gravelly loam, the Wheeling sandy loam, and the Wheeling silt loam, while the terraces of the tributary streams are represented by a single type, the Tyler silt loam.

The third division of soils comprises the recent alluvial deposits in the valleys of the Ohio River and its larger tributary streams. The resulting soil types are the Huntington loam and the Huntington fine sandy loam. The latter occurs in narrow strips bordering the river and represents areas where the coarser materials, such as sand and vegetable matter, were deposited in times of flood. The Huntington loam is often found farther back from the stream areas where the finer materials—fine sand, silt, and clay—were deposited by quieter currents. In the Ohio Valley these two soil types, as shown by various excavations, are found as a veneer over the sandy and gravelly terrace materials.

Along the small tributary streams only patches of soil are found, and these are usually too small to be shown upon a map of the scale used. Along the larger streams, such as Wheeling, Grave, Fish, Fishing, and Middle Island creeks, there is considerable bottom land. The channels of these streams are nearly level with the Ohio River, and the valleys in places are a half mile or more in width. The bottoms are all subject to overflow, and the soil formed there, though often rather variable in texture, is a loam having the characteristics of Huntington loam.

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

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Meigs clay loam.....	281,280	46.2	Wheeling gravelly loam.....	2,240	0.4
Rough stony land.....	263,104	43.1	Upshur clay.....	1,856	.3
Huntington loam.....	25,152	4.1	Brooke clay loam.....	1,024	.2
Dekalb loam.....	24,512	4.0	Huntington fine sandy loam..	640	.1
Dekalb silt loam.....	3,712	.6	Wheeling sandy loam.....	192	.0
Tyler silt loam.....	3,008	.5			
Wheeling silt loam.....	2,816	.5	Total.....	609,536	.....

DEKALB LOAM.

The soil of the Dekalb loam, to an average depth of 8 inches, consists of a light-brown to gray silt loam, usually very mellow and loamy. The subsoil from 9 to 15 inches is lighter in color and more compact, but similar in texture to the soil. Occasionally the subsoil is a silt loam to 20 or 24 inches, but usually becomes heavier at about 15 inches, below which it is a brownish-yellow to yellow compact silty clay to clay loam. Brown, gray, and red mottlings are found throughout the lower subsoil. When wet the subsoil is plastic, but when dry the silt content is sufficient to make it friable. The characteristic feature of the subsoil is the soapy feel, due to the soapstone in the formation from which the type is derived. Small mica flakes are also thickly interspersed throughout the subsoil. At a depth of 4 to 6 feet the Dekalb loam rests on a mass of broken shale and sandstone fragments, beneath which is the bed rock. Scattered over the surface and through both soil and subsoil are small shale and sandstone fragments, but these are never numerous enough to interfere with cultivation. In many parts of the type stones are almost entirely absent. The soil is not difficult to cultivate, and when properly handled there is no trouble from puddling or baking.

With the exception of a few small areas in the southwestern part of Tyler County, the Dekalb loam is confined to Marshall County, and is best developed in the northern half, where the ridges and hilltops are broader and the surface is not so badly eroded by streams. This type is found only on flattened hilltops and wide ridges, where the rate of weathering of the underlying rocks is more rapid than the erosion. On the steeper slopes erosion carries away the soil as rapidly as it is formed and thus exposes the subsoil and underlying rock fragments. Such areas were mapped as Meigs clay loam. These two types naturally merge into each other, no distinct dividing line being possible. The farmers have recognized the difference between them, and very often the fences separating the cultivated land from the pasture land are the dividing lines between the Dekalb loam and the Meigs clay loam. The topography of the Dekalb loam is such as to furnish ample drainage.

In this area the Dekalb loam is derived directly from the underlying shales and sandstones of the Dunkard formation of the Coal Measures. The fine-grained shales and sandy shales predominate, giving this type a heavy subsoil. The original timber growth consisted largely of red and white oak, hickory, poplar, maple, and beech. There was also some chestnut. Practically all of the type is cleared at present.

With the exception of Brooke clay loam, the Dekalb loam is the most productive upland soil in the area, and is well adapted to all of the

farm crops grown in this region. In order of importance, the crops are hay, corn, wheat, and oats. Hay yields 1 to 2 tons per acre, with an average of about $1\frac{1}{2}$ tons; corn from 30 to 60 bushels, with an average of 40 bushels; wheat 10 to 25 bushels, with an average of 12 to 15 bushels; and oats 20 to 40 bushels, with an average of 30 bushels per acre. Some potatoes, fruit, and vegetables are grown, mostly for home consumption.

