

**UNITED STATES DEPARTMENT OF AGRICULTURE**

**Soil Survey**  
of  
**Wyoming County, Pennsylvania**

By

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In cooperation with the  
**Pennsylvania State College School of Agriculture**  
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# SOIL SURVEY OF WYOMING COUNTY, PENNSYLVANIA

By B. H. HENDRICKSON, in Charge, and R. T. AVON BURKE, United States Department of Agriculture, and K. V. GOODMAN and R. L. SMITH, Pennsylvania State College

## COUNTY SURVEYED

Wyoming County is in the northeastern part of Pennsylvania (fig. 1). Tunkhannock, the county seat, situated near the center of the county, is 21 miles north of Wilkes-Barre and 18 miles northwest of Scranton. The area of the county is 407 square miles, or 260,480 acres.

Wyoming County is hilly and mountainous. The more mountainous section, comprising more than one-third of the total area, lies in the southwestern part. Two large mountain areas, known as Dutch Mountain and North Mountain, are in the southwestern part, and outlying high mountains are Miller Mountain and Osterhout Mountain, which lie south and east, respectively, of Tunkhannock. Russell Hill, north of Vosburg, and several other high ridges, locally termed mountains, occur in other parts. In the northern and eastern parts are large areas of lower hills, on which most of the farms are located. The county is bisected by Susquehanna River, which flows southeastward in a deep narrow valley (pl. 1, A). Other important streams are Tunkhannock Creek, Bowman Creek, and Mehoopany Creek, all of which are comparatively swift flowing.

The relief of the county in general is that of a deeply dissected plateau, the tops of the higher mountains in the southwestern part being somewhat flat. They are remnants of the original peneplain. The mountain sides are long steep slopes. In many places, there is as much as 1,000 feet difference in elevation between the mountain tops and the stream valleys. Some of the other mountains show as great local differences in relief, but in most places the abrupt slopes range from 300 to 600 feet in height, terminating in rolling country of the adjoining lower hills.

Most of the lower hills are gently rounded and do not show plateau characteristics, but in places they also break off abruptly in sharp valley walls ranging from 200 to 400 feet in height. Bordering the channel of Susquehanna River, on the outside of several of the bends are precipitous rock cliffs from 300 to 400 feet high, caused by undercutting currents of the river. Nearly all the valleys are V-shaped and have narrow bottoms. The drainage system is of a dendritic pattern, dissection is thorough, and the valleys are narrow. Parts of the valleys of the larger streams are flanked with terraces, or bench lands, and low rolling hills of glacial outwash and morainic materials.

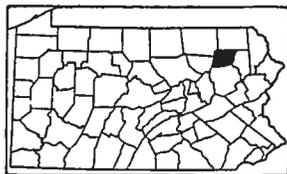


FIGURE 1—Sketch map showing location of Wyoming County, Pa.

There are two large natural lakes—Lake Carey and Lake Winola—in the county, in addition to several smaller ones, and a chain of lakes near Jenningsville in the northwestern part.

In general, the southwestern part of the county is higher, rougher, and more inaccessible than the remainder which is largely rolling or hilly land, with a few detached high hills and mountains.

The elevation of the high plateau in the southwestern part of the county ranges from 2,200 to 2,400 feet. Miller Mountain is 2,227 feet above sea level (4).<sup>1</sup> Susquehanna River leaves the county at a low-water elevation of approximately 560 feet, the lowest elevation in the county. Thus, it may be seen, the range in elevation within the county is about 1,800 feet. Most of the valley lands have an elevation ranging from 600 to 1,000 feet and the hill lands under cultivation range from 1,000 to 2,000 feet above sea level. Plate 1, *B*, is a typical view of the rolling farm lands with their high mountain background.

Extensive areas of forest and forest land are in Wyoming County, approximately 70 percent of the land being wooded and primarily suited for timber production rather than for ordinary farm-crop production. This land is now sustaining a vigorous second growth of mixed forest trees, practically all the virgin timber having been logged for merchantable lumber and tanbark. Lumbering still continues on a much reduced scale. Two tanneries are in the county, and a few portable sawmills supply local demands for lumber. Small quantities of mine props are cut for use in the nearby coal-mining districts. A few sugar-maple trees produce a small supply of sugar and sirup.

The present forest growth<sup>2</sup> consists of 85 or 90 percent of broad-leaved trees and 10 or 15 percent of conifers. The dominant broad-leaved species are chestnut oak, red oak, white oak, hard maple, and soft maple. Other common deciduous trees are basswood, yellow birch, black birch, cottonwood, sycamore, elm, aspen, and hickory. The conifers include white pine, pitch pine, and hemlock.

The forested areas of the deeper better drained upland soils, as the Westfield and Walton soils, including most of the extensive areas of rough mountainous land, are producing mixed stands of hemlock and chestnut oak, with varying quantities of red maple, red oak, white oak, and black birch.

Wooded upland areas of Canfield, Wellsboro, and Volusia soils, not so well drained, in general support a mixed growth of the beech-birch-maple association or some variation of it, as beech, ash, soft maple, black birch, and poplar, although in places white pine and hemlock make up nearly the entire stand on these soils.

The shallower droughtier upland soils, as those of the Lehew, Lectonia, and Lordstown series, and the higher mountain ridges generally, in wooded areas produce mainly aspen, yellow birch, black birch, soft maple, and hemlock, with scrubby chestnut oak and red oak.

On the well-drained bottoms, as on soils of the Tioga and Barbour series, sycamore, hard maple, and hemlock flourish; and on poorly

<sup>1</sup> Italic numbers in parentheses refer to Literature Cited, p 35

<sup>2</sup> Authority T A Liefeld, research assistant in forestry, Pennsylvania State College of Agriculture. Basis Growth data collected on 50 scattered plots in Wyoming County in the summer of 1929.

drained bottoms and other wet soils, willow, river birch, black ash, yellow birch, and some hemlock are the principal trees. Burned-over areas of upland timberland grow up to fire cherry, poplar, and yellow birch, with a few hemlocks, and these are followed by oak and maple.

Wyoming County was organized from a part of Luzerne County in 1842. The early settlers were of English, Irish, and Dutch descent, who came from the Eastern States, moved up the valley of Susquehanna River, settled in the valleys, and began clearing land for agriculture. Sawmills, gristmills, and tanneries soon became established.

The present population is largely composed of descendants of the early settlers, together with Italian, Lithuanian, and Polish farmers who have entered the county in increasing numbers in the last few years.

The population of the county, according to the 1930 census,<sup>3</sup> is 15,517, all of which are classed as rural. Of the rural population, 6,464 are classed as rural farm, and 9,053 as rural nonfarm. Ninety-six percent of the population is native white, and the density of the population is 39.1 persons a square mile. Tunkhannock, the county seat, has 1,973 inhabitants and is the principal town. Smaller towns are Nicholson, Factoryville, Meshoppen, Laceyville, Mehoopany, Mill City, Beaumont, Center Moreland, Noxen, and Forkston. The summer population of cottagers at Lake Carey and Lake Winola, in addition to summer residents who live similarly along the lower part of Susquehanna River within the county, is reported to number 2,000 people. These summer residents cause a large demand for local farm produce. The farming population is well distributed throughout the eastern half of the county, but the western half is more sparsely settled, and the southwestern highlands are unbroken woodland, with the exception of small settlements along the principal valleys.

Wyoming County is served by the main line of the Lehigh Valley Railroad, with its Montrose branch, and by the main line of the Delaware, Lackawanna & Western Railroad. United States Highway No. 6, a concrete highway, crosses the county from northwest to southeast through Tunkhannock. This is a much traveled through route from New York City and Scranton to the west. At Osterhout, a connecting highway, United States Highway No. 309, of concrete construction leads to Wilkes-Barre. United States Highway No. 11 (the Lackawanna Trail), another concrete highway, passes through Factoryville and Nicholson in the extreme eastern part of the county, providing ready access to Binghamton, N.Y., to the north, and to Scranton, to the southeast. A concrete State highway leads from Tunkhannock northward to Montrose, thence to Binghamton. The county is thus well supplied with all-weather highways for transportation in three directions and to its important markets. The rural districts are well supplied with graded dirt roads, many of which are very hilly and stony but are maintained in fair condition. Telephones, schools, and churches are numerous in the farming districts. Several portable sawmills are in the county; tanneries are in operation at Noxen and Tunkhannock; and a small woolen mill and an iron works are at Tunkhannock.

<sup>3</sup> Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given when possible.

## CLIMATE

The climate of Wyoming County is that of the cool, temperate, humid zone. According to Weather Bureau data collected at Scranton, Lackawanna County, which should be representative of climatic conditions in the valleys of Wyoming County, the mean annual precipitation is 37.05 inches. In most years the rainfall is fairly well distributed throughout the year, the summer months receiving the maximum, when the average is 11.65 inches.

The mean annual temperature at Scranton is 49.4° F. The maximum difference in elevation of the farms, about 1,400 feet, is said to cause a difference of about 2 weeks in the length of the growing season, the lower lying valley lands having the longer seasons. At Scranton, the average date of the last killing frost is April 19, and of the first is October 13, giving an average frost-free period of 177 days, or approximately a 6-month growing season for tender vegetation. Killing frost has been recorded at this station as late as May 10 and as early as September 14.

Long summer droughts are not common. Cloudy and showery weather, which prevails during the spring and fall, favors pasture and hay land, and makes the climate suitable for such crops as oats and potatoes.

Table 1, compiled from records of the United States Weather Bureau, gives the normal monthly, seasonal, and annual temperature and precipitation at Scranton, Lackawanna County, Pa.

TABLE 1—Normal monthly, seasonal, and annual temperature and precipitation at Scranton, Lackawanna County, Pa

[Elevation, 805 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1900)	Total amount for the wettest year (1927)	Snow, average depth
	° F	° F.	° F	Inches	Inches	Inches	Inches
December.....	30 7	69	-13	2 61	2 61	3 64	12 8
January.....	26 6	68	-15	2 80	2 13	2 14	10 6
February.....	27 3	64	-10	2 72	2 75	2 55	11 0
Winter.....	28 2	69	-15	8 13	7 49	8 33	34 4
March.....	35 7	82	-1	3 12	2 98	1 99	10 4
April.....	48 1	88	19	2 05	1 81	2 35	2 5
May.....	59 4	93	27	3 44	2 81	4 47	0
Spring.....	47 7	93	-1	9 21	7 60	8 81	12 9
June.....	67 8	99	39	3 57	3 54	4 07	0
July.....	71 7	99	44	3 83	4 63	4 48	0
August.....	69 8	102	43	4 25	1 27	4 77	0
Summer.....	69 8	102	39	11 65	9 44	13 32	0
September.....	62 9	93	31	2 86	1 72	1 45	0
October.....	51 8	90	23	2 91	2 66	9 16	( <sup>1</sup> )
November.....	40 5	77	12	2 29	2 37	4 26	4 6
Fall.....	51 7	93	12	8 06	6 75	14.87	4 6
Year.....	49 4	102	-15	37 05	31 28	45 33	51 9

<sup>1</sup> Trace.

## AGRICULTURAL HISTORY AND STATISTICS

The early agriculture of Wyoming County was concerned chiefly with the production of subsistence crops and domestic animals. Hay, corn, oats, wheat, rye, barley, potatoes, and fruits were the principal crops. The agricultural census of 1880 reports hay as the leading crop in 1879, when it was grown on 18,618 acres; and oats, buckwheat, and corn ranked next in importance, being grown on 9,951, 9,275, and 8,346 acres, respectively. Rye and wheat followed next in order of acreage planted, on 5,228 and 5,019 acres, respectively. Potatoes were grown on 2,604 acres.

Succeeding census reports, by decades, indicate that hay became increasingly important, and oats and buckwheat became the favored small grains.

The 1930 census reports hay grown on 21,827 acres in 1929, oats on 4,574 acres, corn for silage on 4,633 acres, buckwheat on 2,127 acres, potatoes on 1,262 acres, corn for grain on 1,033 acres, rye on 366 acres, wheat on 416 acres, and vegetables for sale on 511 acres. The orchards are reported to contain 129,108 apple trees, 25,087 peach trees, 5,734 pear trees, 11,005 plum trees, and 9,839 grapevines.

