

SOIL SURVEY OF CECIL COUNTY, MD.

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INTRODUCTION.

Cecil County is the most northern of the Eastern Shore counties of Maryland. It lies between $75^{\circ} 46'$ and $76^{\circ} 14'$ west longitude and $39^{\circ} 21'$ and $39^{\circ} 43'$ north latitude. The greatest width is 25 miles, while the length north and south is practically the same. On its northern border and for a short distance along its eastern boundary the county comes in contact with Pennsylvania. Delaware lies east of the greater part of the county. The broad Susquehanna River and Chesapeake

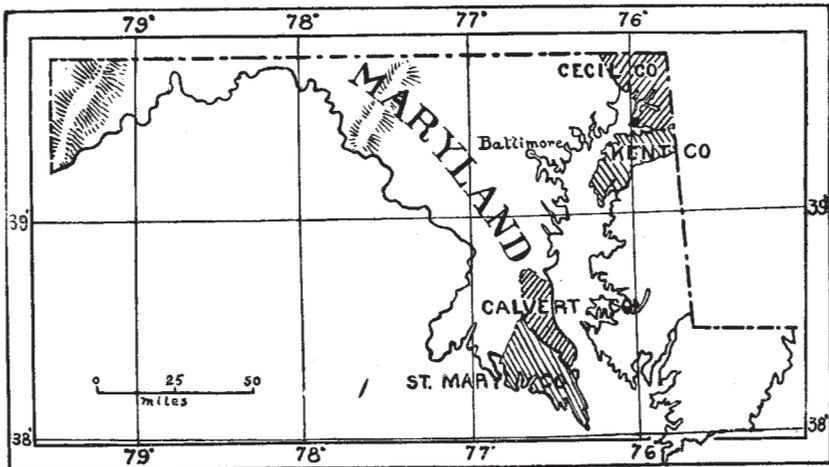


Fig. 7.—Sketch map of Maryland, showing area surveyed.

Bay bound the county on the west, while the Sassafras River separates it from Kent County on the south. The area of the county, exclusive of the broad waterways, is about 375 square miles (240,000 acres). (Fig. 7.)

PHYSIOGRAPHY.

Cecil County is one of the few Maryland counties that contain within their borders two essentially distinct types or classes of topography. These two different classes are found typically developed in the northern and southern parts of the county, while in the central portion there is a gradual blending of the two, consequently the distin-

guishing features of both are lost. The northern part of the county, including about one-third of the entire area, belongs to the prominent physiographic division of the United States known as the Piedmont Plateau. The southern part of the county belongs to the Coastal Plain region, which extends as a wide border along the Atlantic Coast States.

The Piedmont Plateau region in Cecil County consists of a broad, rolling plateau, through which the largest streams have carved deep, narrow, winding valleys. Along the Susquehanna the plateau or upland rises abruptly 200 or 300 feet above the river. The plateau varies in elevation from 200 to 350 or 400 feet above sea level, but an elevation of 540 feet is reached a short distance southwest of Rock-springs. Along the Susquehanna River and larger streams the country is hilly and broken, but away from the streams the gently rolling character of the plateau is quite marked. The most level part of the plateau is in the north central part of the county, in the neighborhood of Brick Meeting House. The greater part of the drainage of this upland region is carried away by the Big Elk and Little Elk creeks, the Northeast and Little Northeast creeks, Principio and Octoraro creeks. Of these creeks the Octoraro is the only one which empties into the Susquehanna. The other creeks flow into the Chesapeake Bay, although they become greatly distended when they reach the comparatively low areas of the Coastal Plain region.

The Coastal Plain in Cecil County covers the greater part of the county, and is characterized by broad necks of land separated by wide tidal rivers. Along the junction of the upland with the Coastal Plain country there are large, rounded, gravel hills rising to an elevation of over 300 feet. These also form the backbone of Elkneck. These hills merge gradually into long, sloping terraces, which extend to the broad tidal rivers. In the lower part of the county the broad river necks stretch for miles, with gently rolling surfaces rising from 60 to 80 feet above tide water. The streams on these broad necks are small and only a few miles in length, broadening into wide tidal rivers in their lower courses. The drainage on these necks is not thoroughly established, although there are no undrained areas of any great extent. On Elkneck the streams are short, and during the greater part of the year are dry on account of the gravelly nature of the soils. In the area along the margin of the two physiographic divisions of the county the streams flow rapidly, cutting through the covering of sands and clays of the Coastal Plain into the harder rocks of the Piedmont Plateau.

GEOLOGY.

As the surface features of the county readily fall into two widely divergent classes, so the geologic formations are separated into two systems, representing the oldest, most altered series of rock, as well as the most recent geologic deposits. (For geological sections across

the county, see figs. 8 and 9.) The rocks of the northern part of the county embrace those which are characteristic of the Piedmont Plateau from New England far into the Southern States. They consist of granites, schists, gneisses, and serpentines cut by intrusive masses of diabase and gabbro. These rocks represent the older portions of the earth's surface, and they have been greatly altered and folded by the long-continued processes of metamorphism. Just when they were formed and what was their original composition have not been satisfactorily explained by geologists, although the work of recent

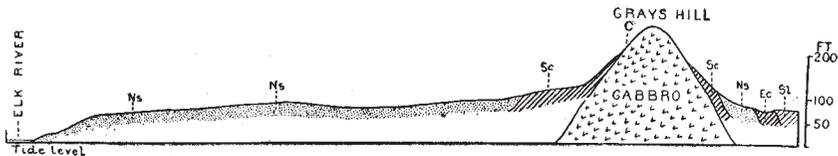


FIG. 8.—Profile from Elk River northeast through Grays Hill: *Sl*, Sassafras loam; *Ns*, Norfolk sand; *Sc*, Susquehanna clay; *C*, Cecil clay; *Ec*, Elkton clay.

years places the time of their origin at a much later date than formerly. The gneiss and schist for the most part are supposed to have originally consisted of sedimentary deposits.