The farmers well recognize the fact that to prevent erosion and to maintain the productive power of the soil it must be kept in grass as much as possible. The usual rotation is corn, wheat, and hay, the land remaining in meadow or pasture from three to six years. A field is thus in corn not more than one year out of five or six.

Some of the farmers have used commercial fertilizers to a slight extent, principally on the wheat, but they say that after once fertilizing a field more and more must be added each year to maintain the yields, and for this reason the use of commercial fertilizers has been practically abandoned. Stable manure is used in small quantities and gives excellent results. However, as only a few animals are kept on the farms the quantity of manure produced is very limited. A few farmers near the cities find it profitable to haul manure from the livery stables. It is important that all available manure be preserved and applied to the soil.

The northern end of the area, where the Dekalb loam is the prominent soil, is the most prosperous from an agricultural standpoint. The most desirable upland farms of the area are those which contain a large percentage of this type for the general farm crops and a sufficient area of Meigs clay loam for pasture.

The average results of mechanical analyses of fine-earth samples of the soil and subsoil of this type are given in the following table:

Mechanical analyses of Dekalb loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17675, 17677.....	Soil.....	0.2	2.4	1.3	3.0	8.9	65.6	17.9
17676, 17678.....	Subsoil.....	.9	3.0	1.9	5.6	11.6	45.9	30.7

DEKALB SILT LOAM.

The soil of the Dekalb silt loam is uniformly a light-brown mellow silt loam with an average depth of about 8 inches. The subsoil to a depth of 36 inches or more is either a very light brown or a pale-yellowish material, varying in texture from a silty loam to a silty clay loam. The soil is quite similar in texture to that of Meigs clay loam, but the subsoils of the two types are very different both in texture and color. Sometimes small fragments of sandstone and sandy

shale are found in the soil and subsoil and scattered upon the surface, but this is not a conspicuous characteristic of the type, and rock fragments are never numerous enough to interfere with plowing.

The Dekalb silt loam is not a widely distributed soil, being usually found only in small areas. In the present survey it generally occurs upon narrow ridges or in small shelflike positions 100 feet or so above the larger streams. It is a residual soil derived from the weathering of some of the heavier, massive sandstone strata of the Dunkard series, and the usual topography is nearly level to gently rolling and in a few places slightly hilly. It is a well-drained soil and absorbs moisture well. It is slightly droughty, however, in a dry season.

The original forest growth was chestnut and oak. At some time or other all of the type has been under cultivation. It is not considered an especially good soil for any particular crop, but when handled carefully and well manured it is a fair soil for all general farm crops of the region. Corn yields from 25 to 60 bushels per acre, oats from 20 to 50 bushels, wheat from 10 to 25 bushels, and potatoes from 50 to 150 bushels. Apples, cherries, plums, berries, and garden vegetables all do well, but are grown only for home use, the same being true for strawberries and raspberries. It is believed that the growing of strawberries, raspberries, early potatoes, and vegetables for market would prove profitable on this soil.

In the early days of the settlement of the region the Dekalb silt loam was not so rapidly taken up and cleared as the limestone soils to the north in Burke and Ohio counties or as the Dekalb loam nearer by. This was due largely to the general recognition of the fact that soil derived from sandstone is usually not as productive as that derived from limestone or marly or limy shale. Sheep raising never was popular upon this soil, for the reason that bluegrass does not thrive upon it.

The soil is slightly acid or "sour," and could be improved by applications of lime and manure and by the growing of clover. At present clover does not obtain a good stand and soon dies out. As the type is not of large extent it has no great influence upon the general agricultural conditions and value of farm lands in the area.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil:

Mechanical analyses of Dekalb silt loam.

Number.	Description.	Fine gravcl.	Coarse sand.	Me- dium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17136.....	Soil.....	0.1	1.1	1.5	10.7	9.5	62.6	14.3
17137.....	Subsoil.....	.1	1.1	1.5	12.9	12.2	52.3	19.7

WHEELING SILT LOAM.

The soil of the Wheeling silt loam to an average depth of 12 inches is a loose, mellow, brown or yellow-brown silt loam, often containing some fine sand. The subsoil from 12 to 36 inches varies from a silt loam to a clay loam, but is usually a brownish-yellow to yellow, compact silt loam. Below 24 inches it sometimes contains considerable fine sand, and in places becomes nearly a pure fine sand at 36 inches. A part, if not all, of the type is underlain by sand and gravel at varying depths below 3 feet.