In general, although the varieties and yields of crops in Wyoming County during the 1880-1930 period varied considerably, there has been principally a reduction in the oats, buckwheat, rye, and wheat acreages, particularly of the last two crops in recent years, with general maintenance of the acreage in hay. Most of the corn grown in recent years has been used for silage. Doubtless much of the crop land formerly used for growing small grains is now used for pastures for dairy cattle, and for truck crops.

The principal cash crops are buckwheat, potatoes, some baled hay, apples, peaches, pears, cabbage, sweet corn, and tomatoes. Table 2 gives the value of all agricultural products, by classes, as reported by the 1920 and the 1930 Federal censuses.

TABLE 2—Value of agricultural products, by classes, in Wyoming County, Pa., in 1919 and 1929

Crop	Value		Livestock and products	Value	
	1919	1929		1919	1929
Cereals.....	\$567, 617	\$147, 785	Domestic animals.....	\$1, 729, 681	\$1, 444, 543
Other grains and seeds.....	1, 336	406	Dairy products, excluding home use.....	1, 157, 695	1, 154, 556
Hay and forage.....	937, 575	504, 457	Poultry and eggs.....	255, 270	500, 823
Vegetables.....	637, 181	268, 579	Wool.....	6, 328	4, 354
Fruits and nuts.....	201, 621	198, 420	Total.....	3, 148, 974	3, 104, 276
All other crops.....	2, 019	586	Total agricultural products.....	5, 496, 323	4, 284, 509
Total.....	2, 347, 349	1, 180, 233			

In 1929, lime and fertilizer were purchased for use on 690 farms, or 49 percent of the 1,409 farms in the county, at a total cost of \$53,050, or an average expenditure of \$76.88 on each farm reporting. The use of fertilizer on an appreciable scale dates from 1910. In 1929, farm labor was employed on 626 farms, or 44.4 percent of all the farms in the county, at a total cost in money wages of \$195,237,

or an average of \$311.88 a farm. Good farm laborers are hard to obtain.

The number and size of farms have not changed greatly in the 1880-1930 period. The 1930 census reports 1,409 farms in Wyoming County, with an average size of 104.5 acres, of which 50.4 percent is improved land, including crop land and plowable pasture.

According to the 1930 census, 1,267 farms are operated by owners, 128 by tenants, and 14 by managers. Both cash- and share-rental systems are used, which vary with the locality and distance from crop markets, namely, Wilkes-Barre and Scranton. In the northern and northwestern parts of the county, in the sections more distant from good roads and railroads, some hill farms may be rented for payment of taxes. Some farms located in the southern part, which are used to considerable extent for vegetable growing, are rented on a cash basis. The customary dairy-farm rental arrangement provides that the owner furnish livestock, tools, and one-half the cost of fertilizer and seed, in return for which he receives half the farm income.

In nearly all the farming sections, the farm buildings are substantial and well maintained, and the equipment is modern. Large hay barns and cattle barns with silos are in general use, and the farm homes are good. The 1930 census reports 565 motor trucks, 306 tractors, 70 electric motors, 507 gas engines, and 1,043 automobiles on farms. Telephones were on 661 farms, water was piped to dwellings on 591 farms, and 384 farm dwellings were lighted by electricity.

Dairying is the principal agricultural industry and furnishes the largest item of cash income on most farms. Its importance has developed in the last few decades, as the following census data indicate. The 1900 census gives the value of dairy products, excluding home use, in 1899 as \$200,293; in 1910, the figure is \$414,251 for 1909; the 1920 census, reporting for the year 1919, which was a "boom year", gives the value as \$1,157,695; and the 1930 census reports a value of \$1,154,556 in 1929. The value of poultry and eggs has risen markedly during the same period. In 1909 the value was \$155,066; in 1919 was \$255,270; and in 1929 was \$500,823.

Practically all the dairymen ship raw milk, through local milk-receiving stations, by rail to New York, Scranton, and Wilkes-Barre. High winter production of milk is the aim of most of the dairymen. The raising of beef cattle, sheep, and swine is a minor industry. Poultry farming, or the production of sizable flocks on general and dairy farms, is increasing.

#### SOILS AND CROPS

According to the 1930 census, 58 percent of the area of Wyoming County is in farms, of which 50.4 percent is cultivable, that is, approximately 29.2 percent of the entire area of the county is cultivable farm land. Dairy farming predominates, with a few farms specializing in poultry, fruit, and truck, or a combination of two or more types of farming.

The adjustment of the agriculture to climate and soil adaptabilities and market demands seems to be good. General suitability of the soils for clovers and grasses, and the close connection with large cities

of the nearby coal-mining districts has made the development of the dairy industry logical. The production of market milk has proved more profitable than raising and fattening beef cattle and hogs. Oats, buckwheat, and corn for silage all do well, so that much of the dairy cattle feed is produced in the county. Fruit growing on the better soils has been generally successful, and the production of miscellaneous truck crops is in response to market demands.

In their original virgin condition, all the lands of the county, except the bottoms, terraces, and some of the Wooster soils, were both stony and gravelly. The rock material in the soils consisted of large quantities of both large and small fragments of local sandstone and shale. A great deal of hand labor has been expended by farmers in picking loose stone from the surfaces of cleared fields as they have been plowed up from time to time. Stone fences are very common on upland farms, and stone piles are numerous in fields, in fence corners, and in low places. The term gravelly, used in connection with many upland soil names, refers to the large numbers of angular rock pieces, slabs, and chips less than 6 inches in their largest dimension, which remain in the soils. In most places these fragments constitute 25 percent or more of the soil mass. Most of the uncleared areas of upland soils are both stony and gravelly, although the soil names indicate stoniness only, as Canfield stony loam.

The Wooster soils are of moderate extent and occur almost entirely in the larger valleys. They are derived from the valley morainic type of glacial deposit, as differentiated from the plains type occurring in less mountainous sections of the glaciated belt north and west of Pennsylvania. The characteristic physiographic forms are those of rounded low hills, although in some places the land is somewhat flat, and the formations have the appearance of high terraces. In such places, however, the deposits differ from those underlying the associated Chenango soils in that there is little stratification of the parent materials. Most of the Wooster soils were originally both gravelly and stony throughout their profiles. Approximately half the gravel and stones are angular, and half are rounded. The proportion of rounded loose rock and gravel is therefore much higher than in any other upland soil. The thickness of the morainic materials underlying the Wooster soils ranges from 20 to more than 100 feet.

The red soils of the county occur in the northwestern part, in the vicinity of Jenningsville, Lovelton, Forkston, and Mehoopany. The hardpan soils of the Volusia series are most extensively developed near the Susquehanna County line in the northern part, although well-distributed smaller areas are on the lower slopes in many sections. The brown upland soils of the Westfield and Canfield series occur generally throughout the hill section. The deeper Wooster soils, of morainic origin, occur along valley sides at a prevailing lower elevation than the Westfield soils. The bottoms and terraces border the principal streams. The Leetonia and Mardin soils occur only in the southwestern highlands.

The soils of Wyoming County, according to their value for crop production, may be divided into eight groups as follows: (1) Well-drained deep upland, terrace, and bottom soils; (2) imperfectly drained upland soils; (3) hardpan soils; (4) shallow soils; (5) soils

of the steeper slopes; (6) organic soils; (7) dark-colored poorly drained soils; and (8) miscellaneous soil materials.

In the following pages the different soils of the county are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3—Acreage and proportionate extent of the soils mapped in Wyoming County, Pa.

Type of soil	Acres	Per- cent	Type of soil	Acres	Per- cent
Westfield gravelly silt loam.....	17,984	6.9	Leetonia stony loam.....	6,848	2.6
Westfield gravelly loam.....	2,240	.9	Leetonia stony sandy loam.....	1,984	.8
Westfield stony silt loam.....	6,016	2.3	Lehew gravelly silt loam.....	3,840	1.5
Westfield stony loam.....	576	.2	Lehew stony silt loam.....	2,880	1.1
Lackawanna gravelly silt loam.....	4,928	1.9	Lackawanna gravelly silt loam, steep phase.....	7,744	3.0
Lackawanna stony silt loam.....	1,664	.6	Lackawanna stony silt loam, steep phase.....	10,432	4.0
Walton gravelly silt loam.....	14,080	5.4	Wooster gravelly silt loam, steep phase.....	1,600	.6
Walton stony silt loam.....	4,672	1.8	Canfield gravelly silt loam, steep phase.....	1,792	.7
Wooster gravelly silt loam.....	9,024	3.5	Volusia gravelly silt loam, steep phase.....	384	.1
Wooster stony silt loam.....	3,008	1.1	Lordstown gravelly silt loam, steep phase.....	4,096	1.6
Wooster gravelly loam.....	3,136	1.2	Lordstown stony silt loam, steep phase.....	9,920	3.8
Chenango gravelly loam.....	3,008	1.1	Lordstown gravelly loam, steep phase.....	1,024	.4
Chenango silt loam.....	1,408	.5	Lordstown stony loam, steep phase.....	1,216	.5
Chenango gravelly sandy loam.....	1,068	.4	Leetonia gravelly silt loam, steep phase.....	960	.4
Otisville gravelly loam.....	192	.1	Leetonia stony silt loam, steep phase.....	5,248	2.0
Tioga fine sandy loam.....	2,816	1.1	Lehew gravelly silt loam, steep phase.....	2,176	.8
Tioga fine sandy loam, high-bot- tom phase.....	2,624	1.0	Lehew stony silt loam, steep phase.....	2,048	.8
Tioga silt loam.....	1,920	.7	Muck and peat.....	3,520	1.4
Tioga gravelly sandy loam.....	1,088	.4	Alluvial soils, undifferentiated.....	6,208	2.4
Tioga gravelly sandy loam, high- bottom phase.....	1,728	.7	Chippewa silt loam.....	1,664	.6
Barbour gravelly loam.....	1,280	.5	Lickdale stony loam.....	1,536	.6
Canfield gravelly silt loam.....	14,912	5.7	River wash.....	192	.1
Canfield stony silt loam.....	4,864	1.9	Rough stony land (mainly Leetonia and Lehew stony loams).....	37,440	14.4
Mardin gravelly loam.....	2,368	.9			
Wellsboro gravelly silt loam.....	6,784	2.6			
Wellsboro stony silt loam.....	832	.3			
Volusia gravelly silt loam.....	5,632	2.2			
Volusia stony silt loam.....	5,888	2.3			
Canfield gravelly silt loam, shallow phase.....	640	.2			
Lordstown gravelly silt loam.....	5,120	2.0			
Lordstown stony silt loam.....	4,480	1.7			
Lordstown stony loam.....	384	.1			
Leetonia gravelly silt loam.....	2,496	1.0			
Leetonia stony silt loam.....	6,272	2.4			
Leetonia stony silt loam, shallow phase.....	576	.2			
			<b>Total.....</b>	<b>260,480</b>	<b>-----</b>

#### WELL-DRAINED DEEP UPLAND, TERRACE, AND BOTTOM SOILS

The group of well-drained deep upland, terrace, and bottom soils includes all the best general-purpose farming soils of the county. These soils are brown or reddish brown and are mainly medium textured, friable, porous, drought resistant, more than 3 feet deep, well drained, and range from medium to high in productivity. The principal soils in this group are the medium-textured gravelly loam and gravelly silt loam upland soils of the Westfield, Walton, Wooster, and Lackawanna series, the terrace soils of the Chenango and closely related Otisville series, and the first-bottom soils of the Tioga and Barbour series. Soils of this group cover more than 60 percent of the cultivated area.

The principal crops grown on these soils are clover and timothy, oats, corn for silage, buckwheat, potatoes, vegetables, orchard fruits, and many minor crops. Orchards are planted principally on the



A Susquehanna River Valley, 2 miles north of Tunkhannock B, Typical farm lands of Wyoming County with their high mountain background



upland soils. Crop yields on the bottom lands are in general higher than on the uplands. Acre yields obtained on the bottom-land soils of this group are as follows: Clover and timothy, from 1 to 2 tons; oats, from 30 to 50 bushels; silage corn, from 8 to 12 tons; and corn for grain, from 25 to 40 bushels. Good yields of wheat, rye, truck crops, and vegetables are obtained. Acre yields on the upland soils, embracing the principal agricultural soils of the county, are as follows: Clover and timothy hay, from 1 to 1½ tons; oats, from 25 to 40 bushels; silage corn, from 6 to 10 tons; buckwheat, from 20 to 35 bushels; potatoes, from 100 to 300 bushels; wheat, from 20 to 30 bushels; rye, from 15 to 25 bushels; corn for grain, from 25 to 40 bushels; and cabbage, from 8 to 10 tons. Satisfactory yields of sweet corn, tomatoes, and cucumbers are obtained on farms devoting small fields to the intensive cultivation of these crops. Apple, peach, and pear orchards are numerous, and several commercial orchards are on the upland soils of this group.

