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BUREAU OF CHEMISTRY AND SOILS
In cooperation with Pennsylvania State College School of Agriculture and Experiment Station

SOIL SURVEY
LYCOMING COUNTY, PENNSYLVANIA

BY

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CONTENTS

	Page
County surveyed	1043
Climate	1047
Agriculture	1049
Soils	1053
Berks gravelly silt loam	1059
Berks silt loam	1060
Berks shale loam	1060
Berks gravelly loam	1061
Upshur gravelly silt loam	1062
Upshur gravelly loam	1064
Upshur shale loam	1065
Upshur silt loam	1065
Upshur stony silt loam	1066
Hagerstown silt loam	1067
Hagerstown stony clay	1068
Murrill silt loam	1069
Lackawanna gravelly loam	1070
Lackawanna stony loam	1071
Lackawanna silty clay loam, poorly drained phase	1072
Wheeling loam	1073
Wheeling silt loam	1074
Wheeling gravelly loam	1075
Wheeling fine sandy loam	1075
Wheeling fine sand	1076
Holston silt loam	1076
Moshannon fine sandy loam	1077
Moshannon loam	1078
Moshannon gravelly sandy loam	1078
Dekalb gravelly loam	1079
Dekalb stony loam	1079
Dekalb stony sandy loam	1082
Lordstown gravelly silt loam	1082
Lordstown silt loam	1083
Lordstown stony loam	1084
Lordstown stony sandy loam	1084
Lickdale stony loam	1085
Lycoming gravelly silt loam	1086
Lycoming silt loam	1087
Lycoming loam	1088
Lycoming gravelly loam	1088
Tyler silt loam	1089
Pope silt loam	1089
Pope fine sandy loam	1090
Atkins clay	1090
Muck	1091
Rough stony land	1091
Summary	1091

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By E. H. STEVENS, in Charge, and B. H. HENDRICKSON, United States Department of Agriculture, and C. B. MANIFOLD, C. G. DEGEN, and AUSTIN L. PATRICK, Pennsylvania State College

COUNTY SURVEYED

Lycoming County is in north-central Pennsylvania. It is bounded on the north by Tioga County, on the east by Sullivan County, on the southeast by Columbia County, on the south by Montour, Northumberland, and Union Counties, and on the west by Clinton and Potter Counties. It is very irregular in shape, the northern boundary line being the only one which is continuous in one direction for any considerable distance. It is the largest county in the State, having an area of 1,231 square miles or 787,840 acres.

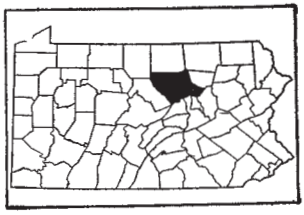

FIG. 35.—Sketch map showing location of Lycoming County, Pa.

Physiography.—Lycoming County lies across the boundary between the ridge belt and the Allegheny Plateau, both of which are features of the Appalachian system. The boundary line, the Allegheny front, runs very close to the northern boundaries of Shrewsbury, Mill Creek, Eldred, and Hepburn Townships, and from the northwest corner of the latter it runs southwestward to the county line near the middle of the west side of Watson Township. The ridge belt lies south of this line and the Allegheny Plateau north of it.

The ridge belt consists of a series of hilly lowland belts and narrow mountain ridges running approximately parallel, and that part of the belt in Lycoming County constitutes only a small part of the entire belt. In this county the belt includes a hilly lowland immediately south of the Allegheny front. From the western boundary of the county to the western boundary of Mill Creek Township this lowland is about 8 miles wide. East of Mill Creek Township it widens and includes the entire southeastern corner of the county. It extends westward south of Bald Eagle Mountain, which forms the southern boundary west of Mill Creek Township, and covers a considerable part of Washington and Brady Townships. The hills rise to a height of about 1,000 feet above sea level, and such smooth areas as are present lie at elevations ranging from 600 to 700 feet. West of Mill Creek Township the valley of Susquehanna River runs along the southern side of this lowland. Its elevation ranges from about 500 feet where it turns southward in the eastern part of the county to about 550 feet on the western border. The streams which dissect the lowland, all tributaries of Susquehanna River, have cut into the lowland to a depth in some places as great as 450 feet.

In its western part this lowland belt is bounded on the south by Bald Eagle Mountain, a narrow ridge with an even crest about 1,600 feet above sea level. This ridge is less than 2 miles wide at its base and maintains a strikingly even width throughout its length. It slopes to a sharp crest at the top.

South of Bald Eagle Mountain is a lowland belt, about 700 feet above sea level and about 5 miles wide on the western boundary of the county. It narrows toward the east and finally ends in a point about halfway across the county. It is known as Nippenose Valley. South of Nippenose Valley is North White Deer Ridge, very similar in shape to Bald Eagle Mountain but a few hundred feet higher. It bounds the south side of Nippenose Valley, Bald Eagle Mountain bounding the northern side and the two uniting into one ridge at the eastern end of the valley. A gradually narrowing mountain ridge extends eastward from the junction for about 8 miles where it terminates rather abruptly, Susquehanna River turning southward immediately east of the terminus.

In a similar way, a few miles east of the western boundary of the county, North White Deer Ridge joins another ridge south of it. The western end of the combined ridge lies west of the county line, but the ridge itself, known as South White Deer Ridge, extends southeast from the junction for a few miles before it crosses the southern boundary of the county. These two ridges inclose the western extension of the main lowland where it narrows and finally ends.

Briefly, the southern half of the county south of the Allegheny front consists of a hilly lowland ranging in elevation from about 500 feet in the valleys of the rivers draining it to 1,000 feet on the hilltops. In this area there is a single ridge which forms a very much flattened letter Z, each arm or stretch of which is locally recognized as a single ridge and has received a name of its own.

The lowland soils are underlain by a series of shales and other rocks which yield readily to the forces of erosion but the ridges are formed by the upturned edge of a sandstone layer and are resistant to the forces of erosion. Because the ridge was subjected to complex folding and equally complex erosion in several successive erosion periods it now assumes its present zigzag course.

That part of the county north of the Allegheny front consists of a plateau which lies at an elevation slightly greater than 2,000 feet. The Allegheny front consists of the southward facing steep slope by which this plateau drops to the hilly lowland already described. It is dissected by a few large creeks, each of which has cut a valley about a thousand feet deep. A considerable number of small ravines and hollows branch widely. These have not dissected the region completely but have left considerable areas of smooth, undissected land.

In addition to the sharply cut, deep, narrow creek valleys which traverse this area, it is crossed by a series of more or less well-defined lowland belts separated by flat-topped ridges. The best defined of these belts is known as Beach Valley. It runs, as a belt 3 or 4 miles wide, northeastward across the northwest corner of Gamble and the southeast corner of Cascade Townships. It lies a few hundred feet below the level of the plateau both north and south of it and 300 feet higher than the lowland south of the Allegheny front. It con-

sists of a hilly upland more thoroughly dissected than the plateau but with smoother slopes.

Another lowland of about the same kind runs northeastward across Cogan House Township east of Little Pine Creek. It lies nearly 500 feet lower than the plateau immediately south of it. Its surface is strongly rolling and resembles the lowland belt immediately south of the Allegheny front.

Along the larger streams of the county are well-developed bottom lands and terraces. These are narrow, as a rule, within the Allegheny Plateau region, but the flood plains and terraces broaden out considerably as the streams emerge into the hill country. In the mountains the smaller tributaries have developed no flood plains, but in the lowlands and the hill country they are usually bordered by narrow strips of bottom land.

Elevations above sea level range from about 500 feet where Susquehanna River leaves the area to more than 2,300 feet on the highest points of the plateau region. The average elevation of the ridges within the Allegheny Plateau is about 2,100 feet; elevations in the hill country in the central part of the county range from 900 to about 1,400 feet; and Bald Eagle Mountain rises about 1,500 feet above sea level.

Lycoming County is entirely within the drainage basin of West Branch Susquehanna River. The most important tributaries are Pine, Lycoming, Loyalsock, and Muncy Creeks, all of which drain that part of the county lying north and east of the river. Pine, Loyalsock, and Lycoming Creeks all rise in lowland belts of the plateau region outside the county, but in Lycoming County they have cut through elevated sections of the plateau and formed narrow valleys averaging between 1,000 and 1,500 feet in depth. Little Muncy, Little Pine, and Larrys Creeks all have rather extensive drainage basins within the county. The territory south of the river is drained by several small streams. The drainage of Nippenose Valley is entirely subterranean, the several mountain streams disappearing as they reach the limestone strata which form the valley floor. Uniting underground, they emerge in an immense spring at the valley outlet and form a fairly large stream, Nippenose Creek, which has cut a rugged gap through Bald Eagle Mountain. This stream joins West Branch Susquehanna River opposite Jersey Shore.

Small branches and streamlets extend to all parts of the county, and practically every farm has one or more drainage outlets. Drainage is thorough in the elevated parts of Allegheny Plateau, but the region is not so well watered as other parts of the county. Natural drainage is well established nearly everywhere, except for occasional narrow strips of alluvial deposits where a semimarshy condition prevails. These strips are most common in depressions in White Deer Valley, but small areas occur in places on colluvial slopes and around stream heads where seepage occurs, especially in the lowlands of the plateau region and on the north side of Nippenose Valley. The water supply is everywhere adequate for farm use, except in Nippenose Valley where a few farms are dependent upon cisterns or water piped from the mountain springs and streams.

The streams have cut deep valleys through which they flow rapidly, and the process of stream cutting is still active. West Branch Susquehanna River has a fall of about 3 feet a mile; the

larger tributaries descend from 8 to 30 feet a mile; and many of the small streams in the mountains have gradients ranging from 100 to 200 or more feet a mile. The large bowlders strewn throughout their channels testify to their immense carrying power in flood periods. Most of the larger streams are capable of developing considerable water power, which was largely utilized, when the lumber industry was at its height, for the purpose of floating logs to the great mills then at Williamsport. There are still numerous water-power grist mills throughout the county.

The first settlement of Lycoming County was made about the middle of the eighteenth century, and development was comparatively rapid. The county was organized from Northumberland County in 1795; at that time it embraced a much greater area than it now has, the present boundaries having been established in 1847. Important factors in the early growth of the county were the construction of the Philadelphia & Erie Canal in 1834 and the opening of a railroad from Williamsport to Ralston in 1839. The latter facilitated the development of coal and iron mines.

The present population is densest in the valley of West Branch Susquehanna River and its environs, and all the more important towns are located there. The mountainous regions are very sparsely settled except along the railroads and in the lowland belts. The population is made up largely of native-born whites, although there are many families of German extraction and a sprinkling of other nationalities in the industrial centers. The early settlers came largely from the southeastern part of the State. The population of Lycoming County, according to the 1920 census, is 83,100, of which 36,458, or 43.9 per cent, is rural. The rural population has decreased since 1890, when it was 40,547. The density of the rural population in 1920 was 29.9 persons to the square mile.

Williamsport, which in 1920 had a population of 36,198, is the county seat and the largest city in the north-central section of the State. It is an important railroad center, supports a diversity of manufacturing enterprises, and is a trading center for much of the surrounding territory. South Williamsport, with 4,341 inhabitants, and Duboistown, with 756, are the largest suburbs and are both incorporated boroughs. Jersey Shore, in the western part of the county, has 6,103 inhabitants, and is an important business center. Other places of importance are Montoursville, Muncy, Hughesville, and Montgomery. Other towns of less than 1,000 population are Ralston, Trout Run, and Picture Rocks. In addition to these there are numerous small villages and rural centers.

Nearly all settled parts of the county have excellent transportation facilities. The Philadelphia & Erie division of the Pennsylvania Railroad, one of the most important branch lines of that system, follows the river valley through the county. The Northern Central division diverges at Williamsport and runs north to Elmira and Canandaigua, N. Y. The western and northwestern parts of the county are served by the Pennsylvania division of the New York Central Railroad, which terminates at Williamsport with a line to the bituminous coal fields in Clearfield County. The Philadelphia & Reading Railroad has a line to Williamsport. The Williamsport & North Branch Railroad and the Susquehanna & New York Rail-

road serve the eastern and northeastern parts of the county, respectively. The north-central and southwestern parts of Lycoming County are rather remote from railroads.

A considerable mileage of State highways is regularly dragged and kept in the best possible condition, and a number of the main highways are constructed of concrete or macadam. The State is now undertaking an ambitious program of concrete road building within the county. The public highways, called township roads, form a network over all the settled regions of the county, and are kept in good condition during the summer. In the mountains, roads are few and in many places are very rough. The natural difficulties in the way of road construction and maintenance in Lycoming County are unusually severe and excellent progress is being made in view of these conditions.

Telephone service and rural mail delivery are universal throughout the settled portions of the county. In regions covered by State forest, the State department of forestry maintains its own telephone lines.

Williamsport and Jersey Shore are the principal markets for farm produce. Curb markets for the disposal of vegetables and other farm produce are held at both places twice each week, and at Williamsport the market has become an institution largely used by nearby farmers and well patronized by the inhabitants of that city and its suburbs. New York, Philadelphia, and Baltimore are the main outside markets. Dairy products are shipped to various places. There are two creameries at Trout Run and one at Jersey Shore. Some milk is shipped to New York from Hepburnville and other stations on the Northern Central Railway above Ralston.

CLIMATE

There is a wide variation in climate in Lycoming County. In the West Branch Susquehanna River Valley and its environs, the comparatively low elevations and the tempering influence of the water markedly moderate the temperatures, whereas the mountainous sections are characterized by long, severe winters and short, cool summers. The appended climatological data compiled from the Weather Bureau records at Williamsport are representative for the Susquehanna Valley, and similar data from the Weather Bureau station at Wellsboro, Tioga County, about 40 miles north of Williamsport, are more representative of the plateau region, embracing the northern half of Lycoming County, as well as of sections of high altitude south of the river.

At Williamsport the mean annual temperature is 50° F. and at Wellsboro is 46.2°. At the latter place the temperature ranges from a recorded maximum of 101° to a recorded minimum of −28°, and at Williamsport these extremes are 103° and −17°, respectively. The mean summer temperature is 70.8° at Williamsport, 4.2° higher than at Wellsboro.

The average date of the last killing frost is April 26 at Williamsport and of the first is October 13, giving a normal frost-free season of 169 days. The Wellsboro figures show a striking difference. Here, the average date of the last killing frost is May 11 and of the first is September 23, giving a frost-free season of 134 days, 35 days

shorter than at Williamsport. The latest recorded killing frost occurred at Williamsport on May 22 and at Wellsboro on June 20, and the earliest recorded occurred at Williamsport on September 15 and at Wellsboro on August 25. The grazing season extends from five to nearly seven months.

The temperature variations in the several sections of the county are distinctly reflected in the agriculture, so much so that the county might be divided into three zones on that basis. The first zone is the Susquehanna River Valley and its immediate environs. Here, the production of dent corn for seed is commercially successful and peaches are successfully grown. The frost-free season averages 169 days, and the grazing season approximates seven months. The second zone embraces the central hill region of the county and Nippenose and Mosquito Valleys. In these localities dent corn is successfully grown, but the commercial production of seed corn is not practiced and peaches thrive only in selected localities. The frost-free season covers about 140 days, and the grazing season lasts fully six months. The third zone includes the Allegheny Plateau, most of the intervening lowland belts, and also the high areas south of the river. In this zone dent varieties of corn are replaced by flint corn; rye is sometimes substituted for wheat; buckwheat, a cool-climate crop, is more extensively grown than in other parts of the area; and peaches fail except upon a few lower slopes of exceptional warmth and protection. The growing season ranges from 100 to 120 days, and the grazing season is a few weeks longer.

At Williamsport the mean annual rainfall of 39.99 inches is ample for all crops grown in the county and is fairly well distributed throughout the year. It is heaviest during the summer, the mean for June, July, and August being 12.47 inches. The snowfall is usually heavy, especially in the northern part of the county.