The rocks of the Piedmont Plateau contain many important economic products. The exposures of granite along the Susquehanna have for many years been extensively quarried at a number of places, the chief of which are at Port Deposit and Frenchtown. Both of these towns annually place on the market large quantities of fine stone suitable for building and other purposes. There are many other smaller quarries in the county which furnish considerable stone for

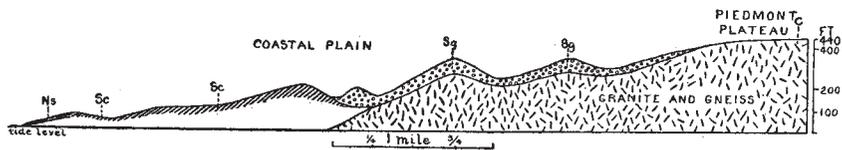


FIG. 9.—Profile from tide level to Piedmont Plateau, northeast of Charlestown: *Ns*, Norfolk sand; *Sc*, Susquehanna clay; *Sg*, Susquehanna gravel.

local use. Formerly there were soapstone and serpentine quarries, as well as flint and spar mines, which were worked, but none are in operation at present. At one time iron ore and large quantities of chrome were mined in the northern part of the county, but these mines have long been idle, for they are too "lean" to compete with the richer deposits found elsewhere. Gold has also been found in small quantities, and at different times its discovery caused much excitement, but little or nothing came of these finds, and they were soon forgotten. This section abounds in rocks admirably suited for making excellent roads and turnpikes, but little systematic effort has

been made in this direction. The deposits of gabbro, the hard, fine-grained, bluish rock found so extensively in the northwestern part of the county, are best adapted to road making, but good, durable roads can be made from almost any of the rocks in this section.

The rocks of the Coastal Plain series of formations in the lower part of the county consist principally of unconsolidated beds of gravel, sand, and clay. In some places these have become indurated, and local beds of sandstone and ironstone are found. From an economic standpoint the beds of highly colored clays are the most important. They furnish valuable deposits suitable for making brick and pottery, and also contain deposits of iron ore. The gravel, where it occurs in considerable quantity, makes good road material, and it is utilized for this purpose in the central part of the county. The deposits of the Coastal Plain series of rocks range in age from the Jurassic to the Pleistocene, or most recent geological epoch.

CLIMATE.

While there are at present no stations of the United States Weather Bureau situated in Cecil County, continuous records were kept at Woodlawn for a number of years, and from these and from records of stations in adjoining counties the following table¹ of the temperature and rainfall has been compiled. The other stations are situated at Darlington, Harford County, and Chestertown, Kent County, and at Newark, Newcastle County, Del. None of these stations are more than a few miles distant from Cecil County. The figures given are the averages of the Woodlawn and the three outside stations mentioned. The extreme range of temperature from records of a long number of years is 110°, or from -12° in the winter to 98° in the summer. The last killing frost in the spring rarely occurs later than the third week in April, and the first severe frost has not occurred before the 8th of November. Doubtless there is some difference in the temperature and rainfall records between the northern uplands of the county and the lower river beds of the southern part, but the records are not sufficiently complete to determine these.

Climatological data for Cecil County, Md.

Months.	Mean monthly temperature.	Mean maximum temperature.	Mean minimum temperature.	Mean daily range of temperature.	Highest recorded temperatures.	Lowest recorded temperatures.	Rainfall records.
	° F.	° F.	° F.	° F.	° F.	° F.	Inches.
April	51	61	42	20	94	20	3.7
May	62	72	53	20	94	37	4.3
June	71	81	61	20	94	42	3.9
July	75	84	67	17	98	50	4.3
August	74	83	63	21	98	49	5.7
September	68	76	58	19	97	36	4.0
Annual ...	54	63	45	18	98	-12	47.8

¹ Maryland Weather Service, vol. 1, 1899.

AGRICULTURAL CONDITIONS.

As might be expected from the diversified surface, the agricultural conditions are quite distinct and characteristic in the respective portions of the county. The great range in the character of the soils, from those absolutely barren to the most productive, is probably the greatest factor in the diversified agricultural conditions. While formerly there were many large farms in the county, these have been divided and subdivided until now the average-sized farm does not contain more than from 100 to 120 acres. These farms vary greatly in value, according to the improvements and character of soil. In some of the poorer portions unimproved land brings but a few dollars per acre, and there is no great demand for it at any price. In the better sections good farm land brings from \$40 to \$75 per acre. In the more prosperous farming sections the improvements are good and prove the thrifty and industrious character of the farmers, but in the gravel and clay hills of the central part the improvements are poor, consisting of ragged, dilapidated fences, small dwelling houses, and patched-up barns and sheds. In the good farming districts the dwelling houses are comfortable, some of them being quite pretentious, while the barns and other buildings are in keeping with the general character of the country. Neatly trimmed hedge fences form an attractive feature of the farm surroundings. Many of these farms are tilled by the owners. This is especially the case in the northern part of the county, but there is also a large number of farms which are in the hands of tenants who are not greatly interested in improving the farms and in bringing them to a high state of cultivation.

A large portion of the county is still forested and uncultivated. While originally the entire county was thickly timbered with various kinds of hard-wood and soft-wood trees, none of the original growth is left standing. In many parts the light timber growth has been removed every few years regularly for making charcoal and also for use in smelting the ores which were formerly extensively mined.

Wheat, corn, timothy, and clover are the main crops, and these are grown over the entire county. Truck is grown to some extent, but in the northern central part, growing late crops for canning purposes has for a long time been an important industry. Tomatoes and corn are the principal crops grown for this purpose, and for a long time Cecil and Harford counties have ranked among the prominent tomato-canning districts of the country. Competition with the Middle Western States has somewhat diminished the proportions of this industry, but it still is a large source of revenue to the farmers and to the hands employed during the growing season. The canneries are all small, situated short distances apart, and are only run for a few months in the late summer and the early autumn. If the small, scattered canneries were grouped into larger and better equipped factories, more centrally located, operated from early spring until late fall, and were prepared to can a greater variety of products, they could be much more profitably oper-

ated. At present the profits are divided among a number of small, poorly equipped plants, which tend to cripple the industry rather than to encourage it.

The fruit industry of Cecil County also deserves mention, as large quantities of peaches and pears are annually placed on the markets. Although the cultivation of apples and cherries is less, these, as well as small fruits, are grown both for home consumption and for the markets.

The market advantages of Cecil County are good, for with the rapid and abundant transportation facilities the county enjoys, the products can soon be placed on sale in the large Eastern cities. The county is midway between Baltimore and Philadelphia, and these cities consume the greater part of the farm products. There are two main lines of railroads which cross the county between these cities, in addition to branch lines of one of these roads, which furnish an easy outlet for the northwestern part of the county. The southern part of the county, while it has no railroads, possesses fine waterways, and consequently cheap water transportation to Baltimore and Philadelphia. Several points in the southern part are reached by daily steamboats as well as by sailing vessels of various descriptions.

No systematic efforts have been made to equip the county with roads built on scientific principles, and the majority of the roads are not in very good repair. Some of them have been made of broken stone and gravel, and these are above the general average of country roads. Others, again, are deep and sandy, making the hauling of heavy loads over them almost impossible at any time of the year. The roads are all free, are maintained at the expense of the county, and connect all of the towns and villages, with frequent intersecting cross-roads.

