VIRGINIA GEOLOGICAL SURVEY
UNIVERSITY OF VIRGINIA
THOMAS LEONARD WATSON, PH. D.
DIRECTOR

Bulletin No. XVI.

The Country About Camp Lee, Virginia

BY

ALBERT W. GILES

PREPARED IN CO-OPERATION WITH THE
UNITED STATES GEOLOGICAL SURVEY

CHARLOTTESVILLE
UNIVERSITY OF VIRGINIA
1918


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Central portion of the Camp Lee Cantonment. Camp headquarters in right center, with drill grounds at right and left and in back. Hostess house in foreground.
(Thompson Illustragraph Co.)

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VIRGINIA GEOLOGICAL SURVEY,
UNIVERSITY OF VIRGINIA,
CHARLOTTESVILLE, July 30, 1918.

Governor Westmoreland Davis, Chairman, and Members of the State Geological Commission:

GENTLEMEN:—I have the honor to transmit to you herewith, and to recommend for publication as Bulletin No. XVI of the Virginia Geological Survey Series of Reports, a manuscript and illustrations of a report entitled "The Country About Camp Lee, Virginia," by Albert W. Giles.

This report embodies the results of a geographic study of Camp Lee and the country round about, and has been prepared by the Virginia Geological Survey in coöperation with the U. S. Geological Survey.

Respectfully submitted,

THOMAS L. WATSON,
Director.

THE COUNTRY ABOUT CAMP LEE, VIRGINIA

By Albert W. Giles.

INTRODUCTION.

Camp Lee, one of the sixteen cantonments of the National Army, is situated about 3 miles east of Petersburg, Va., in an area abounding in historic associations and a variety of interesting natural features. The historic associations date from early colonial days, for Captain John Smith ascended James River to the mouth of the Appomattox, up which he pushed his way to the "falls," the limit of navigation, and indicated on his map, published in 1612, the present site of Petersburg, applying to it the name "Appomatuck." It was here that the romantic and valorous Nathaniel Bacon defeated the Appomattox Indians in 1686. Petersburg and Richmond lie on the route traveled by Colonel William Byrd in journeys incident to his duties in surveying the boundary between Virginia and North Carolina. In 1727 Colonel Byrd selected the site for a town which he first called Peter's Point but later renamed it Petersburg, and in 1733 the town was incorporated. It is an interesting fact that Colonel Byrd named this town for his friend Peter Jones, one of the pioneer traders.

Why should there have been a trading post at this place? To one familiar only with the country as it is to-day the reasons for its location may not be apparent. Farms stretch almost continuously from the Blue Ridge to the Atlantic coast, and as one travels on the railroads from the cities and towns of the interior to the seaports at the mouth of James River he sees little change in the character of the country as he passes Petersburg or Richmond. In early colonial times, however, the region west of the sites of Richmond and Petersburg was an unknown wilderness without roads other than Indian trails, but the country to the east, although more heavily forested and abounding with tidal marshes and inland swamps, was easily traversed along the navigable streams. The early settlers naturally moved by boats through the "sylvan Venice," as John Fiske aptly calls Tidewater Virginia, until they encountered the "falls" of the rivers, beyond which they could not go in such craft, and there they established villages and other settlements. The fact that the present site of Petersburg was at the upper limit of navigation led Peter Jones to select it as a proper place for a post for trading with the Indians. In fact, Colonel Byrd says in his journal: "These two places [Richmond and Petersburg], being the upper-

most landings of James and Appomattox rivers, are naturally intended marts, where the traffic of the outer inhabitants must center."

Petersburg was one of the battlefields of the War of the Revolution. On April 24, 1781, the British under General Phillips landed at City Point, on the James, and the next day they marched to Petersburg, where they were opposed only by a relatively small body of militia commanded by Baron von Steuben. The British captured the city and burned the tobacco stored there, but they first permitted Mrs. Bolling, owner of the warehouses, to remove it so that the buildings might be preserved, and in this act as well as in others conducted themselves as "men of honor and cavaliers." Bollingbrooke House, where Mrs. Bolling lived, is said to have been connected with more military incidents of the Revolution than any other house in Virginia. The British General Phillips, "the proudest man of the proudest nation on earth," died there on May 13, 1781, while the town was being bombarded by General Lafayette, and was buried in the graveyard adjoining Blandford Church. One week after Phillips's death Lord Cornwallis entered Petersburg and stayed a few days in Bollingbrooke.

It seems that Petersburg was not a scene of fighting in the War of 1812, but it contributed 103 young men to the Federal Army, and President Madison, in an address expressing his thanks for the services of these men, called Petersburg "the Cockade City of the Union," an appellation that persists to the present day.

Although far from the battle scenes of the Mexican War, Petersburg was represented in them by General Winfield Scott, who captured the City of Mexico on September 14, 1847. He was born in Petersburg on June 13, 1785, and his natal place justly feels proud of the distinction he attained in the service of his country.

Petersburg was a battleground more than once during the Civil War. Skirmishes occurred there in September, 1861, and in October, 1862, but the real siege of the town by the Federal troops began on June 15, 1864. The early intrenchments crossed the site of Camp Lee and extended in a great crescent from a place near City Point around south of Petersburg nearly to Dinwiddie. Later the Confederate lines were driven in and the town was closely invested by the Federal Army under General Grant. The explosion of the mine that produced the famous "Crater" just east of Petersburg took place on July 30, 1864, and the town capitulated on April 3, 1865, six days before General Lee's surrender at Appomattox Court House, which lies some 80 miles to the west. Thomas Nelson Page says that "when Petersburg was in a state of siege the favorite ride was across

"East Hill."—This is all that remains of "Bollingbrooke," the British Headquarters during the Revolution. Here Cornwallis, Arnold, Tarleton, and Phillips were quartered during the spring of 1781, and here died General Phillips, of the British Army, described by Jefferson as "the proudest man of the proudest nation on earth."

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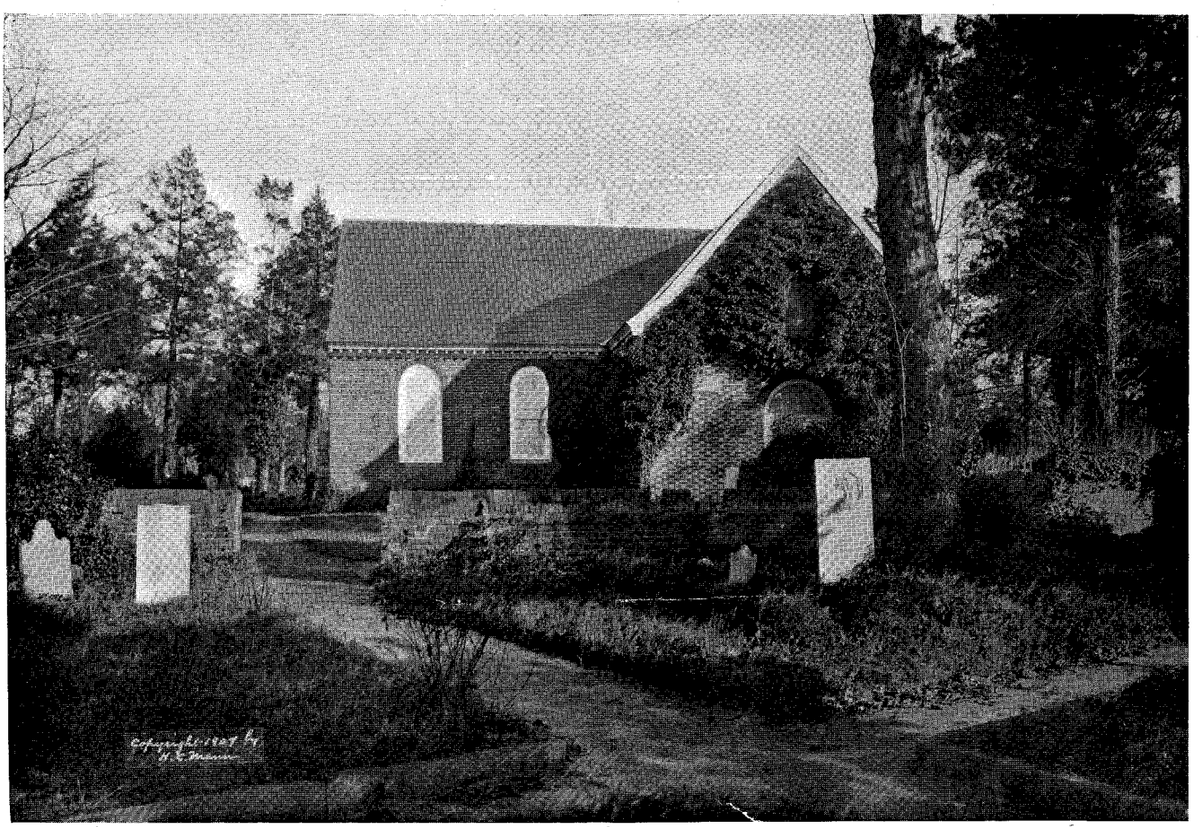

Old Blandford Church.—It was erected in 1735, and was the principal church of Bristol Parish, which was established in 1642 by an Act of the House of Burgesses. It belongs to the City of Petersburg, and is now used as a Confederate Memorial Chapel.

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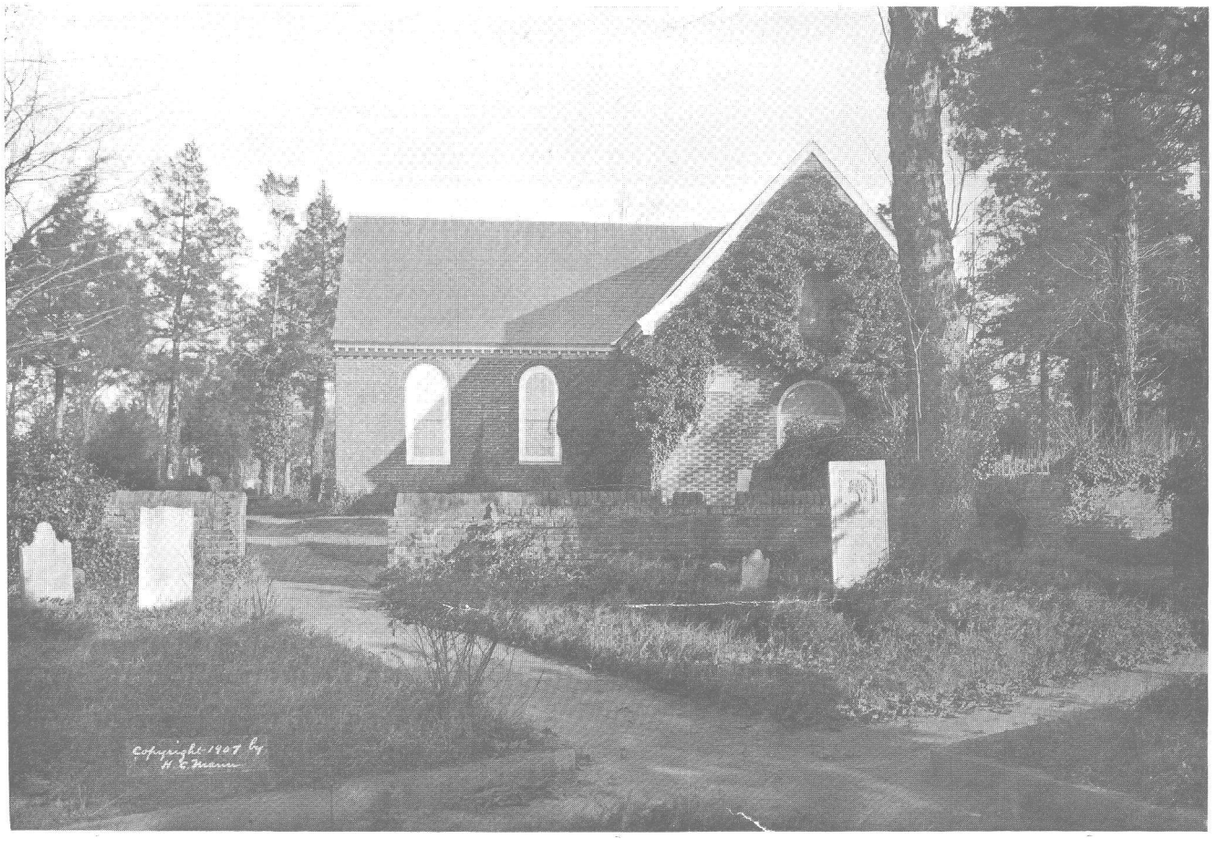

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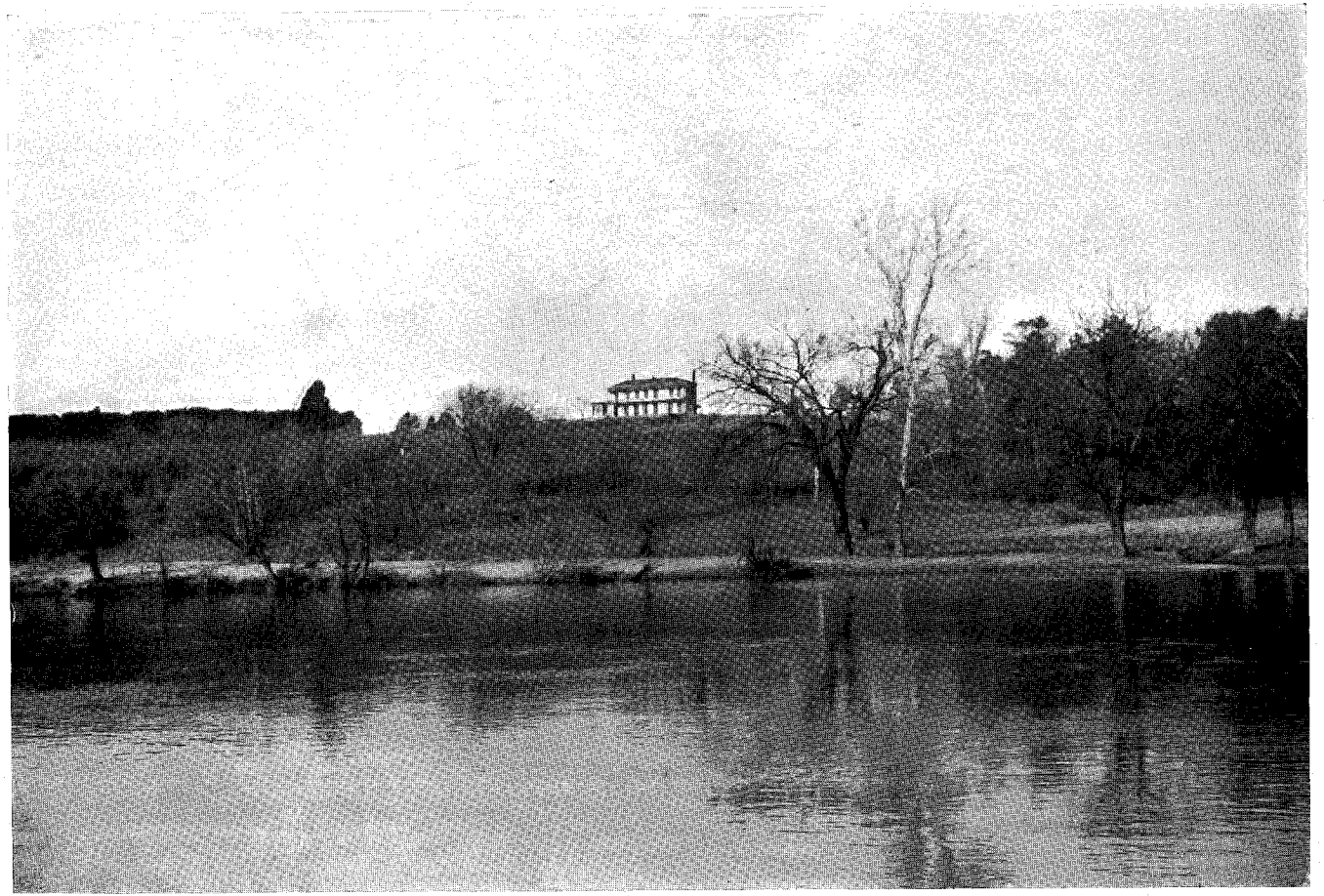

LAFAYETTE'S HEADQUARTERS.—From this hill on the north bank of Appomattox River, in the spring of 1781, General Lafayette shelled the City of Petersburg, then in the hands of the British. General Phillips, of the British Army, who lay dying at Bollingbrooke, complained that his enemies would not even let him die in peace.