**Westfield gravelly silt loam.**—Westfield gravelly silt loam is the most extensive and most important agricultural soil in Wyoming County, and more than 90 percent of it is in cultivation. It is locally called "brown loam."

The 8-inch surface soil is mellow gritty brown silt loam. It is underlain by mellow or friable gritty yellow silt loam or heavy silt loam, which continues without noticeable change downward to bed-rock lying at a depth ranging from 3 to 10 feet below the surface. At least 25 percent of the surface soil material is made up of chips and slabs of loose gray sandstone and shale, of a maximum size of 6 inches in diameter. The subsoil and substratum are usually similarly gravelly and stony, the loose stones consisting of larger angular and rounded rocks. Practically all the loose gravel and stones are of local origin, and from 5 to 20 percent of them are rounded, the rest being angular.

This soil and the other Westfield soils have been formed from the mantle of loose till, or ground moraine, which was spread liberally over the original land surface by continental glaciers. The loose till parent material is a yellow friable loose silty soil material carrying large quantities of loose stones. It is without compaction.

In the mapping of Westfield gravelly silt loam, some small areas of the Wooster soils, of deep morainic origin; some strips of Lords-town gravelly silt loam; and small areas and spots of Canfield and Volusia soils of similar texture were included. Where occurring near the red-land soils, the Westfield soils contain some admixture of red stone and parent soil materials and have a somewhat red cast.

Westfield gravelly silt loam has its largest development in the northeastern half of the county, where it dominates the uplands, occurring commonly on upper slopes and broader ridges. Very little of this land remains uncleared.

The characteristic surface relief ranges from rolling to hilly. Some long gentle slopes and broad smooth undulating hilltop areas occur, but, as a rule, rolling land predominates, associated with many slopes of hilly character. The surface configuration is fairly smooth, but in many places it is marked by depressions and rises, or sags and swells, which are associated with uneven thicknesses of

deposition of the parent material. Both surface and internal drainage are very good.

The natural vegetation is a mixed second-growth forest which includes oak, beech, maple, poplar, hickory, birch, and pine. The organic-matter content of the soil is low, but natural productivity is good, comparing favorably with that of other upland soils of Pennsylvania not derived from limestone. The surface soil, subsoil, and substratum are moderately acid in reaction. The water-holding capacity and drought resistance are good.

Westfield gravelly silt loam is utilized for the production of practically all crops commonly grown in the county. Dairy farming predominates among the agricultural industries. Clover and timothy yield from 1 to 1½ tons an acre; oats, from 25 to 40 bushels; silage corn, from 6 to 10 tons; buckwheat, from 20 to 35 bushels; potatoes, from 100 to 300 bushels; and corn for grain, from 25 to 40 bushels. Some rye and wheat are produced. Many orchards are on this soil, and garden vegetables do well. Small fields of cabbage and other truck crops are grown on many farms, especially in the southern part of the county. Alfalfa and sweetclover are grown to some extent.

The usual crop rotation is corn, 1 year; oats, in which timothy is sown, 1 year; followed by a seeding of red clover the following spring. The timothy and clover comprise the hay crop. Most farmers plow up the sod after one season's growth and return the land to corn the following spring. Some farmers keep the land in hay for 2 years or more, or use some of the grass for pasture. Wheat, mainly winter wheat, usually follows corn or oats. Potatoes occupy no stated place in the rotation, but they preferably follow the plowing under of a good clover sod or other legume. Buckwheat usually follows oats or corn, or it is used as a catch crop, being planted as late as July 1.

The common practice is to spread barnyard manure on the sod before breaking the land for corn, and most farmers use about 200 pounds of superphosphate for corn. Similar quantities of superphosphate or 4-12-4\* fertilizer are used for oats and buckwheat. Lime, in quantities ranging from one-half ton to 1½ tons of ground limestone an acre are customarily applied once in the rotation.

Sheet erosion is very active, especially in cultivated fields of hilly relief. The amount of erosion going on is difficult to evaluate, as there is no consistent discernible textural difference between surface soil and subsoil, and the colors of the two layers are similar. Observations after heavy rains clearly indicate, however, that much soil is being washed away, unheeded by the farmers.

**Westfield gravelly loam.**—Westfield gravelly loam is not very extensive, but it has some agricultural importance, and about 75 percent of it is in cultivation. The principal areas are in the southern part of the county, on the uplands east of Whites Ferry and Falls.

The surface soil is mellow brown loam, 8 inches thick. It is underlain by mellow yellow loam which continues downward without change to bedrock lying at a depth ranging from 3 to 8 feet below the surface. The bedrock is gray fine-grained sandstone.

\* Percentages, respectively, of nitrogen, phosphoric acid, and potash

The surface soil contains large quantities of gravel, mainly angular sandstone and shale fragments, and the subsoil and substratum are in most places both gravelly and stony. About 10 percent of the loose gravel and stones are more or less rounded. This soil as mapped includes small areas of shallow soil.

Westfield gravelly loam has the same surface relief and drainage characteristics as Westfield gravelly silt loam, and it occupies the same physiographic position.

This soil is used for the same purposes as Westfield gravelly silt loam, but it is not quite so productive, as the water-holding capacity and drought resistance are not quite so good.

**Westfield stony silt loam.**—Westfield stony silt loam is fairly extensive but is of little agricultural importance, as almost all of it is forested. Small areas occur in many parts of the county in association with other Westfield soils. The general physiographic position of this soil is on the higher hills.

Both surface soil and subsoil are stony as well as gravelly, otherwise the soil is similar to Westfield gravelly silt loam. The surface is, as a rule, strewn with numbers of angular stones and some rounded glacial boulders, which also occur throughout the soil mass. Some areas are excessively stony and are indicated on the map by rock-outcrop symbols. This soil is well adapted to forestry.

**Westfield stony loam.**—Westfield stony loam is a very inextensive wooded soil occurring in a few areas, principally in the eastern part of the county. This soil is like Westfield gravelly loam except that the surface soil is stony. Both gravel-size and stone-size gray sandstone fragments and some shale fragments and boulders are common throughout the soil mass.

**Lackawanna gravelly silt loam.**—Lackawanna gravelly silt loam is not extensive, but 90 percent of the land is in cultivation. Scattered areas occur in the red belt of the county, in association with the Walton soils.

The surface soil is brownish-red or purplish-red mellow gritty silt loam, 8 inches thick. It is underlain by red friable gritty silt loam or heavy silt loam continuing downward without change to bedrock of red shale, which lies at a depth ranging from 3 to 20 feet below the surface. The surface soil is prevalingly gravelly, and in most places the subsoil and substratum are also stony. The loose rock fragments are mainly angular red shale and sandstone, with few boulders. This soil has been derived from loose red till comparable, except as to color, with that giving rise to the Westfield soils. About one-half of the abundant loose stones in the mass are rounded, and one-half are angular red shale and sandstone fragments and boulders. There are no large stones in the surface soil to plow depth in cultivated fields, as the pieces larger than about 6 inches in diameter have been picked off. The loose rock content of some areas includes as much as 50 percent of gray sandstone and shale fragments. These areas invariably have a paler red color in both surface soil and subsoil but are not extensive, hence were combined in mapping.

Areas of Lackawanna gravelly silt loam occur principally in Mehoopany Creek and Bowman Creek Valleys, in low slope positions on the valley sides. The soil is similar to Wooster gravelly silt loam in some respects and uses.

The surface relief ranges from rolling to hilly, and drainage is excellent. The natural vegetation is like that on Westfield gravelly silt loam. The water-holding capacity and drought resistance are good. The organic-matter content is low, the acidity is moderate, and the natural fertility is equal to that of any good upland non-limestone soil of Pennsylvania. Farmers consider this the best upland soil in the county.

Acre yields of timothy and clover range from 1 to 1½ tons; of oats, from 20 to 40 bushels; of buckwheat, from 20 to 35 bushels; of silage corn, from 6 to 10 tons; and of potatoes, from 100 to 300 bushels. This is a preferred soil for potatoes, and orchards do well. Methods of handling, cultivation, crop rotation, and fertilization are the same as those employed on Westfield gravelly silt loam.

**Lackawanna stony silt loam.**—Lackawanna stony silt loam is an inextensive forested soil which occurs in scattered areas in the red belt and to a small extent in the southwestern highlands. It is like Lackawanna gravelly silt loam in profile, except that the surface soil is stony rather than gravelly.

**Walton gravelly silt loam.**—Walton gravelly silt loam is an extensive and important agricultural soil in Wyoming County, and about 90 percent of it is in cultivation. Many large areas are in the vicinities of Lovelton, Jenningsville, and extending southeastward in a belt through the environs of Mehoopany and Tunkhannock to Lake Winola. Scattered areas are near Thurston and Vernon. This soil is generally known as "red-shell" or "red-shale" land.

This soil is very much like Westfield gravelly silt loam in all characteristics except color which in the Walton soil is pale red, owing to an admixture of different quantities of red shale and gray sandstone in the parent material. Characteristically, about one half the stones are gray and about one half red, as evidenced by their occurrence in the stone fences.

In Wyoming County this soil has in general a well-blended pale-red color throughout, and in only a few places does it have brown or yellow surface soil and upper subsoil layers overlying a red lower subsoil layer and substratum, a color stratification peculiar to the Culvers soils in some other places.

The 8-inch surface soil is pale brownish-red gritty mellow friable silt loam or heavy silt loam. Material of like texture continues downward without change to bedrock lying at a depth ranging from 3 to 10 feet below the surface. The parent material is loose pale-red thin upland till, as distinguished from deep morainic deposits. Most of the loose stones more than 6 inches in diameter have been picked off the cultivated fields.

This is an important dairy-farming soil. It is equal to, or slightly better than, Westfield gravelly silt loam in productivity; has similar surface relief, drainage, and other characteristics; and is put to the same uses.

The shallow areas associated with this soil are not extensive and are of little agricultural importance, but about 40 percent of the land is in cultivation. This shallow soil occurs on hilltops and ridges in the glaciated red belt of the county, in association with other red-land soils. The surface soil is pale brownish-red mellow gritty silt loam 8 inches thick. It is underlain by pale-red gritty silt loam or

heavy silt loam, resting on red shale bedrock. Several included areas have the appearance of having been derived from materials of glacial origin, as they contain a few boulders. However, as the soil material very closely resembles the truly residual soil, these areas were included in mapping. Angular chips and gravel-sized fragments of red shale are common throughout the soil mass which is also stony below plow depth. Rock outcrops are common.

This included soil is a thin, ridge soil, not very productive or drought resistant, and average crop yields are not large. Some clover and timothy hay, oats, and buckwheat are grown. Most of the land is in pasture.

**Walton stony silt loam.**—Walton stony silt loam is principally in woodland. Some areas comprise stony pasture land. This soil is in the same parts of the county that other Walton soils occur. It is similar to Walton gravelly silt loam, except that the surface soil is stony. Some areas of thin glacial material are included with this soil. The areas of shallow soil are wooded or used for pasture. A small area of Walton stony loam is also included in mapping.

**Wooster gravelly silt loam.**—Wooster gravelly silt loam is of moderate extent and of considerable agricultural importance, as about 90 percent of it is in cultivation. Nearly all of it occurs in the larger valleys, bordering on, or close to, the streams in the valleys of Susquehanna River, Tunkhannock Creek, and Bowman Creek. It is locally called "brown loam."

The surface soil is brown mellow gritty silt loam 8 inches thick. It is underlain by yellow mellow gritty silt loam which continues downward to a great depth. Gravel is plentiful to plow depth, and the lower soil layers and the substratum are both gravelly and stony.