The Wheeling silt loam is confined to the higher terraces along the Ohio River, the largest and most typical areas occurring on the second bottoms, usually on the same level or slightly lower than the Wheeling gravelly loam. In some localities there is no distinct terrace separating the Huntington loam from the Wheeling silt loam, and here the dividing line between these two types is indistinct. Narrow strips of the Wheeling silt loam are sometimes found between the Wheeling gravelly loam and the foot of the hills, and other areas are located on a still higher or third terrace, as at Steelton, 3 miles north of New Martinsville. Wherever the soil occurs as a high terrace bordering the foot of the valley hills it is usually considerably eroded by the small streams and drainage from the bordering hills, its characteristic level topography is lost, and it becomes gently rolling and in places irregular in surface. Where this is the case the soil is lighter in color and is slightly more sandy than the average of the type. On account of elevation above the river it is not overflowed, and its position, together with the gravelly and sandy substratum, gives fairly good drainage. However, near the base of the hills, where the drainage water collects, there are narrow areas so low and wet as to be entirely unfit for cultivation. If drained, these areas would be as productive as the rest of the type.

The Wheeling silt loam is an alluvial deposit of the Ohio River, being laid down after the glacial gravel was carried in, but at a much earlier date than the deposition of the Huntington loam, and at a time when the waters of the Ohio River were at a higher level than at present. Since then the soil has become weathered and has lost the characteristics of a first or overflowed bottom.

The Wheeling silt loam has all been cleared and is under cultivation. It is one of the most productive soils in the area, being well adapted to potatoes, corn, wheat, and hay. Oats are produced to a slight extent. Potatoes yield from 150 to 225 bushels per acre, with an average of 175 bushels; wheat 15 to 25 bushels, with an average of 18 bushels; corn 50 to 80 bushels, with an average of 65 bushels, and hay 1 to 2 tons per acre. One of the rotations practiced by the farmers on this soil, and one which is to be highly recommended, is as follows: Corn or potatoes, wheat, clover, and timothy. The first year the hay is mostly clover;

in succeeding years it is mostly timothy. The land is left in grass three years or more, which practice has proved beneficial. Stable manures give excellent results, but commercial fertilizers are not used. The farmers living on the bottom lands of the Ohio River are prosperous and well to do. Their farms, containing some hill land, sell for \$80 to \$100 an acre. The bottom land alone could not be bought for less than \$150 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Wheeling silt loam:

Mechanical analyses of Wheeling silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17142, 17695	Soil	0.2	1.0	0.6	5.3	8.1	69.3	14.8
17143, 17696	Subsoil . . . . .	.0	.1	.3	7.7	13.4	59.1	19.1

WHEELING GRAVELLY LOAM.

The soil of the Wheeling gravelly loam has an average depth of about 8 inches and consists of a brown loam usually containing considerable fine gravel and coarse sand. Local variations occur in which the soil contains considerably more than the average quantity of silt, or where the sand content is rather high, in such places the interstitial material ranging from a silty loam to a heavy sandy loam. The subsoil to a depth of several feet is a light-brown or yellowish gravelly loam. The gravel particles vary in size from one-fourth of an inch to 4 inches in diameter and consist largely of waterworn shale and rounded fragments of the harder rocks. Occasionally these shale and rock fragments are strewn over the surface, but never to a sufficient extent to interfere with cultivation. On the whole, the type is a loose, porous soil, easily handled, and never too steep for tilling.

The Wheeling gravelly loam is confined to the terraces of the Ohio River and occurs usually as long, narrow strips whose elevation above the low water of the river ranges from 40 to 80 feet. Its topography varies from nearly level to rolling and hilly. The loose, open nature of the subsoil insures good natural drainage, which over the hilly portion of the type is rather excessive. This type consists of reworked material brought from the glacial region to the north when the volume of the river was greater than now. The sand, gravel, and stones found beneath the surface represent approximately the character of the original deposits. The surface soil, however, has been more or less modified by weathering of the gravel and by an accumulation of organic matter since deposition,

thus making it a fairly good soil for general agriculture and trucking. It was originally covered with hardwood common to the region, but none of this forest is now standing. It was one of the soils first cleared in the early days, because it offered fine sites for buildings.

The Wheeling gravelly loam is better adapted to corn than any other general farm crop, the yields averaging about 45 bushels per acre. The yield of wheat ranges from 10 to 25 bushels, with an average of about 15 bushels, and of hay usually not more than 1 ton per acre. All general farm crops do better in a fairly wet season than in a dry season, as this soil is somewhat inclined to be droughty because of the loose, open, gravelly nature of the subsoil.