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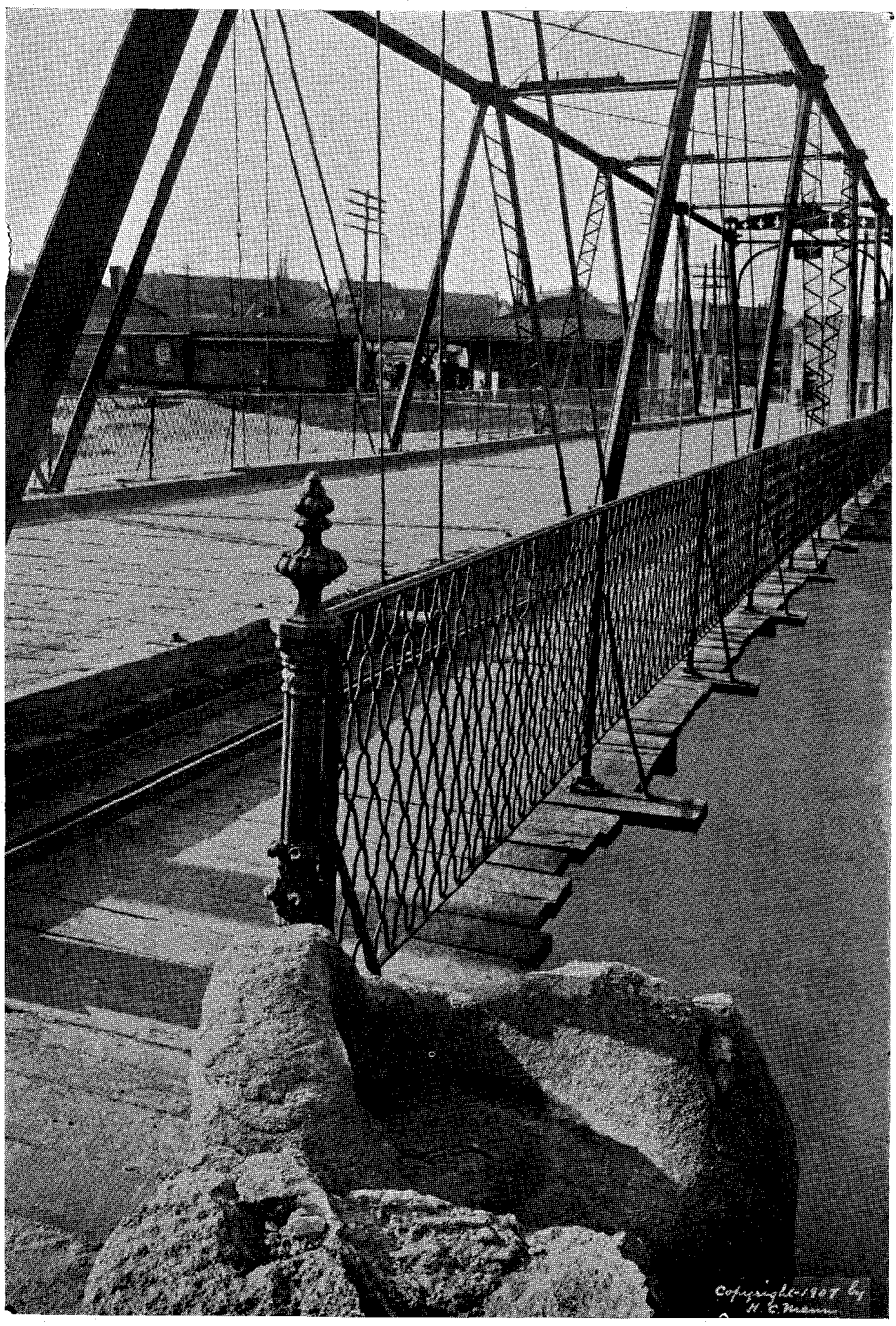

POCAHONTAS BASIN.—At the end of Pocahontas Bridge, on the north bank of Appomattox River, stands this stone basin, said to have been used by the Indian Princess Pocahontas during visits with her father, Chief Powhatan, to this portion of his hunting grounds.

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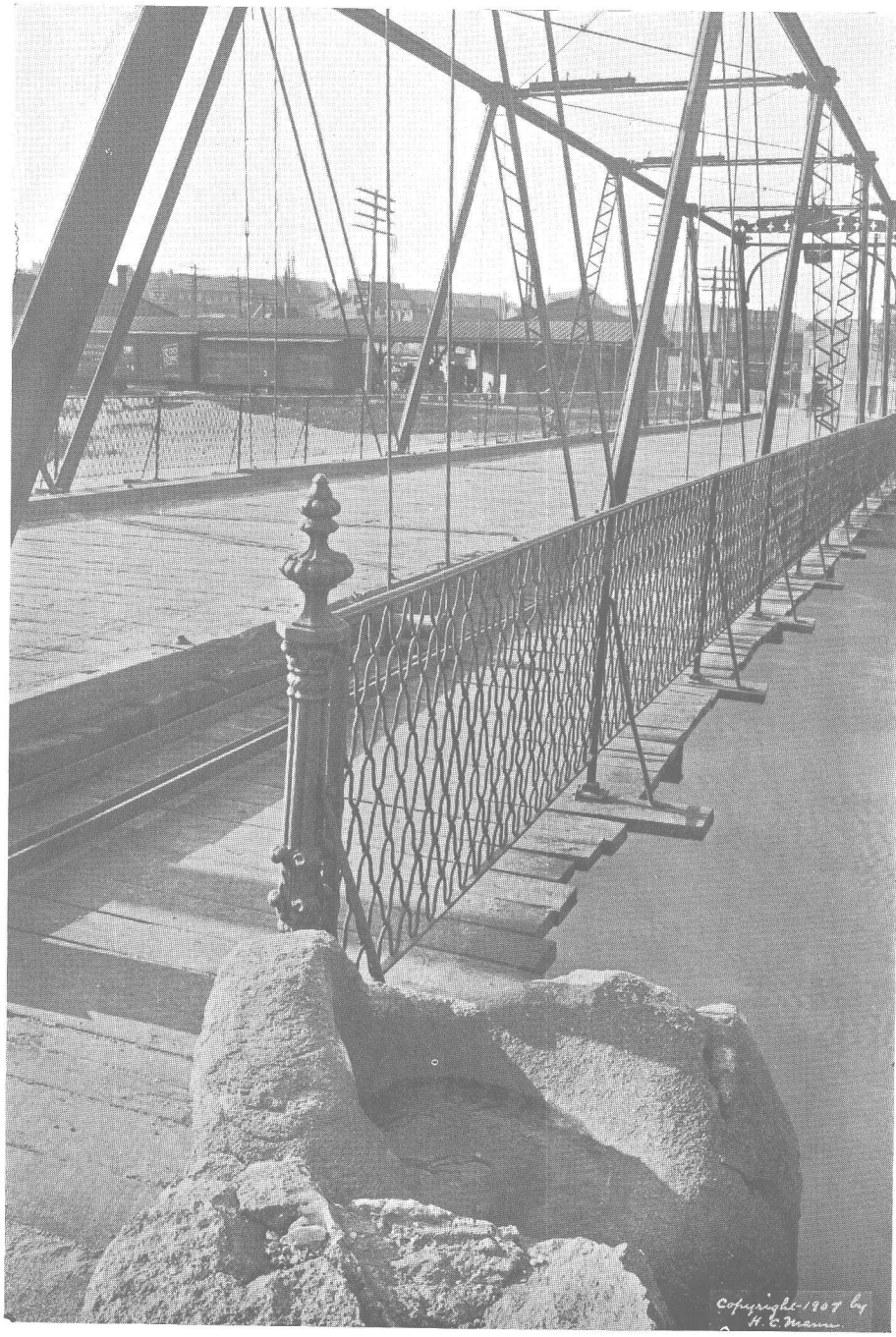

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LEE'S HEADQUARTERS.—Here General Lee was quartered during the siege of Petersburg, until the extension of the lines to the right made the Turnbull place on Cox Road more convenient to his army.

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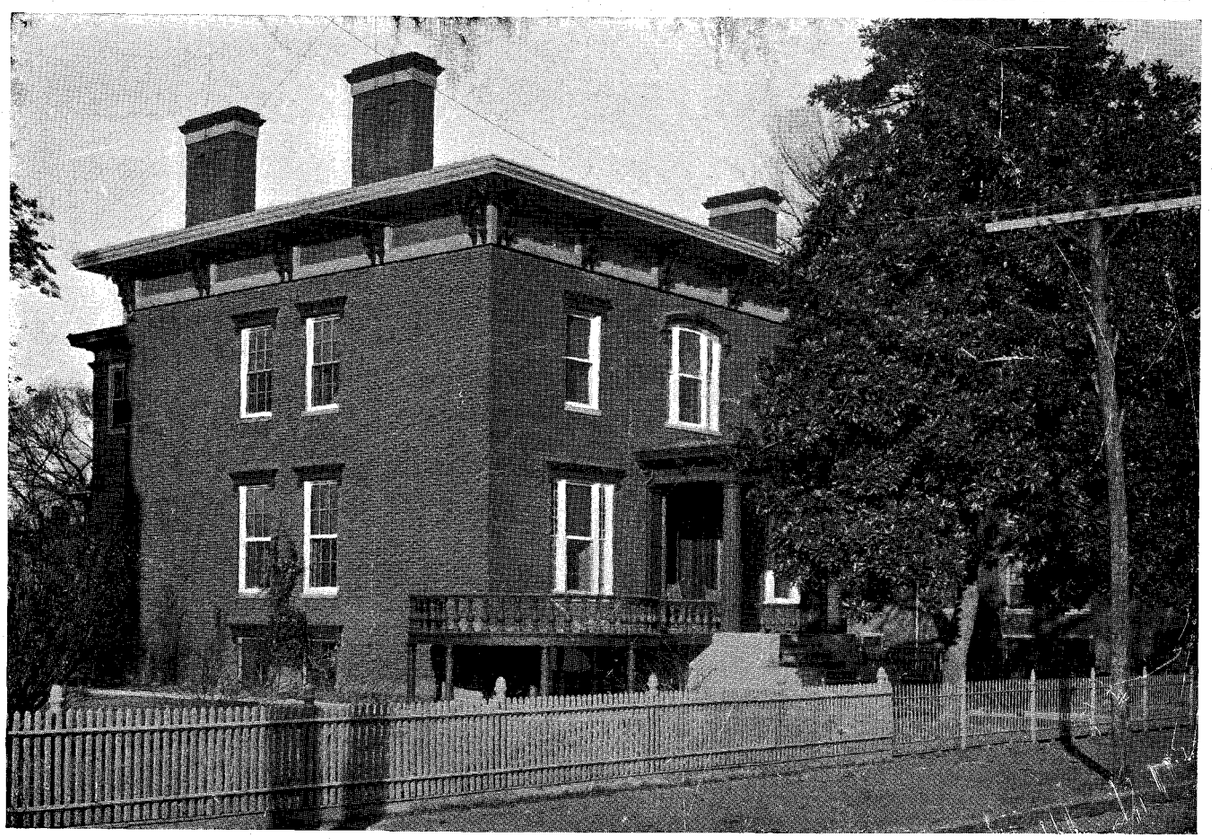

GRANT'S HEADQUARTERS.—In this house, Lincoln held his last interview with General Grant on April 3, 1865. It is now the residence of Mr. Simon Seward.

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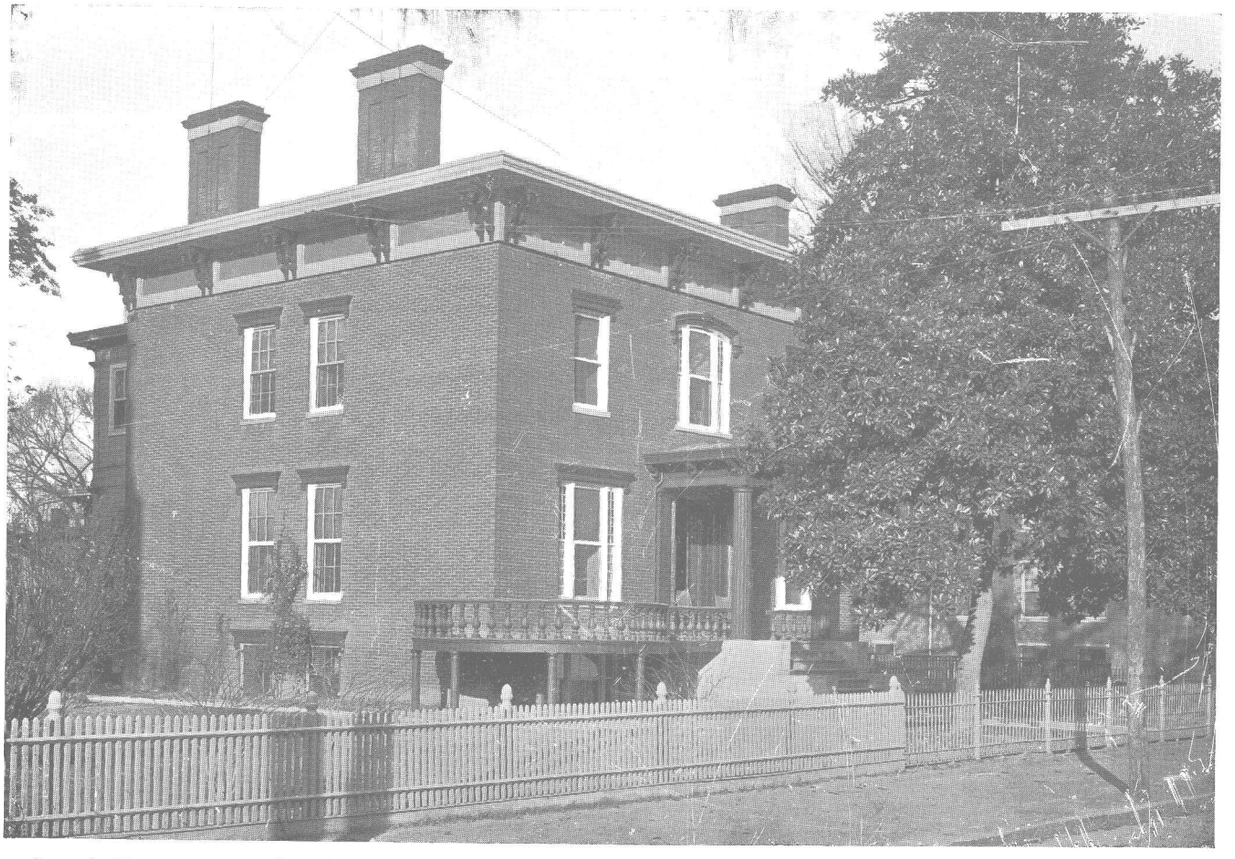

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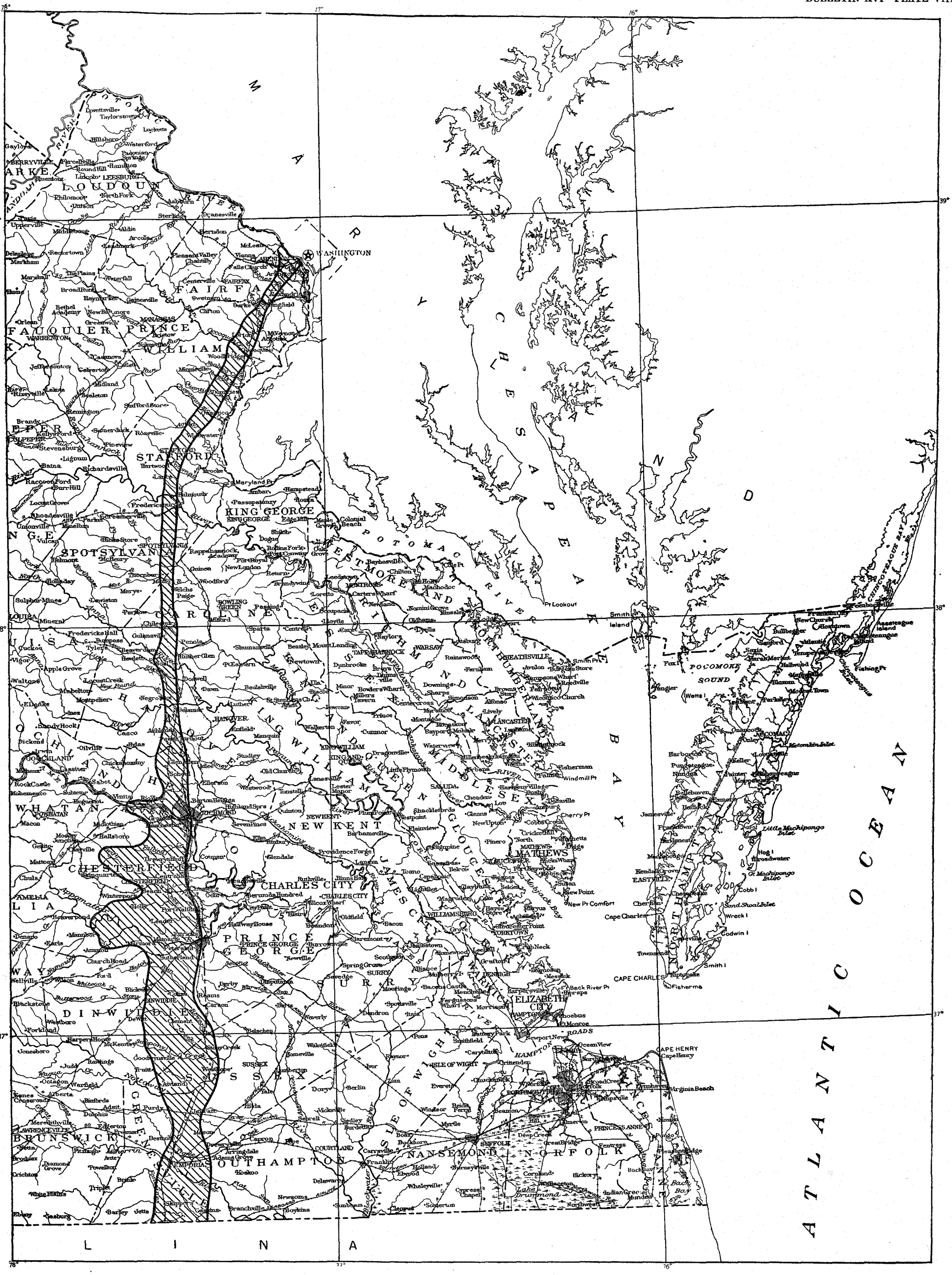


MAP OF EASTERN VIRGINIA SHOWING LOCATION AND EXTENT OF FALL BELT (OBLIQUE LINED BELT), AS MAPPED BY L. H. STEPHENSON.

a bridge which was under Federal fire, and horseback rides in autumn were all the more exciting in that a dash across the open space might be followed by a shell crashing behind the horses."