The following tables give the normal monthly, seasonal, and annual temperature and precipitation at Williamsport and Wellsboro:

Normal monthly, seasonal, and annual temperature and precipitation at Williamsport

(Elevation, 521 feet)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1895)	Total amount for the wettest year (1890)	Snow, average depth
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	30.5	66	−12	3.05	2.35	4.25	8.6
January	27.3	66	−17	3.00	2.92	3.50	9.6
February	26.6	62	−17	2.56	.59	3.70	9.6
Winter	28.1	66	−17	8.61	5.86	11.45	27.8
March	36.6	83	−5	3.35	1.16	4.30	8.4
April	48.6	90	8	3.38	2.17	4.00	1.1
May	60.7	96	30	3.20	2.37	6.20	.0
Spring	48.6	96	−5	9.93	5.70	14.50	9.5

Normal monthly, seasonal, and annual temperature and precipitation at Williamsport—Continued

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1895)	Total amount for the wettest year (1890)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
June	68.5	96	37	3.90	4.99	3.60	0.0
July	73.1	100	46	3.96	1.93	3.80	.0
August	70.7	103	44	4.61	2.30	4.30	.0
Summer	70.8	103	37	12.47	9.22	11.70	.0
September	63.9	94	31	3.21	2.12	3.90	.0
October	52.6	90	22	3.37	1.13	6.40	.0
November	40.8	79	6	2.40	1.95	1.30	1.0
Fall	52.4	94	6	8.98	5.20	11.60	1.0
Year	50.0	103	−17	39.99	25.98	49.25	38.3

Normal monthly, seasonal, and annual temperature and precipitation at Wellsboro, Tioga County

(Elevation, 1,419 feet)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1895)	Total amount for the wettest year (1889)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	28.2	65	−28	2.60	3.12	3.93	11.4
January	24.3	66	−27	2.57	2.75	7.02	12.2
February	23.6	62	−25	2.35	1.24	2.98	11.3
Winter	25.4	66	−28	7.52	7.11	13.93	34.9
March	32.7	81	−25	3.25	1.46	3.24	11.7
April	44.6	88	13	3.58	2.24	8.15	2.9
May	56.8	95	21	4.05	2.97	3.45	T.
Spring	44.7	95	−25	10.88	6.67	14.84	14.6
June	64.5	96	31	4.05	1.39	10.04	0
July	68.9	101	34	4.00	.98	3.06	0
August	66.4	100	33	3.71	2.24	.83	0
Summer	66.6	101	31	11.76	4.61	13.93	0
September	59.7	93	25	3.21	2.16	2.71	0
October	49.1	88	13	3.20	2.04	5.61	T.
November	37.5	76	−2	2.63	1.63	9.07	2.7
Fall	48.8	93	−2	9.04	5.83	17.39	2.7
Year	46.2	101	−28	39.20	24.22	60.09	52.2

AGRICULTURE

The agriculture of Lycoming County consists predominantly of general farming, with cereals and hay holding the first and second places of importance. In 1919 the value of the cereal crop, according

to the census, was $3,833,673; of other grains and seeds, $35,365; and of hay and forage, $2,002,488. The value of vegetables in that year was $1,182,290; of fruits and nuts, $272,022; and of all other crops, $35,070. The value of animals sold and slaughtered was not reported by the 1920 census, but the 1910 census reported this item at $559,364. In 1919 the value of dairy products, excluding home use, was $1,614,813; the value of all domestic animals, $3,821,178; and of poultry and eggs, $841,993. A large proportion of the vegetables are consumed on the farm, although in some places, as near Williamsport, market gardening is important.

Of the cereals, corn holds first place as to acreage, but oats and wheat are not far behind. Hay and forage crops are grown on the largest total acreage, not including pastures used exclusively for grazing.

The following table, based on United States census data, gives the acreage and production of the principal crops for the census years 1879 to 1919, inclusive:

Acreage and production of the principal crops, 1879, 1889, 1899, 1909, and 1919

Crop	1879		1889		1899		1909		1919	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	24,887	880,332	22,999	715,005	29,160	988,520	28,078	714,870	27,668	1,291,881
Wheat	23,418	287,699	22,133	341,550	25,261	275,490	22,318	347,632	24,618	391,996
Oats	19,422	490,065	23,518	661,982	25,176	853,370	25,450	561,227	25,613	660,332
Rye	7,510	60,826	6,280	67,361	6,679	65,130	6,171	64,282	6,710	69,651
Buckwheat	7,615	109,821	6,631	111,021	8,379	143,750	9,684	146,490	7,590	144,656
Potatoes	3,560	400,282	3,661	254,861	4,362	433,081	4,872	374,152	3,797	378,658
		Tons		*Tons*		*Tons*		*Tons*		*Tons*
Hay [1]	35,002	32,693	41,599	51,324	44,865	46,782	45,530	49,490	63,632	102,370
		Pounds		*Pounds*		*Pounds*		*Pounds*		*Pounds*
Tobacco	319	463,686	126	134,791	276	227,350	97	107,561	129	173,300

[1] Includes harvested forage crops beginning with 1899.

These figures show the trend of farm crop production for the last 40 years and the present status. They show that there has been no very radical change in the kind of agriculture, in the acreage, or in the yields of the crops. There has been some increase in the oat and corn acreage, but very little in that of wheat. The acreage of rye, buckwheat, and potatoes has been about constant. The greatest increase has been in the hay and forage crop, the expansion in this amounting to 18,102 acres or 28.4 per cent for the 10-year period from 1909 to 1919, or an increase of more than 81 per cent in the last 40 years.

Crop yields have not changed greatly since 1879. In that year corn yielded an average of 35 bushels an acre for the county; in 1919 the yield was 47 bushels, but this seemingly was due more to the favorableness of the season than anything else. In 1909 the corn yield was only 25 bushels an acre. There has been some increase in the yield of wheat, 12.3 bushels an acre being obtained in 1879, 15.5 bushels in 1909, and 15.9 bushels in 1919.

The hay crop of 1919 included 12,229 acres of timothy grown alone, with a yield of 15,819 tons; 1,978 acres of clover alone, yielding 2,682 tons; and 28,221 acres of mixed timothy and clover, with a production of 40,752 tons. Coarse forage and silage crops make up the principal part of the remainder of the hay and forage crops, the acreage of the former amounting to 17,982 and of the latter 2,394.

The increased acreage devoted to hay and forage has been accompanied, apparently, by some increase in the importance of the livestock and dairy industries, as indicated by the data shown in the following table:

Value of animal, poultry, and dairy products in 1899, 1909, and 1919 [1]

Year	Animals sold and slaughtered	Dairy products marketed	Poultry products
	Dollars	*Dollars*	*Dollars*
1899	375,091	304,876	----------
1909	559,364	562,440	323,764
1919	----------	1,614,813	841,993

[1] United States census.

A little tobacco is grown, but the crop can not be considered of much importance. Only 111,289 apple trees and 55,471 peach trees are reported by the last census, showing that fruit is not a very important crop.

The area of land farmed has not changed much since 1879, when it was 45.4 per cent of the area of the county. There was a rise to 47 per cent in 1899, followed by a decline to 42.2 per cent in 1919. Also the size of the farms and the proportion of improved land have undergone no startling changes, as shown by the United States census data in the following table:

Per cent of land in farms, size of farms, and proportion improved, 1879, 1889, 1899, 1909, and 1919

Year	Land in farms	Size of farms	Proportion improved
	Per cent	*Acres*	*Per cent*
1879	45.4	103.0	55.7
1889	42.7	99.0	60.9
1899	47.0	97.0	58.4
1909	45.9	97.1	57.7
1919	42.2	100.8	60.1

In the chapter describing the several soil types, agriculture is discussed in its relation to soil in such a way as to show the effect of the soil and surface features upon tillage methods, crops, and crop yields. This covers the range from nonarable rough stony land to rich alluvial soils along West Branch Susquehanna River.

Probably as good a conception of the agriculture of the uplands as could be had is afforded by the farm practices on Berks gravelly silt loam, an extensive and representative soil. On this soil corn yields vary, according to local estimate, from 20 to 50 bushels an acre; wheat, from 10 to 25 bushels; hay, from 1 to 2 tons; buckwheat,

from 15 to 35 bushels; rye, from 10 to 20 bushels; and potatoes, from 50 to 150 bushels. These yields may be considered as representative of the great areas of shale soil; somewhat better yields come from the rich terrace soils. Here, the average is usually less than the higher limits given, being about 30 bushels for corn, 30 for oats, 16 for wheat, 20 for buckwheat, 13 for rye, 80 for potatoes, and 1¼ tons for hay. The yields vary with the efficiency of soil treatment and the condition and kind of soil aside from seasonal influence.

A five-year rotation is commonly practiced, consisting of corn, oats, wheat, timothy and clover, and timothy alone. Some sod land is broken after the first year, thus shortening the rotation to four years. Rye sometimes takes the place of wheat, and in emergencies, due to unfavorable weather and other factors, buckwheat is substituted for any of the other crops. This common scheme of crop succession is varied considerably from farm to farm in order to adjust the field to the local surface configuration.

The soil is usually well prepared. Up-to-date equipment is used by the better farmers, but some fields are too steep to allow satisfactory use of riding plows or binders. Generally upland surface features are unfavorable to the use of tractors, although some fields may be very well suited to them.

Contour cultivation as a means of checking erosion should be more generally practiced, and it is believed some slopes would be benefited by terracing. Although erosion is not so active here as it is on similar slopes farther south, it is gradually thinning the soil. This is the slow sheet erosion where effects often are not observed until bedrock has been exposed in a long-used field.

Grasslands commonly are given a dressing of stable manure before plowing for corn. Some manure is applied to wheat land, usually before or after turning under the oat stubble, or as a winter top-dressing. Acid phosphate is frequently applied to wheat at the time of planting, at the rate of 1 sack, or 167 pounds, to the acre, and sometimes a low-grade complete mixture is used instead of acid phosphate. Corn also sometimes receives a light application of fertilizer. Lime is extensively used and is usually applied to wheat land.

Good crops of clover can generally be considered essential to the maintenance of best soil production conditions under the prevailing method of farming. Many of the soils need lime, and to insure a good clover growth this need should be met. A moderate application in each rotation is probably better than heavier treatment at longer intervals. Lime should be applied on plowed land prior to seeding a small-grain crop which is to serve as a nurse crop for clover. After the lime is applied it should be mixed with the soil by harrowing or disking.[1] Expenditures for fertilizer in 1919 amounted to $228,916.

Large areas of steep, stony, and shallow soil are best suited to forestry because of the poor yields that may be expected from them and of the difficulty of cultivating them. Trees thrive on these areas, even where the slope is very steep.

In 1919, 79.2 per cent of the farms were operated by owners, 17.9 per cent by tenants, and 2.9 per cent by managers. Under these con-

[1] GARDNER, F. D. THE USE OF LIME ON LAND. Pa. Agr. Expt. Sta. Bul. 131, pp. 171–204, illus. 1914.

ditions, a large part of the farm labor is performed by the farmer and his family, so that the labor problem is not so important here as it is in localities where other kinds of farming prevail, or where there is a lower percentage of owner operation.

SOILS

The soils of Lycoming County vary from those that are well developed and have distinct horizons to those which represent little more than freshly decomposed rock material. The former occur on the smoother areas where erosion has not interfered with the soil-forming processes which normally take place in such climate as prevails here. There are no black soils characteristic of grass-covered prairies.

The entire county was heavily forested in the virgin condition, and thousands of acres have not been cleared. Light-colored soils predominate in tree-covered areas, but there are also reddish soils which owe their color to the parent rocks. The forested soils contain little organic matter even at the surface, because in this climate vegetable matter lying on the surface decays and disappears largely in the form of gas (carbon dioxide) and water. The mineral residue, of course, remains, but this does not add humus to the soil. Where the vegetable matter is plowed under, as is done in cultivated fields with the residues of clover, timothy, and other crops, the soil is considerably more brownish than the virgin surface soil. On higher elevations some organic matter does enter the soil, but it is present not in the surface but in the subsurface layer.

Much of the soil on the high plateau in the northwestern part of the county is podsol, that is, it consists of three distinct layers, as follows: (1) Beneath the leaf mold a light-gray surface layer, which has been leached of its organic matter; (2) a brown layer in which organic matter leached from the surface has accumulated in the form of a precipitate; and (3) a yellowish layer containing little organic matter.

The character of the soils on the more steeply rolling lands depends much upon the character of the underlying rocks, for erosion, in such places, does not allow the development of normal or mature soil. Where there is sandstone either sandy soils or soils with an abundance of sandstone fragments occur, and where there is shale silty and shaly soils are found. The reddish-brown soils of the region have this color because the rocks immediately beneath have it, and it is a color which even long periods of weathering can not obliterate. Small quantities of material washed from these red lands and deposited as alluvium many miles downstream have the same red color.

Most of the upland soils, even those derived from pure limestone, contain little lime carbonate. The material of the Hagerstown soils does not effervesce with acid, although these soils were formed through the decay of limestone. The lime carbonate has been drained away as it was slowly made soluble by weathering. If this happens with limestone, it is not to be expected that lime carbonate will be present in soils formed from sandstone and shale rocks which originally contained no trace of lime carbonate, as is true of im-

mense areas of Dekalb and of most of the Berks soils. As a matter of fact, most of these soils are acid.

Material from limestone, nevertheless, always leaves an impress upon the soils. The well-drained limestone soils of the humid temperate region are invariably more productive than those from rocks of low lime-carbonate content. Even the lime present in an occasional stratum of the parent rock of the Upshur soils, when it is not too deep, contributes to the superior productivity of these soils. Deoxidation has taken place in soils of imperfect drainage and aeration, giving rise to lighter colored and mottled soils; whereas oxidation, in the areas of good drainage and aeration, has caused the development of brownish topsoils and yellow and reddish subsoils.

Usually the soils of the county in flat or nearly flat areas are heavier in texture in the subsoil than in the topsoil, because of the translocation, by percolating water, of fine material from above. This condition prevails more or less even on some of the sloping areas, and is best developed on flats, such as the terraces or second bottoms of West Branch Susquehanna River.

Part of the county was once covered by a moving sheet of ice. The grinding action of the glacier reduced and mixed the surface rocks to form more heterogeneous soil material than that formed from the same rocks through decay in place and gave to the subsoils a more intimate mixture of rock particles and soil. The glaciated Lordstown and Lackawanna soils are composed of material which has come from the same shale and sandstone rocks that gave rise, by undisturbed residual process, to the soils of the Berks and Upshur series, but the subsoils of the two former soils are more friable because of the presence of more grit and other rock particles.

Soils are separated into series on the bases of a common origin and of similar characteristics in color, structure, drainage, and position. The soils of a series are differentiated as soil types on the basis of texture, and soil types in some cases have phases to cover minor variations of color or other characteristics. In the survey of this area, 15 series, comprising 40 types and 6 phases, exclusive of rough stony land and muck, have been differentiated.

Residual soils.—Residual soils of the county have been grouped in the following soil series: Dekalb, Berks, Upshur, Hagerstown, Lackawanna, and Lordstown.

The Dekalb soils are characterized by grayish-brown topsoils and yellow, heavier subsoils which are friable in the sandy soils and moderately stiff in the heavier types. A common characteristic of some of these soils is the presence of a thin, leached gray layer at the surface, underlain by an orange-colored or coffee-brown section in which organic matter has accumulated. This layer grades to yellowish material containing less organic matter. These soils occur mostly in the plateau region in very flat, undulating, and gently rolling areas, and the drainage is good. They are derived from light-colored sandstone and shale poor in lime carbonate. The material is residual from the rocks directly beneath, but in some places colluvial material has accumulated along lower slopes. The soils are underlain, at a depth ranging from 1 to 5 feet, by bedrock, except in the colluvial strips where the soil is much deeper. Three soil types, Dekalb gravelly loam, Dekalb stony loam, and Dekalb stony sandy loam, were mapped in this county.

The Berks soils are a more decided brown than the Dekalb and are more uniformly yellowish in the subsoils, which may be friable or slightly stiff. They have not the gray surface layer and brown subsurface layer comparatively rich in organic matter which characterize timbered Dekalb soils. The material comes from light-colored shales and sandstones containing little lime carbonate. This soil occurs on hills, ridges, and slopes east of the plateau region, and drainage is good. Four members of the Berks series, gravelly silt loam with a deep phase, silt loam, shale loam with a steep phase, and gravelly loam were mapped in this county.

The Upshur soils include those having chocolate-brown topsoils, and chocolate-red, moderately stiff or friable subsoils. They are derived from weathered reddish-brown sandstone and shale, and the color of the soil is much the same as that of the parent rocks. Some of the unweathered strata contain carbonate of lime. The areas are prevailingly hilly, in places mountainous, and the drainage is good. Five members of the Upshur series, gravelly silt loam, gravelly loam, shale loam, silt loam, and stony silt loam with a steep phase were mapped in Lycoming County.

The Hagerstown series includes soils of brown or reddish-brown color, which have reddish-brown or dull-red, friable, or slightly plastic clay subsoils. They are derived from the weathering of rotten pure limestone, and are not extensive, occurring only in small limestone valleys and in connection with scattered exposures of limestone. They are, however, among the most valuable soils of the county. The series is represented in this county by two soils, Hagerstown silt loam and Hagerstown stony clay.

The soils of the Lackawanna series have reddish-brown topsoils and brownish-red subsoils of about the same texture. They are derived mainly from the glaciation of brownish-red shales and sandstones, and their color corresponds closely with the color of the parent rocks. They differ from the Upshur soils in being more open and in having a somewhat different color, owing to foreign rock fragments in the glacial drift. Areas of these soils are rolling or hilly. Three members of the series are mapped in this county: Gravelly loam, stony loam with a steep phase, and a poorly drained phase of silty clay loam.

Soils derived principally from the glaciation of gray shales and sandstones have been grouped in the Lordstown series. These soils are characterized by grayish-brown or light-brown soils and yellow or yellowish-brown friable subsoils. The depth to bedrock is usually slight, although some areas are underlain by deep drift. The series includes four members: Gravelly silt loam, silt loam, stony loam, and stony sandy loam.

Colluvial soils.—The colluvial soils of the county are grouped in the Lickdale, Murrill, and Lycoming series.