The surface relief is gently undulating or rolling, and the drainage is excellent. Natural productivity is about the same as that of Westfield gravelly silt loam, to which this soil is closely related and very similar. The organic-matter content is low and the acidity moderate.

This soil is used in much the same manner as Westfield gravelly silt loam, but most of it occurs at a lower elevation and has a longer growing season. It is also better located as regards roads and railroads. This soil is generally regarded as a somewhat better soil for these reasons and also because the soil material is thicker than in the Westfield soils.

**Wooster stony silt loam.**—Wooster stony silt loam is neither an extensive nor an agriculturally important soil. It occurs in well-scattered areas in the larger valleys. Very little of the land has been cleared, and the cleared areas are used largely for pasture. This soil is like Wooster gravelly silt loam, except that the entire soil mass is stony and bouldery, the percentage of rounded stone being large. Some small strips having steep relief and a stony loam texture are included in mapping. Most of the soil is in woodland.

**Wooster gravelly loam.**—Wooster gravelly loam is an inextensive soil, but it has some agricultural importance. It has the same general distribution and occurrence as Wooster gravelly silt loam. About 80 percent of the land is in cultivation.

The 8-inch surface soil consists of brown mellow loam which is underlain by yellow mellow loam to a great depth. The surface soil is gravelly, below which the soil material in most places is both grav-

elly and stony. Some small areas having a brown sandy surface soil and subsoil are included in mapping.

The surface relief is more billowy than that of Wooster stony silt loam, but the soil is similar to that soil in other important characteristics. The drought resistance and water-holding capacity are not quite so good as in the stony silt loam, and the natural productivity is slightly less. This is an excellent soil for orchards and deep-rooted crops in general, particularly alfalfa.

**Chenango gravelly loam.**—Chenango gravelly loam is not a very extensive or agriculturally important soil. About 75 percent of it is in cultivation. It occurs only in the large valleys, adjoining the bottom lands.

The surface soil is mellow brown gravelly loam 8 inches thick. It is underlain by yellow mellow gravelly loam to a depth ranging from 20 to 24 inches, below which are very gravelly beds of stratified sand and rounded gravel, extending to a great depth.

This soil has been derived from glacial outwash which now stands as high terraces from 20 to 80 feet above stream level. Practically all the gravel is water rounded. A small proportion of the soil contains but few gravel in the surface soil.

The land is nearly flat or gently undulating, although narrow strips of steeply sloping edges of terraces are included in mapping. Drainage ranges from good to excessive. The organic-matter content of the soil is low and the acidity moderate. Natural productivity, water-holding capacity, and drought resistance are poor.

This soil is used in the production of clover and timothy hay, oats, buckwheat, silage corn, potatoes, orchards, and pasture. It is an excellent soil for alfalfa. Yields tend to be poor in dry seasons, and the best yields are obtained in seasons having well-distributed rainfall. Heavy manuring, or other methods of adding organic matter to increase the water-holding capacity of the soil, is important if good yields are to be obtained.

**Chenango silt loam.**—Chenango silt loam is a soil of very small extent, but it is practically all in cultivation. It occurs along Susquehanna River and the lower Tunkhannock Creek Valley.

The soil consists of a brown mellow gritty silt loam surface layer, 8 inches thick, underlain, to an average depth of 30 inches, by yellow mellow gritty silt loam, below which the lower subsoil layer and substratum become very gravelly and sandy and extend to a great depth. This soil is similar in origin, relief, and most other characteristics, to Chenango gravelly loam. The surface soil and subsoil are, however, comparatively free of gravel, and the texture of the soil material is somewhat heavier than in the gravelly loam. This soil is likely to be somewhat droughty in unfavorable seasons but is not particularly so in normal seasons. Fairly good crops of clover and timothy hay, oats, buckwheat, potatoes, and corn are grown. Dairying is developed to some extent.

**Chenango gravelly sandy loam.**—Chenango gravelly sandy loam is a soil of small extent and little agricultural importance. About 50 percent of the land is in cultivation. The principal areas are at Tunkhannock and about 2 and 4 miles southeast of that place. Smaller bodies are in other parts of the Susquehanna River Valley.

This soil is like Chenango gravelly loam, except it is coarser textured. The 8-inch surface soil is yellowish-brown gravelly sandy loam or gravelly fine sandy loam, which is underlain by yellow gravelly sandy loam passing, at a depth ranging from 15 to 24 inches, into stratified gravel and sand. Important gravel pits are located on this soil.

The surface relief is, as a rule, less smooth than that of other Chenango soils, being characteristically ridgy and uneven. In many places areas having coarse gravel streaks on the surface support little vegetation of any kind, and some fields have been abandoned. This is a poor grass soil and is of little use for pasture. Some small fields are devoted to alfalfa and rye. This is the droughtiest soil in the county, and it is doubtful whether other crops than those mentioned can be profitably grown on it.

**Otisville gravelly loam.**—Otisville gravelly loam is a soil of very small extent and little agricultural importance, occurring in a few small areas in the larger valleys, except that of Susquehanna River. About half the land is in cultivation.

The surface soil is yellowish-brown gravelly loam 8 inches thick. It is underlain by yellow gravelly loam which, below a depth ranging from 15 to 24 inches, passes into beds of stratified water-rounded gravel and sand. In places the surface soil and subsoil are somewhat red.

This soil has been derived from kame and esker material of fluvio-glacial origin. The surface relief is hummocky, characterized by small hills and hummocks, the relief of which is independent of surrounding physiographic land forms.

This soil is similar to Chenango gravelly loam, differing from that soil in that the surface relief is rolling, hilly, or hummocky, instead of flat. It is a droughty soil. Alfalfa, rye, and buckwheat are the surest crops.

**Tioga fine sandy loam.**—Tioga fine sandy loam is a very inextensive soil, but nearly all of it is in cultivation. The principal areas are in the Tunkhannock Creek Valley, bordering the stream channel. This is first-bottom land. Its surface is, in few places, more than 8 feet above low-water level, and the land is frequently inundated. Most of the areas are flat or slope gently toward the stream, and drainage is good.

The surface soil is brown fine sandy loam 10 or 12 inches thick, grading into a yellowish-brown fine sandy loam or loamy fine sand subsoil which extends to a depth of 36 or more inches. Most of the cultivated areas are in corn or hay.

Small areas of loam texture, scattered along the stream bottoms, are included with this soil in mapping, and these are nearly all in cultivation. Such areas lie sufficiently high above ordinary stream level that periods of inundation are not very frequent and are of short duration.

This included soil is brown loam, 10 or 12 inches thick, grading into yellowish-brown loam. It varies to some extent as mapped, many of the bodies having a very fine sandy loam texture in both surface soil and subsoil, and some of the loam-textured areas are gravelly in both layers. The surface relief is in general flat, and drainage is good.

The loam areas are largely used for corn, clover and timothy hay, oats, and potatoes, and some truck crops are grown. As a rule yields are very good.

**Tioga fine sandy loam, high-bottom phase.**—The high-bottom phase of Tioga fine sandy loam is not extensive, but nearly all the land is in cultivation. Most of it occurs in narrow strips, principally in the Susquehanna River and Tunkhannock Creek Valleys. It is a recent terrace soil, the surface lying but slightly above stream overflow, or first-bottom level. The surface soil is brown fine sandy loam or very fine sandy loam about 8 or 10 inches thick. It is underlain by a similar-textured yellow subsoil.

Small bodies occur within areas of Tioga fine sandy loam, high-bottom phase, that are essentially a gravelly loam in texture. The surface soil in such areas is principally brown mellow gravelly loam 8 or 10 inches thick, underlain, to a depth of 36 inches, by mellow yellow gravelly loam. Some small bodies which contain little gravel are included, and some have a silt loam texture. In origin, position, relief, and drainage the gravelly areas are like the rest of the high-bottom phase. The organic-matter content is fairly good and is well maintained. The soil is productive, being used for the production of the usual farm crops, and in addition it produces good truck crops.

A few small areas occur in the lower Bowman Creek Valley near Eatonville, which have a reddish-brown very fine sandy loam surface soil, 8 or 10 inches thick, grading into red or pale-red fine sandy loam. A few small areas of somewhat finer, and some of coarser, texture are included. These included areas resemble the similar-textured high-bottom Tioga soils in all respects and uses, differing only in having a prevailing red color in both surface soil and subsoil. The land is substantially flat or smoothly sloping toward the streams and downstream, and drainage is excellent. The organic content is rather low and the acidity moderate. Crops suffer from insufficient moisture during dry periods. The land is generally maintained in a good state of productivity by most farmers. Heavy manuring is practiced in order to maintain the organic-matter supply in the soil. Good yields of corn, oats, clover and timothy hay, potatoes, and miscellaneous vegetables are generally obtained.

The surface relief of Tioga fine sandy loam, high-bottom phase, is essentially flat, although the surface configuration in places is ridgy and uneven. The gravel throughout the profile are mainly red and water rounded, and some are of stone size. A few areas having a more sloping surface and occupying an alluvial-fan position are also included.

This soil has but little agricultural use. It is neither a strong nor a fertile soil. Some small fields of corn, clover, and timothy hay, potatoes, and garden vegetables are grown, and the rest of the land is in pasture or woodland.

**Tioga silt loam.**—Tioga silt loam is a very inextensive soil, but nearly all of it is in cultivation. Long narrow areas of this soil occur, mainly along Susquehanna River, upstream from Vosburg.

This is first-bottom land, but only at rare intervals is it overflowed. The surface relief is essentially flat or gently sloping toward the river, and drainage is good.

The soil consists of brown mellow silt loam, from 12 to 15 inches thick, grading into yellowish-brown mellow silt loam which extends to a depth of 38 or more inches. Included in mapping are some small areas carrying considerable water-rounded gravel. A small proportion of the soil as mapped has a yellow and gray mottled subsoil, indicative of sluggish internal drainage.

This is a very productive soil. Clover and timothy hay, corn, oats, potatoes, and cabbage are the principal crops.

**Tioga gravelly sandy loam.**—Tioga gravelly sandy loam is neither extensive nor important agriculturally, and very little of the land is in cultivation. This soil occurs in scattered areas and strips along the stream courses of the larger streams and on islands in Susquehanna River.

The 8- to 10-inch surface soil is brown gravelly sandy loam. It is underlain by yellowish-brown gravelly sandy loam or sand. The gravel is all water rounded.

This is first-bottom land frequently inundated by flood waters. The areas are essentially flat, with surface irregularities, such as numerous gravel bars and overflow channelways. Drainage is fairly good. No attempt is made to farm this soil on the river islands, most of which are wooded. Most of the areas along the smaller streams are in woodland pastures.

**Tioga gravelly sandy loam, high-bottom phase.**—Tioga gravelly sandy loam, high-bottom phase, is an inextensive and unimportant soil occurring principally in the valleys of Mehoopany Creek and Bowman Creek. A small proportion of the land is in cultivation.

This soil consists of a layer of reddish-brown gravelly sandy loam, 8 inches thick, underlain by red or pale-red gravelly sandy loam to a depth of 36 or more inches. It is a recent terrace soil, its surface lying but slightly above the overflow level of the stream.

**Barbour gravelly loam.**—Barbour gravelly loam is an inextensive soil occurring on the smaller stream bottoms in the red-land districts of the county. Practically all the land is in cultivation.

The surface soil is reddish-brown gravelly loam, 8 or 10 inches thick. It grades into red gravelly loam which extends to a depth of 36 or more inches.

Included with this soil, because of their small extent, are small bodies of fine sandy loam, very fine sandy loam, and silt loam, which are more or less gravelly both in the surface soil and subsoil but are prevailing red in color.

This soil, as a whole, is flat but is irregular to some degree in surface configuration. Drainage is in general good. This is first-bottom land subject to inundation. It is fertile and is used principally for clover and timothy hay, corn, oats, and pasture land.

#### IMPERFECTLY DRAINED UPLAND SOILS

The group of imperfectly drained upland soils includes Canfield gravelly silt loam, Canfield stony silt loam, Mardin gravelly loam, Wellsboro gravelly silt loam, and Wellsboro stony silt loam. These are brown and red soils and have a slight claypan formation in their subsoils, which causes imperfect or sluggish natural drainage. They are fairly good crop land, and the cultivated part comprises about 20 percent of the cultivated area of the county.