PHYSICAL FEATURES OF EASTERN VIRGINIA.

GENERAL RELATIONS.

The words of Colonel Byrd, regarding the "naturally intended marts," contain deep insight into the dependence of social and economic development on the surface features of the earth, for they show his recognition of the three major physical divisions of eastern Virginia and the relation of these divisions to human activity. The easternmost division is Tidewater Virginia, which is crossed by navigable streams that empty into Chesapeake Bay and are affected by the rise and fall of the tide; the middle division comprises the "falls," or rapids, which occur in all of the principal rivers. The line connecting these rapids, marking the head of navigation, has been generally known as the Fall Line, but because of the length of the rapids the term "line" is not appropriate and is here replaced by the term "Fall Belt," which is applied to a belt of country of variable width including the principal rapids and cascades; and the westernmost division is the region that lies inland of the "falls" and is without navigable waters, for here the streams are shallow and narrow and their beds in places are rocky.

Camp Lee lies entirely within Tidewater Virginia, for the tide extends up Appomattox River to the lower end of the rapids at Petersburg and up the James to the rapids at Richmond. Tidewater Virginia is only a part of a belt of similar country which extends along the coast from Cape Cod far into Mexico and which constitutes the Coastal Plain, one of the major geographic provinces of the eastern United States. From New Jersey to Georgia this province is bounded on its seaward side by the Atlantic Ocean and on its landward side by the Fall Belt, but throughout this area the character of the country varies considerably, the part south of Cape Lookout, N. C., being regular in width and only slightly indented by bays or sounds, whereas in the part between Cape Lookout and the mouth of Hudson River at New York there are many such features, and tidewater reaches up the rivers entirely across the province.

As may be seen at Camp Lee, the land in Tidewater Virginia is composed of clay, sand, and gravel; and, although it may, at first glance, appear to an observer as one great plain, on more detailed inspection it may be divided into a number of more or less definite subordinate plains which

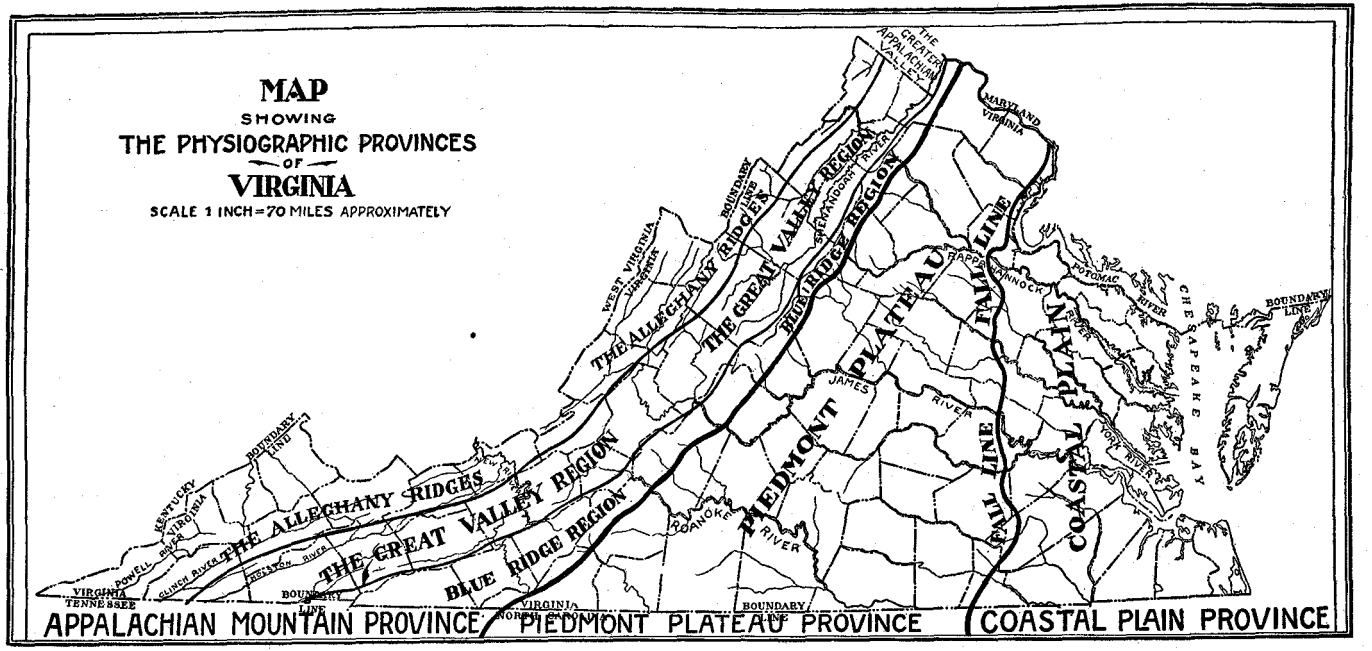


Fig. 1.—Sketch map of Virginia showing physiographic provinces. (After Watson.)

stand at slightly different altitudes and are separated by relatively steep slopes. In other words, the surface, when viewed broadly, is seen to be terraced, each terrace comprising a relatively flat surface backed by a slope rising to a higher elevation and faced by a more or less steeply sloping surface on its side toward an estuary or toward the sea. The loose, unconsolidated clay, sand, and gravel of the Coastal Plain rest upon granite or similar compact, hard crystalline rock, which crops out in the Fall Belt and in the Piedmont Plateau westward to the Blue Ridge.

Long ago both the hard crystalline basement rocks and the unconsolidated materials of the Coastal Plain were gradually and slightly tilted seaward, so that the eastward dip of the beds is steeper than the slope of the land surface. The dip of the crystalline rocks between Petersburg and the ocean is shown by the fact that at Petersburg they are at tide level, whereas in a well boring at Fort Monroe, near Norfolk, their upper surface

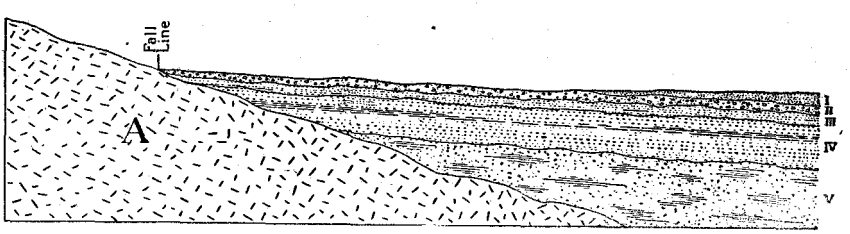


Fig. 2.—Generalized section showing relations of the Coastal Plain formations (I-V inclusive) to the Piedmont Plateau crystalline rocks (A). (After Watson.)

was reached at a depth of 2,240 feet. The relation of the hard and soft rocks and their slope toward the sea may be seen in traveling up any of the river valleys that cross the Fall Belt. For example, the contact of the clay and sand of the Coastal Plain with the underlying granite, as shown in Plate IX (A), can be seen in Petersburg, and the eastward slope of the upper surface of the granite can be clearly traced along the gorge of the Appomattox. That the sand and clay beds of the Coastal Plain once extended farther inland than they do to-day is shown by their presence as isolated remnants on some of the higher land several miles back of the eastern edge of the Fall Belt. As the rate of cutting is much faster in soft or unconsolidated rock than in hard rock, the gradient of a stream bed where the harder rock is succeeded by the softer rock is necessarily steepened. There is, therefore, along the western border of this province a strip of country in which the streams have cut down through the unconsolidated materials of the Coastal Plain and formed narrow gorges in the underlying hard granite,

as is strikingly exemplified in the cascades and rapids of such streams as the Appomattox and the James where they cross the Fall Belt.

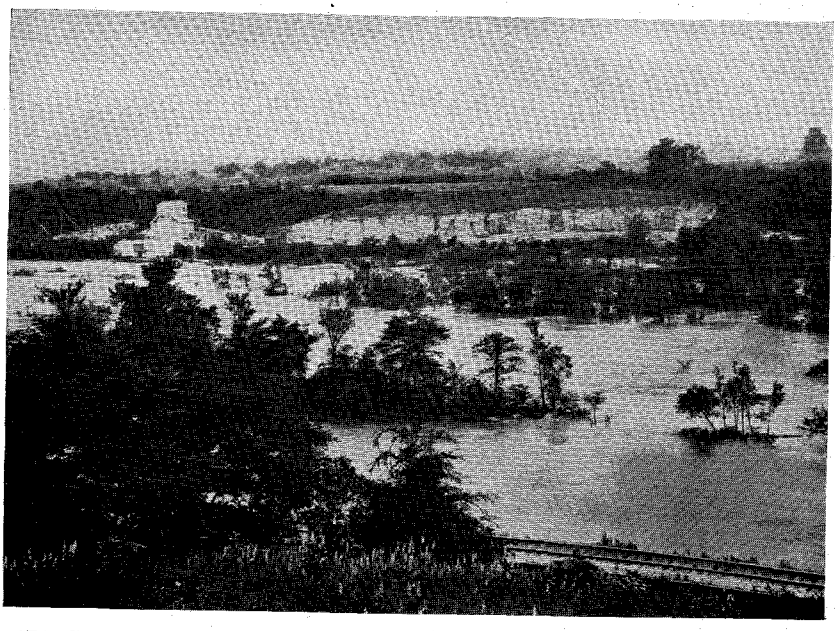
A few miles inland from the eastern margin of the Fall Belt, as may be seen about 10 miles west of Petersburg, there is no gravel, sand, or clay of the kind that underlies the Coastal Plain, except here and there on the tops of ridges. Below the soil lies clay or some other material produced by the decay of the hard rock, but in places granite projects above the level of the soil. To one who travels across this country by wagon or automobile it appears rolling, if not hilly, but to one who obtains a widely extended view from the top of a ridge the divides appear to be of nearly the same height, so that if the valleys were filled the surface would really constitute a plain. The valleys are rather narrow and steep-sided, most of the stream beds are rocky, and there are no extensive plains or terraces that rise one above another, such as occur in the Coastal Plain. Country of this kind extends from the Fall Belt inland to the foot of the Blue Ridge, and, because it lies at the foot of the mountains, it has come to be known as the Piedmont Plateau. The Piedmont Plateau extends northward from Virginia to New Jersey and southward to Alabama and is one of the large geographic provinces of the eastern United States.

COASTAL PLAIN.

Character of surface.—The Virginia part of the Coastal Plain (or Tidewater Virginia) comprises about 10,500 square miles, or one-fourth of the area of the State. Of this large region about 2,365 square miles is covered by Chesapeake Bay and the many estuaries that mark the lower courses of its tributary streams. Its length, from the North Carolina line to Potomac River at Alexandria, is 185 miles, and its maximum width in the latitude of Fredericksburg is about 115 miles.

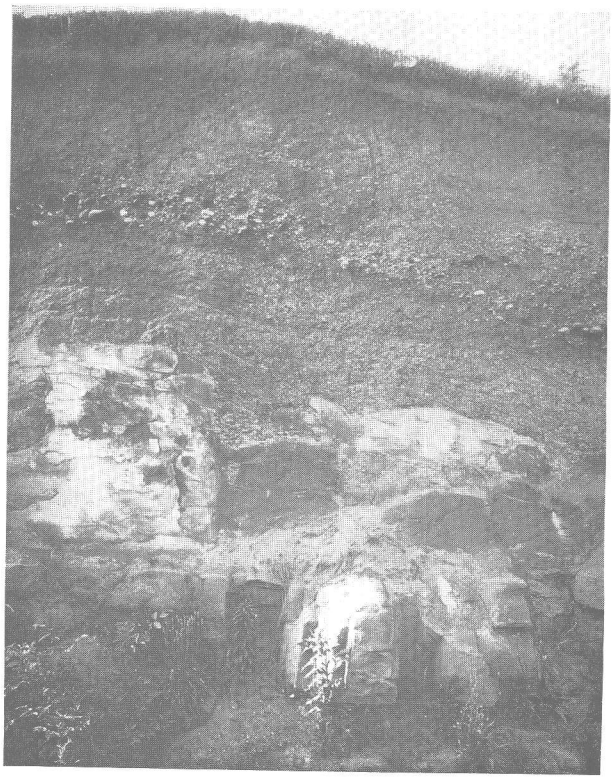
The Coastal Plain is only the landward part of a much broader surface, which, if the waters of the Atlantic Ocean were removed, would be found to extend as a plain 75 or 80 miles east of Cape Henry. At the outer edge of the submerged part of this plain, which is also known as the continental platform, the water has a depth of 300 to 600 feet, but beyond this edge the sea bottom descends steeply into the abyssal depths of the Atlantic. Although the shore line, according to the records of man, is apparently fixed, it is in reality very changeable, having shifted in past geologic time back and forth across the low, sloping plain as the land rose or sank with reference to the level of the sea. At one time the shore was farther west than Petersburg; at another time it was far out in what is now the Atlantic Ocean.

(A) Coastal Plain sands resting on granite.



(B) Gorge of James River at Richmond, illustrating stream conditions in the Fall Belt.

U. S. Geol. Survey.



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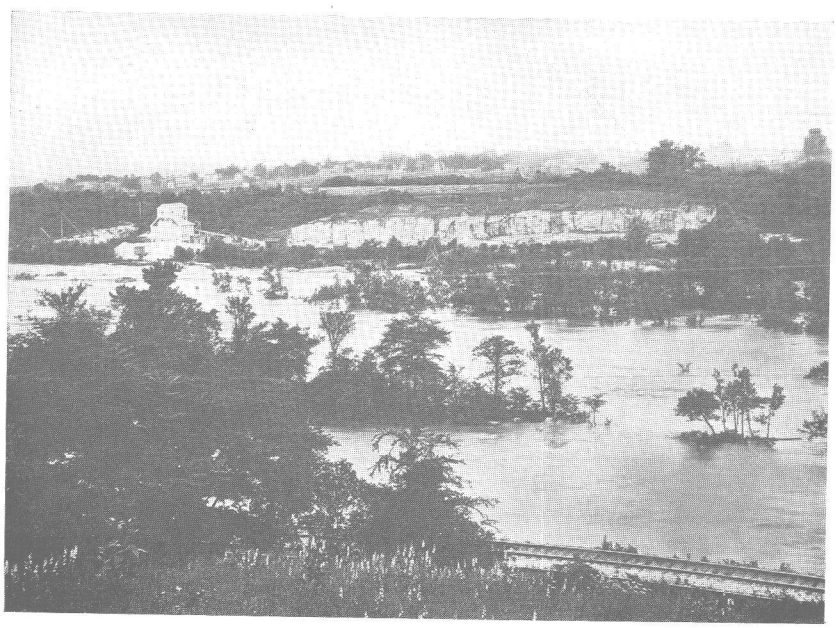

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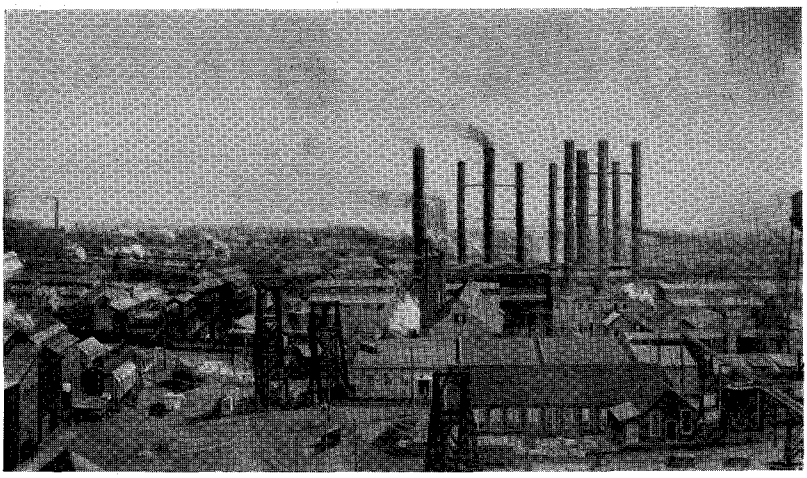
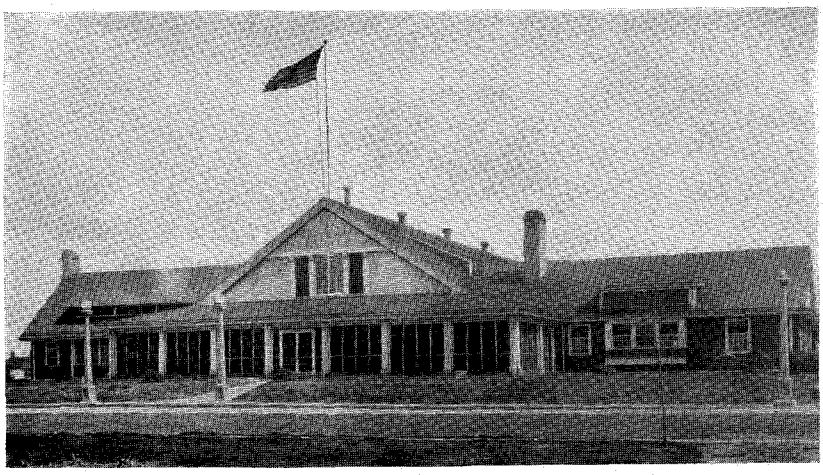
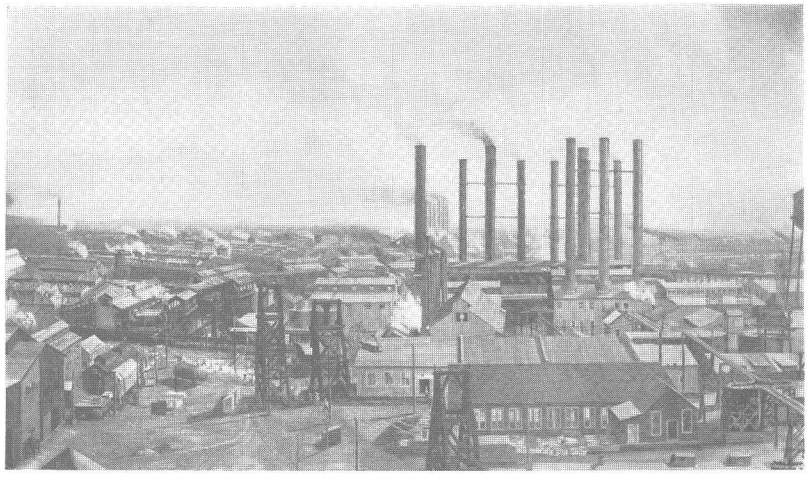


(A) A bird's-eye view of Hopewell Works.