The Lickdale soils have gray or yellow surface soils and pale-yellow subsoils mottled with light gray and blue. They have developed under conditions of poor drainage from the same materials as have produced the Dekalb soils. They are found on colluvial slopes in many places, but small areas occur throughout the county wherever Dekalb soils are present. Only one type, Lickdale stony loam, was mapped.

The members of the Murrill series have brown soils and yellowish-red, slightly friable subsoils. Sandstone fragments are present throughout the soil, which was derived mainly from sandstones and which has been deposited as colluvial or valley-filling material, brought from the Dekalb slopes adjacent to Nippenose and Mosquito Valleys. This soil is influenced by the limestone which underlies it at varying depths. In places the subsoil is partly derived from limestone and is more friable than in the Hagerstown soils. Its color and close association with limestone differentiates it from the Dekalb soils. One type, Murrill silt loam, has been shown on the map.

In the Lycoming series have been grouped those soils occurring on the high benches east of Montoursville, near Hughesville and Muncy, on the floor of White Deer Valley, and in many other scattered areas in the central part of Lycoming County. They have light-brown or brown topsoils, are yellowish brown in the upper part of the subsoils, and are yellow or light reddish in the lower part. A distinguishing feature is their friability from the surface downward. The rather stiff subsoil found in some areas is residual from the underlying rocks. The general presence on the surface and throughout the soil and substratum of angular and subangular fragments of sandstone, and in places the abundance of large foreign rock fragments (chiefly sandstone and quartzite), indicate that the soils are colluvial or valley-filling material which has accumulated as the mountain ridges have weathered. The soils are underlain mostly by red and gray shales, and where erosion has locally removed the overlying accumulations the exposures of these rocks have given rise to small areas of Upshur and Berks soils in association with Lycoming soils. A few bowlders or well-rounded cobbles are encountered throughout the soil. The upper parts of the benches on which these soils occur are flat and look somewhat like stream terraces. Four members of the series, gravelly silt loam, with a stony phase, silt loam, loam, and gravelly loam, have been mapped.

Alluvial soils.—The alluvial soils of the county are grouped into six series. Wheeling, Holston, and Tyler soils occur on second bottoms or terraces; and Moshannon, Pope, and Atkins soils occur on first bottoms which are subject to overflow.

Wheeling soils have brown or deep-brown topsoils and yellowish-brown or slightly reddish brown subsoils. They are friable throughout. They consist of a mixture of sediments brought down both from regions of Dekalb, Berks, and Upshur soils and from those glaciated soils farther north which are also related to the Dekalb and Upshur. Five members of the series have been differentiated and mapped: Loam, silt loam, gravelly loam, fine sand, and fine sandy loam.

Holston soils are composed of sediments washed from areas of Dekalb and Berks soils and have lighter brown surface soils than do the members of the Wheeling series and their yellow subsoils are less friable. One soil type, Holston silt loam, was mapped in this county.

Tyler soils are poorly drained terrace soils having gray topsoils and rather stiff subsoils, mottled gray, yellow, and brown. They are derived mainly from the sediments which give rise to the Holston soils. Tyler silt loam was mapped.

The Moshannon series includes first-bottom soils derived from the reworking of material from Upshur and Lackawanna soils. The soils are reddish brown throughout. Three members of this series have been mapped in Lycoming County: Moshannon fine sandy loam, with a low phase, Moshannon loam, and Moshannon gravelly sandy loam.

The Pope soils represent the first-bottom correlative of the Holston soils. Pope silt loam and Pope fine sandy loam were mapped in this county.

The Atkins soils are the first-bottom correlative of the Tyler soils. Atkins clay was mapped.

The following table gives the acreage and proportionate extent of the various soils mapped in Lycoming County:

Acreage and proportionate extent of the soils mapped in Lycoming County, Pa.

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Berks gravelly silt loam	49,536	7.1	Moshannon fine sandy loam	13,120	1.8
Deep phase	6,464		Low phase	1,024	
Berks silt loam	7,936	1.0	Moshannon loam	6,784	.9
Berks shale loam	13,568	2.2	Moshannon gravelly sandy loam	3,456	.4
Steep phase	4,096		Dekalb gravelly loam	1,536	.2
Berks gravelly loam	9,216	1.2	Dekalb stony loam	58,432	7.4
Upshur gravelly silt loam	24,832	3.2	Dekalb stony sandy loam	96,384	12.2
Upshur gravelly loam	26,304	3.3	Lordstown gravelly silt loam	14,528	1.8
Upshur shale loam	3,136	.4	Lordstown silt loam	1,920	.2
Upshur silt loam	1,856	.2	Lordstown stony loam	23,936	3.0
Upshur stony silt loam	27,968	5.3	Lordstown stony sandy loam	5,120	.7
Steep phase	13,632		Lickdale stony loam	1,984	.3
Hagerstown silt loam	1,856	.2	Lycoming gravelly silt loam	14,976	2.8
Hagerstown stony clay	576	.1	Stony phase	7,296	
Murrill silt loam	5,120	.7	Lycoming silt loam	4,992	.6
Lackawanna gravelly loam	35,584	4.5	Lycoming loam	5,632	.7
Lackawanna stony loam	44,608	6.7	Lycoming gravelly loam	3,840	.5
Steep phase	7,936		Tyler silt loam	3,456	.4
Lackawanna silty clay loam, poorly drained phase	1,664	.2	Pope silt loam	5,312	.7
Wheeling loam	10,304	1.3	Pope fine sandy loam	2,368	.3
Wheeling silt loam	7,872	1.0	Atkins clay	576	.1
Wheeling gravelly loam	11,264	1.4	Muck	320	.1
Wheeling fine sandy loam	4,992	.6	Rough stony land	185,984	23.6
Wheeling fine sand	128	.1	Total	787,840	
Holston silt loam	4,416	.6			

BERKS GRAVELLY SILT LOAM

Berks gravelly silt loam consists of a layer of grayish-brown or light-brown silt loam from 6 to 12 inches deep, underlain by pale-yellow or yellow, moderately friable or slightly stiff silty clay loam. In many places, especially in forested areas, the surface soil has a slightly yellowish cast, and the subsurface layer is yellow silt loam. In cultivated fields, on the other hand, where clover and grass have been grown for long periods the soil may be brown. Many angular shale and fine-grained sandstone fragments are present. These increase in quantity with depth, and partly weathered, bedded shale or sandstone is found at a depth varying from 18 to 36 inches. Where normally developed, small rock fragments constitute from 10 to 50 per cent of the soil mass. This imparts a loose structure, allows rapid absorption of rainfall, and admits of tillage under a wide range of moisture conditions. Even in its virgin state the soil is comparatively free from large stones.

Berks gravelly silt loam, as mapped, includes a number of variations, chiefly in the depth of the soil and in the quantity of gravel it contains. There are included also many small patches of shale loam, gravelly loam, and a few of stony silt loam. These soils are so closely associated that it is sometimes difficult to distinguish between them. In such places arbitrary divisions are drawn on the map. Where the beds are sharply inclined, strata of varying hardness and structure are exposed within short distances of each other, and in each small area the soil which is the product of rock decay has retained the characteristics of the parent material, with the resulting variations in depth, content of rock fragments, texture, and color.

This soil occurs throughout the central and southeastern parts of the county and is the most important soil in that part of the hill region which is underlain by gray shales and sandstones.

The land is prevailingly rolling or hilly. Many small, smooth, gently rolling areas are included, but no level land. This soil is naturally well drained and on some of the steeper slopes drainage may be excessive. A few narrow strips of land along the bases of slopes where seepage occurs resemble Lickdale soils but are too small to separate on the map. They are locally called "spouty land."

Although Berks gravelly silt loam is exceeded in extent by several other soils, agriculturally it is perhaps the most important soil in the county, and fully 75 per cent of it is under cultivation. Uncleared areas support a forest growth consisting mainly of second-growth oak, chestnut, maple, pine, hemlock, black birch, and dogwood, and an undergrowth of mountain laurel, witch-hazel, huckleberry, and other shrubs. The principal crops are hay, corn, wheat, oats, buckwheat, potatoes, and rye. Vegetables and fruits are grown for home use, and to a small extent for market, especially near Williamsport. Apples, peaches, and cherries are the principal fruits, and there are a few commercial apple and peach orchards. Dairying is generally practiced, most herds having from 7 to 10 cows. Larger dairies near Williamsport and the other important towns supply the local demand for whole milk. Hogs and a few beef cattle are kept on practically every farm. Most farmers raise some poultry and there are some small poultry farms.

Corn yields from 20 to 50 bushels an acre; oats, from 20 to 45 bushels; wheat, from 10 to 25 bushels; hay, from 1 to 2 tons; buckwheat, from 15 to 35 bushels; rye, from 10 to 20 bushels; and potatoes, from 50 to 150 bushels. Under exceptional conditions and more efficient soil treatment higher yields are obtained.

A five-year rotation is commonly practiced, consisting of corn, oats, wheat, timothy and clover, and timothy alone. Meadows are sometimes broken after one year, shortening the rotation. Rye occasionally takes the place of wheat, and in case of emergency buckwheat is used as a substitute for other crops. Because of the hills the rotation may vary considerably on individual farms. Potatoes have no place in the rotation, but practically every farmer grows an acre or more each year, and this is considered an excellent potato soil. The preparation of the land for all crops is customarily thorough. Modern equipment is in general use, though some fields are too steep to allow the use of riding plows and cultivators or of binders. The land is too uneven for the general use of tractors.

Contour cultivation as a means of lessening erosion is practiced on some of the steeper slopes, but is by no means a general custom. Erosion is, on the whole, not severe.

Grasslands are given a dressing of stable manure before breaking for corn, and many farmers also apply manure to wheat land, either before turning under the oat stubble or as a top-dressing in winter. An average of 1 sack, or 167 pounds, an acre of acid phosphate or complete fertilizer is usually applied to wheat at the time of planting, and corn sometimes receives a light application of commercial fertilizer. Lime is widely used and is commonly applied to wheat ground.

The current value of this soil varies from $20 to $125 an acre, depending upon location, surface features, and improvements. The average selling price is about $50 an acre.

In the improvement of Berks gravelly silt loam attention should be directed to the ability of the soil to produce clovers, particularly red clover, because where it is impossible to succeed with clovers the highest success with nonleguminous crops can not be attained. The soil is acid, and where liming has not been practiced clover fails, or at best makes only a mediocre growth. Moderate applications of lime once in each rotation are preferable to heavy applications at longer intervals. It is well to apply lime on the land during the preparation for the small grain which is to serve as a nurse crop for clover. Lime should be applied after plowing and should be thoroughly mixed with the soil by harrowing or disking. It should never be drilled in with seeds, nor mixed with commercial fertilizer.

Investigations at Pennsylvania State College have shown that fertility in this soil is best conserved by the application of stable manure reinforced by acid phosphate. Two such applications should be made in the rotation, on corn and on wheat. From 6 to 8 tons of manure should be applied to the acre. An acre application varying from 200 to 300 pounds of acid phosphate should be made to corn, and from 200 to 350 pounds to wheat. Where sufficient hay can be produced for farm use, it is recommended that the rotation be shortened to four years by breaking up the meadow after one year. This practice will be especially beneficial on farms where the supply of stable manure is insufficient for two applications in a rotation.

Berks gravelly silt loam, deep phase.—The deeper light-brown or brown color of the topsoil of Berks gravelly silt loam, deep phase, is imparted by a greater quantity of humus than is contained in the typical soil. A smaller quantity of rock fragments is present throughout the soil. At a depth of about 10 inches the pale-yellow silty clay loam subsoil occurs. In forested areas, the soil may be more nearly yellow. Bedded shale lies more than 3 feet below the surface in most places. The most extensive areas of this soil are in the hills northeast of Montoursville and north of Williamsport. It occurs as accumulations, largely of fine material from the higher slopes in positions between hills, at the heads of many streams, and in small areas along the lower slopes of stream valleys. There are a few large stones on the surface and embedded in the soil. The surface varies from undulating to rolling and is less irregular than that of Berks gravelly silt loam in connection with which it is farmed. Few farms consist entirely of the deeper soil, which is

almost all improved, is more productive, and consequently more valuable than the typical soil and which will respond to the same methods of improvement. It is not so thoroughly drained, however, especially in "spouty" areas.

BERKS SILT LOAM

Berks silt loam consists of a surface layer of light-brown, mellow silt loam from 6 to 12 inches deep, a thin subsurface layer of pale-yellow silt loam, and a yellow, friable silty clay loam subsoil. The subsoil may be rather plastic just above a depth of 3 feet. A small or moderate quantity of shale fragments is everywhere present. In places the subsurface layer is lacking and in others bedrock occurs above a depth of 3 feet, but most of the soil is 4 or 5 feet deep.

Some areas are closely related to Berks gravelly silt loam, deep phase, and have been similarly formed. Small patches of deeper, darker soil on smooth colluvial slopes and fans such as occur near Linden and Nisbet have been included with this soil in mapping. A number of stony areas containing an abundance of shale and sandstone fragments have been indicated on the map with stone symbols.

The largest areas of this soil are east of Larrys Creek station and near Hughesville. The soil occurs in low saddles between hills, in depressions around stream heads, and on benches. The land is moderately rolling but nowhere steep, and drainage is good except around stream heads and at the bases of slopes.

Though of small total area this soil is nearly all under cultivation and is the most productive of the Berks soils. The kinds and methods of farming are similar to those practiced on Berks gravelly silt loam, and the yields are equal and sometimes surpass those obtained on that soil. Land of this kind is usually sold in connection with other Berks soils and generally enhances their value. Berks silt loam can be improved and its fertility maintained by the use of the measures recommended for Berks gravelly silt loam.

BERKS SHALE LOAM

Berks shale loam is brownish-gray shaly silt loam, underlain at a depth varying from 6 to 8 inches by very shaly yellow silt loam, which grades to very shaly silty clay loam. In cultivated fields where erosion has not been excessive, the soil has a decidedly brown color in many places, owing to the humus worked into it. In forested areas, the yellowish silt loam comes nearly to the surface, but usually about an inch of grayish silt loam is on top. The soil layer is usually thin, and at a depth ranging from 12 to 30 inches there occurs a mass of broken, partly weathered shale rock which in many places constitutes more than half of the soil material. The rock consists, for the most part, of fine-grained, greenish, or yellowish chips containing little lime carbonate. In some areas moderately thick sandy shale is present in such quantities that after a rain scarcely any of the fine soil is visible at the immediate surface, and only a mass of the flat fragments remains.

This soil closely resembles both Berks gravelly silt loam and Berks gravelly loam and in many places is so closely associated with

these soils as to make accurate mapping difficult. The differentiation has been made chiefly on the basis of the shape and quantity of shale fragments. The fragments common to the shale loam are flat and usually thin, whereas those predominating in the gravelly soils are not so flat, many being almost cubical. The areas of highest shale content, where the characteristics imparted by the rock fragments transcend in importance those of the interstitial fine soil material have been mapped as shale loam. In Nippenose, Mosquito, and White Deer Valleys there are a few shale outcrops.

This soil occurs mainly on sharp knobs or hills and is most extensive west of Lycoming Creek Valley. The abrupt hills which flank the river valley are common to this soil type. The tops of the hills are generally narrow and comparatively smooth and curve gently to the rounded slopes below. Surface drainage may be excessive, because of the slope and the porous structure imparted by the loose shale fragments, and erosion may be severe, although locally it has been partly checked by contour cultivation.

Berks shale loam is of rather wide distribution and is agriculturally important. Most of it is under cultivation and is devoted to the crops and kinds of farming that predominate on the previously described Berks soils. Rye is, perhaps, more important, sometimes displacing wheat in the rotation. The difficulties in the way of tilling this land preclude as intensive cultivation as that practiced on the gravelly silt loam member, and consequently yields and land values are decidedly lower. It is not a good pasture soil.

The price of Berks shale loam in 1920 varied from $10 to $50 an acre. In the vicinity of Williamsport it may command higher prices.

In general, the suggestions for the improvement of Berks gravelly silt loam apply to this soil. More stress should be laid upon the incorporation of vegetable matter which will materially increase the moisture-holding capacity as well as the productivity of the soil. Stable manure could well be supplemented by green-manure crops, such as rye or vetch. Clover is a necessary part of the rotation and a clover crop should be plowed under from time to time.

Berks shale loam, steep phase.—Berks shale loam, steep phase, occurs on steep slopes which are generally unsuited to cultivation. The soil material is shallower than in the typical soil and on many slopes large rock slabs or fragments are found as a result of the weathering of exposed ledges of parent rock. By far the greater part of this soil is uncleared and supports a good second-growth forest. Most of the cleared areas have been abandoned or are used for pasture. Erosion renders cultivation difficult, and this soil has little present or potential agricultural value except, possibly, for pasture.

BERKS GRAVELLY LOAM

Berks gravelly loam consists of grayish-brown or light-brown mellow loam, underlain at a depth varying from 5 to 8 inches by yellowish-brown or yellow friable loam or silt loam. In cultivated fields the soil color is more brownish than in virgin areas, owing to the incorporation of the organic matter of crop residues. The angular fragments of sandstone and shale makes the soil open, thus allowing perfect underdrainage and aeration.