The soil is used to a limited extent for early truck crops, and judging from observation in this as well as in the Wheeling area it is evident that trucking on a more extensive scale would prove successful, especially as the large markets along the river are so near. Irish potatoes do especially well and yield on an average about 125 bushels per acre. Apples would no doubt do well, as would also plums, cherries, and pears. The soil needs careful attention in order to maintain its productivity. Barnyard manure is the only fertilizer used, and where applied in sufficient quantities the results are all that could be desired.

The Wheeling gravelly loam is not an extensive type, but its convenient location with respect to markets and its adaptation to truck, small fruits, and berries gives it some importance. Owing to its location along the river and the possibility of its future demand for factory sites, this type is held at figures usually beyond the reach of small farmers.

The results of mechanical analyses of fine-earth samples of the soil and subsoil of the Wheeling gravelly loam are given in the following table:

Mechanical analyses of Wheeling gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17689.....	Soil.....	8.5	15.3	13.6	9.0	3.0	35.7	14.0
17690.....	Subsoil.....	10.4	24.2	20.9	9.9	4.0	18.2	12.8

WHEELING SANDY LOAM.

The Wheeling sandy loam consists of about 10 inches of light-brown sandy loam of fine to medium texture, underlain by a yellowish or lighter brown, rather incoherent sandy loam or sand to a depth of 30 inches, below which it often becomes a sticky sandy

loam. Owing to its loose loamy nature it possesses good natural drainage and is an easy soil to till.

The Wheeling sandy loam occurs as a terrace of the Ohio River, and is found in areas sufficiently large to be shown upon the map in only two localities—around Moundsville and west of Graysville. As the type is largely covered by the city there is no need of discussing it from an agricultural standpoint. A full discussion of the origin of the type and its especial adaptation as an apple soil may be found in the Report of the Soil Survey of the Wheeling area, West Virginia.

The results of mechanical analyses of samples of the soil and subsoil of this type are given in the following table:

Mechanical analyses of Wheeling sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17693.....	Soil.....	0.5	2.1	6.5	41.0	9.2	35.1	6.2
17694.....	Subsoil.....	.0	.4	3.6	42.7	10.9	34.5	7.6

TYLER SILT LOAM.

The Tyler silt loam is a variable type, the different phases being mapped together on account of the small extent of each. The soil to a depth of 10 inches consists of a dark-gray or brown mellow silt loam, underlain to 15 inches by a lighter gray or yellow silt loam. From 15 to 36 inches the subsoil varies from yellow or yellow-brown compact clay loam to a heavy plastic clay. In some places the subsoil is a yellowish sticky sandy clay, while in others, as along Middle Island Creek, it is a heavy silt loam, and below 24 inches contains considerable fine sand. The subsoil is often mottled gray and brown, has a soapy feel, and contains numerous small mica flakes. Part, if not all, of the type is underlain by rounded and flattened sandstone gravel, which is also scattered over the surface in a few places. Beneath the gravel is the bed rock upon which the soil was deposited by the stream. In a few places where erosion has carried away the soil the rock is exposed at the surface.

The Tyler silt loam is confined to the second bottoms along the larger tributary streams of the Ohio River, the largest areas being found along Middle Island Creek. These terraces are from 20 to 100 feet above the level of the stream and are never overflowed.

The areas of Tyler silt loam, at one time level, have been more or less dissected by streams and gullies caused by the drainage water from the slopes. Seepage and drainage water collects on the greater part of the areas, and the drainage conditions are very poor. This gives the soil the local name "crawfish land."

The Tyler silt loam is of alluvial origin, being deposited by the streams when their waters were at a higher level than at present. Some of the type near the base of the hills may be partly colluvial in origin.

The original tree growth, principally beech, has all been removed. When cultivated, about 35 bushels of corn, 25 bushels of oats, and from 1 to 1½ tons of hay per acre are produced on this soil. It is not well adapted to wheat. On account of the lack of drainage nearly all of the type is in meadow or pasture. Thorough underdrainage and liberal applications of stable manure would greatly increase the yields of all crops.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of the Tyler silt loam:

Mechanical analyses of Tyler silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17138, 17687.....	Soil.....	0.2	1.5	1.2	6.5	7.0	66.6	16.4
17139, 17688.....	Subsoil.....	.1	.8	1.0	6.9	10.5	54.8	25.2

HUNTINGTON LOAM.