(B) Dupont Club, "A" Village.

E. I. Dupont Co.



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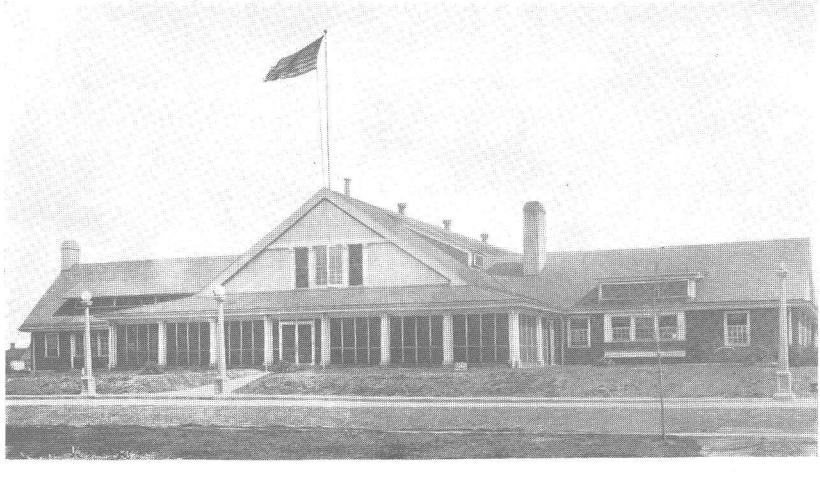

(B) Dupont Club, "A" Village.

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That portion of the great plain which is above water slopes gradually, but with decreasing amount, from an altitude of about 300 feet on the border of the Piedmont Plateau to sea-level at the shore line on the east. This seaward sloping surface, though on the whole fairly uniform, is in detail steplike, consisting of several broad flats or gently sloping plains miles in width, separated by short and more or less well-defined steeper slopes. Viewed in a broad way each of these plains extends in a rather narrow belt entirely across the State and in general parallel with the coast. Each is flanked at the back by a slope rising above its generally even surface and at the front by a similar slope leading down to the next plain below. These plains and the slopes separating them are well shown about Camp Lee, for the lower end of the military reservation includes part of a narrow but very flat plain and the slope upon which the barracks are built leads up to one of the most extensive plains in this region. Although these features when viewed in a broad way are true terraces, the flat portions of many of them are broad enough to constitute plains, and hence they are usually spoken of as plains or terrace plains. The plains cross the State from north to south, but they are not continuous, being interrupted by all the larger valleys. The higher plains are preserved only on the uplands between the valleys, but the lower ones are represented along the principal valleys as well as across the interstream areas.

As all the plains are well developed on the uplands between the streams, it follows that the terraces were not formed by stream action but are due to agencies of some other kind. It is believed, for reasons to be given presently, that they were formed largely by waves and currents, acting along the shores of the ancient sea or along the shores of estuaries that ages ago reached from the sea far back into the interior of the province. How waves and currents could have produced the terrace plains and slopes that are characteristic of the Coastal Plain in Virginia may be understood by a study of what the waves and currents are doing to-day along the Virginia coast.

An excellent place at which to study the work of waves and currents is Virginia Beach, near Norfolk, where, as on almost every other seacoast facing the open ocean, two processes are always active, except at periods of unusual calm. To watch the sea here during a storm is indeed a thrilling experience. Some distance offshore, even as far as a quarter of a mile, the crest of a wave may be seen to mount higher, perhaps break, and then continues as a great roller toward the land. The crest of the roller soon curls over and comes tumbling, foaming onward, rising higher and higher,

makes a sudden final leap, and with a thundering crash strikes the shore with all its mighty force. The vertical bluffs, which in many places stand above the beach, have been produced by the impact of such waves. Should one return to Virginia Beach after the lapse of several years and again examine the bluff, he would not find it in the same place, for the waves of each storm strike its face and wear it farther and farther inland.

The cutting of shore cliffs is not the only work accomplished by the waves. In shallow water the base of a high wave drags on the sea bottom and stirs up mud and sand, or even small pebbles, that may be there, while its upper part is rapidly driven landward, and water is actually heaped along the shore. The rhythmic grinding sound of water running down a beach and dragging sand or shingle with it after the crash of each wave is known to every one familiar with the seashore. Roller follows roller, wave crash follows wave crash, and as the water piled up at the shore cannot move seaward on the surface it must return along the bottom, and by a pulsating creep, called undertow, finds its way into greater and greater depths and carries with it material torn from the bottom by incoming waves or loosened by their pounding on the coast. The undertow drags seaward sand and gravel, and may actually scour and deepen the sea bottom until its strength is spent, when it drops its load and builds up the sea floor.

Undertow is only one of the several transporting agents that are active near or along shores. The strong winds at Virginia Beach blow mostly from the northeast, as may be inferred from the southwestward bending of the tree trunks in that vicinity, but, as the trend of the coast is nearly due south, the crests of the storm waves form an angle with the shore. Each wave produced by a northeast wind, therefore, first strikes the northern part of the shore and closes in toward the south as if it were one blade of a pair of scissors. It is fascinating to watch this shearing by successive waves and see sand, gravel, and drift gradually carried southward. Besides wind-induced currents, there are alongshore currents due to other causes that need not be described here.

The two processes observed at Virginia Beach are the cutting away of the seaward edge of the land by the waves and the transportation of material seaward by the undertow and southward by the dominant alongshore currents. Both processes are coöperating to produce a plain whose inner edge lies about at sea-level and whose outer edge is 100 feet or less below sea-level. The surface of the cut part of the plain passes so gradually either by a slope or a curve into that of the built part that the boundary between them may not be recognizable. In fact, a part of the plain that was

originally cut by waves or the drag of the undertow may subsequently be built up by the deposition of sand and gravel. Not all the material distributed over the sea bottom is derived from cutting at the shore, for the streams that empty into the sea are bringing their loads of mud, sand, and perhaps gravel; and these materials are distributed over the sea floor by waves and currents and aid in building the submarine plain.

The different kinds of sea cliffs and terraces and the combinations of agencies that have produced them and other shore features constitute a most interesting subject that cannot be adequately described in a few paragraphs. However, in this connection the essential things to understand are the production of a seaward-facing cliff by wave-cutting along the edge of the land and the development of a submarine terrace at shallow depths along the edge of the sea.

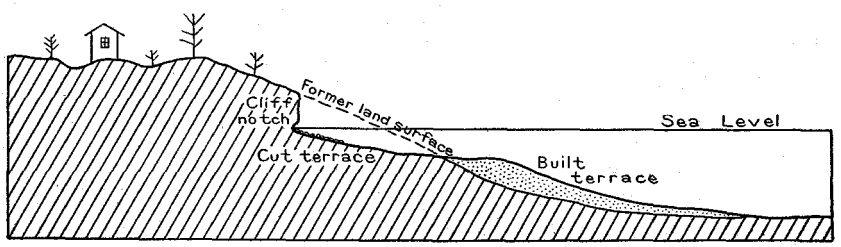


Fig. 3.—Diagram illustrating the formation of marine terraces and cliffs. The cliff is formed as the coast recedes before the constant attack of the waves. The cut terrace represents the lower limit of effective cutting by the waves, the built terrace represents the deposition of materials swept outward over the surface of the cut terrace by the recession of the waves and the undertow.

Should the height of the land above sea-level remain constant for a long time the processes above described will form a great submarine plain, bounded on its landward side by a bluff or a steep slope and on its seaward side by a gentle slope. The plain surface will not be restricted to the sea bottom, off the land that faces the open ocean, but will extend up the estuaries and may merge into terrace plains that have been formed by river processes above the head of tidewater in the stream valleys.

If the height of the land above sea-level should increase, after the formation of such a plain as has been described, and the surface of the plain be brought above sea-level, there would be laid bare a vast nearly level tract bounded on both its landward and seaward margins by relatively steep slopes, with extensions of its surface up the estuaries that existed during the time of its formation, as is shown in the accompanying diagram (fig. 3).

It can now be made clear why it is believed that each of the terrace plains in Tidewater Virginia has been produced by wave-cutting and the action of currents at and near an ancient shore. Each terrace plain, as may be seen between Petersburg and City Point, is bounded on its landward side by a rather steep slope, and its surface is very gently inclined—so gently as to be imperceptible to the eye—either toward an estuary or toward the present seacoast. These relations are analogous to those that now exist along the coast at Virginia Beach, where an uplift of the sea bottom high enough to convert it into dry land would expose to view a terrace flat bounded by a seaward-facing slope at its landward margin, exactly similar to the great terrace flat that extends inland from the Virginia shore to the sharp rise of the surface on the west side of Dismal Swamp.

As the several plains or terraces in Tidewater Virginia were formed in large part by sea waves, it naturally follows that part of the Coastal Plain must have been under water when each terrace was formed. As the terraces lie at successively lower altitudes from the Fall Belt to the coast, it is evident that during each period of terracing now represented by one of these plains the sea extended inland a shorter distance than during the preceding period.

The succession of events, as worked out by geologists, is about as follows: After the last of the clay, sand, and gravel formations (exclusive of the terrace deposits) composing the Coastal Plain had been laid down in shallow water along the margin of the Atlantic coast a movement of the earth's crust raised both the surface of the Piedmont Plateau and the Coastal Plain of that time. Immediately before this elevation the two provinces together probably had the aspect of a moderately even plain, with some hills in the plateau portion rising somewhat above the generally even surface. The uplift caused the shore line to shift eastward, perhaps as far as the edge of the continental platform, and added a strip of the sea bottom to the previously existing land. Into this newly elevated land the streams cut their channels to base-level, and, on account of the looser condition of the materials of the Coastal Plain, erosion proceeded more rapidly in that area, producing valleys wider than those in the Piedmont Plateau. In this manner were produced the deep valley that later became Chesapeake Bay and also the valleys that became the estuaries of all the tributary rivers.

Later the crust of the earth sank until the land was 300 feet lower than it is at the present time, and the waves of the Atlantic beat upon a shore west of Petersburg. During a period of stability that followed this submergence a broad flat was produced, partly cut along the shore by the waves

and partly built out under water by the undertow and other currents. This flat was later raised above the sea and became land, at a time so long ago that it has since been deeply trenched by the streams, and only here and there considerable tracts of its once even surface are left.

Still later a part of the Coastal Plain east of this flat emerged from the sea, and during the next pause in land movement a new and lower terrace was formed. In the formation of the second terrace the waves removed a large part of the higher terrace in Virginia, leaving only those portions which are seen to-day in the vicinity of the Fall Belt. The steep slope connecting the two plains in many places marks the position of the sea cliff formed at this time by the undercutting of the waves.

In a similar way other terraces were formed at lower levels, each one representing a period of land stability which followed an uplift of the Coastal Plain and during which the assault of the waves drove the shore line landward, cutting deeply into the edges of the previously formed terrace. The successive upward movements of the land between the periods of wave-cutting resulted in a steplike arrangement of the terrace plains from the Fall Belt to the present seashore.

In all six terraces are recognized, and each one has received a name—generally the name of the locality at which the terrace was first studied or is best displayed. In the order of formation, from the highest to the lowest, they are the Brandywine terrace, occurring at altitudes above 220 feet and below 300 feet; the Sunderland, ranging in altitude from 110 to 200 feet; the Wicomico, from 50 to 90 feet; the Chowan, from 25 to 45 feet; the Pamlico, less than 25 feet above sea-level; and the Recent, which is now being developed at or just below sea-level. The diagram (fig. 4) on page 12 indicates the relations of the terraces to one another and to sea-level at the time of their formation.

As soon as each terrace plain was raised above sea-level the streams began to cut trenches in its even surface. The older, higher plains, because they have been long exposed to weather and the work of streams, are crossed by many drainage lines, which carry away the excess of rain water and leave the soil in good condition for cultivation. But the surfaces of the younger, lower plains are crossed by few streams, and water falling on them tends to collect in low places, forming swamps or marshes, locally of very great extent, such as the Dismal Swamp.

The larger streams of the Coastal Plain were flowing in their present courses long before the formation of the terrace plains, and upon each successive emergence of the land from beneath the ocean waters they oc-

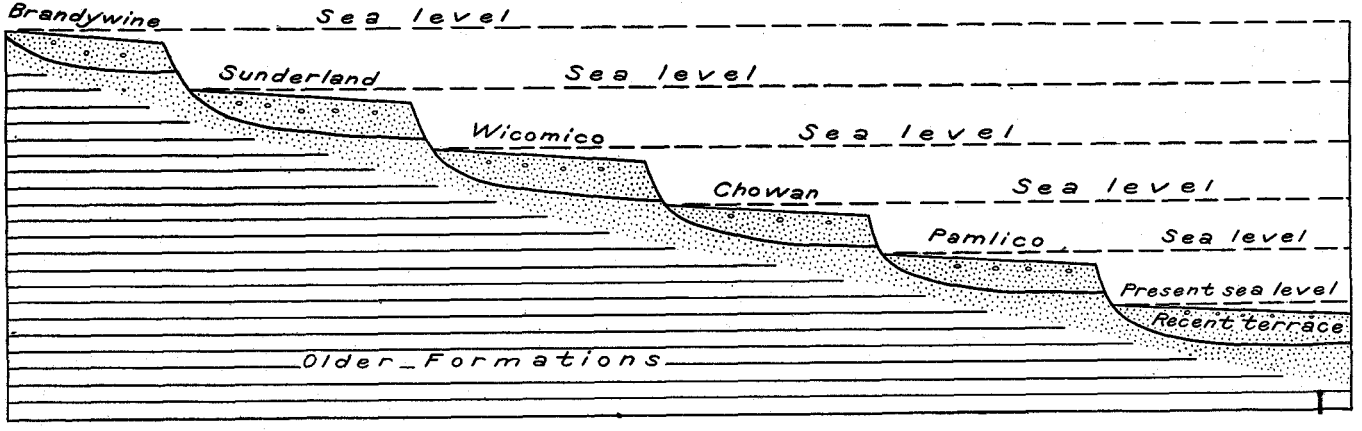


Fig. 4.—Diagram illustrating ideal arrangement of the various terrace formations of the Coastal Plain region around Petersburg, with the position of sea-level at the time of formation of each terrace. (Modified after Shattuck, Maryland Geological Survey.)

cupied those parts of their old valleys that had not been filled or cut away. The smaller valleys throughout much of the region, however, were obliterated by the encroachment of the sea, and when the land rose some of the waters found new courses down its gentle slope.

Drainage.—Three types of drainage lines are developed in the Coastal Plain province: (1) Estuaries, (2) tidal reaches above the estuaries, and (3) streams above tide level.

The most prominent feature of the drainage of the Coastal Plain of Virginia is the broad estuaries that penetrate the State nearly to the Fall Belt. They divide the Coastal Plain into a series of long peninsulas and constitute the natural avenues of communication that led to the early settlement of the adjacent lands. Tidewater Virginia, as it is so expressively designated, became for this reason the leading section of the State in the pioneer days and so remained during the seventeenth and eighteenth centuries. Chesapeake Bay, which is in reality the estuarine part of Susquehanna River, is the main body of water of the region, and into it discharge the tributary estuaries of Tidewater Virginia, including the Potomac, Rappahannock, and James, which extend entirely across the Coastal Plain, and many smaller estuaries, of which York, Piankatank, and Wicomico are the largest.

These estuaries, which in places have a maximum depth of 150 feet, are ancient valleys cut by rivers that crossed the Coastal Plain when it stood higher above the sea than at present; they were converted into water bodies or "drowned" valleys when the land sank and permitted the waters of the sea to flow into them, a mode of origin which is at once suggested by even a casual examination of any fairly good map of the State. Most of the main estuaries are widest at their lower ends, as are also the branching tributaries and subtributaries, even down to the smallest. Similar estuaries would be produced by the submergence of any land surface on which the streams are flowing in shallow valleys.

The main channels of the streams that carved these drowned valleys are clearly indicated by the soundings recorded on the charts issued by the United States Coast and Geodetic Survey, except at a few places where they have subsequently been filled and obliterated by material torn from the shores by waves and currents or by sediment brought into them by tributary streams. Some of the channels can be traced not only in the estuaries but also out to sea across the continental platform, or submerged portion of the Coastal Plain, showing that in the past the mouths of the rivers were many

miles east of the present shore—some of them perhaps as far east as the line where the continental platform breaks off abruptly to the ocean depths.