Berks gravelly loam occurs in most places on comparatively high ridges (1,500 to 1,600 feet high) east of the Appalachian Plateau. It is derived from light-colored sandstone and sandy shale containing little lime. It is not very extensive, but most of it is under cultivation. The depth to bedrock is generally less than 3 feet on the higher positions, but the soil is occasionally deeper on some of the lower slopes where material has accumulated by wash and creep from above. The average depth to bedrock is less than in Berks gravelly silt loam.

Some areas of Hanceville gravelly loam, Lickdale stony loam, and Berks gravelly silt loam have been mapped with this soil because of their small extent.

The texture of Berks gravelly loam ranges from silty to very sandy. The rock fragments are chiefly small but are copiously distributed on the surface and through the soil. Forested areas have a growth about like that on Berks gravelly silt loam. The same crops and farming methods are used in the cultivated areas but yields are slightly lower. In general, this soil requires about the same treatment as Berks gravelly silt loam.

UPSHUR GRAVELLY SILT LOAM

The topsoil of Upshur gravelly silt loam is from 8 to 12 inches deep and consists of chocolate-reddish brown silt loam, much of which contains enough coarse particles to make it somewhat gritty. The subsoil is chocolate-red silty clay, which locally, when moist, has a peculiar, greasy feel, apparently imparted by minute mica flakes derived from the parent rock. The upper part of the subsoil is friable, but the lower part may be very plastic. Small angular fragments of chocolate-red shale and sandstone are present in abundance throughout the soil. In shape and size these rock fragments are similar to those on Dekalb gravelly loam and range from flat, thin shale chips to blocks from 1 to 5 inches in diameter. Bedrock is usually reached within 3 feet of the surface.

Like Berks gravelly silt loam, this soil is subject to many local variations of texture, color, and depth, owing to the exposure, within short distances of each other, of rock strata of varying hardness and texture. Thus the soil may show small patches of Upshur shale loam, Upshur gravelly loam, and Upshur silt loam. Near the Berks soils this soil has partaken of the characteristics of both the Berks and Upshur soils, resulting in a blending or dulling of the typical soil colors. At the base of the Allegheny escarpment the thin layer of slumped material, which covers the surface in places, consists of gray sandstone fragments and fine material which has imparted to the surface soil a lighter color than is present in the typical soil.

Upshur gravelly silt loam predominates in a belt from 1 to 4 miles wide, extending from Tombs station on Pine Creek eastward nearly to Picture Rocks. A few areas occur in Cogan Valley and in the southwest corner of Rose Valley. The material is derived from the chocolate-red rocks which underlie the region.

The land is prevailingly steeply rolling and hilly; the surface features consist of irregular ridges from which rise rounded knolls; and the whole region is dissected by narrow valleys with steep sides. Many small areas with gentle slope occur in low saddles or

basins around drainage heads, but level stretches are few. Surface drainage is excellent, and the fine material of the soil is retentive of moisture.

This soil is one of the most important in the county. It has a large aggregate area, and it is roughly estimated that from 70 to 80 per cent of it is under cultivation. The remainder is forested chiefly with second-growth oak, chestnut, hemlock, pine, maple, and birch. A few of the most abrupt slopes are unsuited to cultivation and are in pasture or woodland. The principal crops are identical with those grown on Berks gravelly silt loam, as are the other farm enterprises and methods. Fertilization of wheat is the rule, most farmers applying a low-grade complete fertilizer or acid phosphate in quantities ranging from 100 to 200 pounds to the acre. A light application of fertilizer is sometimes made upon oats; corn ground is manured and sometimes fertilized, and wheatland is manured if the farm supply is sufficient for both corn and wheat. Potato land is heavily manured, and potatoes are commonly grown on part of the land reserved in the rotation for corn. The use of lime is general.

Under the prevailing methods, corn yields from 20 to 50 bushels an acre; clover, from 1½ to 2 tons; timothy, from 1 to 1½ tons; wheat, from 12 to 30 bushels; oats, from 25 to 50 bushels; buckwheat, from 15 to 40 bushels; and potatoes, from 75 to 200 bushels. This is considered a somewhat better corn and grass soil than Berks gravelly silt loam, and is fully its equal for other crops.

Land values varied from $25 to $100 an acre at the time the survey was made, the average was about $50 an acre. Farms on this soil are not, generally speaking, so favorably located with respect to the larger towns as are those within the gray shale belt to the south. If they were, their productivity would justify higher land values.

Like the Berks soils, Upshur gravelly silt loam is deficient in lime. Numerous analyses at Pennsylvania State College show a lime requirement for Upshur soils very similar to that for Berks soils.[2] The parent rocks of the Upshur soils are calcareous enough to effervesce with hydrochloric acid in certain strata only. Here and there in the Appalachian region these calcareous beds have influenced the soils enough to make them better producers of bluegrass than Dekalb or Berks soils. Lime should be used in sufficient quantities to safeguard the clover crop. A moderate application once in each rotation is recommended, the quantity depending on the kind used and the lime requirement of the soil.[3]

The fertilization and manuring of this soil should be accomplished in the same manner as that suggested for Berks gravelly silt loam. The surface color of Upshur gravelly silt loam is deceptive, as the dark chocolate-red shade which usually indicates a rather high supply of organic matter is almost entirely imparted to it from the parent rock, and the supply of humus in the surface soil is little, if at all, greater than that of the Berks soil of the same texture. The same care as is found to react favorably upon Berks and Dekalb soils should be exercised in replenishing this soil with organic matter in the form of stable manure and green-manure crops.

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[2] WHITE, J. W. LIME REQUIREMENT OF PENNSYLVANIA SOILS. Pa. Agr. Expt. Sta. Bul. 164, 36 p., illus. 1920.

[3] Lime-requirement tests of soil samples are made free of charge by the county agent at the farm bureau office in Williamsport.

UPSHUR GRAVELLY LOAM

Upshur gravelly loam consists of chocolate-brown loam from 6 to 12 inches deep, underlain by chocolate-red, friable silty clay loam having, when moist, the greasy feel characteristic of the clays derived from the regional chocolate-red shales. Both soil and subsoil contain numerous angular and subangular fragments of chocolate-red sandstone and arenaceous shale, small or medium in size. Most of these fragments are flat but average more than an inch in thickness. The broken bedrock is usually 3 or more feet beneath the surface.

This soil varies considerably in different localities. In Cogan Valley it is partly colluvial in places, the texture ranges from fine sandy loam to silt loam, the subsoil is porous and its reddish color is not so intense as in other sections, the rock fragments are small and some areas are comparatively rock free. In Pine Creek Valley the larger stones have been removed from the fields to make the land more easily cultivable. Some areas along the base of the Allegheny escarpment, and others occurring in association with Upshur gravelly silt loam, have been modified by wash and creep. In some places this has resulted only in the presence of angular gray sandstone fragments on the surface, but in other places there are colluvial accumulations of considerable depth which contain some rounded pebbles and cobbles. Because of its heterogeneous character this material resembles the glacial Lackawanna soils, and where it occurs near the southern limits of glaciation there has been some confusion in mapping.

This soil is mainly derived from coarser grained rocks, but a few areas on Bodst and Blessing Mountains are residual from chocolate-colored shale formations. A few small tracts are derived from the chocolate-colored shales and sandstones south of the river. The widest development of Upshur gravelly loam is in Cogan Valley, where it covers fully 80 per cent of the valley area. It is rather extensive immediately south of the Allegheny front from Cogan Station westward and occurs on some of the lower mountain slopes along Pine Creek. Small tracts are included in areas of Upshur gravelly silt loam in the central part of the county.

The surface features are typical of the hill soils of the area and are similar to those of Upshur gravelly silt loam. In Cogan Valley dissection has not been so thorough as in other regions where the soil occurs, and except around the borders of the valley the ridges are broad and the slopes are long and smooth with few sharp inclines. Many of the slopes in Pine Creek Valley are steep and the land is well drained, with the exception of a few very small patches where seepage occurs. The porous soil readily absorbs rainfall, and few areas suffer from drought in normal seasons.

Upshur gravelly loam is of moderate importance in the agriculture of Lycoming County, although most of it is cleared and cultivated. About 30 per cent is uncleared and supports the characteristic second-growth forest of the region.

South of the plateau region this soil is farmed in the same manner as the closely allied Upshur gravelly silt loam, but in Cogan Valley the agriculture is less intensive. Here the usual rotation is not closely adhered to, corn is less important because of the short frost-

free season, and wheat is not so extensively grown, its place in the rotation being frequently taken by rye. Grasslands are sometimes cut for several years, and less livestock is kept than in most parts of the county. Some farms have been abandoned, and considerable areas are devoted to pastures which are, in many places, sparsely stocked. However, some farms scattered throughout the valley are in an excellent state of cultivation. Although Upshur gravelly loam of the lighter sandy phases is only moderately productive, the areas are too inextensive to account for the apparent ebb of agriculture in Cogan Valley. This condition is more probably due to its remoteness from railroads, the farms being from 8 to 15 miles from shipping points. The long wagon hauls necessary in procuring lime and fertilizer have discouraged their use, with the result that many farms have deteriorated. Yields are lower than on Upshur gravelly silt loam, and the average yields are somewhat lower in Cogan Valley than elsewhere.

Land values ranged from $15 to $75 an acre at the time the survey was in progress, with an average value in Cogan Valley of about $30.

Upshur gravelly loam could produce good yields of practically all the general farm crops adapted to the region. To build up and maintain its fertility, livestock enterprises, particularly dairying, should be extended, as the recent opening of creameries at Trout Run affords better markets for dairy products in Cogan Valley than have been available in the past. The use of the liming methods previously suggested, together with judicious conservation and use of stable manure and green cover crops, will result in the improvement of this soil.

UPSHUR SHALE LOAM

Upshur shale loam consists of chocolate-brown shaly silt loam, to a depth of about 8 inches, underlain by chocolate-colored, very shaly, silty clay which feels slightly greasy when moist. The proportion of shale fragments increases on approaching the partly weathered shale rock which is present from 18 to 30 inches below the surface. The shale fragments are small and thin and in many places constitute more than 50 per cent of the soil mass.

This soil occurs on rounded hilltops and slopes in the red shale belt south of the Allegheny escarpment and the areas are rolling and hilly. Drainage is everywhere excellent and the porosity of the shaly soil facilitates tillage and renders cultivation possible even in very wet weather.

Although from 80 to 90 per cent of this soil is cultivated, it is comparatively unimportant because of the small total area. It is devoted to the same crops as near-by tracts of Upshur gravelly silt loam and closely approaches the latter in yields and land values. It is considered an excellent potato soil.

The methods recommended for the improvement of Berks and Upshur gravelly silt loams are applicable to Upshur shale loam.

UPSHUR SILT LOAM

Upshur silt loam consists of chocolate-brown silt loam from 8 to 10 inches deep, underlain by chocolate-colored silty clay loam which when moist becomes rather plastic in the lower part. It is com-

paratively free from the shale and sandstone fragments common to the other members of this series. Bedrock commonly occurs at a depth varying from 2½ to 4 feet.

Upshur silt loam occurs in widely scattered areas throughout the unglaciated parts of Lycoming County. In White Deer Valley it occurs on low prominences and is derived from the local argillaceous chocolate-colored shales. In the hill region below the Allegheny front, there are scattered areas where it is associated with the more extensive Upshur soils. On the ridges of the Allegheny Plateau, the soil is residual from chocolate-colored shales.

Areas of Upshur silt loam are smooth and are dominantly gently rolling. Even on the plateaus the land is in many places nearly level. Drainage is adequate but never excessive.

This soil is inextensive and is of minor agricultural importance. It is practically all improved except in the plateau region. On the high elevations the combination of a short frost-free season, inaccessibility, and remoteness from markets has retarded and will continue to retard its fullest use for agriculture.

In the hill and valley regions this soil is farmed in connection with other soils, and crops are rotated under the general system prevalent in this part of the State. Yields are good. Upshur silt loam is considered equal to any of the Upshur soils in productivity, and it generally enhances the value of lands with which it is sold. It responds to the methods of restoration suggested for Upshur gravelly silt loam.

UPSHUR STONY SILT LOAM

Upshur stony silt loam consists of chocolate-brown silt loam from 6 to 10 inches deep, underlain by chocolate-colored silty clay loam or silty clay. Both topsoil and subsoil contain numerous rock fragments, most of which are flat slabs of chocolate-colored shale and sandstone. In the mountain regions the surface in places is thickly strewn with blocks of gray sandstone which have fallen from the higher slopes. This soil differs little from other Upshur soils except in the quantity and size of the rock fragments. Some included small areas have the texture of loam rather than of silt loam. At the immediate base of the Allegheny escarpment and on some of the slopes the surface soil has a lighter color, in places pinkish, and represents a mixture of Dekalb and Upshur soil materials.

This soil is derived from several chocolate-colored rock formations of similar mineral composition. The soil in the area near Morgan Valley School is derived from the chocolate-colored fine-grained strata which have given rise to a texture nearer that of loam than silt loam.

The land is hilly. There are a few gently sloping areas, and none of the areas mapped is too steep to be in some way suited to agriculture. As a whole, the surface is rougher than that of any other Upshur soil.

Upshur stony silt loam is extensive but not important in the agriculture of the county. It is estimated that less than 15 per cent is under cultivation, the remainder being in forest or pasture. The clearing of the land and the removal of the larger stones have so altered the quantities of rock originally contained that cultivated

fields were commonly included with the gravelly Upshur soil. Some of the timber stands are valuable, though the virgin forests have all been removed.

The same crops are grown on this soil as on other members of the Upshur series, but agriculture is less intensive. Considerable buckwheat is grown in the mountain regions. Some parts of this land are too steep to allow the use of modern machinery and it is necessary in such places to cradle grain crops. The practice of rotating crops according to the usual systems in Lycoming County is not rigidly observed.

Farm lands have a lower value than those of other Upshur soils, because of the large quantities of rock, the steep slopes, and the remoteness from market. The value of forested areas depends upon the timber growth.

Suggestions offered for the improvement of Upshur gravelly silt loam are applicable to this soil.

Upshur stony silt loam, steep phase.—The steep phase of Upshur stony silt loam differs from the typical soil primarily in surface features. Except for the higher rock content the soils are very similar.

As mapped, this soil occurs on some of the steeper slopes of that part of the central hill region which comprises the Catskill rocks, but it is found mainly on mountain slopes within the Allegheny Plateau, particularly along Little Pine and Lycoming Creeks. Here the land, in many places, is as rugged as rough stony land, but the weathering of the comparatively soft shales and sandstones has given rise to fine soil material which rough stony land lacks. The steepness renders it unsuited to agriculture, but the forest growth is far superior to that of rough stony land, and natural reforestation is rather rapid. In places there are valuable tracts of timber. Hemlock appears to thrive especially well on shaded slopes.

Upshur stony silt loam, steep phase, is generally best suited to forest. Some areas may in the future be developed for fruit growing or pasture, but under present conditions it would not be practicable to improve this soil for agricultural purposes.

HAGERSTOWN SILT LOAM

The topsoil of Hagerstown silt loam is brown or slightly reddish-brown silt loam from 6 to 15 inches deep. The subsoil of brownish-red or dull-red, moderately stiff clay, is underlain by bedrock at a depth ranging from 2 to 5 feet. Some eroded patches of clay loam or silty clay loam are included with this soil in mapping. Both topsoil and subsoil contain appreciable quantities of limestone fragments, but not in such abundance as to interfere with cultivation. Small exposures of the underlying limestone are common, and are usually bordered by areas of Hagerstown stony clay which are too small to be separated on the map. This soil is a product of the weathering of limestones. In a few areas on the south side of Nippenose Valley, and in Mosquito Valley, the subsoil is browner and the underlying rock is rather shaly limestone.

Hagerstown silt loam occurs mainly in Nippenose Valley. There are three small areas in Mosquito Valley, and others in White Deer Valley and West Branch Susquehanna River Valley, the largest of

these lying 1½ miles northeast of Elimsport, and midway between Hughesville and Pennsdale.

This land is undulating or moderately rolling. The areas in Nippenose Valley are characterized by rather abrupt hollows, called sinks, which are not erosional but are caused by the undermining of the limestone which lies beneath and the consequent collapse of the rock strata supporting the soil. Some of these sinks are now in the course of development. Surface drainage is uniformly good. The streams which rise in the mountains surrounding Nippenose Valley have developed subterranean channels as their courses reached the soluble limestones, and in this valley there are now no surface streams though several abandoned channels are present. The surface water penetrates the soil mass and drains through the underground channels. Erosion is nowhere severe.

Hagerstown silt loam is inextensive but is regarded as one of the most valuable soils of the county, and probably more than 90 per cent of it is under cultivation. It is devoted to the same crops grown in other parts of the county, and the generally practiced crop rotation of this region, which was described in connection with Dekalb gravelly silt loam, is used. Dairying and hog raising are fully as important as on other soils of Lycoming County. Tobacco was formerly grown to some extent, but this crop has been practically discontinued.