The Huntington loam to an average depth of about 12 inches consists of a brown or dark-brown loam, underlain to a depth of 30 inches or more by a lighter colored, somewhat heavier loam. Throughout both soil and subsoil there is considerable very fine sand. There is much variation in the soil, often within short distances. Where the drainage conditions are poor the subsoil is apt to be drab-colored. Very often there is no distinct line of demarcation in color between soil and subsoil, the gradation from dark brown at the surface to light brown or yellowish at 30 inches being imperceptible. Usually there are numerous very fine mica flakes in both soil and subsoil. The soil is mellow and easily worked when dry.

The Huntington loam occurs as first bottoms along the Ohio River and its larger tributaries. Its usual topography is flat, with a slight fall toward the stream, and it is never cut or eroded. It is subject to several overflows each year, especially during the spring months, but after planting and during the growing season there is little danger of damage from floods. Both surface and underground drainage are fairly good. Only a few depressions are seen where artificial drainage would be beneficial.

As found along the Ohio River, the Huntington loam consists of a mantle of recent alluvial material spread over the gravel deposits of

the Glacial period. In places the wash from the adjoining hills contributes to its formation, and in general this soil is still in the process of upbuilding, as each overflow deposits a thin layer of loam and organic matter washed from the uplands. As found along the larger tributary streams, it also consists of a deposit of recent alluvial material washed from the hills, but instead of resting upon a deposit of gravel, as along the river, it usually rests upon bed rock.

None of the original hardwood timber is now standing. In the early days the type was in great demand as a general farming soil, being regarded then, as now, as an especially strong soil for corn. The present yield of corn ranges from 50 to 100 bushels, with an average of about 60 or 70 bushels per acre. It is also very well adapted to potatoes, the yield ranging from 75 to 150 bushels per acre. Hay yields from 1 to 2 tons per acre, and this is considered a very desirable soil for this crop as well as for pasture. Sometimes the yield of wheat is fair, but the type is not well adapted to that crop. In favorable seasons it is a productive soil for almost any crop, and because of the frequent overflows it does not need any fertilizer. Nearly all of the type is cleared and under cultivation, but there are a few trees still growing upon it, these being, in the order of their importance, sycamore, beech, elm, walnut, willow, and tulip. It would be an excellent soil for truck were it not subject to overflow.

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

Mechanical analyses of Huntington loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17681.....	Soil.....	0.0	0.3	0.4	7.9	13.9	54.1	22.7
17682.....	Subsoil.....	.0	.5	.7	4.7	16.2	52.9	24.3

HUNTINGTON FINE SANDY LOAM.

The soil of the Huntington fine sandy loam to an average depth of about 12 inches is a fine sandy loam varying in color from light brown to dark brown and in small areas to nearly black. The subsoil to a depth of 36 inches or more is about the same in texture as the soil, but is lighter colored, although in places it seems to contain nearly as much organic matter as the soil. The organic matter in both soil and subsoil is accounted for by the fact that small fragments of limbs, bark, leaves, and other débris in the flood waters of the Ohio River were deposited with the fine sand.

The soil is easy to plow and cultivate, being mellow and having little tendency to pack or bake. The elevation of the type above low

water in the river is usually less than 30 feet, and consequently a large proportion of it is under water every spring and sometimes later in the year. In the present area the type is found principally upon the small islands of the Ohio River, but it occurs also as long, narrow strips bordering the banks of the river. In these latter locations the type is somewhat higher lying than the area back of it, forming a natural levee. The soil is alluvial in origin and is still in the process of formation.

None of the hardwood timber which originally covered this soil is now standing. Where the soil is accessible and occurs in large areas it is in great demand for the production of corn and truck crops, though in the present area practically none of it is used for extensive trucking. Corn yields on an average about 45 or 50 bushels per acre. Usually wheat is not a safe crop, because of the liability of its being drowned out. Oats do well some years, but are liable to rust. Hay yields on an average from three-fourths ton to 1 ton per acre. It is an excellent soil for Irish potatoes, as was shown farther up the river in the Wheeling area. Cabbage yields about 300 barrels per acre. Besides the above-mentioned crops, asparagus, tomatoes, onions, radishes, and lettuce may also be produced with profit.

Because of its limited extent and its principal occurrence upon rather inaccessible islands in the river, the type has no great influence upon the general agricultural conditions and values of land in the present area. It is of importance, however, because of its especial adaptation to truck crops, its nearness to market, and its apparent inexhaustible productivity, renewed with each overflow of the river. It might be well to adopt some system of intensive trucking upon the islands and arrange for the transportation of the products to the near-by markets by water.