The crops grown and acre yields on these soils are as follows: Clover and timothy hay, from 1 to 1½ tons; oats, from 20 to 40 bushels; buckwheat, from 15 to 35 bushels; and silage corn, from 5 to 8 tons. Corn does not do so well in normal seasons as it does on the better drained soils, and potatoes do not yield so well. Fairly good orchards are on these soils, but the better drained soils are preferred as orchard sites. The areas having rolling or hilly surface relief are fairly well drained, but those in which the relief is gently sloping are rather cold, wet, and late. A larger proportion of these soils than of the soils of the well-drained group is in pasture.

**Canfield gravelly silt loam.**—Canfield gravelly silt loam is both an extensive and an agriculturally important soil, and approximately 80 percent of it is in cultivation. It is locally called "brown hardpan land" or "brown loam." Areas of this soil, some of which are large, occur in association with the Westfield and Volusia soils in nearly all parts of the county except the southwestern highlands. This soil is best developed on most of the broader ridge tops a few miles away from Susquehanna River, where stream dissection has not been so complete and less hilly local relief prevails.

The surface soil, which extends to a depth of 8 inches, is brown, mellow, gritty silt loam or heavy silt loam. It is underlain by mellow or friable gritty yellow or pale-yellow silt loam or heavy silt loam to an average depth of 20 inches. The lower subsoil layer, to a depth of 36 or more inches, is mottled light-gray and yellow slightly or considerably compacted heavy silt loam or silty clay loam, grading in most upland areas into a more compact and generally heavier textured substratum claypan consisting of similar-colored silty clay or clay, which rests on bedrock of gray arenaceous shales at a depth ranging from 4 to 20 feet below the surface. The soil material is gravelly throughout, and stones occur in most places below plow depth. About 90 percent of the loose rock fragments are angular gray sandstone and shale, and the rest are rounded to some extent. A few included areas contain less gravel and stone than the typical soil.

The parent material of the dominant or upland thin till type of Canfield soil is moderately compacted glacial till. Some of the areas of Canfield soil mapped in Wyoming County, particularly those occurring at the lower elevations, have been formed on slightly compacted deep morainic materials. In most places this material differs from that of the upland thin till, or Mardin soil, in that the compaction and mottling become less, instead of greater, below a depth ranging from 3 to 4 feet, and the soil material continues downward to a depth ranging from 20 to 50 feet as a friable or slightly compacted yellow silty mass carrying large quantities of gravel, stones, and boulders.

The surface relief of most of this soil is undulating or rolling, but some areas of gently undulating relief are on the broader divides and some occupy long gentle slopes. This soil in many places occurs in an intermediate topographic position between the lower lying Volusia soils and the higher lying Westfield soils, although in places it caps the hilltops, though rarely the highest ones. In some places it occurs on low slopes.

Surface drainage, or run-off, is good, but internal drainage is sluggish or poor. The natural vegetation consists of mixed hardwoods and pines. Natural productivity is fairly good, the organic-matter content is rather low, the acidity ranges from moderate to high, and the water-holding capacity and drought resistance are only fairly good.

This is one of the important dairy-farming soils of the county. Clover and timothy hay yield from 1 to 1½ tons an acre; oats, from 20 to 40 bushels; buckwheat, from 15 to 35 bushels; silage corn, from 5 to 8 tons; and potatoes, from 100 to 200 bushels. The soil is better adapted to shallow-rooted crops than to corn or orchard trees, and it is a good pasture soil. The areas of more rolling relief and better drainage usually produce better crops than the flatter areas. Grasses and small grains do well in normal seasons. Installation of tile drains is practical in many places, but only a small proportion of the cultivated land has been so improved. Methods of cultivation, crop rotation, and fertilization are in general like those in use on farms on Westfield gravelly silt loam.

**Canfield stony silt loam.**—Most areas of Canfield stony silt loam are forested, and the soil is fairly extensive. Many bodies occurring in association with Canfield gravelly silt loam are used as farm wood lots or stony pasture land. The soil also occurs in flatter positions on the mountains in the southwestern part of the county.

This soil is like Canfield gravelly silt loam, except that the surface is stony. The loose stones consist of both angular and rounded gray sandstone and shale fragments. Some small areas are included in which the soil mantle ranges from only 1½ to 2½ feet in thickness above bedrock, and many rock outcrops occur.

**Mardin gravelly loam.**—Mardin gravelly loam is a very inextensive soil and is of slight agricultural importance. About half of it is in cultivation. A few small somewhat flat areas occur in the southwestern part of the county at elevations of more than 2,000 feet above sea level.

This soil is like Canfield gravelly silt loam in all important respects, except that the textures of the surface soil, the subsoil, and the substratum are slightly coarser, and the material is less compact.

In virgin areas the soil consists of a 3-inch topsoil of black mold underlain to a depth of 12 inches by whitish-yellow loamy fine sand, this material, in turn, changing below to brown, yellow, and gray mottled somewhat compacted loam or heavy loam, which rests on gray sandstone at a depth ranging from 4 to 8 feet below the surface. The entire soil mass is both stony and gravelly, the loose rocks consisting of both angular and rounded gray sandstone and conglomerate.

Cultivated areas consist of an 8-inch layer of brown mellow loam underlain by yellow or pale-yellow mellow or friable loam or heavy loam, passing, below a depth ranging from 20 to 24 inches, into yellow and light-gray mottled somewhat compacted silt loam or silty clay loam, which continues downward, resting on bedrock of gray sandstone at a depth ranging from 4 to 20 feet below the surface. The gravel and stone content throughout this soil is like that in Canfield gravelly silt loam, except that it contains a larger percentage of sandstone than of shale fragments.

Included in mapping, because of their small extent, are small shallow areas in which the thickness of the soil material ranges from only  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet over bedrock, also a few bodies having a stony surface soil.

The water-holding capacity, drought resistance, and natural productivity are not quite so good as in Canfield gravelly silt loam, but the land is put to the same uses.

**Wellsboro gravelly silt loam.**—Wellsboro gravelly silt loam is fairly extensive and of considerable agricultural importance, about 80 percent of it being in cultivation. Its occurrence is limited to the red belt of the county principally, where it occurs in association with the Walton and Lackawanna soils. This soil is called "red-shell land" or "chocolate land."

The soil is mellow chocolate-colored or dark brownish-red gritty silt loam, 8 inches deep, underlain by red friable gritty silt loam or heavy silt loam to an average depth of 20 inches, below which is a lower subsoil layer composed of considerably compacted light-gray, yellow, and pink mottled heavy silt loam or silty clay loam. Typically this material grades below a depth ranging from 3 to  $3\frac{1}{2}$  feet into a heavier more compact claypan of similar-colored silty clay or clay, which rests on red shale at a depth ranging from 4 to 10 feet below the surface.

This soil is the red-land counterpart of Canfield gravelly silt loam which it resembles in all important characteristics, except color. The soil is in general gravelly to plow depth and gravelly and stony below. The loose rock fragments, largely angular, are mainly red shale. In areas associated with Walton soils, more gray rock fragments occur. The soil is utilized in the same manner as Canfield gravelly silt loam, with equivalent results.

**Wellsboro stony silt loam.**—Wellsboro stony silt loam is of small extent and has no agricultural importance. It is like Wellsboro gravelly silt loam, except that the surface soil is stony. Most areas are entirely in woodland, and some are in pasture.

#### HARDPAN SOILS

Soils of only one series, the Volusia, have a definite hardpan. These are brownish-gray soils having a dense hard subsoil at an average depth of 15 inches below the surface. Internal drainage is very poor. These soils occupy only 5 percent of the cultivated area of the county. They are cold, wet, late soils.

The principal crops grown and yields are clover and timothy hay, from 1 to  $1\frac{1}{2}$  tons an acre; oats, from 20 to 35 bushels; buckwheat, from 10 to 25 bushels; and rye, from 15 to 25 bushels. Yields of corn range from fair to low and are very uncertain. The Volusia soils are fairly good pasture soils, and in wet seasons the hay crop is satisfactory, but corn suffers from excessive moisture, and in droughty seasons all crops suffer. Crops with shallow root systems do best, but potatoes, garden vegetables, and orchards do not do well. Many abandoned farms and fields are on these soils. Benefits to be derived from artificial drainage do not cover the cost of installation.

**Volusia gravelly silt loam.**—Volusia gravelly silt loam is not a very extensive soil but is of some agricultural importance, as about 75 percent of it is in cultivation. It does not occur in large areas

in Wyoming County but in a considerable number of small areas, most numerous in the northern part of the county. It is locally called "hardpan land." This soil, as well as the other Volusia soils, has been derived from compact till originating from gray sandstone and shale rock materials.

The cultivated soil is brownish-gray fairly mellow gritty silt loam or heavy silt loam to a depth of 8 inches. This material is underlain, to an average depth of 15 inches, by pale-yellow or yellowish-gray friable gritty silt loam or heavy silt loam, mottled somewhat with gray. Below this is the compacted claypan lower subsoil layer consisting of yellow and light-gray mottled heavy silt loam or silty clay loam, which is moderately plastic when wet, tough, and impenetrable by water and most plant roots. This material becomes increasingly compact and heavy with depth, becoming very dense light-gray compacted clay resting on bedrock of gray shale at a depth ranging from 4 to 15 feet below the surface. In most places the soil is gravelly throughout, and it is also stony below plow depth. About 90 percent of the loose stone content consists of angular fragments, and the remaining 10 percent of more or less rounded gray sandstone and shale. A few blue limestone pieces occur in places in the substratum. Included with this soil as mapped are some small areas containing less gravel in the surface soil, and a few fields have a gravelly loam texture.

The surface relief of most areas ranges from rolling to hilly, but a few undulating areas occur on the broader upland divides and some on long gentle slopes. Where this soil occurs in association with the Westfield and Canfield soils, it usually occupies the lower slopes. The surface configuration over most areas is smooth, with little irregularity. Dark spots and strips are common.

Surface drainage is good, as a rule, but internal drainage is very poor. The organic content is considerable, ranging higher than that of the principal upland agricultural soils, and the acidity ranges from moderate to high. Natural productivity is rather low, on account of the comparatively small plant-root feeding zone above the claypan. This soil does not retain moisture well, hence is not drought resistant. It is a cold, wet, late soil.

Large areas are in old hay land and pasture, and most of the abandoned farms of the county are on this soil. Clover and timothy hay is the main crop, yielding from 1 to 1½ tons an acre. Oats yield from 20 to 35 bushels and buckwheat from 10 to 25 bushels. Corn, orchard, potato, and garden-vegetable yields are generally not satisfactory. This soil is better adapted to dairy farming than to other types of agriculture, particularly where silage corn, alfalfa, and other grain and feed crops can be grown on the better drained soils.

Periodic applications of lime are required to offset soil acidity and insure the growth of clover. An acre application ranging from 150 to 200 pounds of superphosphate is usually placed under small grains. Tile drainage has been used to a small extent but does not appear to have justified the cost of installation.

**Volusia stony silt loam.**—Volusia stony silt loam is a moderately extensive soil, and it has little agricultural importance, none of it being in cultivation. It occurs principally on low slopes and flats along tributary streams and on some higher hilltops in the northern

and eastern parts of the county. The surface relief of many areas is flatter or less undulating than that of Volusia gravelly silt loam which this soil closely resembles, except that the surface soil is stony. Considerable areas are in stony pasture fields, and the rest of the land is woodland.

#### SHALLOW SOILS

The group of shallow soils includes the upland soils of the Lordstown, Lehev, and Leetonia series, and the shallow phase of Canfield gravelly silt loam. The shallow upland soils are mostly gravelly silt loams, ranging from brown to red in color. These soils are situated mainly on hilltops, and the soil material is from only  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet thick over bedrock. About 10 percent of the cultivated area of the county is composed of soils of this group. The crops grown are clover and timothy hay, oats, buckwheat, and some corn. Yields are generally low, owing to the low water-holding capacity, and crops do best in rather wet seasons.