Corn on Hagerstown silt loam yields from 30 to 60 bushels an acre; oats, from 25 to 50 bushels; wheat, from 15 to 30 bushels; and hay, from 1½ to 2½ tons. Bluegrass grows well, and the soil affords excellent pasturage.

The surface soil has no tendency to become compact or bake and is easily maintained in good tilth, except in the small areas in which clay lies near the surface. Modern farm implements are used. Sources of lime are close at hand and burnt lime is very generally used, many farmers burning their own supply. Moderate or light applications are common. Corn, wheat, and frequently oats are fertilized. Manure is applied to cornland and often to wheatland.

Land values in 1920 ranged from $75 to nearly $200 an acre, averaging about $100.

Fertilization for maintaining productivity on this soil should include the application of stable manure, acid phosphate, and moderate quantities of lime.[4]

HAGERSTOWN STONY CLAY

Hagerstown stony clay consists of reddish-brown clay from 3 to 6 inches deep, underlain by dull-red plastic clay, which rests upon bedrock at a depth ranging from 6 to 30 inches below the surface. Angular limestone fragments are abundant.

This soil occurs in Nippenose Valley in close association with Hagerstown silt loam. It is also found in small areas in connection with outcrops of limestone in West Branch Susquehanna River

[4] Detailed and specific recommendations for the improvement of Hagerstown soils will be found in the following: GARDNER, F. D., NOLL, C. F., and LEWIS, R. D. FORTY YEARS' RESULTS WITH FERTILIZERS. GENERAL FERTILIZER EXPERIMENTS. Pa. Agr. Expt. Sta. Bul. 175, 23 p., illus. 1922. This bulletin deals with a comprehensive series of fertilizer tests at the college experiment station. The plots are the oldest in the United States and the results should be thoroughly indicative of the factors limiting crop production on limestone soils.

Valley and White Deer Valley. It has a rougher surface than the silt loam and occurs on steep or abrupt slopes with many limestone outcrops. There are numerous quarries and limekilns.

The total area of this soil is small. Most of it is cleared, but cultivation is not general, the land being mainly used for pasture. It is a productive soil, but is difficult to till on account of the limestone fragments and the proximity of bedded rock to the surface. The tenacity of the soil hinders cultivation in wet weather. The shallower areas tend to be droughty. Where cultivation is possible good yields, especially of clovers, are obtained. It is sold mainly in connection with other soils. Hagerstown stony clay may be improved by the use of measures suggested for Hagerstown silt loam.

MURRILL SILT LOAM

Murrill silt loam consists of brown, mellow silt loam to a depth of 10 or 12 inches, underlain by yellowish-brown, reddish-yellow or dull-red, gritty clay loam or clay which is much more friable than the subsoil of Hagerstown silt loam. In places the lower part of the subsoil resembles that of the latter soil, indicating that some of the subsoil material is derived from limestone. Sandstone fragments are present in moderate quantities throughout the soil, and in places there are a few limestone fragments. Certain areas, as mapped, consist more nearly of loam than silt loam, and there are also stony and gravelly spots. Small tracts of Hagerstown soils were included in mapping.

Murrill silt loam occurs only in Nippenose and Mosquito Valleys. In the latter valley its area is less than 100 acres, but in Nippenose Valley it is the dominant soil, occurring not only on the lower parts of the colluvial slopes but in the center of the valley. It is of colluvial origin, and is mainly derived, not from the underlying limestones, but from valley-filling material derived from the sandstone common to the bordering hills. Its close association with limestone and with Hagerstown soils, however, has undoubtedly had considerable influence upon its productivity. Some limestone material has by wash or other means been mixed with the soil or represents the deeper subsoil material.

The land is smoothly rolling and well drained, the surface water finding egress by subterranean channels as on Hagerstown silt loam. Like the latter, Murrill silt loam is characterized by small sinks, or depressions, some of which are too abrupt to be cultivated.

It is roughly estimated that about 75 or 85 per cent of this soil is under cultivation. It is farmed in the same manner as, and in connection with, Hagerstown silt loam. Limekilns are close at hand, and liming is almost universally practiced. Owing to the fact that the surface soil is more mellow and open than that of Hagerstown silt loam, Murrill silt loam is somewhat more easily tilled; and though Hagerstown silt loam is capable of producing higher yields in favorable seasons, it is probable that these yields are equaled and exceeded by the average crop yields on Murrill silt loam. The two soils are held at about the same price.

The measures used for the improvement of Hagerstown silt loam are recommended for Murrill silt loam.

LACKAWANNA GRAVELLY LOAM

The topsoil of Lackawanna gravelly loam is chocolate-brown or reddish-brown, mellow, gritty loam from 8 to 12 inches deep. The subsoil is friable, gritty chocolate-colored clay loam or silty clay loam material. The upper part of the subsoil is, in many places, friable silt loam or loam material, which at a depth of about 18 inches grades to the heavier underlying material. The subsoil has a somewhat lighter-red color than that of the Upshur soils and is distinctly more friable. Scattered over the surface and intermingled with the soil are numerous fragments of red and gray sandstone, the former predominating. Cobbles of sandstone and conglomerate are present in places, and many of the smaller rock fragments are rounded.

Over a considerable area the texture of the surface soil ranges from loam to silt loam. Areas having a silty texture are particularly noticeable near Buttonwood and Lairdsville and in Rose Valley. In the vicinity of Oregon Hill some of the soil has a reddish-yellow or brick-red subsoil, owing to the fact that the soil here is derived from glacial drift which contains a considerable admixture of gray sandstone material.

Bedrock is usually more than 3 feet below the surface, and in places the glacial drift attains considerable depth, but some shallow areas, too small to be shown satisfactorily on the soil map, are scattered throughout the regions where this soil occurs. In these areas the drift mantle is less than 3 feet deep, and the material of the subsoil is residual, resembling the subsoil of the Upshur soils.

Lackawanna gravelly loam is widely distributed within the glaciated section of Lycoming County. In the southeastern townships, especially in the vicinity of Unityville and northeast of Lairdsville, it is the dominant soil. In Rose Valley and near Buttonwood and Oregon Hill, as well as in other localities where red shales and sandstones underlie the drift, it is the principal farming soil. Near Loyalsock and Cogan Station, where Loyalsock and Lycoming Creeks emerge from the plateau region, the recession of the ice lobes which lay in the valleys of these streams has left small areas of this soil. In these localities it is in places confused with colluvial Upshur soils, which it resembles. Practically all of this soil was stony loam in its virgin state, but clearing the land for cultivation resulted in the removal of the larger stones from the fields. This process was continued as large rock fragments were brought to the surface by tillage so that at present the rock fragments in cultivated fields approximate gravel in size. The large stones were collected in piles or worked into fences.

Areas of this soil vary from undulating to steeply rolling. The ridges are generally smoother and better rounded than those common to the residual Upshur soils, and the slopes are less abrupt. Within the plateau region the soil occurs at elevations ranging from 1,500 to more than 2,000 feet, whereas below the Allegheny Front the elevations are from 800 to 1,400 feet. Drainage is good except in small areas along stream courses. Where large enough to be shown, these patches have been mapped as Lackawanna silty clay loam, poorly drained phase.

Lackawanna gravelly loam is one of the leading agricultural soils of the area, and practically all of it is under cultivation. The uncleared lands associated with it were mapped as Lackawanna stony loam.

General farming, including dairying, is the common practice. The principal crops are hay, oats, wheat, corn, buckwheat, rye, and potatoes. Dairy herds of varying size are kept on practically every farm, except in remote sections within the plateau. Hog raising is a common phase of farming. Good yields of all farm crops are obtained, and the soil is fully as productive as the Upshur soils of the area. In the higher elevations the growing season is too short for the production of dent corn. Rye is frequently substituted for wheat in these localities, and buckwheat is more commonly grown than elsewhere. In the better-developed farming regions the cropping is carried on under the common scheme of rotating corn, oats, wheat, and grass (two years). Fertilization practice is similar to that for the Dekalb, Berks, Upshur, and Lordstown soils. Liming can not be said to be generally practiced. Most of the soil is a considerable distance from shipping points, as well as from local sources of lime.

Land values in 1920 ranged from $25 to $75 an acre. Some well-improved and favorably located farms command higher prices, and depleted lands sometimes can be purchased for less than the minimum figure. The average selling price is about $40 an acre.

This soil is deficient in lime, and analyses have shown that the lime requirement is closely similar to that of Upshur soils. In general, the methods outlined for the improvement of Dekalb, Berks, and Upshur soils are applicable to Lackawanna gravelly loam. Lime has probably been less generally applied upon this soil than upon the Upshur soils, and the use of moderate amounts in each rotation can not be too strongly urged.

LACKAWANNA STONY LOAM

The fine material of Lackawanna stony loam, in both topsoil and subsoil, is similar to that of Lackawanna gravelly loam, the chief difference being in the size and quantity of the stones. Large quantities of rock fragments of all sizes, including occasional massive bowlders and blocks of red and gray sandstone, are scattered over the surface and throughout the soil. These rock fragments constitute from 30 to 60 per cent of the soil mass. Although bedrock in most places is consideraly more than 3 feet below the surface, there are in places excessively stony shallow areas having small exposures of Catskill rocks.

This soil has a wide distribution and occurs in close association with Lackawanna gravelly loam. It is extensive both north and south of Muncy Creek, near Picture Rocks and Mawrglen. A broad area occurs north of Proctor, and there are numerous large areas throughout the drift-covered regions of red sandstone and shale. Some of it is found at higher elevations than the gravelly loam, as on the crest of Burnetts Ridge, near Masten, and several other prominences in this part of the county; but it is most com-

monly found in the lowlands of the plateau and in the hill region south of the Allegheny escarpment, in the extreme eastern townships. Elevations range from about 1,000 feet in the hill country, to considerably more than 2,000 feet on the plateau ridge crests. In general, the drift is deeper at the lower elevations.

The surface is prevailingly hilly, but there are broad areas of comparatively smooth surface. The highest ridges in many places are undulating or rolling, but they are flanked by steep slopes which render them inaccessible. Stream dissection is thorough and the soil is well drained throughout.

None of the Lackawanna stony loam is under cultivation. With the exception of scattered, partly cleared tracts which are devoted to pasture, it is forested with second-growth oak, chestnut, sugar maple, beech, birch, pine, and hemlock. The virgin timber on this soil included some of the finest in the county, and reforestation has been more rapid than on most of the forest soils of Lycoming County. A few valuable timber tracts are now standing.

Land values depend upon the location, quality, and condition of the timber stands. Much of the land is sold in connection with near-by areas of Lackawanna gravelly loam.

A large part of the Lackawanna stony loam has a potential agricultural value. When cleared and placed in a cultivable condition by the removal of the larger stones, it is a strong soil, but the expense of putting the land in such a condition makes the agricultural development of this soil impracticable under present economic conditions. Some cleared areas of Lackawanna gravelly loam can be purchased at the present time for less than the probable cost of preparing Lackwanna stony loam for agriculture.

Lackawanna stony loam, steep phase.—The steep phase of Lackawanna stony loam is a surface rather than a soil condition. Some of the areas are too steep to be farmed, shallow patches are numerous, and the soil is commonly more stony than the typical soil. It occurs on steep slopes, many of them, especially within the Allegheny Plateau, being practically as steep as those of rough stony land and differing from the latter only in the presence of a greater quantity of fine soil material. All of the soil is forested and has no present value for farming purposes except for pasture in a few localities. It supports a much better timber growth than does rough stony land.

LACKAWANNA SILTY CLAY LOAM, POORLY DRAINED PHASE

Lackawanna silty clay loam, poorly drained phase, has a surface soil of mottled gray and brown silty clay loam and a mottled gray, blue, and rust-colored subsoil of silty clay or clay which may be very plastic. The lower part of the subsoil has a chocolate-colored tinge. Glacial bowlders, cobbles, and a few angular sandstone fragments are scattered over the surface and the subsoil is very stony.

There are many local variations of this soil. Near the center of the larger areas for a few inches near the surface, the soil may be peaty, and a few small areas of peat and muck have been included in mapping. Both topsoil and subsoil vary considerably in texture. The topsoil ranges from heavy loam to clay loam, and the subsoil in places is appreciably sandy. The color is not uniform and varies

with the drainage, the more poorly drained areas having a basic gray color, whereas some included small elevated areas have the color of the neighboring Lackawanna soils. In some of the boggy tracts the soil is silty clay loam, dark blue in color, or with bluish, rust-brown, or yellowish-brown mottlings; others are clay at the surface and grade to blue or mottled blue and yellow, plastic clay, which contains rust-colored concretionary material; in others the surface soils are sandy clay loam or loam.

Lackawanna silty clay loam, poorly drained phase, occurs in association with other Lackawanna soils and is derived from the same materials, but has developed under very poor drainage conditions. It is most extensively developed in the lowlands near Oregon Hill and Buttonwood. The soil occurs in depressions or flats about the heads of streams and on the lower parts of the slopes. Much of it is rather boggy, the poor drainage being due to seepage. Its total area is small, and practically none of it is cultivated. A large proportion is devoted to pasture, affording fair grazing, and the remainder is forested with second-growth hardwoods, hemlock, and pine. Land values are comparatively low.

WHEELING LOAM

The topsoil of Wheeling loam is deep-brown mellow loam from 10 to 15 inches deep. The subsoil is yellowish-brown or slightly reddish-brown loam material which grades to friable loam or silty clay loam with a somewhat more pronounced reddish-brown color than the upper part of the subsoil. Below a depth of 30 inches the subsoil in many places becomes lighter in texture, approaching fine sandy loam. Gravel or stones are almost entirely absent in this soil, but the substratum, at a depth of 4 or 5 feet, in many places contains a considerable quantity of waterworn gravel and cobbles.

Along some of the streams of the county which flow mainly from red shale regions, the subsoil color is almost chocolate colored, closely approaching the color of the Moshannon first-bottom soils, and representing the terrace correlative of the Moshannon.

Wheeling loam occurs on level or nearly level terraces along the Susquehanna River and some of its tributaries. Most of the terraces are low, and at rare intervals parts of the lowest of them are inundated as they were during the high river stage in the June flood of 1889. In many places the terraces grade imperceptibly into the first bottoms so that much of the soil might be said to lie in abandoned flood plains rather than on terraces in the true sense of the word. Excellent drainage prevails.

This is an important agricultural soil. It predominates throughout the main valley of West Branch Susquehanna River within the area, and practically all of it is in a high state of cultivation. It is retentive of moisture and has a structure favorable to easy tillage.

The principal crops are corn, oats, wheat, hay, and potatoes. Some vegetables are produced near Williamsport and in the vicinity of Jersey Shore a few farmers raise tobacco, although the production of tobacco has declined in recent years. Practically all farms support moderate-sized herds of dairy cattle, and hog raising is important. Seed-corn production has been increasing in importance

in West Branch Susquehanna River Valley, and bids fair to become an attractive enterprise on this soil. Sweepstakes and Whitecap are the seed varieties. Excellent yields of all farm crops are obtained. Corn yields range from 40 to 80 bushels an acre; oats, from 30 to 60 bushels; wheat, from 15 to 40 bushels; timothy, from 1½ to 2 tons of hay; and clover, from 1½ to 3 tons. Potatoes yield from 100 to 250 bushels an acre. The average yields approximate for corn, 50 bushels; wheat, 20 bushels; oats, 40 bushels; and hay, 2 tons an acre.

In general, the same methods of crop rotation and fertilization prevail on Wheeling loam as on the upland soils. The rotation is frequently shortened to four years by breaking grasslands after the first year, and corn thus assumes more importance than on upland soils.

In West Branch Susquehanna River Valley and near-by tributary valleys, land values in 1920 ranged from $150 to $300 an acre, but in less highly developed and favorably located sections, this land is held at prices from $50 to $100 an acre, and much of it is sold in connection with other soils.

No specific data is available relating to the maintenance of productivity on Wheeling loam, but it is generally recognized that the use of lime is very beneficial, and that the production of maximum crops requires the use of stable manure reinforced by acid phosphate. On farms where it is desired to extend the production of corn, particularly for seed, it would seem that a shortening of the rotation would be advisable. This could be accomplished by the elimination of one of the small-grain crops, by cutting grass only one year, or by the use of both measures, in which case a three-year rotation of corn, oats, or wheat, followed by clover, could be adopted.

WHEELING SILT LOAM

Wheeling silt loam consists of deep-brown, mellow silt loam, 10 or 12 inches deep, underlain by yellow-brown friable silty clay loam material which in the lower part of the subsoil becomes slightly reddish brown, and in places markedly reddish brown. In many places the deeper part of the subsoil, usually below a depth of 30 inches, is distinctly lighter textured than the upper part. There is little or no gravel or stone above a depth of 3 feet.

This soil occurs only in West Branch Susquehanna River Valley and the broad adjoining alluvial plains near the mouth of Muncy Creek, the largest areas occurring in the latter locality and near Jersey Shore. Like Wheeling loam, it is found on level terraces, but it is usually farther from the river than areas of Wheeling loam, and the land is somewhat higher as a whole, although some areas lie adjacent to the flood plains. Drainage is uniformly good.