The following table gives the results of mechanical analyses of the soil and subsoil of the Huntington fine sandy loam:

Mechanical analyses of Huntington fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Me- dium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17685.....	Soil.....	0.0	1.4	8.4	39.6	12.0	30.9	7.6
17686.....	Subsoil.....	.0	.5	6.9	37.4	9.9	35.1	10.4

MEIGS CLAY LOAM.

The soil of Meigs clay loam is rather variable because of its steep location and the influences of the underlying outcropping formations of soft sandy shale and brittle red clayey shales. The soil, however, is usually a silty loam ranging in color from brown to yellowish, with

an average depth of about 8 inches. The subsoil is likewise rather variable in texture, but usually it is a silt loam or loam to a depth of 18 inches and the color is lighter than that of the soil. From 18 to 36 inches it is usually a clay loam or clay varying in color from yellowish to reddish. The red color is always due to the presence of the soft red shales which often outcrop along the steep slopes, and wherever these are present the subsoil has a soapy feel when rubbed between the fingers. Another characteristic of the subsoil is that it nearly always contains some coarse sand. Very often the subsoil rests upon shale and disintegrated rock fragments at a depth varying from 20 inches to 4 feet, their nearness to the surface depending upon the steepness of the slope and the amount of erosion which has taken place. Scattered throughout both soil and subsoil and strewn upon the surface are usually many small soft sandstone and shale fragments, though these, as a rule, are not present in sufficient amounts to interfere with cultivation.

This is one of the most widely distributed types of soil encountered, and is well developed in all parts of the area except in Wetzel County. It is derived from the red shales and soft sandstones and sandy shales of the Dunkard series, and the rate of erosion is approximately equal to that of the weathering. The soil carries a relatively large proportion of loose, incoherent, micaceous sandy material, the product of a partial weathering of the micaceous sandstone fragments below.

The most constant—and, in fact, the only constant—characteristics of this type are its steep, broken topography and content of shale and sandstone fragments, and therefore it really represents more a condition than a type of soil. Except in areas where there is no better farming land, it is not cultivated very extensively, being better adapted to pasture than to cultivated crops. Where cultivated it requires much care to prevent erosion, and even with terracing and contour cultivation the fields are often damaged. On the whole, it is believed that this soil should be kept in permanent pasture or mowing lands, as continued cultivation has in many cases rendered the land worthless even for pasture.

In the northern and northwestern parts of the area the Meigs clay loam occupies the slopes intermediate between the rounded hilltops of Dekalb loam and the slopes at the bottom of the gorges or valleys. In the vicinity of Cameron and St. Joseph, where this is the prevailing type, it occupies the long, steep hillsides and the narrow ridges. Drainage is excessive over most of this type, and as the derivative rocks are usually only 2 to 4 feet from the surface the land is droughty. The bed rock is arranged horizontally, so there is little downward percolation and seepage areas are frequent.

The soil is not adapted to the production of a wide range of crops, although general farm crops are grown on it to a considerable extent in

areas where it is the predominating or the better soil. Hay usually does quite well, as it is not much affected by drought. The fine-earth material seems to be quite productive. It is claimed that with proper attention this soil can be made to give a good bluegrass sod. A few very good bluegrass pastures were seen, and these were obtained by seeding to Kentucky bluegrass and allowing the grass to grow for two, or possibly three, years without interruption. On some portions of the type orchards and vineyards would probably do well.

It is believed that this soil should never be planted to any cultivated crop like corn. Its greatest value lies in its use as permanent pasture. It is recommended that orcharding and grape growing be given a careful trial. The prevalence of the locust suggests that this tree might be grown for ties, poles, and posts.

BROOKE CLAY LOAM.

The soil of the Brooke clay loam is a brown or dark-brown heavy loam or clay loam with an average depth of about 8 inches. The subsoil, to a depth of about 20 inches, is yellowish in color and a little heavier than the soil. Below this to a depth of 3 feet or more the texture remains a heavy clay, but the color often grades gradually from yellowish to drab. Small fragments of gray or bluish-colored limestone and limy shale are often scattered over the surface and through both soil and subsoil.

This type occurs only in a few small patches in the northern part of Marshall County. In Brooke and Ohio counties to the north, as shown in the report on the Wheeling area, this soil is very important not only in extent, but because of its production of profitable farm crops. The limestone formation from which it is largely derived, however, dips along Wheeling Creek, and for that reason very little of the type was met with in the Middlebourne area.

For a fuller description of the type and its especial adaptation see the report on the Wheeling area.

UPSHUR CLAY.