SOILS.

The soils of Cecil County range from barren to exceedingly rich and productive lands, and from coarse sandy soils to stiff, intractable clays.

The soils occupy about the following areas:

Areas of the different soils.

Soils.	Acres.	Per cent.	Soils.	Acres.	Per cent.
Cecil loam	52,600	21.9	Susquehanna clay	11,000	4.5
Sassafras loam	50,500	21.0	Cecil mica loam	10,000	4.1
Norfolk sand	46,600	19.4	Elkton clay	7,000	2.9
Susquehanna gravel	45,600	18.7	Conowingo clay	3,000	1.2
Cecil clay	12,500	5.2	Conowingo barrens.....	2,000	.8

CECIL LOAM.

The Cecil loam constitutes a type of soil characteristic of portions of the Piedmont Plateau, not only of Cecil County, but also of large

areas of northern central Maryland and adjoining States as far south as the Carolinas. Beginning at the gorge of the Susquehanna River, in the western part of the county, it continues in an unbroken area several miles in width to the Pennsylvania line on the eastern border. Along its southern border it presents a ragged outline, being buried under the outlying gravel deposits of the Coastal Plain formations. On the northern boundary these formations merge into the other formations of the Piedmont Plateau, with no sharp lines of demarcation of the soils or decided change in the surface features of the country.

The topography of this formation partakes largely of that of the Piedmont Plateau. Along the Susquehanna there is a steep descent of 200 feet or more from the upland to the river bed, steep, rocky

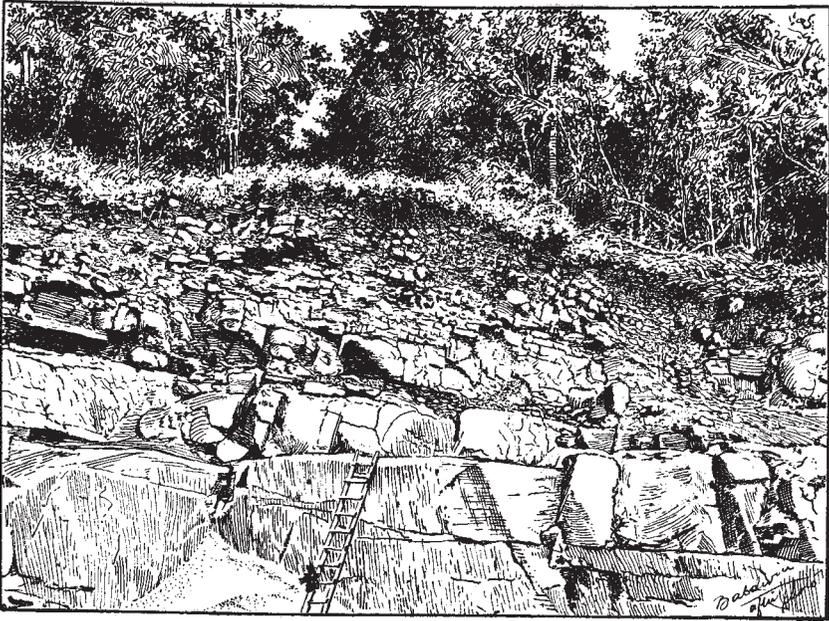


FIG. 10.—Weathering of granite into Cecil loam, near Frenchtown.

hills characterizing this portion of the formation. The remainder of the formation is a rolling upland, broken by the steep, narrow valleys of the various streams which cross it. Many parts of this formation are those which have been referred to as the most level of the Piedmont Plateau in Cecil County. The drainage of this entire area has for a long time been thoroughly established, so that there are no swampy areas; for the formation is not only well drained but also well watered by the many small streams which traverse it in a south-erly direction.

The Cecil loam is derived from the slow weathering of the granites, gneisses, schists, etc., which occur in the Piedmont Plateau. (See fig. 10.) Situated south of the limit of ice action during glacial times, the

slow processes of subaerial decay have had ample time to accumulate a soil covering, shallow or deep, depending on the location with reference to the washing influence of rains. These residual soils are all derived from the rocks which underlie them, or at most have been transported but very short distances. The soils consist of yellow and brown loams, slightly sandy, and about 10 inches in depth. The sand consists generally of sharp, angular grains of quartz, and frequently small bits of the undecomposed granite or gneiss may be found mixed with the soil particles. The subsoils are lighter in color and contain a greater percentage of clay. They may be classed as light, yellow-clay loams. Generally, these clay loams have a depth of 36 inches or more, but they often grade into loose masses of decomposed gneiss or granite at a depth of 30 inches, or occasionally at a depth of even 20 inches. In places the soil covering has a depth of several feet, but these are rare occurrences. On the surface there is usually present an appreciable amount of broken quartz and occasionally pieces of granite, gneiss, schist, gabbro, or any of the rock formations from which the soils are derived. Although the amount of stones may at times equal 40 per cent, generally the amount is much less and does not seriously interfere with cultivation. These stones range from one-half inch to 6 inches in diameter.

The following table gives the mechanical analyses of soils and subsoils of typical samples of Cecil loam:

Mechanical analyses of Cecil loam.

No.	Locality.	Description.	Organic matter, and loss.		Gravel, 2 to 1 mm.		Coarse sand, 1 to 0.5 mm.		Medium sand, .5 to 0.25 mm.		Fine sand, 0.25 to 0.1 mm.		Very fine sand, 0.1 to 0.05 mm.		Silt, 0.05 to 0.005 mm.		Clay, 0.005 to 0.001 mm.		
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.			
4029	Providence, 1 mile SW.	0 to 12 inches	5.55	3.02	5.74	12.64	14.92	13.90	32.96										P. ct. 11.32
4232	Farmington, 2 miles NE.	Yellow loam, 0 to 6 inches.	5.18	3.36	8.52	6.26	14.10	11.95	31.67										19.32
4030	Plumpoint, 1 mile SW.	12 to 30 inches ...	3.76	2.21	5.57	4.18	11.91	13.21	40.22										19.27
4233	Subsoil of 4232.....	Stiff yellow loam, 6 to 24 inches.	4.81	4.54	10.01	6.74	13.79	11.61	27.19										21.01

These soils are classed as good farm lands, and, while they are not naturally strong soils, they can by careful management be made very productive. Generally, they are deficient in organic matter, but this can be remedied by liberal applications of well-rotted stable manure or by the plowing under of green manure. As now cultivated too much money is expended for commercial fertilizers. By saving and applying stable manures these soils could be brought to a higher

state of productiveness than is attained by the use of often inferior brands of commercial fertilizers. Originally these soils were thickly covered with a heavy growth of timber, embracing all the common hard-wood varieties. The greater part of the area is cleared and under cultivation.