The tidal reaches above the embayed portions of the rivers are at sea-level and are affected by the ebb and flow of the tide to their landward ends. In fact, the tidal oscillation at the upper ends of most of them is of greater magnitude than at the lower end of the estuaries; at Richmond, at the head of the tidal reach of James River, the mean tidal range is 4 feet, whereas in Hampton Roads the range is only 2.7 feet. This difference is, of course, due to the piling up of the water as it runs up the constantly narrowing channel. The water of the tidal reaches is as a rule essentially fresh, owing to the volume of fresh water that is constantly flowing in from the nontidal portion of the river above, although the effect of the sea water is manifested in a slight modification of the character of the water even to the heads of the reaches, especially during seasons of drought or long periods of southeasterly winds. The tidal reaches are generally shallower than the wider parts of the estuaries and require a greater amount of improvement to afford navigable channels. In places in the tidal reaches, especially on the convex sides of the curves, the currents cut rapidly into the banks, a process which is characteristic of rivers but which becomes subordinate to wave erosion in the wider parts of the estuaries. A conspicuous feature of the tidal reaches of Virginia is the remarkable series of serpentine curves or meanders that characterize them for several miles immediately above the estuaries; excellent examples of so-called oxbow meanders are exhibited by James River above the mouth of the Appomattox, as is clearly shown on the Bermuda Hundred topographic map.

Meanders are a normal feature at certain stages in the development of streams. They are produced in places where the current becomes sluggish on account of the very gentle slope of the flood plain. In such places the river is easily turned aside from a direct course by any obstruction in its channel, such as the sediment it has dropped, the limb of a tree, a stranded log, or a mass of ice. The current cuts into the bank on the side toward which it is deflected, and at the same time the water becomes slack on the opposite side, too slack to carry its former load of sand and gravel, some of which is deposited, and this part of the channel is gradually filled. As the cutting on one side and filling on the other side are continued the channel bends farther and farther away from its former course.

The meanders of the James and other rivers of Virginia were formed long, long ago before the land had been lifted to its present height above the sea. At that time the river emptied into the estuary near City Point

over a flat flood plain that was probably several miles in width. The river flowed in great curves, and when the land was subsequently upraised it sunk its channel deeper and deeper into the uplifted land until at the present time it is intrenched to a depth of at least 80 feet in the old plain which has been largely obliterated by the cutting of the small tributaries.

The meanders or loops thus inherited from a time when the river flowed on a broad, flat plain have been modified by the stream and tidal currents broadening the bends of the oxbows and narrowing the intervening necks of land. In time the streams will cut entirely through these necks, producing new and shorter channels known as cut-offs, and the old oxbow channels will become filled with sediment at their ends and will be abandoned by the stream. No such cut-off has been made naturally in this region, but an artificial cut, known as Dutch Gap Canal, has turned the principal current of the river across the narrow neck of the promontory, leaving the outer part, known as Farrar Island, entirely surrounded by water.

Most of the streams above tide level are small, being merely the lateral tributaries of the rivers or the estuaries. They were established as soon as the area they traverse was raised above sea-level. In general they have done little cutting, except near their mouths, and the valleys in which they flow are broad and shallow; the channel gradients are gentle; and the bottoms of the valleys are occupied in many places by tree-grown swamps.

PIEDMONT PLATEAU.

The Piedmont Plateau lies between the Coastal Plain on the east and the Blue Ridge Mountains on the west. Beginning as a narrow strip south of the Highlands of southern New York it gradually widens southward to 40 miles on the Potomac, to nearly 165 miles in southern Virginia, and to about 175 miles, its maximum width, in North Carolina; south of this state it narrows and finally terminates in central Alabama. Its total area in Virginia is 15,500 square miles. The altitude of its surface on the west is between 1,000 and 1,200 feet, on the east between 250 and 400 feet; in other words, there is a gentle eastward slope at a rate ranging between 5 and 7 feet to the mile. As seen from the crest of the Blue Ridge, on the west, it looks like a low-rolling plain, but it is generally regarded as a plateau, because from the Coastal Plain, on the east, it appears as an upland tract, and also because the streams that cross it have cut deep trenches in its elevated surface.

The major streams that traverse the plateau in Virginia are Potomac, Rappahannock, James, and Roanoke rivers. All these streams except the Rappahannock have their sources west of the Blue Ridge. The smaller streams rise within the plateau and drain the territory between the major rivers, flowing either into those rivers or directly into Chesapeake Bay. Although the middle and lower courses of these streams within the plateau are rocky gorges, their headwater tributaries commonly flow in broad, shallow valleys separated by low, rounded divides.

The rocks of the Piedmont Plateau are of several kinds. Probably more than half of them in Virginia are igneous rocks—that is, rocks which at one time were in a molten condition but which have subsequently cooled and are now crystalline. Granites, such as crop out in extensive areas west of Petersburg, are of this kind. Other rocks that form a large part of the Piedmont Plateau were laid down on the floor of the sea at a very remote period as sand, clay, and limy mud; later they became hardened into sandstone, shale, and limestone; and finally, as a result of the great pressure and stresses to which they were subjected by earth movements, they reached a crystalline state and now appear as schist, gneiss, and marble. A relatively small part of the Piedmont Plateau rocks are younger sandstone, shale, and limestone that have not yet passed into the crystalline stage. All these rocks are generally resistant to the action of the weather, but on long-continued exposure to percolating water, to frost, to changes of temperature, and to the beating of rain drops, they disintegrate and form rounded hills and gentle slopes on the upland surfaces. The rocks that were originally deposited as sediments on the sea floor but have not yet become crystalline are generally the weakest rocks of the plateau, and in places the processes of weathering have reduced them to very broad, flat-bottomed valleys. The upper surface of the rocks of the Piedmont Plateau slopes eastward, passes under the unconsolidated materials that form the Coastal Plain, and extends to an unknown distance beneath the Atlantic Ocean.

The geologic history of the Piedmont Plateau has been varied and complex, and much yet remains to be learned regarding it. More than once in the early history of this region the rocks composing the outer shell of the earth were folded and tilted by enormous compressive forces, and the result probably was the formation of lofty mountains. The high peaks and ridges were then worn down under the constant attack of the weather and streams, until the surface was reduced to a broad plain only a little above sea-level. The present rocks beneath the surface of the Piedmont Plateau may be considered the "roots" of these former mountains.

Some time after the formation of this plain the region was uplifted, and the streams, which had been meandering over its surface with sluggish flow, were steepened in gradient and so quickened into new life. This revival of their power enabled them to cut vigorously downward, producing the present valleys. The broad divides between the streams are simply the parts that have not been worn away, and hence they rise to the general level of the old plain, whose surface is represented by the even sky line.

Evidences of minor uplifts that have occurred since the formation of this plain are found in the stream terraces along some of the valleys. The traveler passing from a divide down the side of a valley to the bottom does not traverse a continuous slope but instead descends a more or less gentle slope to a level bench, which he crosses, and then passes down other slopes and crosses other benches to the level of the stream. Stream terraces may originate in a number of ways, but in this area the streams probably

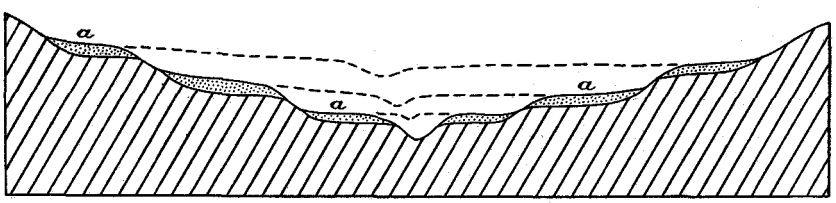


Fig. 5.—Diagrammatic section illustrating stream terraces composed partly of the bed rock of the region and partly of stream-deposited material. The dotted lines indicate the former levels of the flood plain with the positions of the stream.

developed narrow flood plains and then the land was either tilted eastward or uplifted; the effect was to increase the gradient of the streams and cause them to lower their channels rapidly, leaving portions of the former flood plains along the sides of the valleys as terraces.

FALL BELT.

As has been stated, the Coastal Plain is separated from the Piedmont Plateau by a belt of country, ranging from a fraction of a mile to 12 miles or more in width, in which there is a mingling of features characteristic of the two provinces—Piedmont features in the valleys and Coastal Plain features on the divides and ridges. As the streams in crossing this belt descend to its eastern margin, their courses are marked by a series of rapids and cascades over the hard crystalline rocks, and for this reason the belt of mingling is called the Fall Belt. (See p. 3.)

The traveler who crosses the Fall Belt, if he approaches from the east, will doubtless make his way along the upland or interstream ridges, for the valleys are rough and rocky, and only those of the larger streams are followed by important highways or even by the railroads. On the upland he will probably be unaware that he has entered the Fall Belt, for he will still see the sand and clay beds of the Coastal Plain and the flat terrace plains that are characteristic features of its surface throughout Tidewater Virginia. Finally at the inner edge of the Fall Belt these features disappear, and he will see only the gently rolling surface of the Piedmont Plateau. If, however, he approaches from the west and follows down one of the larger streams he will find himself hemmed in by a narrow rocky gorge and will be unaware of the existence of features of the Coastal Plain type until he reaches the lowermost rapids at the eastern edge of the Fall Belt.

Because of the water-power supplied by the cascades and rapids and the fact that they constitute the head of navigation, the Fall Belt has become the site of a chain of cities established at an early day, long before the invention of the steam engine and the utilization of steam power. Among the important cities located along this belt are Trenton, Philadelphia, Baltimore, Washington, Richmond, Petersburg, Columbia, Augusta, Macon, and Columbus.

TOPOGRAPHIC MAP.[1]

The features represented on the topographic map are of three distinct kinds—(1) inequalities of surface, called *relief,* as plains, plateaus, valleys, hills, and mountains; (2) distribution of water, called *drainage,* as streams, lakes, and swamps; (3) the works of man, called *culture,* as roads, railroads, boundaries, villages, and cities.

Relief.—All elevations are measured from mean sea-level. The heights of many points are accurately determined, and those of the most important ones are given on the map in figures. It is desirable, however, to give the elevation of all parts of the area mapped, to delineate the outline or form of all slopes, and to indicate their grade or steepness. This is done by lines each of which is drawn through points of equal elevation above mean sea-level, the vertical interval represented by each space between lines being the same throughout each map. These lines are called *contour lines* or, more briefly, *contours,* and the uniform vertical distance between each two contours is called the *contour interval.* Contour lines and elevations are printed in brown. The manner in which contour lines express altitude, form, and grade is shown in figure 6.

[1] Geologic Atlas of the United States, U. S. Geological Survey.

The sketch (fig. 6) represents a river valley between two hills. In the foreground is the sea, with a bay that is partly closed by a hooked sand bar. On each side of the valley is a terrace. The terrace on the right merges into a gentle hill slope; that on the left is backed by a steep ascent to a cliff, or scarp, which contrasts with the gradual slope away from its crest. In the map each of these features is indicated, directly beneath its position in the sketch, by contour lines. The map does not include the distant portion of the view. The following notes may help to explain the use of contour lines:

1. A contour line represents a certain height above sea-level. In this illustration the contour interval is 50 feet; therefore the contour lines are drawn at 50, 100, 150, and 200 feet, and so on, above mean sea-level.

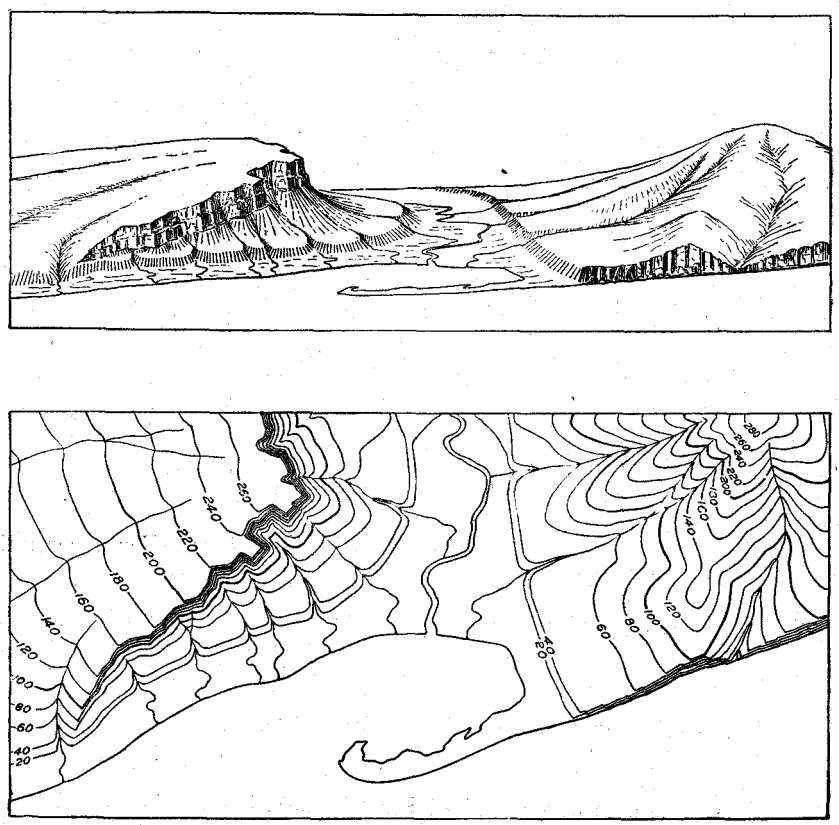


Fig. 6.—Ideal section and corresponding contour map.

Along the contour at 250 feet lie all points of the surface that are 250 feet above the sea—that is, this contour would be the shore line if the sea were to rise 250 feet; along the contour at 200 feet are all points that are 200 feet above the sea; and so on. In the space between any two contours are all points whose elevations are above the lower and below the higher contour. Thus the contour at 150 feet falls just below the edge of the terrace, and that at 200 feet lies above the terrace; therefore all points on the terrace are shown to be more than 150 but less than 200 feet above the sea. The summit of the higher hill is marked 670 (feet above sea-level); accordingly the contour at 650 feet surrounds it. In this illustration all the contour lines are numbered, and those for 250 and 500 feet are accentuated by being made heavier. Usually it is not desirable to number all the contour lines. The accentuating and numbering of certain of them—say every fifth one—suffices and the heights of the others may be ascertained by counting up or down from these.

2. Contour lines show or express the forms of slopes. As contours are continuous horizontal lines, they wind smoothly about smooth surfaces, recede into all reëntrant angles of ravines, and project in passing around spurs or prominences. These relations of contour curves and angles to forms of the landscape can be seen from the map and sketch.

3. Contour lines show the approximate grade of any slope. The vertical interval between two contours is the same, whether they lie along a cliff or on a gentle slope; but to attain a given height on a gentle slope one must go farther than on a steep slope, and therefore contours are far apart on gentle slopes and near together on steep ones.

A small contour interval is necessary to express the relief of a flat or gently undulating country; a steep or mountainous country can, as a rule, be adequately represented on the same scale by the use of a larger interval.

Drainage.—Watercourses are indicated by blue lines. For a perennial stream the line is unbroken, but for an intermittent stream it is broken or dotted. Where a stream sinks and reappears the probable underground course is shown by a broken blue line. Lakes, marshes, and other bodies of water are represented by appropriate conventional signs in blue.

Culture.—The symbols for the works of man and all lettering are printed in black.

Scales.—The area of the United States (exclusive of Alaska and island possessions) is about 3,027,000 square miles. A map of this area, drawn

to the scale of 1 mile to the inch would cover 3,027,000 square inches of paper and measure about 240 by 180 feet. Each square mile of ground surface would be represented by a square inch of map surface, and a linear mile on the ground by a linear inch on the map. The scale may be expressed also by a fraction, of which the numerator is a length on the map and the denominator the corresponding length in nature expressed in the same unit. Thus, as there are 63,360 inches in a mile, the scale "1 mile to the inch" is expressed by the fraction 1/63,360.

THE COUNTRY ADJACENT TO CAMP LEE.

REGION SOUTH OF APPOMATTOX RIVER.

Character of surface.—Camp Lee, as has been shown, is situated in a region that abounds in human historic associations, but it is no less true that this region abounds in features that are associated with and reveal a much more ancient history—the geologic history of this part of the continent, which dates back long before man appeared on the globe. These features are on all sides, and the soldier has but to look about him to see the characters in which this history is written.

A person standing on top of what appears to be the ridge at the south edge of the camp, at an altitude of 160 or 170 feet, sees toward the east, southeast, south, and southwest a level plain of fairly uniform altitude. This plain is a part of the Sunderland terrace plain; the way in which it was formed has been described on pages 6 to 11. When the observer looks toward Petersburg from the western part of the camp he sees a steep slope leading down from the edge of the plain just mentioned to the main road that connects Petersburg and City Point. The encampment is situated in part on this slope, in part on the plain above it, and in part on another and lower plain which is similar to the higher plain but not so extensive.

The Petersburg and City Point highway, east of Harrison Creek, climbs 60 or 70 feet to the main street of the camp. This street is on the slope that leads from the upper to the lower plain. Following the slope toward City Point for about half a mile the road descends to the surface of the lower terrace plain (the Wicomico), which extends at an altitude of about 80 feet across the broad neck of land north of the camp, from steep bluffs overlooking Appomattox River on the west to a point within a mile and a half of the James River estuary on the northeast; and on this plain the highway continues from Camp Lee to Du Pont. The character of the plain, which is remarkable for its smoothness, may be observed from the

main highway leading to Du Pont and also from the Petersburg and City Point branch of the Norfolk and Western Railway. The headwaters of Bailey Creek, on the east, and several other creeks, on the north, have cut deeply into its surface.

Near Du Pont the highway descends about 40 feet to a lower plain which it follows to the margin of the estuary at City Point. On this level plain (the Chowan) is situated the big munitions plant and the new city of Hopewell. The plain is similar in appearance to the two plains already described, but it is at a lower altitude (40 feet above sea-level). It borders Appomattox River from City Point to the National Cemetery, a distance of about 2 miles. South of City Point it terminates in an abrupt slope, which leads down to a still lower plain (the Pamlico) that borders the James River estuary all the way to the mouth of Bailey Creek and lies but a few feet above water level. The steep slope connecting these two plains at City Point is a good example of a wave-cut cliff.