Wheeling silt loam is one of the most important alluvial soils of the county. It is exceedingly productive and practically its entire area, totaling 12.3 square miles, is under cultivation. It is devoted to the kinds of farming practiced on Wheeling loam, and is treated in a similar manner, with equally good yields. Land values are comparable to those of Wheeling loam. The soil responds to the same methods of maintaining fertility, but somewhat heavier equipment is necessary for tillage operations than on the latter.

WHEELING GRAVELLY LOAM

The topsoil of Wheeling gravelly loam is brown loam from 10 to 15 inches deep. This is underlain by lighter-brown or yellowish-brown loam material, which grades to reddish-brown loam or heavy loam material. Well-rounded gravel and cobbles of sandstone and conglomerate are plentiful on the surface and through the soil. In the substratum, the gravel and cobbles are very abundant, in many places constituting by far the greater bulk of the material.

Along many of the smaller streams of the area, particularly those flowing from the glaciated red shale regions within and near the Allegheny Plateau, this soil, as mapped, includes areas which have a slightly chocolate brown topsoil and a distinctly chocolate brown subsoil. These areas probably owe their color to the red shale and sandstone material from which the soil is here derived with little admixture of wash from soils derived from gray sandstones; or to younger and less thoroughly weathered terraces than those on which the typical soil occurs. Such areas occur along the upper reaches of Blockhouse, Lycoming, Loyalsock, and Muncy Creeks and some of their tributaries.

Along Loyalsock Creek above Loyalsock village several areas mapped with this soil have been influenced by glacial outwash, and large cobbles and even small bowlders strew the surface. Such areas have been indicated by stone symbols on the map. The large size of the stones is a serious hindrance to cultivation.

Wheeling gravelly loam occurs on well-defined terraces, usually above all overflow, along West Branch Susquehanna River and its tributaries. The most extensive area is near Hughesville. The land is level, or nearly so, and drainage is everywhere excellent. It is one of the main alluvial soils of Lycoming County, and is considered productive. Except for a few small, inaccessibly located tracts in the mountain regions all of it is cultivated. In the valley of West Branch Susquehanna River and neighboring tributaries, corn is almost as generally grown as on Wheeling loam and Wheeling silt loam, but in many sections within the Allegheny Plateau grass and small grains take precedence, and buckwheat and rye are produced to some extent. In general, however, the farming is similar to that described in connection with Wheeling loam. Owing to the gravelly substratum the soil is inclined to be droughty in many localities, and for this reason yields are appreciably lower than on Wheeling loam.

Land values in 1920 ranged from about $50 to $150 an acre, but in some remote sections lower values prevail.

Suggestions for the improvement of Wheeling loam are applicable to Wheeling gravelly loam. Because much of this soil is droughty, stable manure should be applied twice in each rotation, if possible, and the occasional turning under of second-growth clover will be beneficial.

WHEELING FINE SANDY LOAM

The topsoil of Wheeling fine sandy loam is brown or deep-brown fine sandy loam about 12 inches deep. The subsoil is yellowish-brown or slightly reddish brown heavy fine sandy loam material, which at a depth of about 30 inches becomes lighter in texture, approaching loamy fine sand. It is free from gravel.

This soil occurs on level or faintly undulating terraces in the West Branch Susquehanna River and larger tributary valleys, usually on the outer edges of terraces but in some places bordering the streams. Many of the terrace borders are imperceptible, and some of the lower parts are subject to overflow in periods of exceptionally high water. Excellent drainage prevails everywhere. The largest area is east of South Williamsport.

Though Wheeling fine sandy loam is not extensive in area, all of it is cultivated and it is regarded as a highly productive soil. In general the same crops are grown as on other Wheeling soils, but in the vicinity of Williamsport some early vegetables are grown. Yields closely approach those secured on Wheeling loam. This kind of land in the West Branch Susquehanna River Valley sold in 1920 at prices ranging from $150 to $250 an acre, but in remote localities land values were much lower.

This soil is admirably adapted to the production of vegetables for early markets. In view of the excellent local markets and the good transportation facilities, it would seem that the production of early vegetables could well be extended on favorably located areas.

WHEELING FINE SAND

The topsoil of Wheeling fine sand is brown, slightly loamy fine sand from 10 to 15 inches deep, underlain by slightly reddish brown fine sand or somewhat loamy fine sand. It occurs on low ridges or in hummocky areas on the West Branch Susquehanna River terraces, in close association with Wheeling fine sandy loam. The largest area is 2 miles east of South Williamsport, and a few small areas are near Jersey Shore, but its total extent is very small. It is a moderately productive soil. These lands are sold in connection with other Wheeling soils.

Wheeling fine sand is adapted both in soil characteristics and location to early truck crops.

HOLSTON SILT LOAM

Holston silt loam has a grayish-brown or brown silt loam topsoil from 8 to 12 inches deep, and a yellow subsoil which may vary from silty clay loam to silty clay, and which in many places is very plastic in the lower strata. Scattered subangular and rounded gravel and cobbles are found on the surface and throughout the soil, and water-worn shale fragments are present where the soil occurs in proximity to the shale hills common to Dekalb soils. As mapped it includes areas of gravelly silt loam which are indicated on the map by gravel symbols.

Holston silt loam occurs on second-bottom positions in association with Dekalb and Lycoming soils, and is derived from the same materials. In the West Branch Susquehanna River Valley it commonly occurs next to the uplands, and some areas are partly colluvial, spreading out in fan shape at the base of the hills or where the smaller streams emerge from the uplands. In White Deer Valley this soil occurs on low, rather ill-defined terraces along the small streams, usually in narrow and irregular areas.

The surface of Holston silt loam is level or gently sloping and drainage for the most part is well established, but there are included small patches of poorly drained light-colored soil which, if of sufficient extent, would have been mapped as Tyler silt loam.

The aggregate area of this soil is 6.9 square miles. Around Williamsport some of it is subdivided into city lots, but the remainder is practically all under cultivation or in pasture and is devoted to general farm crops. It is considered productive but is not so highly valued as the heavier Wheeling soils. It is sold mainly in connection with other soils.

It is probable that Holston silt loam is more deficient in lime than the Wheeling soils, and it contains less humus. Improvement should include a liberal use of lime and stable manure. In other respects the measures recommended for improving Wheeling loam apply to this soil.

MOSHANNON FINE SANDY LOAM

Moshannon fine sandy loam has a topsoil of chocolate-brown or chocolate reddish-brown fine sandy loam, from 10 to 24 inches deep, and a chocolate reddish-brown friable subsoil which may vary in texture from fine sandy loam to loamy fine sand. As mapped many textural variations are noticeable. In some localities, as in the Pine Creek bottoms west of Jersey Shore, small areas have a surface soil of loamy fine sand and in other places thin layers of heavy material interspersed with lenses of fine sand occur within the 3-foot depth.

This soil occurs on level or faintly undulating first bottoms, usually adjacent to the streams. Numerous areas are in the West Branch Susquehanna River Valley, and this is the principal soil in the first bottoms of Pine, Lycoming, Loyalsock, and Muncy Creeks, as well as a number of smaller streams. It is very well drained.

Moshannon fine sandy loam is the most extensive of the first-bottom soils in the county. It is seldom subjected to destructive overflow, and practically all of it is intensively cultivated except in a few remote sections. General farm crops are grown, and market gardening is carried on in the vicinity of Williamsport.

Corn is an especially important crop on this soil, and excellent yields are secured. Seed-corn production is practiced to some extent in the West Branch Susquehanna River Valley and near-by valleys. Excellent yields of hay, oats, and wheat are obtained.

Land values have a wide range, depending upon location. They vary from $50 an acre to fully $300 for the best situated lands in the West Branch Susquehanna River Valley.

Moshannon fine sandy loam, low phase.—Areas of the low phase of Moshannon fine sandy loam occur at unusually low elevations above the streams which they border. The soil material is, in general, similar to that of the typical soil, but is subject to more variations, being in places fine sand and containing in other places small gravelly spots. The principal areas are situated along Loyalsock Creek, the largest being near the mouth of the stream.

The land is very hummocky. Drainage is not so good as on areas of the typieal soil. None of it is under cultivation, but some is in pasture, to which it is very well adapted. The forest growth consists of sycamore, soft maple, birch, poplar, and a few hemlocks and pines.

The land is too frequently and severely inundated in flood periods for assured results in cultivation.

MOSHANNON LOAM

Moshannon loam consists of chocolate-brown mellow loam, underlain at a depth ranging from 8 to 24 inches by friable loam or silt loam material of the same color. Occasionally thin lenses or layers of fine sand are found above a depth of 3 feet.

Mapped with this soil are some areas in which the surface soil is silt loam, but which are in other respects similar to the typical soil. The largest area of this character is near the mouth of Muncy Creek.

Moshannon loam occurs on level first bottoms along West Branch Susquehanna River and a number of its tributaries, particularly the smaller streams rising within the several belts of Catskill rocks. Along the more swiftly flowing streams within the Allegheny Plateau the finer sediments have been carried out and very little soil has developed. Practically all of the Moshannon loam is subject to inundation in flood periods, but serious damage to growing crops is infrequent, as high water generally comes in winter or early spring. With the exception of a few small depressions and sloughs, drainage is very well established.

This is one of the most important bottom-lands soils of Lycoming County. The larger areas are all under cultivation, but many of the narrow bands bordering small streams are used for pasture, though parts of them are forested. Fully 75 per cent of this soil is devoted to the general farm crops of the region and gives excellent yields, especially of corn and grass, with the use of less commercial fertilizer than is commonly applied to the upland soils. Some tobacco is grown near Jersey Shore.

Land values vary widely. The narrow strips within the hill region are usually sold in connection with other soils and bring from $25 to $100 an acre but the broader areas of more favorable location command prices ranging from $100 to $300 an acre. Very little of the favorably located soil is changing hands.

MOSHANNON GRAVELLY SANDY LOAM

The soil material of Moshannon gravelly sandy loam is very similar to that of Moshannon fine sandy loam, from which it differs chiefly in containing a large quantity of rounded gravel throughout the soil mass and in containing somewhat coarser sandy material.

Moshannon gravelly sandy loam occurs on low first bottoms along some of the mountain streams of Lycoming County. It is most extensively developed along Little Pine Creek and its tributaries, and much of it is of very recent origin, having been formed in the disastrous flood of 1889, when soil, buildings, and even orchards were washed away, and immense quantities of sand, gravel, and cobbles were deposited in places formerly occupied by fertile fields of Moshannon fine sandy loam.

The drainage in most places is excessive and the soil is very droughty. It is not extensive in area and little is under cultivation, not only because of droughtiness but also on account of the excessive

amounts of gravel, which in many places preclude cultivation. Most of it is pastured or entirely abandoned. A few of the better areas give fair results with the general farm crops. It would seem impracticable to develop or restore this soil in most places.

DEKALB GRAVELLY LOAM

Dekalb gravelly loam consists of a layer, about 8 inches deep, of grayish-brown or light-brown mellow loam and a thin layer of yellowish-brown or yellow friable, heavy loam or silt loam material which grades to pale-yellow silty clay loam. In forested areas, the immediate surface soil is usually gray and is underlain by either yellow or brown material at a depth ranging from 1 to 3 inches. The brown color of the subsurface layer in forested areas is caused by organic matter which has accumulated by leaching from the surface soil, giving rise to what is called a podsolized condition. This layer may be only faintly developed; but where well developed it consists of brown material (usually loam) to a depth of 6 or more inches, below which the color shades to yellow. The more brownish color of the surface soil in cultivated areas is in part the result of the incorporation of organic matter from clover and other crop residues. Angular fragments of sandstone and some sandy shale are plentiful on the surface and throughout the soil; they aggregate from 15 to 60 per cent of the soil mass.

The range of conditions under which Dekalb gravelly loam occurs has been reflected in the variations in the soil. On the smoother areas it is about 3 feet deep but on colluvial slopes is commonly deeper.

This soil occurs in Lycoming County mainly on the ridges of Allegheny Plateau at elevations ranging from 1,800 to 2,100 feet. The surface is generally smooth, and many fields are nearly level. The colluvial slopes are mostly of gentle gradient and are characterized by numerous seepage spots covered by Lickdale soils which have been mapped with this soil. Except for these small areas the soil is well drained.

Dekalb gravelly loam is of but slight importance in the agriculture of the area. Clearing and removing the larger stones has changed Dekalb stony loam to Dekalb gravelly loam. Several tracts on the Allegheny Plateau ridges, abandoned because of their inaccessibility, have been included in land purchases for State forest or for fish and game preserves.

On the high mountain elevations the principal crops are hay, oats, rye, buckwheat, corn, and potatoes, but only moderate yields are obtained. The short frost-free season as a rule precludes the production of dent corn. The suggestions made for the improvement of Berks gravelly silt loam are equally applicable to this soil.[5]

DEKALB STONY LOAM

In the areas where brownish soils predominate, Dekalb stony loam consists of gray or grayish-brown mellow loam about 8 inches deep,

[5] For additional suggestions regarding the improvement of mountain areas of this soil, see: WHITE, J. W. FERTILIZER EXPERIMENTS ON DEKALB SOIL. YIELDS OF CLOVER, CORN, AND KENTUCKY BLUEGRASS. Pa. Agr. Expt. Sta. Bul. 155, 20 p., illus. 1919. This bulletin reports a series of experiments on a closely related soil, situated near Snowshoe, Pa., at an elevation of about 2,000 feet above sea level.

underlain by yellow friable loam or sandy clay material which becomes more gravelly and porous at a depth of about 3 feet and grades into partly decomposed bedrock. In areas where grayish soils predomonate, the surface layer is from 1 to 4 inches deep. The virgin soil in most places has a thin veneer of forest leaf mold over the surface, and is underlain by a thin layer of leached gray soil, loose and noticeably sandy. This grades to a thin layer of brown or dark-brown loam which contains the organic matter leached from the upper layer and which is underlain by yellow material.

Some areas show only an incipient layer of the brown subsurface material. In places the subsoil is yellowish brown and even reddish brown. Dekalb stony loam is characterized by the presence of numerous medium or large sandstone fragments both over the surface and through the soil, and because of the stones it is impossible, in most places, to bore with the soil auger to a depth of 3 feet.

This soil occurs in large areas throughout the Allegheny Plateau region on the more nearly level parts of the ridges, in most places on the lower plateau elevations but in a few places on the steep slopes which grade into the rocky mountain sides. A few hilly areas are in the central hill region. The soil is mainly derived from light-colored sandstones and arenaceous shales which contain little lime carbonate. In most places the land has sufficient slope to insure good surface drainage, and on the level areas the porous earth rapidly absorbs the rainfall.

Dekalb stony loam is one of the most extensive soils of Lycoming County. It is practically all in the virgin state, however, and consists of cut-over forest land. The forest growth consists of young oak, chestnut, maple, birch, pine, hemlock, and an undergrowth of huckleberry, laurel, bracken, and sweet fern. The areas which have been cleared for cropping have been changed to gravelly loam by the removal of the larger stones. This land is, for the most part, held in large tracts by mining and lumber companies and fish and game clubs, and considerable areas are included in State forests. In 1920 it could be purchased at prices varying from $5 to $15 an acre, depending upon the quality of the timber. Some land near English Center and in one or two other localities is underlain by bituminous coal and commands higher prices.

Because of its high elevation, inaccessibility, and excessive stoniness, this soil is best suited to forest. The virgin timber of this region, now largely removed, was noted for its yield and quality. The Pennsylvania Department of Forestry is prepared to advise concerning the approved methods of reforestation.

Included with Dekalb stony loam, as mapped, are a number of small areas of Hanceville soils having brick-red subsoils, the texture of these soils being gravelly loam, stony loam, or stony sandy loam. Hanceville gravelly loam consists of grayish-brown loam about 8 inches deep, underlain by reddish-yellow or brick-red, friable, gritty loam or gritty clay material. In many places the surface soil is underlain by a yellowish subsurface layer not unlike the subsurface layer of Dekalb gravelly loam, but this material grades to red clay. This soil is characterized by an abundance of small, angular, gray, and reddish sandstone fragments about the size of gravel, which are scattered over the surface and throughout the soil to a depth of 3 feet.

Much of this soil originally had considerable large stones over the surface, but these were removed from the fields when the land was cleared for agricultural purposes.

Included areas of Hanceville gravelly loam are mainly south of the river in the Appalachian ridge and valley region. It occurs on colluvial slopes around Nippenose Valley, and at higher elevations, as on the divide east of Bastress, it is associated with Hanceville stony loam and Hanceville stony sandy loam. It is derived from the same character of rocks as those underlying Dekalb soils, and resembles both Kekalb gravelly loam and Murrill silt loam, differing from the former mainly in the color of the subsoil and from the latter in the lighter color and looser structure of the surface soil and the more pronouncedly reddish color of the subsoil. In contrast to Murrill silt loam, Hanceville gravelly loam is not influenced by limestone. Where these soils are closely associated, however, they merge indistinctly into one another. The surface varies from nearly level to rolling, and the soil is uniformly well drained. It is not very extensive, and though the greater part of it is cultivated its agricultural importance is slight. With respect to crops, methods of farming, yields, and land values, it is comparable in all particulars to Dekalb gravelly loam but is probably more productive.