Tomatoes are grown on this soil in large quantities for canning purposes. Almost every farm, especially in the neighborhood of Rising-sun and Zion, has a field of several acres each year in tomatoes. On account of the loamy condition, these are probably the finest corn soils in the county, and it is said that from 40 to 60 or even 80 bushels per acre can be grown. Wheat produces well, from 20 to 25 bushels being a good average crop in favorable seasons. Fifty bushels of oats can be harvested in good years, and clover and timothy make good crops. For many years Cecil County had a reputation in Baltimore markets for the fine quality of hay it produced, and it was on Cecil loam and Cecil clay that it was principally grown. Mixed clover and timothy seed are sown, but the clover rarely lasts longer than one year. The usual rotation practiced on these soils is wheat two years, followed by timothy and clover, which usually lasts two years, then corn, after which again comes wheat. When oats or tomatoes are grown the five-year rotation is varied somewhat, and occasionally the timothy is allowed to stay two years after the clover fails. This depends somewhat on the effect of the winter on the crops. Lime is applied to these soils and the good effects are noticed for several years afterwards. It is often observed that the lime has the effect of sweetening the soils and checking foul or rank growth.

The farms on these soils are usually comparatively small, and are in most cases tilled by the owners; hence they are kept in good shape and the people are in a generally prosperous condition. Some of the best improved farms of the county are located within the limits of this soil formation.

CECIL CLAY.

This formation, like the one just described, is found in the Piedmont Plateau region of Cecil County. The formation occurs in several areas scattered over the northern half of Cecil County. There are 11 of these areas, but the largest and most important are situated in the extreme northern part. The surface of the Cecil clay is probably more rough and broken than the Cecil loam, although there are some areas where the gently rolling character of the country is a rule. The broken and hilly areas of this formation are along the Susquehanna River and the Octoraro and Conowingo creeks. A few of the smaller areas of this formation form prominent hills in the Coastal Plain part of the county. Doubtless these hills were once covered by the gravels which cap the surrounding hills, but subsequent erosion has removed

this coating and they are now isolated areas entirely surrounded by the unconsolidated sands, gravels, and clays of the Coastal Plain. Grays Hill, 2 miles northeast of Elkton, furnishes a striking example of the isolated occurrence of this formation. This hill rises considerably over 150 feet above the surrounding country, which consists of broad terraces and low, marshy areas characteristic of this section of the Coastal Plain country. Fig. 8 (p. 105) shows clearly the relations of Grays Hill to the surrounding country.

These soils are also residual, being derived from the rocks which underlie them. The Cecil clay is for the most part derived from the weathering of the hard, igneous rocks, such as gabbro and diorite. These are dark-colored rocks, which weather comparatively slowly into characteristic spheroidal masses. These large, rounded boulders are thickly scattered over the surface in some places in the Cecil clay. These stony areas are quite abundant on the upland just east of the Susquehanna River. Here the boulders are so thickly strewn over the ground that fields of several acres are often uncultivated on account of them. They vary from a few inches to many feet in diameter and are often spoken of as "niggerheads."

The soils of the Cecil clay consist of heavy reddish loam, to an average depth of 10 inches, underlaid by red clay loam, which grade into stiff red clay. These soils are easily distinguished by their deep red color when in a moist condition. They are seldom over a few feet in depth and pass into broken pieces of gabbro and other rocks, from which they are derived. Generally there is a trace of broken quartz fragments scattered on the surface and mixed with the soils. Often there are small amounts of broken pieces of angular stone, rarely exceeding a few inches in length. These soils are much heavier than the Cecil loam and rank as strong clay soils, capable of standing hard farming, and also capable of being brought to a high state of productiveness. While the soils of this formation are generally quite uniform wherever found, the areas northeast of Brick Meeting House and east of Appleton partake somewhat of the nature of the soils of the serpentine clay (Conowingo clay) as far as their productiveness is concerned. There is doubtless some mixture with the serpentine clay, but as they more closely resemble the Cecil clay in texture and general characteristics they have been correlated with this formation.

The Cecil clay soils are generally classed with the Cecil loam as regards fertility, but by proper cultivation they can be made far more productive, and they are not so easily exhausted. It is said that one-half of the fertilizers necessary on the Cecil loam will suffice on these soils. Lime is used with excellent results, and commercial fertilizers, especially phosphates, are used in addition to frequent applications of stable manures.

The Cecil clay is well adapted to wheat and grass and produces large crops. Wheat will yield from 20 to 30 or even 40 bushels per acre in good years, and from 1 to 2 tons of timothy and clover hay can be harvested. From 50 to 60 or even 80 bushels of corn can be grown in favorable years, and yields of from 50 to 60 bushels of oats are reported. Tomatoes for canning purposes also produce well on these strong red clay soils, and from 200 to 400 bushels per acre can be grown with careful treatment and with favorable weather conditions. Apple trees make a healthy growth and bear well, but peaches and pears do not succeed. The farms are seldom large in this formation, but are improved, well kept, and indicate a generally prosperous condition.

CECIL MICA LOAM.

Like the formation just described, the Cecil mica loam also occupies an area in the rolling uplands of the Piedmont Plateau. There is but one occurrence of this formation in Cecil County, and that is along the northern border in the eastern part, where Maryland comes in contact with Pennsylvania on its eastern as well as northern border. This area is nearly 10 miles in length, and from 1 to 2 miles in width. The surface is rough and broken along Big and Little Elk and Christiana creeks; otherwise it is level or gently rolling. The uplands may rise from 200 to slightly over 400 feet in elevation.

The soils are also residual, having been derived from the decomposition of gneiss and schist, which contain, among other rock-forming materials, large quantities of mica. In the soils this mica appears in broken fragments, from the tiniest bits to particles of over a half inch in diameter. It is so abundant as to make the soils fairly sparkle in the sunlight, and on the soft dirt roads it floats away in the breeze with other dust particles. This feature has given the name to the soils, and they are commonly referred to as the red and white isinglass lands. The soils of this formation are light loams, lighter in texture than the Cecil loam, and they generally have a brownish or yellowish-brown color. They contain considerable sand, but are mostly composed of silt with small amounts of clay. The subsoils, from a depth of 10 to 30 inches, consist of reddish-yellow clay loam, which also contains a large percentage of finely divided mica of the muscovite variety. In texture the subsoils differ little from the soils, although they may contain a slightly increased percentage of silt. At an average depth of 30 inches the subsoils grade into the loose, decomposed gneiss, granite, schist, or whatever rock the soil is derived from. These soils are always warm and dry, and possess excellent underdrainage.