From the preceding description it is apparent that in the peninsula-like area north of Camp Lee there are four nearly level plains at different altitudes above sea-level, each one of which is separated from the plain above or below by relatively steep slopes and is more or less broken into hills around its outer border by small creeks. These four plains are extensively developed throughout the Petersburg and Bermuda Hundred region—in fact, the entire land surface is made up of their remnants and the more or less steep slopes between. In places some of the terrace plains may be lacking, but if one follows the stream valleys far enough he will usually find them well developed at other places.

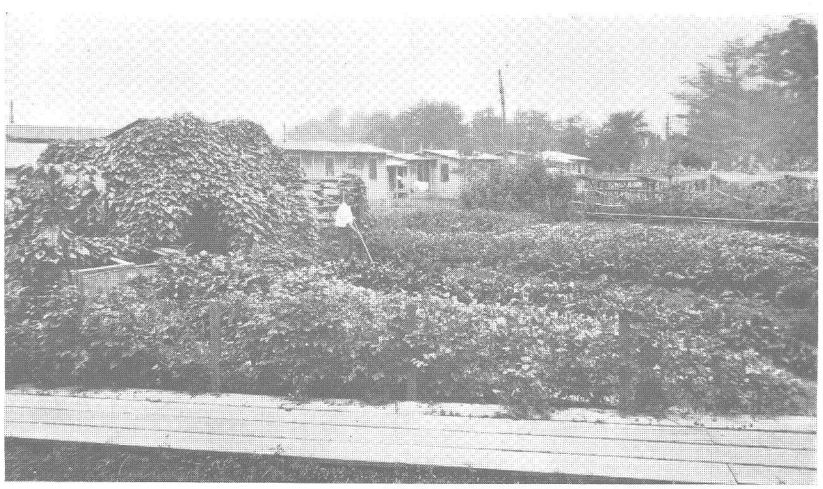
Most of the residence portion of the city of Petersburg is on the level Wicomico terrace plain, which has an altitude of about 80 feet above sea-level and across which runs the highway from Camp Lee to Du Pont. The main road leading west from Petersburg on the south side of the river is also on a narrow extension of this plain for about 2 miles from the center of town, and is parallel to the slope leading up to the next higher plain on the south. Most of Blandford lies upon a remnant of the same terrace, but the northern part of this suburb, along the river, is on the next lower terrace, the Chowan (altitude 40 feet). In Blandford these two terraces are separated by a very steep slope. The lower terrace is only about a quarter of a mile wide in the northern part of Blandford, but east of Poo Run it attains a width of more than a mile, and it extends northward to the abrupt bend of Appomattox River about 3½ miles below the Atlantic Coast Line bridge in Petersburg.

(A) A street in "A" Village, City Point, showing Company Houses.

(B) One of the thousand Dupont "War Gardens."

E. I. Dupont Co.

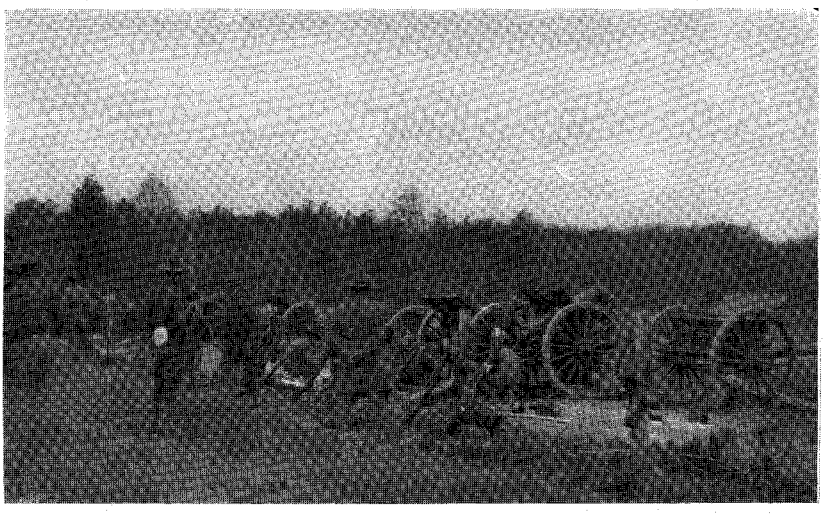
(A) A street in "A" Village, City Point, showing Company Houses.



(B) One of the thousand Dupont "War Gardens."

E. I. Dupont Co.

(A) The 315th Field Artillery, U. S. A., engaged in practice firing. Note the level character of the terrace plain in the foreground.



(B) A nearer view of the 315th Field Artillery.

(Thompson Illustragraph Co.)

(A) The 315th Field Artillery, U. S. A., engaged in practice firing. Note the level character of the terrace plain in the foreground.

(B) A nearer view of the 315th Field Artillery.

(Thompson Illustragraph Co.)

The street leading southward through Blandford from the railroad to "The Crater" first crosses the Chowan terrace, then mounts to the Wicomico terrace, and after passing for half a mile along its level surface ascends by another steep slope to a higher level surface, which continues southward indefinitely. This highest surface is a portion of the Sunderland plain, upon which the larger part of Camp Lee is situated.

The country embraced in the Petersburg quadrangle, as may be seen from the contour map, is devoid of such striking surface features as ridges and deep valleys, but it contains a number of creeks that head only short distances south of Petersburg and Camp Lee and flow southeastward toward the sea, and these streams have excavated in the Sunderland plain broad and shallow valleys. The parts of the plain between the streams are generally broad flats at altitudes ranging from about 140 to 170 feet above sea-level and may be advantageously studied along the two main roads leading southward from Petersburg. The Jerusalem Plank Road utilizes its surface the entire distance across the quadrangle, and similarly the road leading more directly southward follows it along the old route of the Atlantic Coast Line.

Drainage.—The water bodies in the area under consideration are of the three types described on page 13. Only a small part of the estuary of James River lies within this area, but its extreme head, having a width of nearly a mile and a depth of 20 to 40 feet, may be seen at City Point. At City Point Appomattox River enters the estuary from the west. The estuary once probably extended up this stream to Point of Rocks, but this part has been filled by sediment brought down by the river, until the head of the open water has been crowded down within a mile of City Point. The filled portion is now a marsh at water level.

That portion of Appomattox River that extends from the head of the estuary to the rapids in Petersburg may be considered as a tidal reach above the estuary, for the tide flows into it twice daily. The bottom of the valley, in most places about a mile wide, is silted up by the mud brought down by the river and consists of marshes through which the water flows in many connecting channels. One navigable channel, with a controlling depth of 7½ feet, is artificially maintained up to Petersburg.

From City Point to Petersburg the Appomattox lies from 40 to 100 feet below the general surface of the upland on either side, but in only a few places are bluffs precipitous or even steep. The most regular bluffs are those on the south side from City Point to a locality about 2 miles above the mouth of Swift Creek. These bluffs, which are the cut edges of the

terraces, are steep but may be climbed without difficulty. Here and there a wagon road leads down from the terrace plain above to the level of the stream, but there are no crossings either by ferry or bridge. The most conspicuous bluff is Point of Rocks, a nearly vertical cliff of sandstone, on the north side of the river about 3½ miles above City Point.

At Blandford, on the upper end of the tidal reach, the sluggish current flows in interlacing channels through mud flats, forming islands that rise only slightly above the surface of the water. Just above the Atlantic Coast Line bridge the river changes to a swiftly flowing or cascading stream in a narrow, rocky gorge. At Bishop Bridge the channel is extremely narrow and carries but little water, a condition due in large part to the diversion of the water above this point for the development of power. Here the river is not navigable, its current is swift, and the water descends by a series of cascades and rapids between granite walls and over an uneven granite pavement. These are the so-called falls of the Appomattox.

The streams above tide level are small. They have excavated in the plain relatively wide, shallow valleys, separated by broad divides. In the eastern part of the Petersburg quadrangle the streams have trenched backward into the divides, so that the areas of level land are narrower than in the central and western parts of the quadrangle.

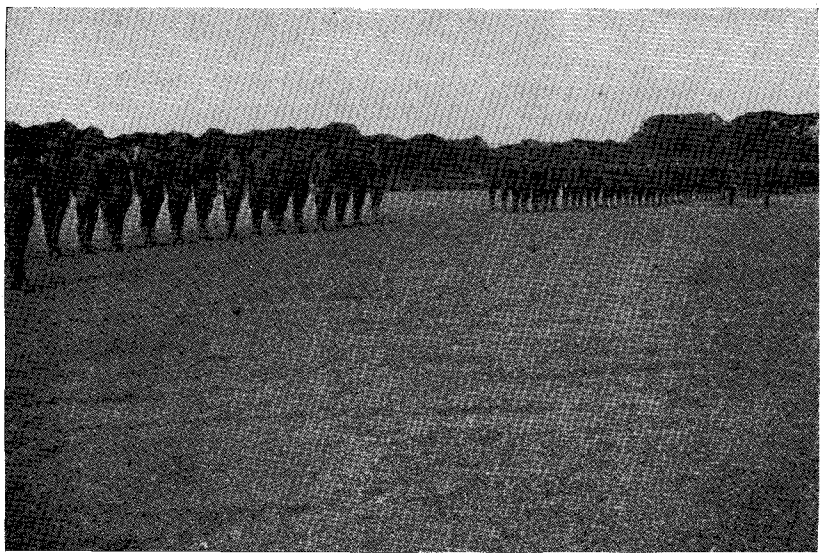
Almost all the major stream courses in the Petersburg quadrangle are bordered by tree-grown swamps, a feature that impresses one who examines the topographic map or drives across the area. The swamps range in width from a few yards to more than a mile, and few of them have been cleared. The streams meander through them with sluggish flow. In times of wet weather the entire swamp becomes a nearly impassable morass, but in dry weather one may cross it almost anywhere without getting wet.

Below Petersburg the mouths of the tributary streams are bordered by broad marshy flats at tide level, but above that place they descend with precipitous courses from the level-topped terraces and develop rapids either at their junction with the river or a short distance above it. In many places these small streams have been dammed, and the water is utilized for the production of power.

REGION NORTH OF JAMES RIVER.

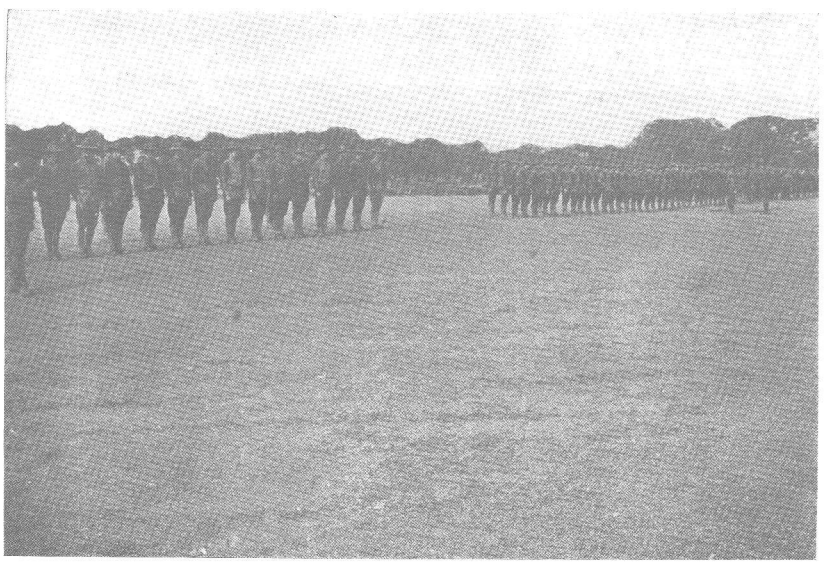
Character of the surface.—The upland north of James River in the Bermuda Hundred quadrangle is a plain of wide extent that corresponds with the highest plain south of James River in the Petersburg quadrangle. It is 160 to 200 feet above sea-level and may be seen to good advantage

(A) A view between the barracks at Camp Lee.

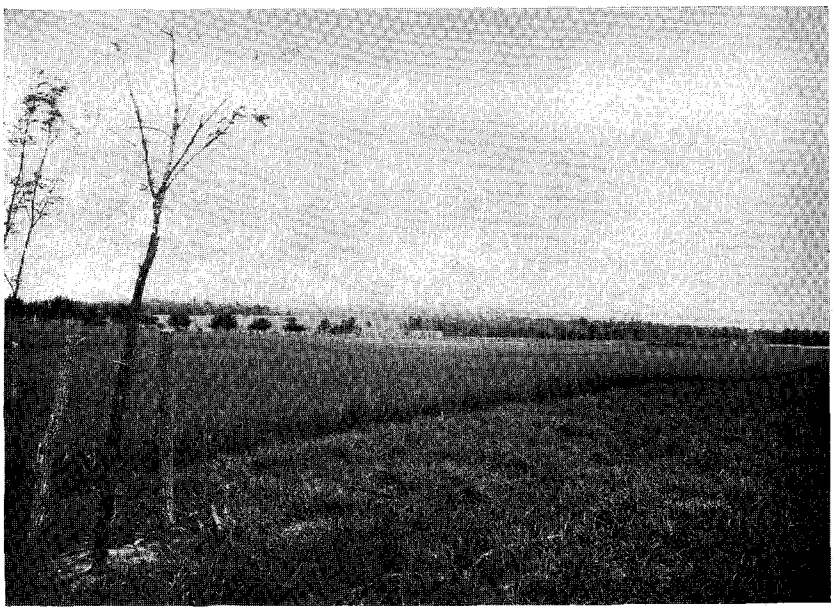


(B) Drilling at Camp Lee on the level surface of one of the high terrace plains.

(A) A view between the barracks at Camp Lee.

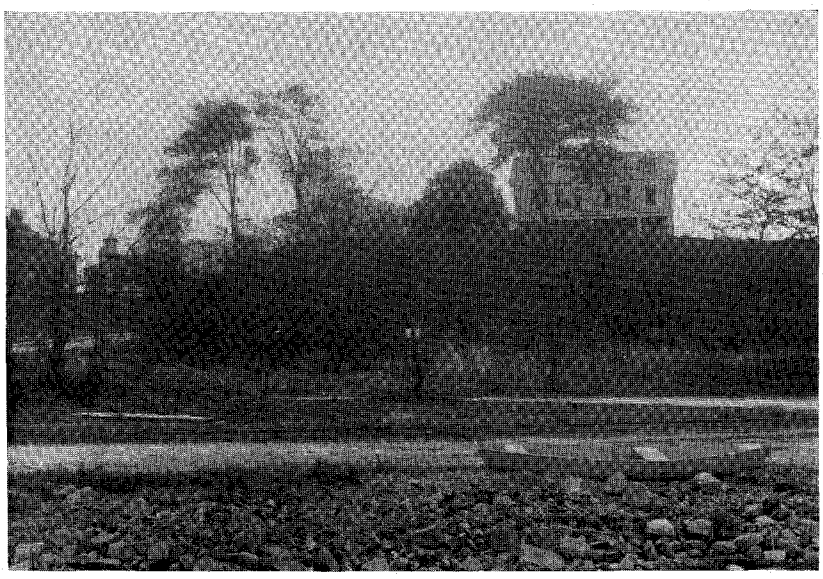


(B) Drilling at Camp Lee on the level surface of one of the high terrace plains.



(A) Malvern Hill battleground. This view well displays the level character of the Wicomico terrace north of the James.

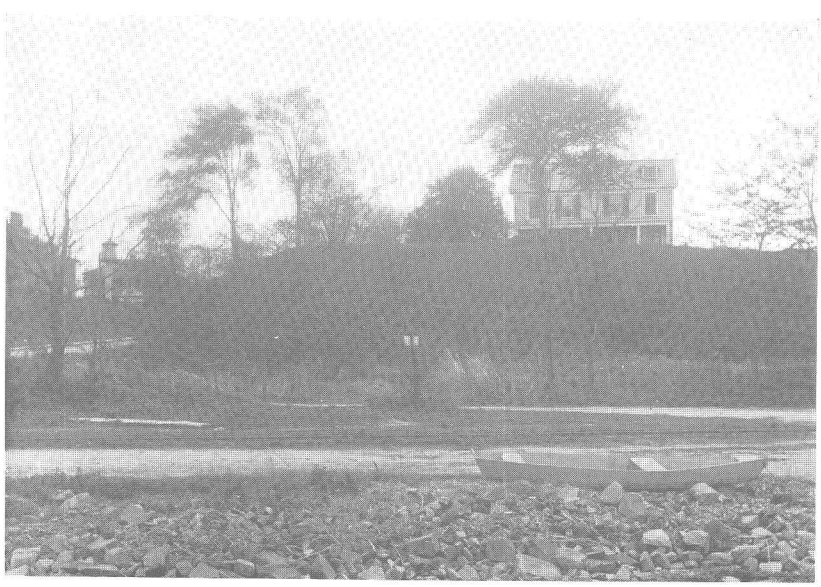
U. S. Geol. Survey.



(B) Face of the Chowan terrace at City Point, Pamlico surface in foreground.

(A) Malvern Hill battleground. This view well displays the level character of the Wicomico terrace north of the James.

U. S. Geol. Survey.



(B) Face of the Chowan terrace at City Point, Pamlico surface in foreground.

from all the roads passing northward from the river. The plain spreads northward 8 or 10 miles beyond the quadrangle nearly to Chickahominy River, and northwestward to Richmond, much of the residence portion of which is built upon its even surface. On this plain were fought during the Civil War some of the most bloody battles of the siege of Richmond, notable among which were the battles of Savage Station and Seven Pines, south of Chickahominy River, and Cold Harbor, north of that stream. The surface rises gently from east to west, reaching an altitude of 200 feet at Edvins and west of Richmond. These highest places may be parts of the principal plain or they may be remnants of a still higher terrace plain that is more extensively developed to the west and northwest, along the border of the Fall Belt.