Included areas of Hanceville stony loam consist of soil which is much the same as the Hanceville gravelly loam but which differ in the abundance of large and small sandstone fragments. In many places the rock is so abundant as to render the soil unfit for agriculture. In many areas the soil consists of a surface layer of leached, grayish material beneath which is a thin horizon of brownish color, underlain by the typical reddish-yellow or brick-red, friable clay loam subsoil. Near Sylvan Dell, a small area of this sandy loam lies on the colluvial slope north of Bald Eagle Mountain. The most extensive area is in the trough-shaped valley immediately north of North White Deer Ridge, where the soil is derived from sandstones and includes some chocolate-colored beds. Where the color is that of the parent rock, the soil approaches or represents Upshur soil. This soil is not extensive and is entirely in cut-over forest land, for though most of it has a sufficiently smooth surface for cultivation, the abundance of stones renders it unfit for agriculture.

Included areas of Hanceville stony sandy loam consist of gray sand or light sandy loam, over which there is, in forested areas, a thin veneer of dark or brownish forest mold. In many places, a brown or coffee-brown subsurface layer is present. This horizon, occurring from 4 to 10 inches below the surface, owes its brown color to the deposition of organic material leached from above. The material below this horizon of organic-matter accumulation is in many places yellow sandy loam to a depth ranging from 12 to 18 inches and grades to reddish-yellow or brick-red friable sandy loam or sandy clay. Both topsoil and subsoil contain large quantities of angular sandstone fragments of varying size. This stony sandy loam occurs only on the higher elevations, usually the tops and slopes of ridges south of West Branch Susquehanna River. With the exception of a few areas, it is uncultivated. The cultivated parts, which have been cleared of the larger stones, represent Hanceville gravelly

sandy loam. Hanceville stony sandy loam occurs in nearly level or rolling country, and the steeper slopes merge into rough stony land. Drainage is excellent and in many places excessive because of the open structure and coarse texture of the soil. The extent of this soil is small and the cultivated land gives only fair crop yields. Most of it is in second-growth forest, to which it is doubtless best suited.

DEKALB STONY SANDY LOAM

In forested areas Dekalb stony sandy loam has a thin coating of dark leaf mold underlain by light-gray sand or light sandy loam from 3 to 8 inches deep. In many places this layer grades to a thin, somewhat compact layer of brown or coffee-brown sandy loam, from 1 to 4 inches thick, which is underlain by a yellow or orange friable subsoil which may be sandy loam, loam, or sandy clay. In places the gray surface and brownish subsurface layers are obscure or absent. Under such conditions the gray surface soil, at a depth ranging from 8 to 12 inches, abruptly grades to yellow sandy loam underlain by the typical yellow subsoil. The deeper part of the subsoil, especially south of the river, is light reddish in color and grades into the Hanceville soils with which it is closely associated. On the surface and throughout the soil, large angular sandstone fragments are present in such proportion as to give, in some places, the characteristics of rough stony land.

Dekalb stony sandy loam occurs throughout the unglaciated sections of the Allegheny Plateau, as well as on the high divides and mountain benches in the Appalachian region, and is the most extensive soil in these localities. On the plateau it is derived from sandstone, conglomerate, and shale, and south of the river it owes its existence to the weathering of sandstones. It occurs on the highest elevations in the plateau region. The surface varies from nearly level to rolling and includes some steep slopes near the stream heads. Drainage is good and even excessive on this porous soil which is leachy and not retentive of moisture.

None of the Dekalb stony sandy loam is under cultivation. Like the stony loam, it is cut-over forest land, much of it being held in large tracts and the various State forest units of the county. The timber growth is similar to that on Dekalb stony loam, and land values are about the same or somewhat lower. It is best suited to forest. Areas from which the larger stones have been removed are cultivated, but yields are low, and though the soil can be improved it is improbable that the measures which would be necessary for building up and maintaining its productivity would justify the expense involved. The areas on the Allegheny Plateau, at least, could well revert to forest.

LORDSTOWN GRAVELLY SILT LOAM

The topsoil of Lordstown gravelly silt loam is light-brown or grayish-brown silt loam from 6 to 10 inches deep. The subsoil is yellow or yellowish-brown gritty friable silty clay loam material. Fragments of gray shale and fine-grained sandstone are plentiful throughout the soil, and bedded shale rock occurs in many places within 3 feet from the surface. Subangular and rounded gravel

and cobbles and a few erratic bowlders are scattered over and embedded in the soil, forming from 10 to 50 per cent of the soil mass. This soil differs from Berks gravelly silt loam in having a more gritty, friable, and porous subsoil. A few small areas with sufficient good-sized stones over the surface to interfere with cultvation have been included in mapping.

This soil occurs almost exclusively in the southeastern end of the county, in the neighborhood of Lairdsville and Unityville. It is derived from the glaciation of gray shales and sandstones, and although there is an appreciable admixture of foreign ice-transported material, the soil mass is local in origin, the ice sheet having transported its material only short distances. Near the boundaries of glaciation, the soil thins out and in many places it is hard to distinguish from the residual soils of the Berks series. It is nearly continuous in the area in which it occurs. Some of the higher hilltops, however, show no evidence of glaciation and were therefore mapped with the Berks soils.

The surface of this soil is rolling or hilly and is much like that of Berks gravelly silt loam. The ice sheet exerted little influence upon the surface configuration, except for a slight smoothing of some of the hills and filling in of valleys. Along some of the valleys there are a few small areas of deep drift which would have been mapped as a separate series, the Wooster, but for their slight importance. A few slopes are too steep for cultivation, but their total area is small. Drainage is well established except for small, widely scattered areas where seepage occurs. Such areas are characterized by mottled subsoils.

Lordstown gravelly silt loam is of slight agricultural importance because of its comparatively small extent. About 65 or 75 per cent is in cultivation or pasture, and the remainder supports the characteristic second-growth forest of the region. It is devoted to the same crops and the methods of farming are about the same as on the corresponding Berks soil. The yields equal, if not exceed, those on the latter soil. This is probably a slightly better corn, grass, and pasture soil than Berks gravelly silt loam on account of its friability and greater depth. Because of its remoteness from the larger centers of population and shipping points of Lycoming County, land values are slightly lower than those of Berks gravelly silt loam.

The measures suggested for the improvement of the latter soil will prove effective with Lordstown gravelly silt loam.

LORDSTOWN SILT LOAM

The topsoil of Lordstown silt loam is light-brown silt loam, averaging 10 inches in depth. The subsoil is pale-yellow silty clay loam material which is more friable and gritty than the subsoil of Berks silt loam. This soil is marked by comparative freedom from stones though both angular and rounded shale and sandstone fragments are scattered on the surface and throughout the soil, constituting a small percentage of the soil mass. In nearly every mapped area of this soil are small patches of poorly drained land affected by seepage. Here the surface soil is grayish and has a tendency to be heavier in texture than the soil around it, the subsoil is mottled with gray, yellow, and rust brown, and is markedly plastic.

Lordstown silt loam, in association with Lordstown gravelly silt loam, occurs around the heads of small streams rising in the region where the latter soil predominates. The silt loam is a deeper soil than the gravelly silt loam, owing to the fact that the depressions in which it occurs have been partly filled in with glacial drift. The areas are commonly gently sloping, and the drainage is fairly good, except in the small seepage spots previously described. The soil is agriculturally unimportant because of its small aggregate extent, but it is practically all under cultivation or in pasture. It is farmed in connection with and in the same manner as Lordstown gravelly silt loam, and is fully as productive. It affords excellent pasturage. Some of the areas containing poorly drained patches are troublesome, as wheat has a tendency to heave in winter, and in excessively wet seasons crops sometimes suffer. Many of these small "spouty" tracts can be rendered more reliable by installing short tile drains. In the improvement of the soil the measures suggested in connection with Berks gravelly silt loam are recommended.

LORDSTOWN STONY LOAM

The topsoil of Lordstown stony loam is grayish-brown loam of open structure, 6 or 8 inches deep. The subsoil is brownish-yellow or yellow, friable, heavy loam or clay loam. The entire soil contains numerous sandstone fragments of considerable size, both angular and partly rounded. The surface soil in many places is made up of three rather distinct layers, like that of Dekalb stony loam, consisting of a thin, superficial layer of dark or brownish vegetable mold, a gray layer from which the humus has been leached, and a brown or coffee-brown layer within which has been deposited the organic matter leached from above. The yellowish subsoil is generally so stony that the auger can not penetrate to a depth of 3 feet.

Lordstown stony loam is distinctly a mountain soil and occurs exclusively on the thinly glaciated plateau tops in the eastern and northeastern parts of the county, where it covers a broad, continuous expanse of territory. It occurs on some of the mountain slopes in this region in placees where the drift mantle has not been removed by recent erosion. The general surface configuration is similar to that of Dekalb stony loam, and the drainage is good, though a few interstream areas of level surface where drainage is deficient are included. The elevations at which the soil occurs range from 1,800 to fully 2,200 feet above sea level.

None of this soil is now under cultivation, though in the past a few small tracts have been farmed. Originally the region supported valuable stands of pine, hemlock, and hardwood timber, but this has been cut almost entirely, leaving the characteristic second-growth forest indigenous to the Allegheny Plateau. Land values depend upon the quality of the timber stands, and are comparable to those of Dekalb stony loam. The land is best suited to forest, and the labor and expense of clearing and placing it under cultivation is not justifiable.

LORDSTOWN STONY SANDY LOAM

Lordstown stony sandy loam consists of gray or grayish-brown sandy loam, from 5 to 8 inches deep, underlain by brownish-yellow

or yellow friable loam which continues to a depth of about 3 feet where it is underlain by a mass of partly disintegrated rock interspersed with some fine material which, in places, continues to a considerable depth. Like Lordstown stony loam and closely related Dekalb mountain soils, the surface soil in many places has the gray, leached layer over a brown or coffe-brown layer in which organic matter has accumulated. The material below this second section is yellowish in color. A variation from the typical soil occurs in the extreme eastern part of the county in Franklin and Jordan Townships, where in several areas in a morainal belt the soil is deeper than in the typical tracts on the ridges of the Allegheny Plateau. Parts of these areas are under cultivation and the larger stones have been removed so that the soil more nearly approaches gravelly sandy loam. In many places, bowlders and cobbles of hard sandstone and conglomerate are profuse over the surface and everywhere the soil contains large quantities of sandstone fragments, both on the surface and throughout the soil.

Lordstown stony sandy loam is most extensive in the southeastern part of Cascade Township and in Plunketts Creek Township. With the exception of the areas in Franklin and Jordan Townships it is a mountain soil, occurring on the higher ridges of Allegheny Plateau. The surface features are like those of Dekalb stony sandy loam and good drainage prevails.

The soil is nonarable and most of it should remain in timber.

LICKDALE STONY LOAM

The topsoil of Lickdale stony loam is brownish-gray or gray heavy loam, about 8 inches deep; and the plastic subsoil, mottled with yellow and rust color, varies in color from almost white to bluish gray, and in texture from rather sandy clay loam to silty clay. In places, the surface soil is mottled with yellow. Fragments of gray sandstone are numerous on both the surface and within the soil mass. There is considerable textural variation in the surface soil, as mapped, some areas having been included in which it is silt loam or silty clay loam.

Lickdale stony loam occurs in widely separated parts of Lycoming County. In the limestone valleys and on the north slope of Bald Eagle Mountain it is a colluvial soil, kept wet during most of the year by seepage. On the Allegheny Plateau it occurs as flat, semidepressed interstream areas, and, in the central gray shale belt, it is found in places on "spouty" slopes and around stream heads. The surface varies from flat to gently sloping and drainage is very poor.

The soil is inextensive and but little of it is under cultivation although a small acreage is devoted to pasture. The forest consists mainly of second-growth hardwoods. The few cultivated areas give fairly good yields in favorable seasons, but the soil is not considered reliable, and crops frequently suffer from excessive moisture.

Under present conditions the development of uncleared areas for agricultural purposes entails the removal of large stones and the installation of artificial drainage systems and is impracticable. For the improvement of those parts now under cultivation, artificial drainage is necessary. After adequate drainage has been provided

the measures suggested for maintaining the productivity of the gravelly Berks soil will be applicable to this soil.

LYCOMING GRAVELLY SILT LOAM

Lycoming gravelly silt loam is light-brown or brown silt loam to a depth varying from 8 to 12 inches, where it is underlain by yellowish-brown or slightly reddish brown silt loam, grading at varying depths to friable, gritty clay loam or silty clay loam. The subsoil color, which apparently is closely related to the drainage, varies from yellow or reddish yellow to brick red. The most pronounced reddish subsoil color is generally found on slopes or rounded ridges, whereas the yellow color is developed, as a rule, on the more nearly level stretches. Angular and subangular fragments of gray and reddish sandstone are present throughout the soil and in the substratum, and in places well-rounded cobbles are present on the surface and embedded in the soil. Over much of the area many of the larger rock fragments have been removed from the fields and collected in piles.

The angularity of the stone fragments and the abundance, in places, of fragments of sandstone and quartzite which are unlike the basal rock, show that the soil represents slumped or valley-filling material accumulated as the mountain ridges have weathered down, just as in case of the Murrill soil and other slope colluvial soils such as the Dekalb and Upshur. In most of the valleys of the county, colluvial or slumped material has accumulated along the lower slopes of the ridges and, in many places, extends over the entire floor of the valley, except where it has been removed by erosion. The depth to residual material from the underlying rocks varies apparently because the surface over which the material has been distributed was uneven before deposition or accumulation began. In proximity to the ridges it is excessively stony, this condition being indicated by stone symbols. On some of the slopes and ridges, erosion has exposed small patches of the underlying rock formations, which give rise to Upshur and Dekalb soils. Murrill silt loam, though similarly formed, differs from Lycoming gravelly silt loam in that it is markedly influenced by underlying limestone.

This soil is extensive in White Deer Valley, where it covers almost the entire valley floor. Along the borders of the West Branch Susquehanna River terraces it occurs in benchlike positions resembling high terraces, but the material is obviously not alluvial. A few small areas occur on benches along Lycoming and Little Muncy Creeks.

Areas of this soil are undulating and gently rolling and include low, level-topped ridges with smooth, gentle slopes. Drainage is well established except in a few small flat areas.

Fully 80 per cent of the Lycoming gravelly silt loam is under cultivation. Some stony areas are uncleared and small farm wood lots are scattered over them. Lycoming gravelly silt loam is devoted to general farming, and usually the farms are well improved and have substantial buildings. Methods of tillage and fertilization are similar to those practiced on the other upland soils of the county. The common four-year or five-year rotation of corn, oats, wheat, and grass is rigidly adhered to. The elevations at which the soil occurs,

ranging from 650 to 750 feet, are favorable for the production of corn. Small dairies are maintained on practically every farm, and hog raising is carried on to a considerable extent. Corn yields from 25 to 75 bushels an acre; wheat, from 15 to 30 bushels; oats, from 25 to 50 bushels; and hay, from 1½ to 2½ tons.

Land values at the time the survey was made ranged from $50 to $150 an acre and averaged fully $75.

Lycoming gravelly silt loam is apparently more deficient in lime than either the Hagerstown or Murrill soils but is less acid than the other soils of the area. The proximity of limestone quarries has led to the general use of lime, moderate applications of which are found to be profitable once in each rotation. This soil will undoubtedly respond to the methods of manuring and fertilization suggested for Dekalb gravelly silt loam. Under judicious treatment it can be brought to a high degree of productivity.

Lycoming gravelly silt loam, stony phase.—Lycoming gravelly silt loam, stony phase, consists of brown loam, which grades, at a depth of about 8 inches, to yellowish-brown loam underlain by yellow silty clay loam or silty clay. Medium or large sandstone fragments are abundant, and in a few places shale chips are present. The lower part of the subsoil is reddish in places and has gray mottlings where it is affected by seepage.

This soil occurs on gentle slopes at the foot of mountain ridges south of the river. The largest areas occur on the north side of Bald Eagle Mountain and around White Deer and Nippenose Valleys. The material which makes up the soil accumulated by creep from the higher slopes, and in many places has attained considerable depth. It comes from soil derived from light-colored shales of low lime content and lacks the reddish subsoil cast that characterizes most of the Lycoming soils.

Nearly all of this soil is forested, but a few small areas in the Nippenose Valley are farmed in the same manner as the near-by Dekalb and Hanceville soils. Where cleared it is productive, but the expense of clearing and of removing the larger stones is so great that no new land is being brought under cultivation at the present time.

LYCOMING SILT LOAM

Lycoming silt loam has a brown surface soil averaging about 10 inches in depth, commonly underlain by brown silty clay loam which grades abruptly to friable silty clay varying in color from yellowish to brick red. The soil is comparatively free from stones. In places, the subsurface layer is almost entirely lacking and some areas have a moderately stiff lower subsoil layer. In others, the material has been removed, exposing small areas of soils derived from the underlying rocks. In the vicinity of Halls station, there are several exposures of Clinton shales. These residual areas are, as a rule, too small to be mapped.