The mechanical analyses of typical soils and subsoils are given in the table following:

Mechanical analyses of Cecil mica loam.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
4222	Lewisville, three-fourths mile S.	Brown micaceous loam, 0 to 10 inches.	4.70	1.72	10.37	5.87	17.64	15.64	35.10	8.59
4223	Subsoil of 4222.....	Yellow loam, 10 to 36 inches.	6.86	2.69	6.44	5.26	22.41	14.20	29.16	12.78
4227	Appleton, 2 miles NW	Yellow loam, 8 to 36 inches.	4.07	4.75	7.93	4.92	10.13	9.24	42.93	15.50

These soils compare favorably with the Cecil loam, as far as their productiveness is concerned. They are naturally fertile; but they must be managed with care or their fertility is soon lost. They contain some quartz rock and broken pieces of gneiss and schist on the surface, but not so large an amount as the Cecil loam. Generally, they are mellow soils, easy to till, and respond quickly to the applications of manures or commercial fertilizers, such as tankage, ground bone, and phosphates.

Corn, wheat, and grass are grown on these soils, and the yields equal those of the Cecil loam. From 15 to 25 and 30 bushels of wheat, 45 to 60 bushels of corn, and 1 to 2 tons of hay are the crop yields in favorable seasons. Tomatoes and corn are grown for canning purposes. The crop rotations practiced are practically the same as on the other Cecil soils. As a general rule, small, well-improved, and carefully cultivated farms are found in this formation.

CONOWINGO BARRENS.

We now come to a class of residual soils occurring on the uplands of the Piedmont Plateau, which, although not differing greatly in texture from the soils just described, are found to be well-nigh worthless when their productiveness is considered. This is the type of soil known as the Conowingo barrens. Four small areas are found in the extreme northwestern corner of Cecil County. Two of these areas are of some size, but the others contain only a few acres. The largest of these areas begins at the Susquehanna, a half mile north of Conowingo, and continues northeast to the Pennsylvania boundary. The other areas are situated near by. All of the areas of this formation are rough and hilly. Conowingo and Octoraro creeks flow through both areas, which accounts for the rough and broken surface of the country.

This soil is derived from the weathering of serpentine, which is an altered eruptive rock of a dark greenish color. The soil generally is a light-yellow or whitish-looking loam, but in places it is almost black. The top soil occasionally has a depth of 8 or 10 inches, and is underlaid by a yellowish-brown loam subsoil to a depth of 36 inches. The soil is generally much shallower, and in the case of the barren hills of this formation the rocks are devoid of any trace of soil covering except that caught in the pockets and crevices of the rocks. Frequently, even on level or lightly rolling areas, the soil covering may not exceed a few inches in depth. These soils, as seen from the mechanical analyses of samples collected, are not essentially different from many of the productive upland soils; but they are unproductive, and in extreme cases will not produce anything in a natural state except a stunted growth of small pines and knotty oak trees. At the best, they are stubborn and unproductive, and although many reasons have been assigned for their sterility, none seem altogether satisfactory. Professor Merrill,¹ in speaking of the Chester County barrens, just across the State line in Pennsylvania, says that these soils are derived from the slow decomposition of peridotites, rocks rich in iron-magnesium silicates, but almost wholly lacking in lime, potash, or other desirable constituents. Hence the soils derived from such rocks are naturally devoid of nutrient matter and can only support a scanty growth of grass and stunted shrubs. The main reason which may be assigned for their unproductiveness is the large percentage of magnesia which they contain, and their slight depth. The analyses of these soils show that they contain very minute quantities of lime and phosphoric acid. Where sufficiently deep to retain moisture for the growing plants, if supplied with manures they are found to be as productive as many soils which have never been called barren.

The following table gives the mechanical analyses of a typical soil and subsoil of the Conowingo barrens:

Mechanical analyses of Conowingo barrens.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
4244	Mount Pleasant, one-half mile W.	Yellow loam, 0 to 12 inches.	<i>P. ct.</i> 3.18	<i>P. ct.</i> 1.10	<i>P. ct.</i> 1.64	<i>P. ct.</i> 1.66	<i>P. ct.</i> 8.10	<i>P. ct.</i> 16.24	<i>P. ct.</i> 53.06	<i>P. ct.</i> 15.52
4245	Subsoil of 4244.....	Brown loam, 12 to 40 inches.	4.51	1 10	1.72	1.22	6.34	15.34	55.30	14.29

¹ Rocks, Rock-weathering, and Soils, 1897.

CONOWINGO CLAY.

There are four small areas of Conowingo clay in the northwestern part of Cecil County. These areas partially surround the Conowingo barrens, and also come in contact with the Cecil clay formation. The surface of the country occupied by these small areas is as rough and broken as in the formation just described, but it consists of large, rounded hills or long, gentle slopes. The greater part of the formation is situated from 200 to 540 feet above sea level. The highest point in Cecil County is found in the area of Conowingo clay, just southwest of Silverspring.

These soils are derived from the decomposition of greenish, serpentine rock, and are usually of sufficient depth to make good lands. A considerable part of the areas is cleared and cultivated the same as are the other productive soils of the uplands. The soils are brownish and yellowish loams, which are underlaid by yellow and red stiff clay loams to a depth of 3 or 4 feet. There is a small amount of broken rock and quartz on the surface, but the percentage is not greater than the average of the upland soils. They are strong soils, which hold moisture and fertilizers well. In many respects they resemble the Cecil clay, but the subsoils of these clays are of a peculiar shade of red, and the soils are not as productive as the Cecil clay. They will produce good crops of tomatoes and corn. Wheat, for some reason, will not yield as well as on the Cecil clay or Cecil loams, but it is rotated with the other crops. The forests consist of a heavy growth of hard wood.

The following table gives the mechanical analyses of the soil and subsoil of the Conowingo clay:

Mechanical analyses of Conowingo clay.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
4248	East of Pilot	Red-brown loam, 0 to 8 inches.	<i>P. ct.</i> 3.92	<i>P. ct.</i> 2.16	<i>P. ct.</i> 3.64	<i>P. ct.</i> 2.52	<i>P. ct.</i> 6.17	<i>P. ct.</i> 9.33	<i>P. ct.</i> 50.40	<i>P. ct.</i> 22.15
4249	Subsoil of 4248.....	Red clay loam, 8 to 48 inches.	6.67	2.42	3.88	2.85	5.90	11.05	30.69	36.91

SASSAFRAS LOAM.