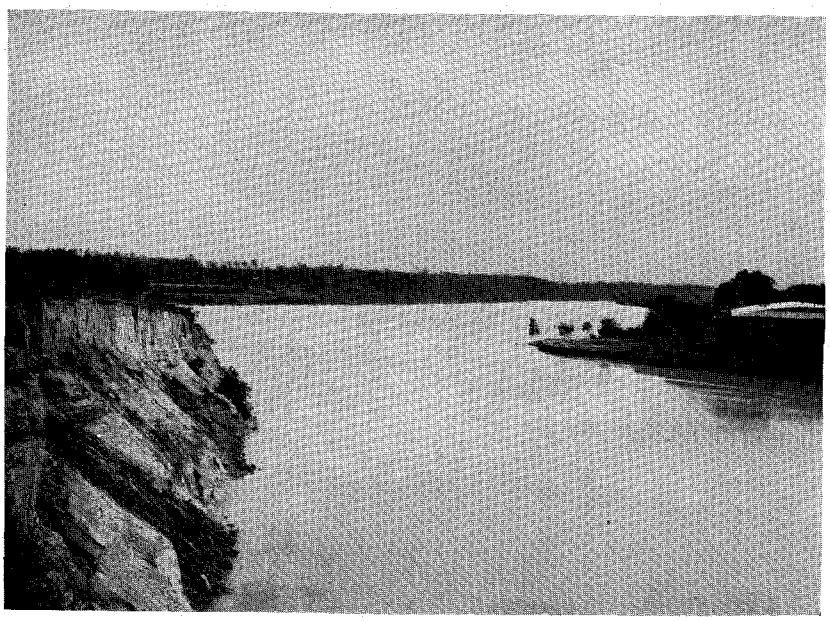
In places the once even surface of the Sunderland plain has been partly destroyed by the small streams, as in the northeast corner of the Bermuda Hundred quadrangle, where the country is gently rolling and much of it lies below an altitude of 160 feet.

West of Edvins, 3 miles north of the northern limit of the quadrangle, James River has swung against the east side of its valley, and there is a steep slope, cut by many sharp ravines, from the upland plain down to the river level. This is exceptional, for in other parts of the area the descent toward the river from the surface of the uppermost plain is made by a succession of relatively steep slopes and plains of greater or less breadth. These lower plains have been trenched by the streams, so that as a rule only remnants of them are left. In the area between Turkey Island and Bailey creeks, however, there is a plain of considerable extent at an altitude of about 70 feet, on which was fought during the Civil War the battle of Malvern Hill. This and other smaller flats at the same elevation are remnants of the Wicomico terrace plain. South of Malvern Hill this plain is separated by a slope from a lower plain (the Chowan) which occupies the northern part of Curles Neck and stands at an altitude of 40 feet above tide level. This plain has here the same altitude as it has west of Bermuda Hundred, on the opposite side of the river, and at City Point and Hopewell, south of the mouth of the Appomattox. A terrace at this level is also well developed on the point of land which extends out to Farrar Island and across which Dutch Gap Canal has been cut.

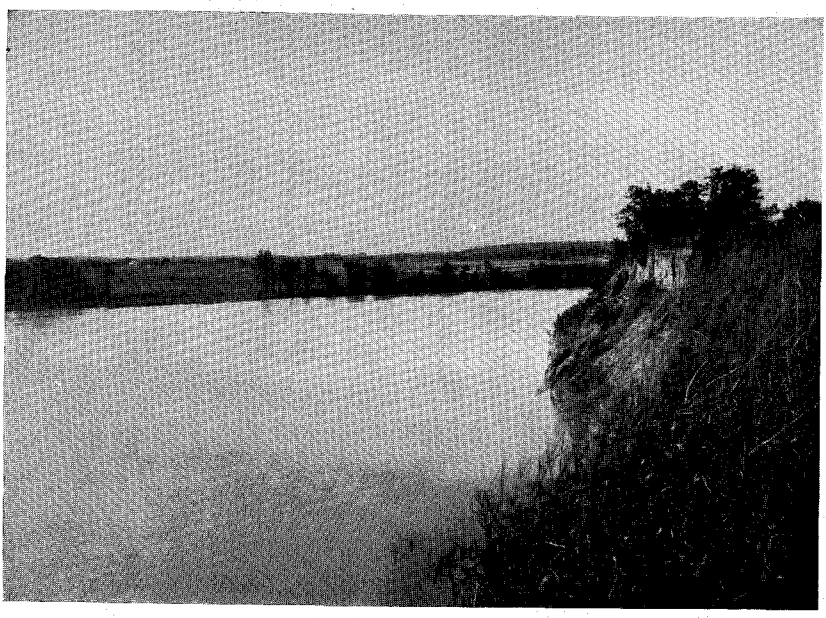
Opposite Meadowville a still lower terrace a mile or more wide (the Pamlico) borders the river at a height of about 20 feet. Part of Farrar Island, south of Dutch Gap Canal, and several other small areas north of James River belong to the Pamlico terrace.

Drainage.—The tidal reach of the James extends from the head of the estuary near City Point to Richmond. The lower part of the tidal reach presents a conspicuous series of oxbow meanders having a channel length of about 23 miles within an air-line distance of only 7 or 8 miles. The development of these bends has been somewhat complex, owing to several changes in the height of the land above sea-level, but they originated as normal stream meanders and were brought to their present condition by a slight rising of the land that permitted the river to sink its channel many feet below the nearly level plain upon which they were formed. At each stage of their development the outer parts of the oxbows were progressively broadened and extended, and the necks became narrower and narrower. The most striking example in this region of such a bend is that which incloses Farrar Island. It is also of great historic interest, for here was made in 1611 the second settlement of a permanent character in Virginia, and 2 miles below at Varina, a landing on the north bank of the river, was the early home of John Rolfe and his Indian princess wife, Pocahontas. Farrar Island was settled by Sir Thomas Dale, High Marshal of Virginia, and 350 men, chiefly German laborers, from Jamestown. The settlement was called Henricopolis (City of Henry, after Prince Henry, son of King James I) and afterwards shortened to Henrico. On account of the German settlers the narrow neck of land connecting Farrar Island with the mainland was called "Dutch Gap," a name that has persisted to the present day. As the two loops of the river were here separated by only 120 yards of land an effort was made to connect them by a canal, but the project was abandoned before it was half completed.[1] No one was public spirited enough to undertake the completion of this project until the exigencies of the Civil War demanded a shorter channel and one less exposed to the fire of the enemy than the one encircling Farrar Island. Accordingly, General Butler, when he was stationed at Bermuda Hundred, undertook the task, and soon the main current of the river was diverted to this cut-off and the long circuit of nearly 7 miles was obviated. At the present time a depth of 22 feet is maintained in the canal, and practically the entire river flows through it. The old channel around the bend has been gradually silted up with mud carried by the river, until now the water has a depth in many places of only a foot or two. If man had not opened this canal it is probable that sooner or later the river itself would have broken through the narrow neck and would have accomplished the same result.

[1] Old churches, ministers, and families of Virginia by Bishop Meade, vol. I, p. 123.

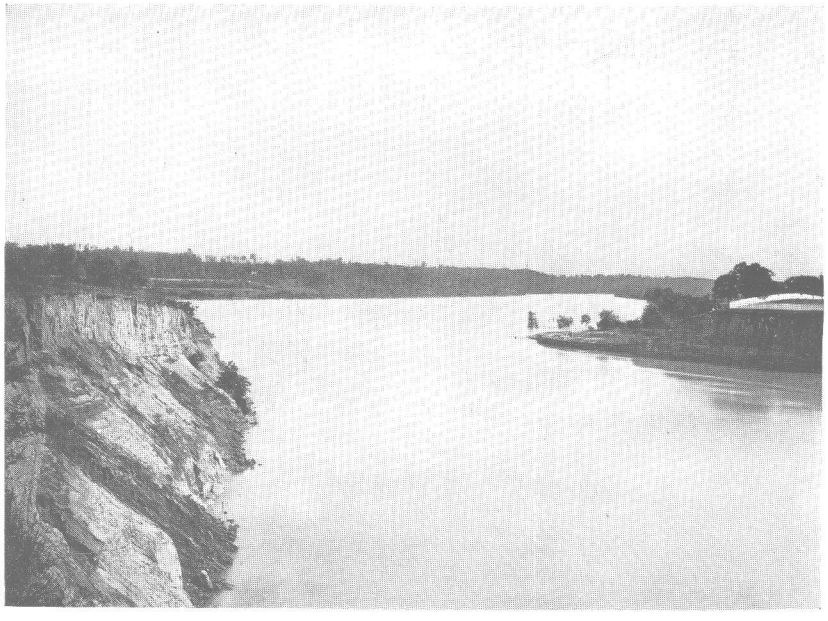


(A) Dutch Gap Canal, looking down stream, Varina landing on left in distance.

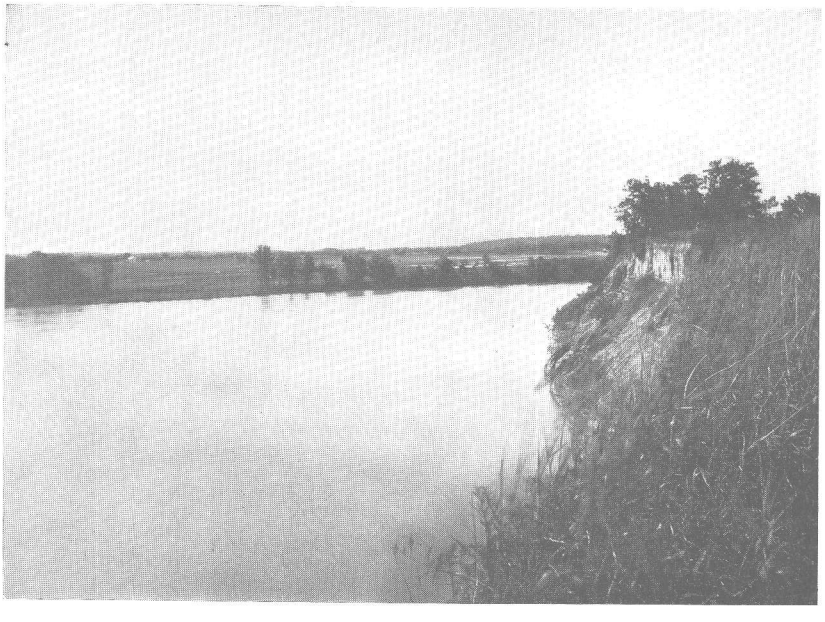


(B) Dutch Gap Canal, looking up stream. Aiken Swamp in middle distance.

U. S. Geol. Survey.



(A) Dutch Gap Canal, looking down stream, Varina landing on left in distance.



(B) Dutch Gap Canal, looking up stream. Aiken Swamp in middle distance.

U. S. Geol. Survey.

U. S. Geol. Survey. Appomattox River near Eppes Bridge in the Piedmont.

U. S. Geol. Survey. Appomattox River near Eppes Bridge in the Piedmont.

The currents of the James are at many places vigorously cutting against the edges of the several terrace plains on the outer parts of the curves, forming bluffs that correspond in height to the altitude of the plains; a conspicuous example is the 100-foot bluff opposite Aiken Swamp. The large tracts of fresh-water swamp inclosed by the oxbows indicate the areas across which the channel has migrated during the development of the bends. The filling of the swampy tracts and their present altitude of only a few feet above sea-level has resulted from the deposition, on the slack-water sides of the curves, of sediments transported by the river and tidal currents.

In the narrow, almost straight stretch of the James north of the northern border of the Bermuda Hundred quadrangle and also opposite Meadowville a series of jetties, indicated on the map by short black lines projecting at right angles from the shores, has been constructed to control the currents and compel them to scour out the sediment that would otherwise accumulate and obstruct the steamboat channel.

The streams tributary to the James in this area are small and flow in shallow valleys except near the river, where they have cut deep trenches with steep sides. In the spring and during periods of wet weather they may be small torrents, but late in the summer and during dry seasons the channels of many of them become dry.

REGION WEST OF APPOMATTOX AND JAMES RIVERS.

In driving northward from Petersburg along the Richmond and Petersburg turnpike the traveler, after crossing Appomattox River, climbs a steep slope to a plain (the Wicomico) at a height of about 80 feet, which continues for a distance of about 4½ miles. This plain is crossed by Old Town, Swift, and Timsberry creeks, which, flowing eastward to the Appomattox, have excavated shallow valleys and rendered the surface in places somewhat rolling. About 5 miles north of Petersburg he leaves the Wicomico plain and mounts to the level of the interstream divides at altitudes of 120 to 160 feet. Here a view both to the east and west discloses a nearly level surface, the Sunderland terrace plain, intersected here and there by broad valleys that open eastward into the valley of James River. The road follows this plain almost continuously to the vicinity of Drewry Bluff, where it descends to Falling Creek, the small stream entering the area of the map from the north one mile west of the James, the crossing of which is less than 20 feet above tide level. Emerging from the valley of Falling Creek the road continues northward to Richmond, in part over a plain (Wicomico) at an altitude of about 80 feet, and in part over the noses

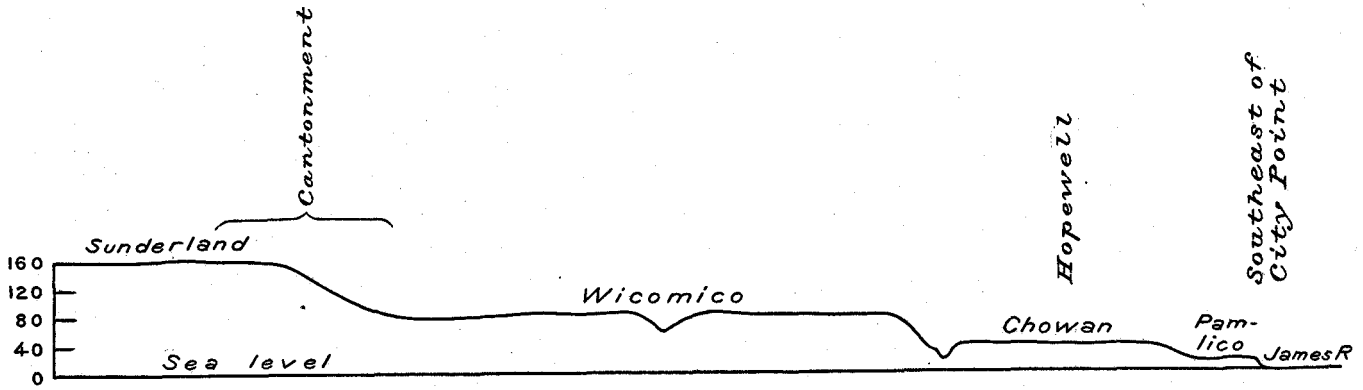


Fig. 7.—Profile across Camp Lee to James River south of City Point.

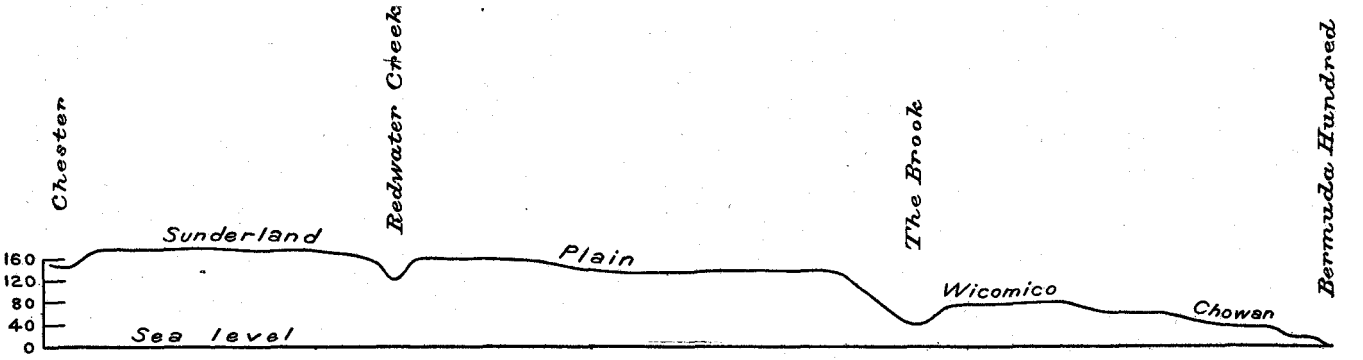


Fig. 8.—Profile from Chester to Bermuda Hundred.

of ridges that represent the eastern dissected border of a higher plain. Therefore, in traveling from Petersburg northward one crosses remnants of two plains, the lower developed along the two major streams and the higher across the broad point of land between them.

West of the turnpike the uplands form parts of the surface of the upper plain, though some of them have been reduced by the streams and the weather slightly below the original level. The general character of the plain is well exhibited on the broad, level divides between the streams, as, for example, west of Brander Bridge, south of Bradley Mill Bridge, west of Chester, and from Chester northward to Drewry Bluff.

A trip across the area from east to west, beginning just north of the mouth of the Appomattox, will disclose features similar to those just described. The village of Bermuda Hundred[1] is situated on a narrow terrace or low flat, 6 to 10 feet above the level of James River. The view from the water front at Bermuda Hundred shows on the opposite side of the James a terrace (the Pamlico) at the same height as the one upon which the observer is standing. To the south across the Appomattox are the towns of City Point and Hopewell upon a higher plain (the Chowan), which terminates at the river in a steep bluff.