The Upshur clay usually consists of 7 inches of reddish-brown or red clay loam or red clay, underlain to a depth of 36 inches or more by a heavy, tenacious, impervious red clay. There are sometimes small patches in the fields, however, which consist of about 3 inches of gray silt loam, underlain to about 7 inches by a reddish-brown heavy silty clay loam, and below this the usual subsoil.

The type is a very difficult one to till because of its stiff, tenacious character, and is spoken of locally as "cold, wet, late land." In dry weather it has a tendency to bake and is difficult to handle, except in case of the more loamy spots described above, which remain mellow and retain moisture well. In wet weather it forms a deep, sticky

mud in the roads, and in dry weather these roads are very hard and rough until packed and worn down by travel or smoothed over with a road machine.

The Upshur clay is found principally in small, unimportant areas in the southern part of the survey. It usually occupies the tops and slopes of small hills and narrow ridges and sometimes occurs as a band extending around the hill, the rocks from which it is derived apparently extending through the hill horizontally.

The surface is generally steep and hilly, but occasionally it is more level, and in such locations the soil is more loamy and better adapted to general farm crops. The soil has a tendency to wash and gully badly, which is due in part to the impervious nature of the subsoil, which prevents it from absorbing rain water readily.

The Upshur clay is a residual type derived from the soft, marly red shales of the Dunkard series. The red color of the soil is not due to recent oxidation, but to the red color of the original sediment forming the Dunkard shales. There are often nodules of limestone and iron ore included in this formation.

The native vegetation consisted of hardwoods, principally oak, hickory, beech, and maple. Practically all of the soil has been cleared of this original growth, but a great deal of it has been abandoned and allowed to gully and to grow up to brush and briars. Much of it is used for pasture with satisfactory results. When carefully handled it is a fair soil for corn and wheat, but too heavy for potatoes, truck, or fruit. Wheat yields from 10 to 20 bushels per acre and corn from 20 to 50 bushels, but the yield of oats is low.

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

Mechanical analyses of Upshur clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		P. ct.	P. ct.	P. ct.	P. ct.	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
17140.....	Soil.....	0.0	0.2	0.4	1.6	1.5	74.7	21.3
17141.....	Subsoil.....	.0	.1	.2	1.1	1.5	50.2	46.2

ROUGH STONY LAND.

In Marshall County the areas of Rough stony land are especially well developed on the hills bordering the Ohio Valley, but in Wetzel and Tyler counties land of this character is of wider distribution and not confined to the river hills.

The surface soil is rather variable, the differences depending upon the steepness of the slope and the character of the sandstone or shale immediately underlying. Usually the surface few inches consists of a

light-brown silt loam or loam containing varying quantities of shale and sandstone fragments. Very often the surface soil rests directly upon fragments of the underlying sandstone or upon the soft marly shale, but usually the underlying formations are farther below the surface, and to a depth of a foot or two there is a loam or a clay loam material intimately mixed with sandstone fragments. In favored places along the slopes there are often small patches of a deeper soil and subsoil.

The Rough stony land is derived from the same formations as Meigs clay loam, and hence the fine-earth material is quite similar. The chief difference is that this type has more unweathered shale and sandstone fragments in it and a steeper and more broken topography, being in the main too steep and stony for profitable general agriculture, though considerable of it is cleared and farmed, especially in localities where there is no better land. Throughout the type there are small areas protected from erosion which have a good soil and can be farmed with reasonable profit, notwithstanding the fact that they are isolated by steep rocky slopes and difficulty is had in removing the crop from the fields. Landslides are very common in the Rough stony land areas, sometimes starting at the top of the hill and stripping everything to bed rock to the bottom of the hill. More often, however, the slides move a few feet or a few rods at most. These naturally produce a rough, uneven slope, with many exposed bare spots, which are often too steep even for a stand of grass.

Rough stony land represents a condition where the rate of erosion is equal to or greater than the rate of weathering, the result of which is that the more resistant sandstone strata often form a succession of conspicuous terraces around the steep slopes. The hard horizontal layers of rock form the steeper parts of the terrace, while the soft sandy shale and marly red shales weather more rapidly and form the more level parts. Narrow level strips along the terraces are often cultivated and the crop yields are moderate. Very fair yields of corn are sometimes obtained upon the steeper slopes for the first year, but they usually are so badly washed and eroded in the second year as to be valueless. By cultivating a narrow strip following the contour of the hill and leaving a narrow strip of sod land above and below, the farmers are often able to grow crops upon a considerable portion of steep, hilly land which it would at first appear to be impossible to cultivate. Most of the type, however, has been left in timber and in many places the timber line represents the boundary between this and other soils.