The largest areas of Sassafras loam are found on the Sassafras Neck, Middle Neck, and the old historic Bohemia Manor, but there are also areas of considerable importance north and northeast of Elkton and east of Perryville. This formation, unlike any of the preceding, lies

entirely within the borders of the Coastal Plain country. It occurs in the southern part of the county as broad, gently rolling terraces, from 40 to 80 feet above mean tide level. In the central portion of the county the formation occurs as sloping terraces, which rise from 40 to 240 feet above tide level. In many places these terraces are level, with almost no difference in elevation for miles. This is especially the case in the neighborhood of Warwick, on Sassafras Neck. Here the country seems to present the perfectly level condition of the old sea floor as it must have appeared when it first emerged from the sea.

The drainage has become established to some extent, and, although there are some small undrained places, the greater part of the larger areas is well drained. Examples of poor drainage on the river necks covered by this formation are shown in the small, circular, pond-like areas, seldom of more than a few acres in extent. In dry weather these places dry up, but during seasons of considerable rainfall they usually contain some water.

The streams of this formation are usually short and carry a small volume of water, for they drain but small areas. In their lower courses they have a width altogether disproportionate to their drainage basins. This is supposed to be due to the fact that this section of Maryland is gradually sinking, so that the lower parts of these small streams may be said to be drowned, and consist of broad expanses of water which rise and fall each day with the incoming and outgoing tides.

The soils of this formation are derived from the weathering of the beds of loam, which are characteristic of certain portions of the Columbia formation. These deposits were laid down in comparatively quiet waters, and since their deposition have undergone but little change. The uniformity of the soils is evidence of the widely extended conditions of deposition over the sea floor. The soils consist of from 8 to 10 inches of light-yellow loam. It is mellow and light, free from stone and gravel, and therefore easy to cultivate, and is underlaid by yellow loam usually heavier in texture than the soil. The subsoils often have a depth of several feet. They are always at least 36 inches in depth, and they generally grade into beds of gravel and sand.

These soils are fertile and productive, and can be brought to a high state of cultivation. Generally, they are naturally well drained, but in some of the more level portions of the uplands they are swampy, and would be much benefited by thorough underdrainage. The country around Warwick, on Sassafras Neck, is inclined to be swampy, especially in wet seasons. Although these soils are uniform, and can be easily recognized, there are some localities where they are slightly lighter in texture, but their generally loamy, mellow nature is noticed wherever the formation occurs. These soils have for a long time been cultivated, and on certain portions of the formation many pros-

perous farms are located. In other portions the farms are largely in the hands of tenants, and although the soils are productive, the general condition of these places is somewhat run down and neglected.

In good years from 20 to 25 bushels of wheat per acre can be raised, but in poorer years 12 to 15 bushels are considered an average crop. Corn will produce from 40 to 60 bushels per acre, about the same yield as the Cecil loam. Oats will yield from 40 to 50 bushels per acre, and good crops of clover and timothy hay are also raised. Tomatoes are grown in small quantities with success on these soils.

The following table gives the mechanical analyses of the soils and subsoils:

Mechanical analyses of Sassafras loam.

No.	Locality.	Description.	Organic matter, and	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			loss.							
4040	Cecilton, 3 miles SE....	0 to 10 inches....	P. ct. 4.13	P. ct. 0.77	P. ct. 1.61	P. ct. 2.07	P. ct. 4.07	P. ct. 17.73	P. ct. 63.43	P. ct. 7.10
4034	Bohemia Bridge, 1½ miles S.	0 to 12 inches....	3.42	4.44	7.97	4.12	4.65	16.08	50.57	8.68
4038	Concord, one-half mile N.	0 to 10 inches....	2.70	1.13	2.38	1.75	7.53	21.19	52.77	10.25
4041	Subsoil of 4040.....	10 to 30 inches....	2.78	.....	1.04	1.40	2.55	19.19	60.35	12.22
4035	Subsoil of 4034.....	12 to 30 inches....	2.57	7.97	13.97	5.37	5.31	12.81	38.33	13.33
4039	Subsoil of 4038.....	10 to 30 inches....	2.70	Tr.	2.17	1.30	4.72	17.11	55.22	15.80

NORFOLK SAND.

The largest continuous area of Norfolk sand is just south of Elkton, the county seat, and north of Chesapeake City. In addition to this large area the formation occurs as a fringe, varying in width from one-fourth of a mile to slightly more than 2 miles, bordering all of the deeply indented river necks of the southeastern part of Cecil County. (See fig. 11.) The larger areas occur as a rolling upland, from 20 to 80 feet above sea level, but where it forms a border around the river necks it extends from the shore line to an elevation of 140 feet. Generally, it consists of sloping terraces, but there may be well-marked rises from a lower to a higher terrace. There are no undrained areas in this formation, but it often surrounds large marshy places along the broad river and bay shore lines.

The Norfolk sand is derived from sandy and gravelly beds of the Columbia. These materials were deposited in comparatively shallow waters by changing currents, which were strong enough to carry coarse grades of sand and occasional beds of gravel. These soils consist of reddish and brown sands, from 8 to 12 inches in depth, overlying subsoils which consist of sands of a reddish or yellow color.

The subsoils contain much less organic matter than the soils, and the sand is generally more compact. Often there may be a trace of well-rounded quartz gravel on the surface, varying from 1 to 6 inches in diameter. On the steeper slopes around the outer margin of the upland of the broad terraces there is often a belt or zone where large rounded gravel and boulders come to the surface, but outcroppings of this nature are seldom noticed on the more gentle slopes. The occurrence of gravel and boulders is more prominent on the steeper slopes around the margin of Sassafras Neck. Gravel beds underlie the Norfolk sand soils, and thus insure their perfect drainage.