**Canfield gravelly silt loam, shallow phase.**—Canfield gravelly silt loam, shallow phase, is a very inextensive and agriculturally unimportant soil. It occurs on a few hilltops, knobs, and ridges, in association with Canfield gravelly silt loam. It differs from the latter soil in that the depth to bedrock ranges from only  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet. About 40 percent of the land is in cultivation to hay, oats, and buckwheat, and the rest is in hill pasture or woodland. Crop yields are in general rather low, as the soil is not resistant to drought. Crops do best when the rainfall is well distributed during the growing season.

**Lordstown gravelly silt loam.**—Lordstown gravelly silt loam is not very extensive, but it is of some agricultural importance. About 50 percent of it is in cultivation. Most of the bodies occur on the higher hilltops and narrow ridges in the northern part of the county, and some small areas are in the southern part.

The 8-inch surface soil is mellow gritty brown silt loam. It overlies mellow friable gritty yellow silt loam or heavy silt loam, which rests on bedrock of gray sandstone and shale at a depth ranging from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet below the surface. The entire soil mass is in most places very gravelly, nearly all the loose gravel being angular fragments of the local rocks. Outcrops of bedrock are numerous. Areas having a gravelly loam texture are included with this soil as mapped.

This soil has been formed from glacial moraine material of the same character as that from which Westfield gravelly silt loam has developed, except that the mantle of loose till is prevailingly less than 3 feet thick.

The surface relief ranges from rolling to hilly, and the elevations of the areas are comparatively high, ranging from about 1,500 to 2,000 feet above sea level. Drainage ranges from good to excessive. In some places the surface is irregular, owing to the irregularity of the underlying bedrock, and numerous small flat spots have a mottled subsoil. The natural productivity is less than that of Westfield gravelly silt loam, and the water-holding capacity and drought resistance are less, but otherwise the two soils are similar.

The principal crops grown are hay, oats, and buckwheat. Much of the land is in pasture, as it is difficult to plow on account of shallowness and frequent rock outcrops. Yields are rather low in normal seasons, and crops do best when rains are well distributed during the growing season. Some fields, in which the thickness of the surface soil and subsoil over bedrock approaches 3 feet, produce better than average yields for this soil. In other fields the soil material is very shallow and has little value except as low-grade hill pasture land.

**Lordstown stony silt loam.**—Lordstown stony silt loam is neither extensive nor agriculturally important. It occurs on knobs and hilltops in association with other Lordstown soils. It is similar to Lordstown gravelly silt loam in its characteristics, except that it is stony as well as gravelly. A few areas are in pasture, and the rest of the land is forested.

**Lordstown stony loam.**—Lordstown stony loam is a very inextensive wooded soil which occurs on a few high hilltops, generally in association with Lordstown stony silt loam. It ranges from 1½ to 2½ feet in thickness over bedrock of gray sandstone, and it resembles the other Lordstown soils in all characteristics except that the surface soil is of loam texture. Rock outcrops and exposed ledges are numerous.

**Leetonia gravelly silt loam.**—Leetonia gravelly silt loam is confined to the high plateau top in the southwestern part of the county and occupies a total area of 3.9 square miles. This soil under forest conditions contains a well-defined gray layer, 1 or 2 inches thick, under the forest duff. Where the land is cleared and put under cultivation this material disappears. Many of the loose stones have been removed from the surface of cultivated fields, and it is doubtful that this soil ever contained as many stones as the other stony soils.

Most of the land is cleared and used for the crops commonly grown in this section—buckwheat, oats, and small patches of potatoes and cabbage. The isolated position of the soil renders it of little value for agriculture.

**Leetonia stony silt loam.**—Leetonia stony silt loam is a comparatively inextensive forested soil occurring only in the highlands in the southwestern part of the county. The principal areas are on top of Dutch Mountain, between elevations of 2,000 and 2,500 feet.

The surface relief is somewhat flat, undulating, or rolling. The substratum is somewhat compact and contains mottling which does not ordinarily occur in the parent materials of Leetonia soils lying at lower levels. Drainage is good. Most of the areas carry large quantities of angular and rounded stones and some gravel-size fragments throughout the soil mass. In addition to loose sandstone and shale rock, considerable conglomerate occurs, mostly as glacial boulders.

In virgin areas the surface soil consists of a 2-inch layer of black mold overlying somewhat white loamy very fine sand which extends to a depth of 8 inches. It is underlain by a 2-inch layer of coffee-brown light gritty silt loam. Between depths of 10 and 40 inches the material is yellowish-brown light silt loam, and between depths

of 40 and 50 inches it is mottled yellow and gray slightly compact loam resting on gray sandstone bedrock.

In places, commencing below a depth of 4 feet from the surface is a 12-inch layer of light-gray loamy sand of vesicular structure, having some siliceous cementation, which rests on bedrock.

Some areas occur in the southwestern mountain tops at elevations of approximately 2,300 feet. Here the soil material averages 3 or 3½ feet thick over fine-grained gray sandstones or shales, from which it has been derived by weathering processes. Angular gravel and stone-size fragments of parent rock are plentiful throughout the profile and scattered over the surface.

**Leetonia stony silt loam, shallow phase.**—The shallow phase of Leetonia stony silt loam is associated with typical Leetonia stony silt loam on the plateau top, and it differs mainly in its slight depth to bedrock which occurs at less than 3 feet below the surface. These shallow areas are entirely in forest.

**Leetonia stony loam.**—Leetonia stony loam is a rather inextensive wooded soil occurring only in the southwestern highlands at elevations ranging from 1,800 to 2,200 feet. It is similar to Lordstown stony loam in all characteristics, except that it has developed a podzol profile. The surface soil consists of a 2-inch layer of black mold underlain to a depth of 10 inches by somewhat white loamy fine sand. Between depths of 10 and 12 inches the material is brown or coffee-brown loam and below a depth of 12 inches is yellowish-brown loam which extends downward to sandstone bedrock lying at a depth ranging from 4 to 8 feet below the surface. Some areas are excessively stony.

Small areas derived from residual materials occur in association with Leetonia stony sandy loam at comparable elevations. Here the soil has been derived from a somewhat finer grained sandstone, and the weathered soil material is in most places a little thicker. The land is mainly forested. The podzol profile in these areas shows a 2-inch layer of black mold underlain to a depth of 6 inches by somewhat white loamy fine sand. Between depths of 6 and 24 inches the material is yellow light loam, and between depths of 24 and 30 inches is yellow fine sandy clay loam which rests on fine-grained gray sandstone parent rock. The soil material is gravelly and stony throughout, the loose rock fragments being angular pieces of the parent sandstone.

**Leetonia stony sandy loam.**—Leetonia stony sandy loam is an inextensive forested or virgin soil which has been derived from residual materials. It occurs mainly in one section of the high mountain plateau about 5 miles directly south of Meehoopany, at an elevation of about 2,300 feet.

The natural vegetation is principally sweetfern, huckleberry, or scrubby oaks and other small trees, including mountain maple and aspen. None of this soil is in cultivation. The land is nearly flat or gently undulating, and drainage is good, although some poorly drained spots occur.

This soil covers a capping rock strata of light-gray sandstone. The podzol profile shows a 2-inch layer of black mold underlain to a depth of 6 inches by somewhat white loamy sand. Between depths of 6 and 18 inches the material is yellow sandy loam, and

below a depth of 18 inches it is yellow light sandy clay loam which rests on gray sandstone parent rock at a depth of about 24 inches. Both gravel- and stone-size angular fragments of sandstone are common throughout the soil mass and over the surface.

**Lehew gravelly silt loam.**—Lehew gravelly silt loam is an inextensive soil, and about 50 percent of it is in cultivation. The small areas occur on hiltops and narrow ridges in different parts of the red-belt section.

The 8-inch surface soil is brownish-red mellow gritty silt loam. It is underlain by red gritty silt loam or heavy silt loam, resting at a depth ranging from 24 to 30 inches on red shale. Angular chips and gravel-size fragments of red shale are scattered throughout the soil mass. Below the surface soil, large loose rocks are common, and rock outcrops are numerous on the surface. Some areas in which the soil material ranges from only 1 to 2 feet in thickness are included in mapping. This soil has been formed mainly by weathering in place of local red shale rock. In places there is considerable probability that glacial action may have been the principal formative agent, although, in general, glacial boulders and other rounded stones are absent. This soil, however, in Wyoming County, does not have an appreciably heavier subsoil than the associated glaciated Lackawanna soils.

The surface relief ranges from rolling to hilly, and drainage is good. On account of the shallowness of the weathered soil material, natural productiveness is less than in the thicker upland soils. Yields are only fair, crops doing best in seasons of well-distributed rainfall. The principal crops grown are timothy and clover hay, oats, and buckwheat. Much of the land is in pasture.

**Lehew stony silt loam.**—Lehew stony silt loam is an inextensive forested soil similar to Lehew gravelly silt loam, except that the soil mass carries a large quantity of loose stones.

#### SOILS OF THE STEEPER SLOPES

The group of soils of the steeper slopes includes steep phases of gravelly silt loam soils, principally, of the Lordstown, Wooster, Canfield, Volusia, Lackawanna, Lehew, and Leetonia, series. These steep areas are, collectively, not extensive, and only about 10 percent of them is in cultivation, other than pasture, so that not much more than 3 percent of the cultivated area of the county is included in this group.

From fair to good yields of the common farm crops are obtained on these steeply sloping soils, and orchards do well. The difficulty in handling teams and farm machinery on the steep slopes, together with the susceptibility of the land to erosion when in cultivated crops, has caused farmers to use most of the cleared areas for pasture.

**Lackawanna gravelly silt loam, steep phase.**—Soil of the steep phase of Lackawanna gravelly silt loam is moderately extensive but not of much agricultural importance. About 20 percent of the land is in cultivation. Areas occur generally in association with the Walton and Lackawanna soils. This soil is similar to typical Lackawanna gravelly silt loam, except that the surface soil is paler red and the relief is too steep for economical crop production. Some crops of

hay, oats, and buckwheat are produced, but most of the soil is in hill pasture, old hay land, or forest. In places the thickness of the soil material over bedrock ranges from 3 to 5 feet.

**Lackawanna stony silt loam, steep phase.**—Lackawanna stony silt loam, steep phase, is a fairly extensive forested soil occurring on hillsides near Forkston and near Noxen. The land is steep but not sufficiently so to be classed as mountainous, otherwise the soil of this phase is similar in profile to that of typical Lackawanna stony silt loam. Small areas of Lackawanna stony loam, steep phase, are included in mapping, in which the thickness of the soil material over bedrock ranges from 3 to 5 feet. An area of about the same extent associated with the Walton soils has a somewhat paler red color but is otherwise similar to the remainder of the steep phase.

**Wooster gravelly silt loam, steep phase.**—Wooster gravelly silt loam, steep phase, is an inextensive largely forested soil occurring in places in association with typical Wooster gravelly silt loam which it closely resembles, except that it has steep relief. In soil characteristics it is similar to the typical soil.

**Canfield gravelly silt loam, steep phase.**—Canfield gravelly silt loam, steep phase, is not an extensive soil, and most of it is forested. It occurs in association with typical Canfield gravelly silt loam which it resembles, except that it is too steep for efficient cultivation. The thickness of the soil material over bedrock ranges from 3 to 5 feet. About 10 percent of this soil is in cultivation, and some hay, oats, and buckwheat are grown in small fields, but most of the land is in hill pasture and woodland. Included in mapping, because of their small extent, are a few areas having a stony surface soil and others in which the soil material is very shallow. Rock outcrops are numerous, especially on the upper slopes.

**Volusia gravelly silt loam, steep phase.**—Volusia gravelly silt loam, steep phase, is a very inextensive wooded soil similar to typical Volusia gravelly silt loam, except that the land is too steep for cultivation. It is used for pasture or woodland. The depth to bedrock ranges from 2 to 5 feet.

**Lordstown gravelly silt loam, steep phase.**—Lordstown gravelly silt loam, steep phase, is not very extensive, and it has little agricultural importance, as only about 10 percent of it is in cultivation. Soil of this phase occurs in many parts of the county in association with typical Lordstown gravelly silt loam.

The profile is like that of typical Lordstown gravelly silt loam, but the soil differs in that the land is too steep for efficient cultivation. The depth to bedrock ranges from 3 to 5 feet. Rock outcrops, which are not numerous, occur mostly on the upper slopes, the principal outcrop areas being shown on the soil map by symbol. Some areas have been included in mapping, in which the soil material averages less than 3 feet thick over bedrock.