This soil occurs most extensively adjacent to the alluvial plains of Muncy and Little Muncy Creeks. The broadest areas are between Pennsdale and Hughesville, and south of Muncy; smaller areas border the West Branch Susquehanna River Valley, in close association with other Lycoming soils.

Lycoming silt loam differs little in its surface features from other Lycoming soils. The land is somewhat smoother and the average elevations are a trifle lower. The drainage is well established.

There is a total area of 7.8 square miles of this soil, nearly all of which is under cultivation, and all of which will respond to cultivation. It is fully as productive as the other Lycoming soils. Near Halls station, Pennsdale, Hughesville, and Muncy, a number of farms, partly or wholly on this soil, rank among the best-improved farms in the county.

The crops are similar to those grown on other Lycoming soils. Dairying is somewhat more important, and several farmers maintain rather large dairy herds. Crop yields probably exceed those secured on Lycoming gravelly silt loam, though accurate data could not be secured. Current land values vary from about $50 an acre to more than $200, depending largely on improvements.

LYCOMING LOAM

Lycoming loam consists of light-brown or brown mellow loam about 10 inches deep, commonly underlain by brownish-yellow or yellow compact loam or silt loam which grades, at a depth of about 18 inches, to friable silty clay loam varying in color from yellow to dull red. This soil is comparatively free from rock fragments but contains a few angular and rounded stones. In some places the subsurface layer is lacking.

Lycoming loam occurs in a number of areas bordering the alluvial plains of West Branch Susquehanna River from Jersey Shore eastward, and several areas are adjacent to the plains along Lycoming Creek. The most extensive are east of Montoursville and northeast of Montgomery.

Areas of Lycoming loam are comparatively smooth and resemble high, partly eroded benches or river terraces, but the material is not water assorted. A large area has a nearly level or gently sloping surface. On a few of the steeper slopes the soil material has been largely removed, exposing small areas of residual soils. The drainage is good.

Lycoming loam has a small total area, aggregating 8.8 square miles. About 85 per cent of it is under cultivation, the remainder being forested with second-growth hardwoods.

The kinds and methods of farming are similar to those practiced on Lycoming gravelly silt loam, and the yields and land values are comparable to those of the latter soil. The methods of maintaining productivity should approximate those suggested for Lycoming gravelly silt loam.

LYCOMING GRAVELLY LOAM

Lycoming gravelly loam consists of light-brown or brown loam, from 10 to 15 inches deep, underlain by yellowish-brown loam or silty clay loam which grades, at a depth varying from 18 to 24 inches, to reddish or dull brick-red, friable silty clay loam. In places the upper part of the subsoil is reddish, but in other places the yellow color extends to a depth of more than 3 feet. Angular and suban-

gular fragments of yellow and red sandstone and conglomerate are plentiful on the surface and through the soil and in places there is a considerable admixture of rounded gravel and cobbles, as well as a few large bowlders, mainly of conglomerate. Rounded gravel is most noticeable over areas situated near Loyalsock and Lycoming Creeks, and it is possible that the soil here is influenced by glacial outwash.

This soil occurs in close association with areas of Lycoming loam which it closely resembles in position and surface configuration but from which it differs in stone content, which is sufficient in places to require the removal of the larger stones from the fields. Drainage is uniformly good.

The largest areas of this soil are near Montoursville and the aggregate extent is about 6 square miles. More than 75 per cent is under cultivation, being devoted to general farming under the common methods of the region, and to dairying. It is regarded as a valuable soil, and with the accepted methods of liming and manuring, supplemented by the use of acid phosphate, can be brought to a high degree of productivity.

TYLER SILT LOAM

The topsoil of Tyler silt loam is gray or brownish-gray heavy silt loam, 8 or 10 inches deep. The light or bluish-gray subsoil of silty clay is mottled with yellow and rust color. The intensity of the mottling, as well as the plasticity of the subsoil, increases with depth. The soil is comparatively free from stone.

The surface soil has many textural variations, in some places approaching silty clay loam and in others, loam. One area east of Williamsport has a distinctly sandy surface in places. In some areas the upper part of the subsoil is pale yellow mottled with gray, and in others it is bluish gray with little mottling of yellow and brown.

Tyler silt loam occurs in flat, imperfectly drained terrace positions. It is found in comparatively small areas along the West Branch Susquehanna River Valley and some of the tributary valleys, one of the largest areas being near Antes Fort. In White Deer Valley, it occurs as several flat, terracelike areas, in interridge depressions.

The total extent is small, about 5.4 square miles. Most of it is cleared, or partly cleared, and it is devoted mainly to pasture. Cultivated areas are productive in favorable seasons, but the soil is not reliable. Crops drown during wet periods, and wheat tends to heave in winter. It is difficult to keep this soil in good tilth, owing to its tendency to puddle when wet and to bake when dry. Artificial drainage is essential before it can be rendered dependable, but where artificial drainage has been provided, the measures recommended for the Dekalb soils will improve Tyler silt loam.

POPE SILT LOAM

The topsoil of Pope silt loam is grayish-brown or brown silt loam, from 10 to 18 inches deep. The yellow or grayish-yellow subsoil may vary in texture from silt loam to silty clay loam, and the lower part of the subsoil is in many places faintly mottled with pale yellow or gray. In some places, particularly in the less well-drained areas,

there is some rust-brown concretionary material in the subsoil, and in others the reddish color of the Moshannon soils is apparent. Some areas have sufficient mottling in the subsoil to represent an approach to Atkins silt loam. Areas of this character are situated near Level Station and Elimsport, but the total extent is too small to warrant the separation of the more poorly drained tracts.

Pope silt loam occurs as narrow strips of first bottom along the small streams which have their sources in the central gray shale belt of Lycoming County and also along the larger streams of White Deer Valley. It is subject to overflow. Drainage is fair or rather poor.

This soil is inextensive. It is estimated that less than 25 per cent is under cultivation, and owing to its occurrence in narrow strips, few fields are large enough to be included in the usual farm rotations. Most of it is devoted to permanent pasture, to which it is well adapted. Hay and corn are the principal cultivated crops. The better-drained areas are productive but are sold mainly in connection with other soils. In some places the adaptability of Pope silt loam for pasture makes it desirable for farms where considerable livestock is kept.

POPE FINE SANDY LOAM

Pope fine sandy loam consists of grayish-brown or brown fine sandy loam from 10 to 15 inches deep, underlain by yellowish-brown fine sandy loam. It includes numerous slight variations of color and texture characteristic of first-bottom soils.

This soil occurs in the bottoms of Lycoming Creek and a few tributaries in the northern part of Lycoming County. A few patches occur south of the river along small mountain streams. Some parts along the more precipitous streams are gravelly or stony.

Pope fine sandy loam is not extensive. Less than half of it is under cultivation, the remainder being waste land subject to destructive washing and with little timber. Drainage is generally good. The cultivated areas are farmed in a manner similar to that used on Moshannon fine sandy loam, but this is not considered so desirable a soil as the latter.

ATKINS CLAY

The topsoil of Atkins clay is bluish-gray silty clay from 6 to 10 inches deep. The subsoil is gray, plastic silty clay, mottled with yellow and rust brown.

Included with this soil, as mapped, is an area in the bottoms of Nippenose Creek, southwest of Antes Fort, in which the soil is gray very fine sandy loam to a depth varying from 5 to 8 inches, underlain by mottled bluish-gray and pale-yellow material varying in texture from fine sandy loam to fine sandy clay. Were this area more extensive it would have been indicated as a distinct Atkins soil.

Atkins clay occurs on poorly drained first-bottom positions along various streams of the county, and is subject to overflow. There are no large areas and in the aggregate it is inextensive. Its use is almost exclusively for pasture, and probably most of it is best suited to this purpose. Artificial drainage would be absolutely necessary before it could be cultivated efficiently.

MUCK

The material classified as muck consists of vegetable matter in varying stages of decomposition, mixed with some mineral material. In color, it varies from very dark brown to black. It is spongy and remains in a saturated condition throughout the year. The depth varies and may be more than 3 feet.

Muck is very inextensive in Lycoming County. The largest areas, in Rose Valley and 2 miles north of the Black Forest Club in the extreme northwest corner of the county, and two small areas near Oregon Hill, are mapped.

None of the muck in Lycoming County has been drained or otherwise agriculturally developed, and the only area which appears to be capable of agricultural development is the one in Rose Valley. Here, the organic matter has reached a comparatively thorough stage of decomposition and contains little fibrous matter. The outlet of this area is so situated that it could be deepened and adequate drainage accomplished.

When drained, muck is an admirable soil for the production of celery, onions, and cabbage.

ROUGH STONY LAND

Rough stony land is a term applied to those areas which have excessively steep slopes and an abundance of large, loose stones and jagged rock fragments which have accumulated as talus from the mountain slopes. It occurs on steep slopes throughout the Allegheny Plateau, and in the ridge region south of the river it covers practically all of the mountain ranges. Some small areas of rock outcrop are included with mapped areas of rough stony land. It is considerably more extensive than any soil in Lycoming County and is unsuitable for farming. A few areas afford sparse pasturage, but the great majority of it is suited only for forest. There is in most places sufficient soil to support a forest growth, but in some places the finer material of rock disintegration has been almost entirely removed by erosion, leaving only a mass of gray or red sandstone fragments.

The original forest growth on rough stony land was more valuable than its present appearance would indicate. It consisted of oak, chestnut, pine, hemlock, maple, and birch, with an undergrowth of huckleberry and mountain laurel. The virgin timber has been entirely removed, and reforestation has been slow and generally rather sparse. Fires have denuded some of the mountain slopes to such an extent that their potentialities for forest production are very small.

The value of rough stony land ranges from $1 to $5 an acre.

SUMMARY

Lycoming County is in the north-central part of Pennsylvania. It is the largest county in the State and contains 1,231 square miles, or 787,840 acres.

The county is hilly and mountainous. The northern half consists of a high mountainous plateau belt, deeply carved by stream channels and broken by several lowland areas. The western and central parts,

south of the plateau belt, include a series of rolling, rounded hills in a belt several miles wide which broadens out in the southeastern part. The broad, level, or undulating areas along West Branch Susquehanna River border the hill country north, and a ridge and valley region comprises the section south of the river. The elevation of the county ranges from 500 feet to more than 2,300 feet above sea level.

Lycoming County lies entirely within the drainage basin of West Branch Susquehanna River, whose most important tributaries are Pine, Lycoming, Loyalsock, Muncy, Little Muncy, Little Pine, Larrys, and Nippenose Creeks. Natural drainage is well established and all parts of the county are well watered.

The first settlements were made in this section about the middle of the eighteenth century, and the county was organized in 1795. Important factors in the early economic development were the construction of the Philadelphia & Erie Canal in 1834 and the opening of a railroad from Williamsport to Ralston in 1839.

According to the census, the population in 1920 was 83,100, of which 43.9 per cent was classed as rural. The density of the rural population was 29.9 persons to a square mile. Williamsport, the county seat, is the largest city in the north-central part of the State. In 1920 it had a population of 36,198. It is an important railroad center and manufacturing and trading point.

Several railroads and first-class highways afford ample transportation facilities. Telephone service and rural mail delivery routes extend to all the settled parts of the county, and the State department of forestry maintains telephone lines in sections covered by State forest reserves.

Williamsport and Jersey Shore are the principal local markets, and New York City, Philadelphia, and Baltimore are the principal outside markets for farm produce. Considerable milk and other dairy products are shipped out of the county.

Climatic conditions in the county vary widely. Throughout the West Branch Susquehanna River Valley and its environs temperatures are markedly more moderate than in the mountainous sections where the winters are long and severe and the summers short and cool. The mean annual temperature at Williamsport, in the West Branch Susquehanna River Valley, is 50° F., with a recorded maximum of 103° and a minimum of −17°. Temperatures in the mountains average about 10° lower than in the valley. The normal frost-free season is 169 days in the valley and about 134 days in the mountainous sections. The average annual rainfall is 39.99 inches at Williamsport and the average depth of snow 38.3 inches. The snowfall is usually heavier in the mountains.

The agriculture of Lycoming County is predominantly general farming, in connection with some dairying. The value of all farm products, as reported by the 1920 census, was $13,644,485. Corn, wheat, hay, and forage crops constitute the principal farm products. Some seed corn is grown commercially. Dairy products, exclusive of those for home use, were valued at $1,614,813 in 1919. A considerable number of hogs are raised.

Land in farms constituted 42.2 per cent of the area of the county in 1920. Of this 60.1 per cent was classed as improved land. The average size of farms in that year was slightly more than 100 acres.

Farm practices and methods are good in all sections of the county. Crop rotations are widely used, seed beds are well prepared, and up-to-date implements and machinery are in general use. Liming of land is practiced to a considerable extent, but in some sections of the county supplies of lime are difficult to obtain, and the soils show the lack of this important soil constituent.

Expenditures for fertilizer in 1919 amounted to $228,916, an average of $89.46 for the 2,559 farms reporting its use. Stable manure, where it is available, is applied to the land.

There were 3,273 farms in the county in 1919, of which 79.2 per cent were operated by the owners, 17.9 per cent by tenants, and 2.9 per cent by managers. Most of the farm labor is performed by the owner and his family, but an average of $296.56 was expended for labor on 1,958 farms reporting in 1919.

The soils of Lycoming County have been classified in 15 series, including 40 types and 6 phases in addition to the miscellaneous classes of land, muck and rough stony land.

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[PUBLIC RESOLUTION—No. 9]

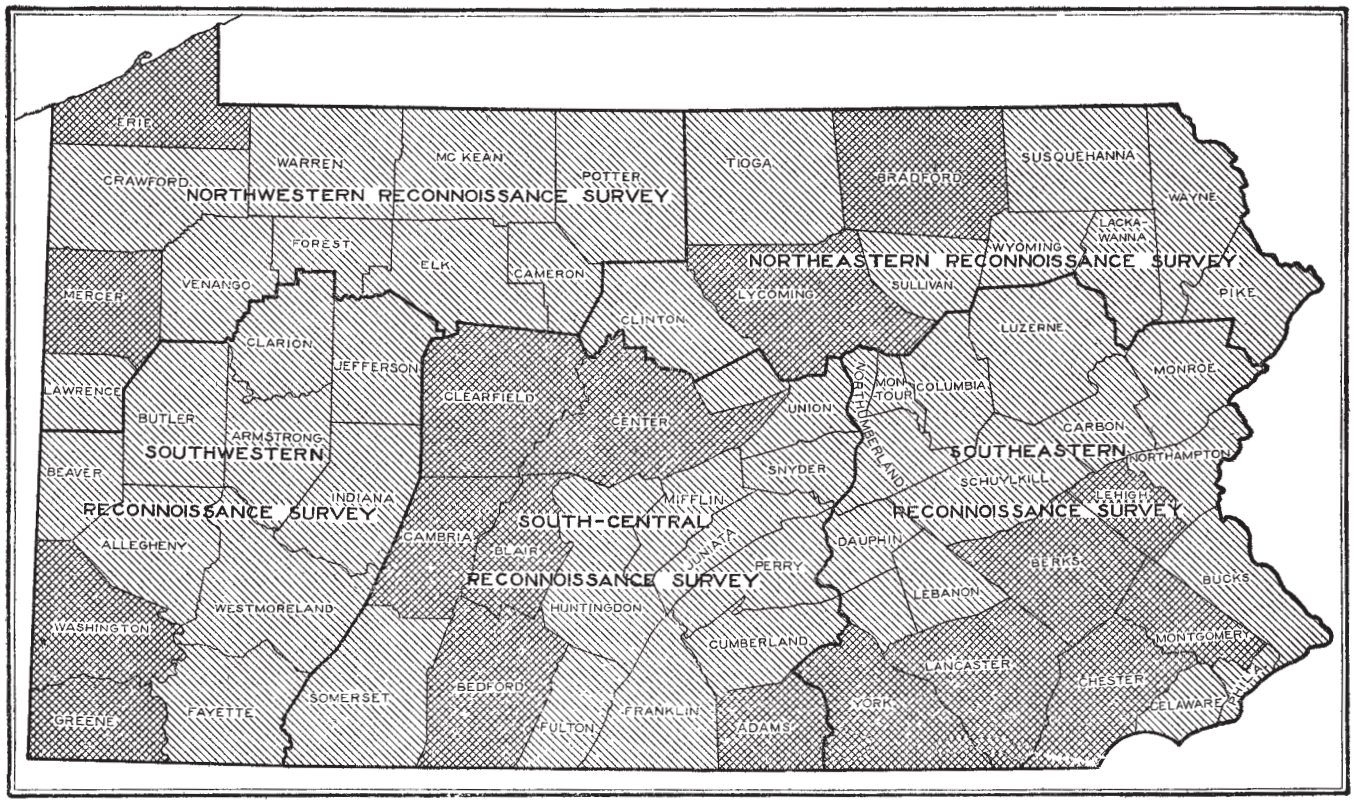
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils]



Areas surveyed in Pennsylvania, shown by shading

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