These soils have never been brought to a high state of cultivation, and the region covered by them is not very prosperous. They sup-

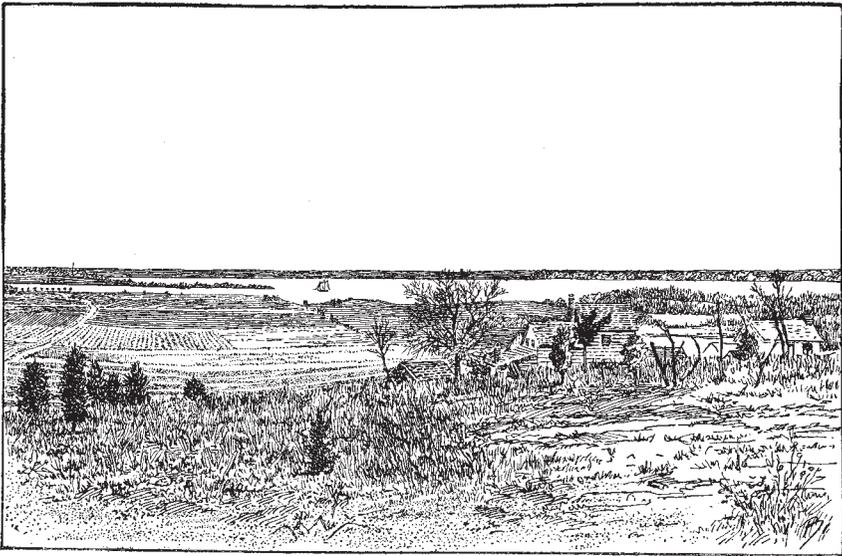


FIG. 11.—Low terraces of Norfolk sand along Elk and Bohemia rivers (drawn from illustration in Vol. I, Maryland State Weather Service).

port a native forest growth, consisting principally of oaks and chestnuts. The same crops are cultivated on these soils which are grown on the heavier and more productive soils, and the comparison of the respective yields of the two classes is not favorable to the sandy soils. On account of their light, sandy nature, they are not adapted to raising wheat and grass, and these crops are grown with almost invariably poor results. Corn does better, but the yields do not compare favorably with the better class of lands in this part of the county. If crops more adapted to a light, porous soil were grown, much better results could be expected. Almost any truck crop or small fruit would succeed. Growing peaches for market would doubtless prove much more profitable than the raising of wheat and corn with the present low yields and low value. The lands between Elkton and

Chesapeake City are in a much poorer condition than might be expected, when the capabilities of these soils for growing special crops are considered.

SUSQUEHANNA GRAVEL.

The Susquehanna gravel also ranks as one of the large soil formations of Cecil County, occupying large areas in the northeast district and the greater part of Elkneck. In the central portion the formation occurs as a series of large hills, situated along the junction of the Coastal Plain formations with the rolling uplands of the Piedmont Plateau. Elkneck, or more properly speaking, that portion occupied by the Susquehanna gravel, consists of a continuous chain of steep, rounded gravel hills. The entire surface of the formation is quite

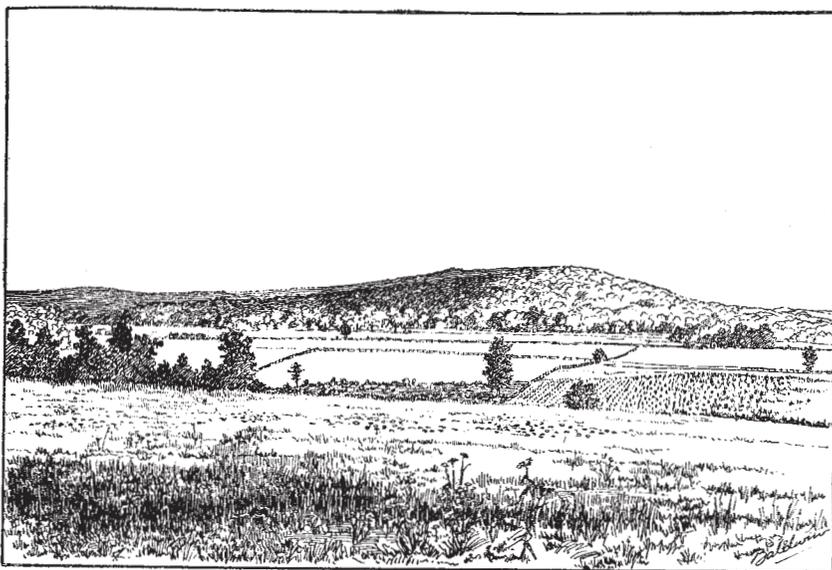


FIG. 12.—Characteristic topography in Susquehanna gravel area.

rough and hilly, with here and there a long slope, which breaks the monotony of steep hills and narrow valleys. (See fig. 12.) On Elkneck the hills rise from 200 to 300 feet above the bay. In the central portion of the county the elevations are somewhat greater, some of the hills rising considerably over 400 feet above mean tide level.

The soils are derived from the gravel beds of several different geologic formations, the principal ones being the late Pliocene and early Pleistocene. These deposits were laid down by swift currents of water during recent geological times and have undergone little subsequent alteration or change. The soil varies somewhat in its composition, but always contains a high percentage of large, well-rounded, quartz gravel, which ranges from one-half to several inches in diameter. To a depth of 8 inches the soil is a gravel loam, beneath which

the gravel content increases to such a great extent that it is almost impossible to penetrate farther with a soil auger. Often the underlying gravel beds are very compact and partially cemented together by a red ferruginous cement. In many places on Elkneck the surface is thickly strewn with great blocks or bowlders of these ferruginous conglomerates, many of which are several feet in length. In the central part of the county the gravels may be deeply stained with iron rust, while in adjoining localities they may be bleached perfectly white. The thickness of these gravel beds varies considerably in different parts of the formation, frequently exceeding 10 feet in depth. Along the northern border of the formation the gravels are mere superficial deposits scattered over the residual soils of the Piedmont Plateau. These gravels were probably once much thicker, but erosion since their deposition has carried them away until now they are thickly scattered over the surface of the rounded hills and slopes of the upland.

The texture of typical samples of the Susquehanna gravel soils can be seen in the following table:

Mechanical analyses of Susquehanna gravel.

[Fine earth.]

No.	Locality.	Description.	[Fine earth.]							
			Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	*Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
4242	Woodlawn, 1 mile W.	Gravelly loam, 0 to 14 inches.	P. ct. 5.16	P. ct. 7.58	P. ct. 11.58	P. ct. 15.99	P. ct. 9.70	P. ct. 11.99	P. ct. 30.32	P. ct. 7.37
4241	Principio, 3 miles S.	Gravelly loam, 10 to 26 inches.	2.53	5.07	8.88	15.68	24.28	11.89	14.68	16.92
4243	Subsoil of 4242.....	Red gravelly loam, 14 to 36 inches.	4.31	4.22	4.32	8.63	8.12	11.85	41.95	17.27

The productiveness of this soil formation also varies greatly, depending on the materials mixed with gravel. On Elkneck and on the larger hills in the northeast district the gravel is mixed with coarse sands and is well-nigh worthless for farming purposes. These lands have always been held in low esteem, and but few if any attempts have been made to cultivate them. They are covered with a thick but small growth of oaks and chestnuts. In many places a small part of the timber is burned for charcoal and, when the iron-ore mines were in operation many years ago, the charcoal industry was of considerable importance. These gravels compact into excellent roads. One may ride for miles in the poorer sections of this formation without seeing any attempt at cultivation, and the general appearance of the country is desolate in the extreme.