The Rough stony land is located along the bluffs of the river and along the lower slopes of the narrow V-shaped valleys of the larger streams. The drainage basin of Fishing Creek is practically all occupied by this type. Along the outer bends of the larger streams are

almost vertical bluffs, showing, however, no prominent ledges, except along Fishing Creek, where the massive sandstone outcrops.

Rough stony land, like the Meigs clay loam, is derived from the Dunkard formation, which consists of alternating and comparatively thin beds of sandstone and shales.

SUMMARY.

The Middlebourne area is located in the northwestern part of West Virginia and includes Wetzel, Tyler, and Marshall counties. In a north and south direction the area is about 45 miles long and from east to west from 12 to 32 miles wide. The entire western boundary is formed by the Ohio River.

The topography is irregular, having the appearance of a mountainous country in miniature. The most conspicuous topographic feature is the narrow, gorgelike valley of the Ohio River in the western part, where the hills often rise to 400 feet in height.

The drainage throughout the area is good, and is principally toward the Ohio River. In many places the surface is quite deeply cut, and erosion has been active.

Several branches of the Baltimore and Ohio Railroad afford excellent transportation facilities, and in addition considerable traffic is carried on by way of the Ohio River. Moundsville, New Martinsville, Sistersville, and McMechen, all located on the banks of the Ohio River, are the principal towns.

The climate is mild, neither the winter cold nor the summer heat being extreme. The average length of the growing season is six and one-half to seven months.

About 60 per cent of the total population are farmers, the remaining 40 per cent being engaged in the various industries, chief among which are the oil and gas industries. The farmers are well to do, but on account of the sale of oil and gas rights are not obliged to work their farms on an extensive scale.

Twelve types of soil were recognized, including the Dekalb, Wheeling; and Huntington series, and several minor types.

The Dekalb loam is found principally in the northern half of Marshall County, and is the most important upland soil. It is principally devoted to sheep grazing, but is well suited to orcharding, truck crops, and dairying.

The Dekalb silt loam, although not suited to general farm crops, is an important fruit and truck soil. It is not extensively developed in the survey.

The Wheeling silt loam is one of the most productive soils of the area, and is nearly all cleared and under cultivation. It is well adapted to potatoes, corn, wheat, and hay. Oats are produced to a small extent.

Potatoes yield from 150 to 225 bushels, wheat 15 to 25 bushels, corn 50 to 80 bushels, and hay 1 to 2 tons per acre. Farms consisting of this soil type with some hill land sell for \$80 to \$100 an acre, but those consisting entirely of this soil can not be bought for less than \$150 an acre.

The Wheeling gravelly loam is better adapted to corn than to the general farm crops, the yields averaging about 45 bushels per acre. The yield of wheat ranges from 10 to 25 bushels, while hay yields not more than 1 ton per acre. This soil is well suited to truck, apples, pears, plums, and cherries.

The Tyler silt loam is confined to the second bottoms along the tributary streams of the Ohio River, and is alluvial in origin. When cultivated it yields about 35 bushels of corn, 25 bushels of oats, and from 1 to 1½ tons of hay to the acre. It is not well suited to wheat. On account of lack of drainage it is mostly in pasture. Thorough under-drainage and liberal applications of stable manure would greatly increase the yields of all crops.

The Huntington loam is an especially strong soil for corn, where it lies along the river and larger creeks. On the terraces just above the overflow lands it is well suited to truck crops and fruit, as well as the general farm crops. Corn yields from 50 to 100 bushels, potatoes from 75 to 150 bushels, and hay from 1 to 2 tons per acre.

The Huntington fine sandy loam occupies small islands in the Ohio River or occurs as narrow strips along the river banks. It is particularly well suited to corn and truck crops, although it is seldom found in very large tracts. Corn yields on an average 45 to 50 bushels per acre and hay from three-fourths to 1 ton. Wheat is not safe on this soil, as it is liable to be drowned out. Oats do well some years, but are liable to rust. The type gives good yields of Irish potatoes and cabbage, as well as asparagus, tomatoes, onions, radishes, and lettuce.

Meigs clay loam in point of productivity is a very desirable type for all farm crops. On account of its liability to wash if cultivated it should either be kept in sod or apple orchards should be planted. The growing of locust posts would prove profitable.

The Brooke clay loam is a very valuable soil for general farming, but its area is limited. The Upshur clay occurs in small patches, and is best suited for pasture. When carefully handled it is a fair soil for corn and wheat, but too heavy for potatoes, truck, or fruit. Rough stony land has little agricultural value and should be kept in forest. The growing of locust trees for posts should prove profitable upon this land.

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