Most of the cultivated fields are on the lower part of the slopes, and they consist in general of small plots of buckwheat, oats, or corn. Some of the soil is old hay land, and much of it is pasture and woodland. Orchards do well on this soil.

**Lordstown stony silt loam, steep phase.**—Lordstown stony silt loam, steep phase, is extensive but is agriculturally unimportant. This soil is similar to typical Lordstown stony silt loam, except

that the surface relief is very steep, the soil material ranges from only 1½ to 3 feet in thickness, and many outcrops of bedrock occur. The land is mainly in forest.

**Lordstown gravelly loam, steep phase.**—Lordstown gravelly loam, steep phase, is of very small extent and is of little agricultural importance. About 10 percent of it is in cultivation. It occurs chiefly in association with other Lordstown soils. The depth to bedrock ranges from 3 to 5 feet, otherwise the soil is similar to typical Lordstown gravelly loam. Land of this kind is mainly in forest.

**Lordstown stony loam, steep phase.**—Lordstown stony loam, steep phase, is an inextensive wooded soil similar to typical Lordstown stony loam, except that the surface relief is steep but not mountainous. All this land is forested.

**Leetonia gravelly silt loam, steep phase.**—Leetonia gravelly silt loam, steep phase, occurs on the rather steeply sloping edges or breaks of the high plateau section of the southwestern part of the county, occupying less steep and less stony areas than rough stony land. Most of this soil is in forest, owing chiefly to its steep surface relief and to its isolated location. In other parts of the county, soils of similar surface relief are used for pasture and to some extent for cultivated crops.

**Leetonia stony silt loam, steep phase.**—Leetonia stony silt loam, steep phase, is a moderately extensive soil in Wyoming County, but it has little agricultural importance. It is similar to the steep phase of Lordstown gravelly silt loam, except that the soil is stony as well as gravelly. Some areas are used as pasture, but most of the land is woodland.

**Lehew gravelly silt loam, steep phase.**—Lehew gravelly silt loam, steep phase, has the same profile as typical Lehew gravelly silt loam, but the surface relief is too steep for other agricultural use than pasture. Much of the soil is too shallow to be plowed successfully, as the thickness of the soil material over bedrock ranges from only 1 to 2½ feet. Small spots of soil derived from thin glacial material occur, in which the depth to bedrock is slightly greater. Outcrops are numerous. Part of the land has been cleared for hill pasture, and the rest is woodland.

**Lehew stony silt loam, steep phase.**—Lehew stony silt loam, steep phase, is similar to typical Lehew stony silt loam, except that it has steep but not mountainous surface relief. The depth to bedrock ranges from only 1 to 3 feet, and rock outcrops are very numerous.

#### ORGANIC SOILS

The organic soils consist of muck and peat, which are very poorly drained and inextensive in Wyoming County. They are undeveloped for farm use, other than for pasture.

**Muck and peat.**—Muck and peat occur in several small bodies within the agricultural districts, but the largest areas are inaccessibly situated on the mountain tops in the southwestern part of the county.

The soil material consists of black well-decomposed organic matter originating from decaying swamp vegetation. It is soft, black, fluffy, light in weight, and very porous, being typically almost free of min-

eral particles. In most of the muck bogs the black surficial material is at least 3 feet thick and is underlain by light-gray deoxidized clay. In some areas muck extends to a maximum depth of 10 feet. In many places seams of brown fibrous peat occur below a depth of 15 inches. Some small areas of shallow muck and of virgin peat are included in mapping, because of their small extent. The muck in Wyoming County is of the acid type.

Muck occupies depressions or basins, having very poor natural drainage. In fact, it has developed under essentially stagnant water or bog conditions, with a high water table. The surface relief is flat. Artificial drainage is required before crops other than blueberries or cranberries can be produced. The natural vegetation on some areas consists of blueberry bushes but more commonly of swamp bunch grass or a thin stand of hemlock and birch.

#### DARK-COLORED POORLY DRAINED SOILS

Gray and dark-colored soils having very poor surface and internal drainage comprise this group, including the inextensive soils of the Chippewa and Lickdale series, and a classification of different-textured poorly drained bottom land and basin material mapped as alluvial soils, undifferentiated. These soils are in general included in pastures.

**Alluvial soils, undifferentiated.**—Alluvial soils, undifferentiated, represent not a soil type but a land classification covering many small strips of very poorly drained flat or nearly flat bottom land and basin land of assorted textures, prevailing yellow or brown loams and silt loams, more or less mottled with gray, underlain by gray or gray and yellow subsoils which are in general heavier, or clayey, in texture. Drainage is everywhere very poor. Some areas are stony, most of the stones having been collected and dumped there by the farmers.

This undifferentiated material is mapped along many of the smaller streams, particularly in their upper reaches. Areas of this kind of land occurring in farms are generally used for pasture.

**Chippewa silt loam.**—Chippewa silt loam is an inextensive and agriculturally unimportant soil which occurs in small spots and strips in many parts of the county, usually around stream heads and on low seepy slopes. It is wet soggy land and is used only for pasture or woodland.

The surface soil is dark-gray gritty silt loam or, in a very few places, silty clay loam, ranging from 3 to 6 inches in thickness. It is underlain, to a depth of 36 or more inches, by mottled yellow and light-gray, light-gray, or bluish-gray heavy silt loam or silty clay, which is somewhat compacted, tough, and plastic.

The surface relief is gently sloping or nearly flat, and drainage is very poor. Many small bodies are included in the farms of the county. Some areas are stony, the loose rock generally having been dumped there by farmers.

In a few low places and around stream heads in the red-land sections, a red-land counterpart of the Chippewa soil occurs. This soil is chocolate-red or dark-red silty clay loam to a depth ranging from 3 to 6 inches. It is underlain to a depth of 36 or more inches

by light-gray, yellow, and pink mottled tough and plastic silty clay or clay. Most of the soil is free of stones or gravel, although these occur on the surface in places. The surface relief is flat, and drainage is very poor. This included soil has no agricultural value, except for pasture.

**Lickdale stony loam.**—Lickdale stony loam occupies the swales and depressions of poorly drained material in the high plateau section. The surface soil is dark gray or almost black and in places is covered by a thin mantle of mucky material. Below a depth ranging from 7 to 10 inches the subsoil is yellow or yellowish-brown fine loam containing gray mottlings, and in the lower depressions it changes to gray loam with yellow and brown mottles. This material passes at a depth ranging from 20 to 24 inches into rather compact gray loam mottled with dark brown, which passes between depths of 30 and 36 inches into gray fairly compact till or, in some places, residual material. The entire soil mass contains much angular gravel and pieces of flaggy sandstone. Drainage is poor. This land is covered with forests and has not been utilized for crop production.

#### MISCELLANEOUS SOIL MATERIALS

The remaining soils or land divisions not heretofore mentioned are stony and mountainous soils which are in forest or occur as river wash along the larger streams. Some areas occur within farm boundaries and are mainly in wood lots, some of which are pastured.

**River wash.**—River wash consists merely of beds and bars of sand and gravel, which have been formed in places, mainly in the channel of Susquehanna River, by flood waters. They are exposed during a part of the year, when the stream subsides to its normal level. This land is devoid of vegetation.

**Rough stony land (mainly Leetonia and Lehew stony loams).**—About one-seventh of the area of the county is embraced in this classification. It is by far the most extensive mapping unit used in this soil survey. The largest areas are in the southwestern part of the county. The classification includes all the long abrupt mountain slopes of Dutch Mountain, North Mountain, Miller Mountain, and Osterhout Mountain, together with a few outlying similar sharp slopes along the banks of Susquehanna River and some of the tributary streams in the agricultural districts.

The great part of the soil material on these slopes is Leetonia stony loam. On the northern slopes of Dutch Mountain and North Mountain and in some other parts of the county, particularly on lower slopes, the soil material is Lehew stony loam. The depth to bedrock ranges from 2 to 5 feet. Rock outcrops are very numerous and extensive, particularly on the upper slopes, and many large rocks are scattered on the surface in places. Abrupt cliffs occur in places. Most of these areas are bare of soil and vegetation, and none has more than a sparse vegetal growth.

Virtually all the rough stony land is in second-growth forest, consisting principally of chestnut oak, red oak, black oak, red maple, and sugar maple, mingled with hickory, cottonwood, aspen, birch, some pine, and hemlock. The undergrowth is sweetfern, huckleberry, mountain-laurel, and rhododendron.

The surface relief almost everywhere is very steep or mountainous, and cultivation of the land is not possible. Some very narrow sharp mountain-top ridges are included with rough stony land in mapping. Most land of this character is suitable for forestry.

#### AGRICULTURAL METHODS AND MANAGEMENT<sup>a</sup>

The most extensively grown crop, red clover and timothy hay, usually follows oats which are used as a nurse crop for the timothy, and the clover is planted early the following spring. Clover and timothy furnish one cutting of hay, which is the principal dry forage for cattle, and the sod is generally plowed under in the fall. Most of the clover is of the common red variety, with a little mammoth red. Lime is applied at the rate of 1 ton an acre of ground limestone. It is customary to apply barnyard manure on the sod or during the winter previous to planting corn which almost invariably follows hay. Most of the corn is used for silage. Sweepstakes, Lancaster Surecropper, and Eureka are the principal varieties grown. For grain, Leaming Improved, Yellow Flint, King Philip, and Smoky Hollow are favored varieties. More of the dent corns are used for grain than formerly. Most of the silage corn is planted in drills, but some is planted in hills for cross cultivation. Some farmers make a maximum acre application of 200 pounds of superphosphate on corn. The crop is planted in early May, and the silage corn is cut in September. Farmers growing corn for grain usually cut the stalks with the ears attached, husk out the mature corn late in the season, and feed the stover as coarse fodder.

Wheat is planted in the fall, and barley, like oats, in the spring. Oats generally follow corn. Local varieties of all three crops are used. Oats are drilled, as early as practical, with clover seed. The usual acre application of fertilizer is about 200 pounds of superphosphate or a 4-12-4 fertilizer. If the preceding corn crop was good and the soil in a productive condition, fair or good yields of oats are obtained without additional fertilizer. The oat harvest is in July. Rye is sometimes planted for grain, or to be plowed under, preceding potatoes, and sometimes it is used for early spring pasture. A part of the small grains is ground into livestock feed at local gristmills. Silver Hull and Japanese are preferred varieties of buckwheat. Buckwheat is seeded about July 1 and is cut from 8 to 10 weeks later. After threshing, most of the grain is taken to local mills and converted into buckwheat flour and middlings. Usually a moderate application of fertilizer or of superphosphate alone is used for buckwheat. A few soybeans are grown for soybean hay.

Rural New Yorker, Sir Walter Raleigh, and Russet varieties of potatoes are grown. Land for potatoes is generally well supplied with organic matter by plowing under a clover sod or some other crop. Fresh manuring before planting potatoes is avoided. Maximum acre applications as high as 1,000 pounds of 4-10-7, 4-10-8, or 4-10-9 fertilizer are used. Acre yields of potatoes range from 100 to 350 bushels, depending on the soil, seed, and treatment. The surplus potato crop, above home and local needs, is sold in Scranton and Wilkes-Barre.

<sup>a</sup>The information in this section of the report is furnished by County Farm Agent Jaquish

In the southern part of the county, especially near Falls, Center Moreland, and Beaumont, many truck farms are operated to supply the nearby cities of Scranton and Wilkes-Barre with cabbage, tomatoes, sweet corn, cucumbers, and other vegetables. Ballhead varieties of cabbage are preferred. Choice land, well manured, is used for this crop. Acre applications as high as 700 pounds of fertilizer high in nitrogen are used. Margold, Bonnie Best, and other varieties of tomatoes are grown. About 500 pounds of 5-10-5 fertilizer is used on tomatoes. Golden Bantam and Evergreen varieties of sweet corn are grown and are fertilized in the same way as tomatoes. For cucumbers heavy applications of manure alone are used.