In the northern part of the area, along its border, where the covering of the gravels is not so deep and where the underlying materials form a combination more favorable for the agriculturist the country assumes a more prosperous aspect and many well-improved farms are to be seen within the limits of this formation. Here it is possible for the plow to mix with the gravel the residual products of the underlying granites and gneisses, and, although still containing a large amount of gravel, the soil is stronger and more productive. A larger timber growth is noticed, and crops that compare favorably with the better class of soils of the county are harvested each year. It frequently happens, even in the poorest, hilliest regions of this formation, that on the long slopes the gravel may overlies a clay which, when mixed with the soil, is fairly productive. There is no doubt that these soils will produce well by applying manure to them, but not such fine crops will be secured as are grown on heavier soils. Crops of wheat yielding 10 bushels per acre are sometimes obtained on fields where the soils seem almost worthless gravel. In some places good yields of corn are obtained, and tomatoes grow rapidly and abundantly, being cultivated extensively in some parts of the area.

ELKTON CLAY.

There are several well-defined areas of this formation along the eastern part of the central portion of the county, the principal ones being located near Elkton and southwest of Chesapeake City. This formation often occurs as well-marked terraces on portions of some of the broad rolling river necks of the lower part of the county. These terraces vary in elevation above tide level from 20 to 180 feet. Elkton is situated along the southern margin of one of the broad, flat terraces which only rises a few feet above mean tide level. Often these areas are low and poorly drained, and they are therefore wet and swampy much of the year.

The soil consists of from 8 to 10 inches of soft loam, which is often grayish in color, sometimes whitish, but the most common colors are brown and yellow. The soil is not unlike that of the Sassafras loam. The subsoil has a depth of 16 inches, consisting of a yellow light clay loam, which is underlaid by a mottled clay loam or clay to a depth of at least 36 inches. This subsoil is of various colors—drab, yellow, red, and pink all mixed together, best described by the term mottled clay. As this clay is very compact the natural drainage of the soil through such material is by no means good. Where this soil occupies a place where the natural conditions are conducive to good drainage the soils are productive and yield good crops of wheat, corn, and grass, as well as oats, potatoes, and tomatoes, but where the formation occupies areas with little opportunity for natural drainage it makes an undesirable soil for general farming purposes. These soils are apt to be cold and wet and late in the spring on account of the compact

nature of the clay subsoils. They bake hard in dry seasons, and it is difficult to keep them in good condition at any period of the growing season. The wet, poorly-drained land on the north of Grays Hill is just such an area. About Elkton and on many other occurrences of this formation are fine farm lands, where good crops are harvested as a general rule. Many dairy farms are situated on these soils. In some few areas a slight trace of white quartz gravel is scattered on the surface, but this is only in exceptional occurrences. Southwest of Chesapeake City are some areas with a thick, heavy growth of oak and pine, but this does not represent the original timber.

SUSQUEHANNA CLAY.

Susquehanna clay, with the possible exception of the Conowingo barrens, is probably the most unproductive soil formation found in Cecil County. The principal area is several miles in extent in the neighborhood of Charlestown, at the head of Northeast River. There are other areas surrounding some of the hills on Elkneck and a small, typical area surrounds the western part of Grays Hill, east of Elkton. The surface generally consists of eroded, even terraces or long deep slopes around the larger hills of Susquehanna gravel. The formation is often found at an elevation of a few feet, but it seldom exceeds 200 feet.

This formation is composed of some of the older Coastal Plain series of deposits, which are capped by a slight covering of late Pliocene and early Pleistocene gravels. The soils of this formation are derived mainly from the series of stiff, impervious clays, for many years grouped under the head of the Potomac formation, but in the last few years this group has been considerably subdivided by geologists. Although the stiff clays are capped by a slight covering of gravelly loam, they are sufficiently near the surface to give character to the soils. The capping on the more level portions consists of from 6 to 10 inches of loose gravel loam. On the slopes and on places where washing is more pronounced the covering of gravel may be removed and the refractory clays are exposed at the surface. Whether or not the gravel is present, the soil of the Susquehanna clay is distinctive and the condition of the country extremely desolate.

Few attempts have been made at cultivating these soils, and these have generally been unsuccessful. The soil is usually considered too worthless to pay the cost of clearing, and the few attempts made at cultivation have proved decidedly discouraging to the farmer. In some localities small fields of corn and wheat were observed, but the yields are small and the stubborn clays difficult to get in condition. Wherever this clay is without a gravel covering it is so stiff that it is plowed with the greatest difficulty. Generally, clay soils are considered productive, but these prove a notable exception. They are almost

impervious to water, and it has been remarked¹ that so slowly does the water move through them that the growing plant will suffer for want of moisture in the midst of plenty.

The timber growth of these soils is characteristic and distinct from that of the Susquehanna gravel, with which this formation nearly always comes in contact. Pine and oak constitute the growth, and the line of demarcation between the Susquehanna gravel and the present formation is well shown by the presence of the pine on the Susquehanna clay. The growth is thick, forming pine thickets rather than heavy forests. The Pennsylvania and the Baltimore and Ohio railroads pass through areas of this formation, the poverty of which is always remarked, much to the detriment of this section of Maryland, as the impoverished condition of this formation is wrongly supposed to be indicative of a much larger section of the State.

The texture of a number of samples of the Susquehanna clay formation is given in the following table:

Mechanical analyses of Susquehanna clay.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
4025	Plum Point, 1½ miles NW.	Stiff red clay, 0 to 8 inches.	<i>P. ct.</i> 4.15	<i>P. ct.</i> Tr.	<i>P. ct.</i> 0.64	<i>P. ct.</i> 0.27	<i>P. ct.</i> 2.77	<i>P. ct.</i> 12.86	<i>P. ct.</i> 36.87	<i>P. ct.</i> 42.26
4028	Leslie.....	Stiff yellow clay, 4 to 36 inches.	4.33	0.78	1.84	1.76	5.66	11.43	39.61	34.95
4023	Plum Point, 1½ miles NW.	Stiff red clay (road cut).	4.28	.....	.....	Tr.	2.12	17.42	40.13	36.20
4026	Subsoil of 4025.....	Red clay, 8 to 36 inches.	4.7875	.31	2.00	9.20	31.27	51.39

¹ Maryland Experiment Station, Bul. 21.

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