There are about 15 commercial orchards in the county, which produce apples mainly, with some pears and peaches. Baldwin, Northern Spy, and Rhode Island Greening apples; Bartlett, Kieffer, and Seckel pears; and Elberta and Belle peaches are the principal varieties. Both sod and clean-cultivation methods of orchard management are in use. Light top dressings of manure or small applications of sodium nitrate are used in orchards. A few plums, German prunes, cherries, and grapes are produced. The fruit is marketed at Scranton, Wilkes-Barre, and at Binghamton, N.Y., largely. A few growers devote acre or half-acre plots to strawberries and raspberries.

The cattle raised and kept for dairy purposes are principally Holstein-Friesians, with some Guernseys and Jerseys. All the cattle in the county were tuberculin tested in 1929. From 5 to 10 percent of the cattle are registered purebred animals, and most of the others are grades, although there are still a few scrubs. Comparatively few beef cattle are kept on the farms.

It is the aim of most farmers to grow as much of the dairy cattle feed as possible. However, the production of winter milk requires large quantities of nitrogenous concentrated feeds, consequently the feed bill is rather large. The feed expense for the county in 1929, according to the 1930 census, was \$651,410. The average farm dairy herd consists of 10 milking cows. The cans of milk are placed on platforms along country roads and are picked up daily and carried to local railway shipping stations.

The sheep raised are of the medium-wool type, mainly Shropshires and Hampshires. Hogs are raised mainly for home and local use, and they are principally Berkshires and Chester Whites.

About 50 farmers keep flocks of more than 500 chickens each. White Leghorns predominate on the egg farms, and Rhode Island Red and Plymouth Rock are the dominant American breeds raised on most farms. The egg markets are New York, Scranton, and Wilkes-Barre. Many farmers engage in the production of market poultry, and a few ducks, geese, and turkeys are raised.

Experiments that have been conducted for a number of years on Volusia gravelly silt loam (6) in Bradford County, which joins Wyoming County on the northwest, indicate that the rotation of oats, hay, silage corn, and buckwheat has been more profitable than the rotation of corn, oats, wheat, and hay, and a greater quantity of winter feed is produced thereby. In the production of mixed clover and timothy hay, a short rotation with frequent crops of clover is recommended.

Studies under Pennsylvania conditions indicate the economy of applying moderate quantities of lime at intervals ranging from 3 to 5 years, rather than using very heavy applications with the expectation of greatly lengthening the intervals (7). Lime is lost from the soil by leaching and by removal of crops. The legumes, such as clover and alfalfa, are not only less tolerant of soil acidity than the cereals, but they require more lime for healthy growth, and they remove more lime from the soil than do cereals. It is important to make the lime application just before seeding the legume. It makes little difference what form of lime is used, so long as it is moderately well pulverized and evenly mixed with the surface soil.

Most Pennsylvania soils make good pasture land (2), and about one-third of the improved land in farms in Pennsylvania is in pasture. A combination of Kentucky bluegrass, Canada bluegrass, red-top, timothy, and white clover makes the best northern pasture, and these grasses seem to thrive wherever the soil is not too poor or too acid. The nonlimestone soils can be made to produce profitable pasture by the systematic use of lime and fertilizer.

To make a good pasture, a soil needs much the same elements of fertility as it does to produce good cultivated crops. Bluegrass and white clover may do well on rich or well-manured soil even if there is a lime requirement ranging from 2,000 to 3,000 pounds of limestone an acre. They will not thrive, however, on soils both poor and acid, and this is the condition prevailing in many poor pastures. In building up such pastures, 2 tons of ground limestone an acre should be applied. Top dressings ranging from 300 to 400 pounds an acre of superphosphates, in connection with lime and seed, have produced an almost solid stand of white clover in 1 year on impoverished hill-side pastures formerly covered with poverty grass and cinquefoil. When a plowable pasture sod has become very poor, results will probably be most satisfactory if the field is plowed and farmed. It is thus possible to obtain a better seed bed and a cleaner, thicker stand of pasture grasses. One method is to plow the old pasture, sowing oats in the spring with some lime and fertilizer, following with wheat or rye with more lime and fertilizer, and if possible a light top dressing of manure, either just before seeding or during the winter. The grasses should be sown in the winter grain planted in the fall and the clovers in the spring.

Red clover (5) is the most valuable legume forage crop in the State. The failure of the clover crop is one of the first indications of the need of lime in the soil. Clover responds well to applications of phosphoric acid and potash. When winter grains are not grown, clover and timothy may be sown with spring grains, as oats, sowing with a grain drill at the same time the grain is sown. An acre application ranging from 200 to 350 pounds of superphosphate or an equal quantity of 0-12-5 is recommended.

One of the most serious problems of the dairyman is to grow sufficient protein feed to balance the home-grown carbohydrate feeds, such as corn, oats, silage, and timothy. Alfalfa (3) is the most efficient producer of high-class protein and will produce 50 percent more hay than common clovers. Also, it withstands drought much better.

Alfalfa must have a well-drained sweet soil properly inoculated. Hardy varieties, such as Grimm, are recommended, as they

produce longer, more durable stands with less winter-killing. Alfalfa is the best forage crop for droughty soils, and it is also adapted to heavier well-drained soils. Spring seeding is recommended, as spring-planted alfalfa is less likely to winter-kill. The crop may be sown on wheat or rye with good results, just as clover is sown, because, unless sown with a nurse crop, alfalfa is likely to be soon choked out with weeds. On dairy farms the rotation may be oats and alfalfa. Best results in cutting alfalfa are obtained if cutting is delayed about 2 weeks after the blooms begin to form, even though this may mean but two hay crops, instead of three, in a season.

Pennsylvania is the leading State in production of buckwheat (1). This crop, which matures in 8 or 10 weeks, will do better than any other grain crop on infertile and poorly tilled land, if climatic conditions are favorable. It is an acid-tolerant crop which responds to good soil, cultivation, and fertilization. A recommended fertilizer application is from 200 to 250 pounds of superphosphate an acre.

Potatoes require good well-drained soil, but not necessarily high in lime. Plenty of organic matter is advisable. Best results are obtained when potatoes follow a legume crop. If high yields are expected, 1,000 pounds of high-grade commercial fertilizer, high in potash, should be applied.

The general use of manure on sod, and lime and superphosphate in connection with the rotation of clover and timothy, corn, oats, and buckwheat is good practice. Deeper plowing is favored. Cover crops are not very successful in the rotation, because most of the plowing is done in the fall. An increase in the acreage of potatoes, as a cash crop, and of sweetclover and alfalfa, for forage crops, is recommended. Improvement in the care of apple orchards is urged.

### SOILS AND THEIR INTERPRETATION

The soils of Wyoming County lie within the hilly and mountainous, deeply dissected upland physiographic division known as the Allegheny Plateau of northern Pennsylvania. Elevations range from 560 to about 2,400 feet above sea level. Most of the mature soils are gray-brown podzolic soils, and small areas on mountain tops are true podzols. The parent soil materials have been derived almost entirely from sandstone and shale materials and were accumulated in part by glacial action and in part by residual decay.

The soils of the lower lands have developed under the influence of a cool humid climate, where the mean annual temperature is 49.4° F., the mean annual precipitation, 37.05 inches, the mean annual snowfall, 51.9 inches, and the frost-free season averaging 177 days. In most of the high uplands the frost-free season is at least 2 weeks shorter, and the mean annual temperature is somewhat lower.

The natural vegetation is second-growth mixed forest. Originally, nearly pure stands of pine and hemlock predominated on the high lands and hardwoods in the lower valley lands. The present growth consists largely of oak, maple, beech, cottonwood, aspen, hickory, white pine, and hemlock.

The coarser textured soils on the higher mountains above an elevation of approximately 1,800 feet, unless derived from red parent

materials, show the characteristic podzol profile. In the podzol soils, the finer textured materials have been removed from the surface soils and deposited in the subsoils, or washed out, leaving mainly siliceous loamy sands which are somewhat white or light gray in color. Iron and aluminum oxides, clayey and silty materials, and colloids, are lacking in the upper mineral soil layer of the podzol soils. Calcium carbonate and other basic salts have been well leached out of the entire profiles. The surficial formation of a layer of highly acid peaty brown or black organic matter, contributing organic acids to the soil solution, are believed to have stimulated leaching. Immediately under the light-gray sandy layer, or bleicherde, there is typically, due to organic coloration, a coffee-brown layer, an inch or two thick. Below this is a yellow friable horizon which is the thickest layer of the solum. In some places a looser layer or slightly cemented horizon of vesicular structure occurs, more or less cemented by siliceous binding material.

A typical podzol profile of Leetonia stony sandy loam is described as follows:

- 0 to 4 inches, dark-brown forest litter
- 4 to 8 inches, nearly white loamy sand, the bleicherde
- 8 to 9 inches, coffee-brown loamy sand
- 9 to 18 inches, yellowish-brown sandy loam.
- 18 to 24 inches, yellow light sandy clay loam which rests on gray sandstone parent rock.

Loose angular sandstone fragments are scattered throughout the solum.

The podzol soils of the county include the Leetonia and Mardin soils. Profiles of these soils have been described in other sections of this report.

The podzol profiles are practically limited to the well-drained or fairly well drained high mountain soils, derived from yellow or brown materials, which are rather coarse textured, mellow, and porous, allowing rapid downward percolation of soil water. Red soil materials, similar in other respects, resist this process.

The gray-brown podzolic soils have a 1- or 2-inch surficial layer of black organic matter. Below this, the mineral soil profile of the well-drained soils is, in general, not strongly developed, so far as texture is concerned. The subsoils average somewhat heavier in texture than the surface soils. Calcium carbonate and other basic salts have been well leached out.

Several soils of the county are not inherently well drained or well weathered, owing to hard subsoils and substrata. The virgin profile of Volusia gravelly silt loam illustrates these conditions and is described as follows:

- 0 to 2 inches, black forest mold
- 2 to 6 inches, dark brownish-gray silt loam or heavy silt loam
- 6 to 10 inches, pale yellow heavy silt loam mottled with light gray
- 10 to 15 inches, light-gray and yellow mottled heavy silt loam
- 15 to 36 inches, light-gray, mottled with yellow, hard silty clay loam

Shale fragments occur throughout the soil. Soil-forming processes have been retarded in soils having this type of profile. Acidity ranges from moderate to high in the surface soil and decreases with depth. In places neutral or alkaline reactions are obtained in the substratum claypan below a depth of 6 feet. Numerous variations

of the selected profiles are apparent in the descriptions of the separate soils.

The soils of Wyoming County, grouped according to profile maturity of weathering, are as follows:

Well-developed podzols. Soils of the Leetonia and Lehew series.

Partly developed podzols. Mardin and Lordstown soils occurring above an elevation of 1,800 feet.

Well-developed gray-brown podzolic soils. Mainly silt loams of the Westfield and Lordstown series, and all Lackawanna, Walton, Wooster, Otisville, and Chenango soils.

Partly developed gray-brown podzolic soils. Silt loams of the Canfield series, and all Wellsboro and Volusia soils.

Undeveloped soils. Chippewa and Lickdale soils, muck and peat, and all recent-alluvial soils of the Tioga and Barbour series, and alluvial soils, undifferentiated.

### SUMMARY

Wyoming County is one of the smaller Pennsylvania counties. It is in the northeastern part of the State. The surface relief is for the most part hilly and mountainous, but some valley lands and extensive hill lands are under cultivation.

Dairying is the predominant type of farming, and raw milk is the principal product sold. The income derived from the sale of raw milk to outside city markets amounts to about \$1,000,000 annually, and the cost of feed, in addition to that produced on the farms of the county, is about half that amount. The production of winter milk is the aim of most farmers. Clover and timothy hay, oats, silage corn, and buckwheat are the principal feed crops. The main cash crops are a part of the buckwheat and potatoes, some baled hay, apples, peaches, pears, cabbage, tomatoes, and sweet corn. Fifteen commercial orchards are in the county. The production of market poultry and eggs is a large item of income on many farms, and on 50 or more farms there are flocks of more than 500 chickens each.

The most fertile and best-improved land is in the larger valleys and in the southern part of the county on the uplands. Farm land in the northern part is generally considered less valuable.

The prevalence of a considerable acreage of good general-farming soils, comparative nearness to markets offering diversified demand for farm products, good transportation facilities, and fairly low land prices are all factors favorable to a reasonably prosperous and stable agriculture under normal economic conditions.

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