Half a mile west of Bermuda Hundred is a steep but short slope that leads up to a higher plain (the Chowan), between 30 and 40 feet above sea-level. This plain is well developed west of Bermuda Hundred, occupying a level area 1½ miles wide extending from Turkey Bend to the confluence of the James and Appomattox. Still farther west, at a distance of about a mile, is another slope, which leads upward to a still higher plain (the Wicomico) at an altitude of about 80 feet. Just south of the main road from Bermuda Hundred to Chester the Wicomico plain is deeply dissected by The Brook, but farther south, in the vicinity of Point of Rocks, the surface of the upland is a smooth plain at the same height. To the north of the road also the plain extends almost unbroken to the vicinity of Meadowville, where it is terminated by a sharp descent.

The little village of Meadowville is situated on the Chowan plain at an altitude of about 40 feet and is one of those old country seats that were

[1] Many persons may not realize the appropriateness of the term "hundred" when applied to a small settlement or village, and they may wonder why it was given to this village. Up to 1633 the settlers of Virginia were organized by hundreds and by plantations, and each group had its representative in the House of Burgesses. Bermuda Hundred was settled by Sir Thomas Dale a few months after he founded the city of Henrico, and as it was only a small settlement it fell into the group of "hundreds," and so was called Bermuda Hundred.

built on commanding sites overlooking the bends of the majestic James. Although the contours on the map do not show it, there is a vertical bluff at Meadowville fully 40 feet high, which is being undermined by the constant sweep of the river currents. James River is here flowing in a valley 1½ to 4 miles wide, within which all its meanders or bends are confined. In each big loop, however, the river swings against the side of the valley, along which it has cut steep bluffs that during war times were of great strategic importance. Within the bends the land descends to water level by successive steps or terraces, as is well shown in Jones Neck, where the high terrace (the Wicomico, at 80 feet) extends nearly to Meadowville, the next lower flat (the Chowan, at 40 feet) halfway out the neck, the next lower (the Pamlico, at 20 feet) within a quarter of a mile of the extremity, and the recently made land, which must be protected from high water by a levee, forms the extreme outer end and east side.

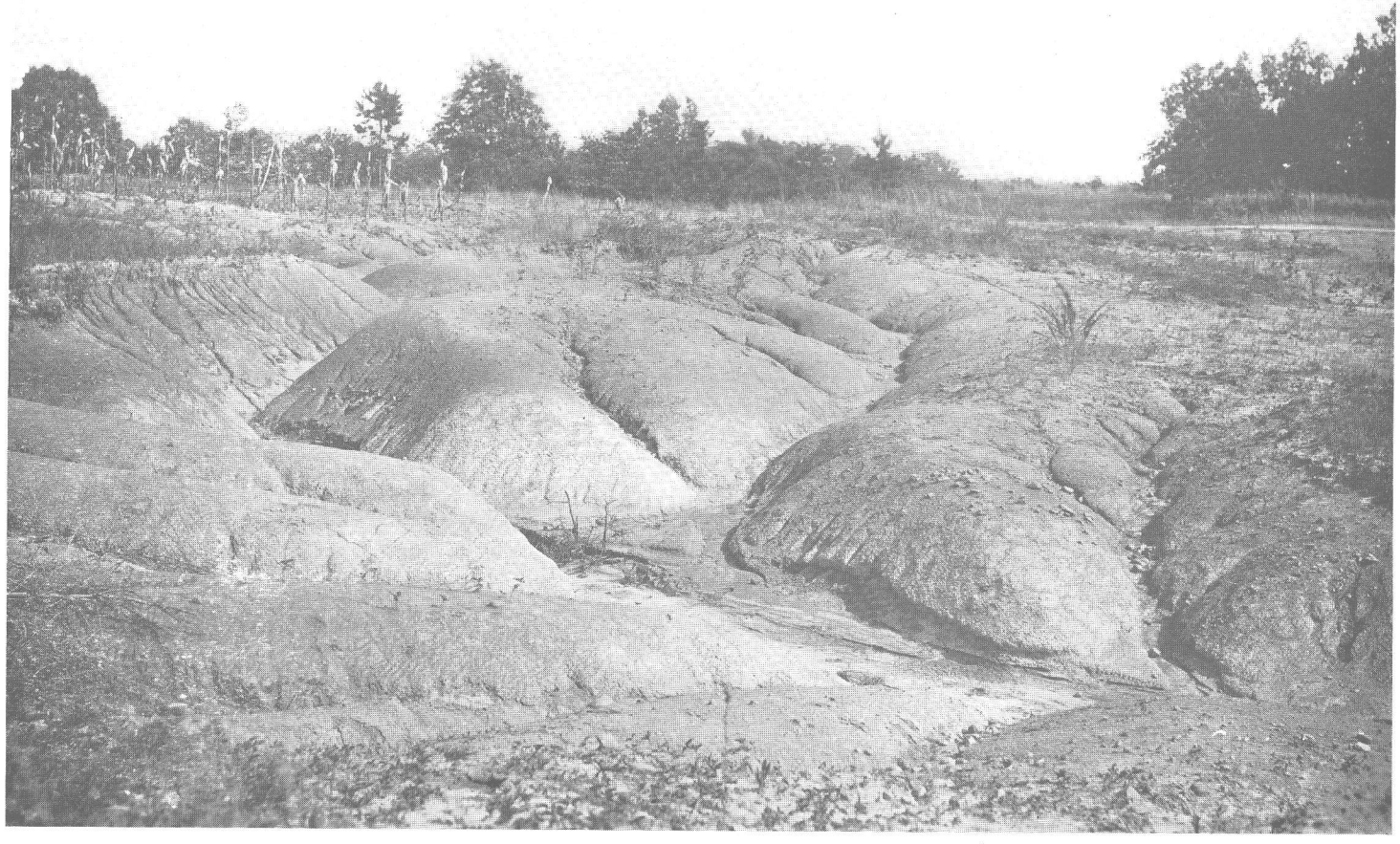
In proceeding westward from either Meadowville or Ochre one soon passes from the Wicomico terrace at 80 feet up a comparatively steep slope to the Sunderland plain at 140 to 160 feet. This plain forms not only the main divide between the two rivers but also many of the long spurs. It is represented by most of the upland in the western part of the Bermuda Hundred quadrangle, though at only a few places is it a perfect plain. When it was formed the surface of the plain was very even, but it has been considerably dissected by streams and more or less modified by weathering, so that now much of it is gently rolling or hilly; however, many tracts of the plain are moderately well preserved and essentially unchanged from their original form.

The streams of the area exhibit the same character as others in this region. On the uplands they flow in broad, shallow valleys with sluggish current, but near rivers their valleys become deeper and the valley sides more precipitous. The valleys are excavated in the clay and sand that underlie the terrace plains. Swift Creek, a tributary of Appomattox River near the southern boundary of the Bermuda Hundred quadrangle, has developed meanders in the lower part of its course in much the same way as the larger streams, such as the James, and these meanders, though differing in some respects from the larger ones, are of about the same significance.

AMELIA QUADRANGLE.

Character of the surface.—In examining the map of the Amelia quadrangle it should be noted that this map is on a much smaller scale than those of the Petersburg and Bermuda Hundred quadrangles, and also that

U. S. Geol. Survey. Rapid washing of the soil on the Piedmont Plateau.



U. S. Geol. Survey.

Rapid washing of the soil on the Piedmont Plateau.

U. S. Geol. Survey. Second-growth pine on the Piedmont Plateau near Petersburg.

U. S. Geol. Survey. Second-growth pine on the Piedmont Plateau near Petersburg.

its contour interval is 50 feet instead of 20 feet. Were the scale and contour interval of the three maps uniform it would be apparent at a glance that the area covered by the Amelia map is in general more hilly than that shown on the other two maps.

The surface features of the Amelia quadrangle are essentially those of the Piedmont Plateau, except in an irregular belt ranging in width from 2 to 14 miles along the eastern border, which forms a part of the Fall Belt (see p. 17) and in which there is a mingling of the Piedmont features with those of the Coastal Plain. The main streams have intrenched themselves about 150 feet below the general plateau level, and the numerous tributary creeks and branches have so completely dissected the old plateau that practically all of it has been reduced to slopes and presents a rolling to hilly, well-drained surface. However, the plateau character of the country is indicated by the nearly uniform altitude of all the main divides, a fact that impresses the traveler wherever openings in the forest permit extended views across the country. In general the area is rather monotonous in the uniformity of its surface features, and one part of the quadrangle is difficult to distinguish from another.

In the belt of mixed surface features along the east side of the quadrangle narrow, rocky valleys of the Piedmont Plateau type separate nearly level interstream areas, such as are characteristic of the Coastal Plain. The western boundary of this belt would be approximately marked by a line connecting the easternmost points to which the 300-foot contour extends on the divides. This boundary was the shore line of a sea which covered practically all of the Virginia Coastal Plain and in which was formed the highest of the well-preserved terrace plains, the Brandywine. (See p. 11.) This shore line, as nearly as can be determined from the present available facts, enters the quadrangle about a mile west of Laird, passes near Dinwiddie, is marked by a bed of well-rounded beach pebbles 3 miles east of Five Forks, and thence extends 2 miles east of Church Road; in the Appomattox Valley it swings in what was then an estuary and crosses the river somewhere near Eppes Falls; thence it swings eastward and crosses the Farmville and Powhatan Railroad near Beach, where it again sweeps far to the west, crossing the headwaters of Swift Creek in a broad curve in the vicinity of Otterdale, and finally swinging back to the east to a point within 2 miles of the northeast corner of the quadrangle.

In the Fall Belt, east of this old shore line, the interstream areas are separable into two more or less dissected plains, the more easterly one, the Sunderland, at elevations of 140 to 200 feet, and the other, the Brandy-

wine, at elevations of about 220 to nearly 300 feet. The contour interval (50 feet) used on the Amelia map is too great to show accurately the boundaries of these two plains, and not enough field work has been done to trace them. The higher plain is most extensive in the northeastern part of the quadrangle, on the long divides between Appomattox River, Swift Creek, and Falling Creek. The soil of the plain areas is prevailingly sandy, and much of it is infertile and has not been cleared for cultivation; this sandy soil is in marked contrast to the clayey soils that are characteristic of the Piedmont Plateau farther to the west.

Drainage.—The central part of the quadrangle is thoroughly drained by Appomattox River and its innumerable tributary creeks and branches, and together they form a type of drainage that may be described as dendritic—that is, treelike in plan. The stream channels are shallow and therefore not navigable, and here and there are cascades and rapids where the down-cutting currents have encountered exceptionally hard rocks that they have not yet been able to remove.

Nottoway River crosses the southwest corner of the quadrangle, the southern third of which is drained by its tributaries; these streams are essentially like the tributaries of the Appomattox. A small area in the northeastern part of the quadrangle is drained by Falling Creek, a branch of the James.

During much of the year the waters are muddy, being loaded with sediment derived from the wash of the light soils on the bordering uplands. The streams in many places have developed narrow flood plains. The slopes of some of the valleys are marked by narrow benches, which may be the upstream continuations of the terrace plains of the area to the east; such benches are particularly well displayed at Goode Bridge, on Appomattox River.

NATURAL RESOURCES.

SOIL.

Many materials of economic value occur in the region about Petersburg, and they have played a prominent part in the development of the region. The soil is one of the most valuable resources, its good quality having led to the rapid settlement of the region in colonial times.

The soil of the Coastal Plain, which is light gray, mottled yellow and brown, has been derived from the beds of unconsolidated sand, clay, gravel, and marl that compose the underlying rocks. The soil of the higher plains,

owing to the thorough oxidation of the iron it contains, is strikingly red. In most places it is sandy and readily worked, but where the clay is near the surface it may be so nearly impervious as to leave the surface soil poorly drained. The lower and more recent plains yield the better soil and for this reason are more extensively cultivated than the higher plains. Probably a large percentage of the surface now wooded and swampy, if cleared and properly drained, would furnish agricultural lands of good quality.

The soils in the Piedmont Plateau portion of the Amelia quadrangle show little diversity, those throughout perhaps three-fourths of the quadrangle being gray or brownish-gray sandy loam of fine to medium texture, as much as 18 inches deep. Below the loam is red sandy clay that merges within a short distance into red clay, which becomes stiffer in the lower depths. At a great depth the subsoil grades into the firm granitic rock of the region. Springs are of common occurrence in this area, and their sites are generally marked by swampy ground and luxuriant vegetation. The sandy loam is found in all positions from the tops of the divides to the bottoms of the valleys. A red clay loam forms the surface soil throughout the rest of the Amelia quadrangle. It is from 4 to 8 inches deep and grades into a stiff red clay subsoil. The clay loam occurs chiefly on the slopes bordering the larger streams but may be found in places on the divides. Here and there on the sides of the valleys the underlying rock comes to the surface. The weathered rock is dark-colored and stained, but on freshly exposed surfaces show a red to gray coarse-grained rock of the granite type.

MINERALS.

Some minerals of economic value occur in the area, particularly within the Piedmont Plateau. North of the village of Amelia mica mines have been operated for many years. The mica is used for stove and furnace doors, insulating apparatus, etc., and is ground fine for use in the manufacture of paints and lubricants. These mines have also produced some valuable rare minerals suitable for gems. The Amelia quadrangle is one of the most famous feldspar-producing areas in the United States. Feldspar, a constituent of granite, is a light-colored hard mineral which, when ground, is used in the manufacture of pottery, wall and floor tiles, door knobs, etc.

A few miles west and north of Petersburg are quarries that obtain granite from the crystalline rock floor beneath the sand and gravel of the Coastal Plain. The rock is a medium gray to dark blue-gray stone, very well adapted to building. It has been quarried extensively and used in most of the territory south of New England for buildings and monuments.

The State, War, and Navy Building in Washington was constructed of similar rock, quarried near Richmond. The Cook quarry is about 2 miles north of Petersburg, on the west side of the Seaboard Air Line Railway, within 300 feet of the crossing of this road by the Belt Line. The Lassiter quarries, comprising three or four openings close together, are about 1½ miles west of Petersburg, on the line of the Virginia Passenger and Power Company, within a quarter of a mile of the Seaboard Air Line Railway.

The mineral resources of the Coastal Plain at and near Petersburg include beds of clay, ocher, greensand, shell marl, and sand and gravel. Clay is worked at Ettricks, at a point near the Richmond and Petersburg Electric Railway, 2 miles north of Petersburg, and at Broadway, on the south side of Appomattox River, 7 miles northeast of Petersburg. Common red brick is the only product manufactured from these clays.

Prior to 1890 a considerable quantity of ocher (mineral paint) of excellent quality was mined on Appomattox River 4 miles southwest of Bermuda Hundred. The deposit, although apparently not exhausted, has not been worked in recent years.

Some of the rocks of the Coastal Plain contain a dark green mineral called glauconite, or greensand, which carries iron, potash, and lime. The potash and lime are valuable plant foods, hence the mineral is used as a fertilizer. In this region all excavations for greensand have been small and intended to obtain material only for the use of a few farmers near-by. Marl, composed largely of shells, is also abundant in the Coastal Plain. It is valuable as a fertilizer, but its use is largely local.

In some localities gravel and sand have been dug from the Coastal Plain terraces for use in the manufacture of cement blocks. A large excavation for this purpose has been made in the river bluff just west of City Point, where sand and gravel make up most of the bluff and clay is present in only a very small amount. Sand and gravel are also obtained on the north bank of Swift Creek 4 miles north by east of Petersburg and on the west bank of the Appomattox 5 miles north-northeast of Petersburg.

WATER.

The domestic water supply of the Coastal Plain is procured from both shallow and deep wells. The shallow water, found at or near the base of the sand and gravel that cover the terrace plains, is the principal source of supply in parts of the Coastal Plain. This water is generally pure and rarely contains much dissolved mineral matter, though in places it may be contaminated by surface drainage. The quantity of water in the shallow

wells is seldom great but is usually sufficient for domestic purposes except in seasons of excessive drought. The deep wells of the Coastal Plain generally furnish uncontaminated water, but locally it contains so much mineral matter as to be unserviceable. This water enters the porous beds where they crop out, toward the west, and percolates eastward down the slope of the beds, filling the spaces between the grains of sand. Because of the height of the source above the places where the supply is tapped by wells considerable hydrostatic pressure is developed, and consequently the water rises in the wells and in places overflows at the surface. Deep wells drilled at Hopewell furnish large quantities of water, and in all probability such wells drilled in almost any part of the Petersburg and Bermuda Hundred quadrangles east of the Fall Belt would obtain similar supplies.

In the excavation of trenches and in other military works within the Coastal Plain water-bearing sands that on account of their tendency to cave may give considerable trouble are likely to be encountered. In some places the water may be led off through an underlying porous sand or drained into some surface channel through a ditch or tunnel, but if free drainage cannot be provided it may be necessary to resort to pumping to keep the water down.

In the Amelia quadrangle water for domestic and commercial requirements is obtained chiefly from springs and shallow wells. Few deep wells have been drilled within the Piedmont Plateau, where the underlying rocks are hard and the obtaining of underground water depends upon the chance occurrence of water-bearing fissures in the path of the drill.

The waters of the streams of the area are soft and suitable for ordinary industrial purposes, and also for domestic uses, provided adequate precautions are taken to prevent them from becoming contaminated by surface impurities or to remove the effect of contamination by proper treatment. The water supply for Petersburg is obtained from Lieutenant Creek, a northward-flowing tributary of the Appomattox within the city limits.

The rapids in Appomattox River where it crosses the Fall Belt immediately above Petersburg afford an opportunity for the development of a total constant water-power amounting to about 20,000 horse-power, of which about 6,000 horse-power is now being utilized. Swift Creek, a few miles north of Petersburg, is capable of furnishing about 1,000 horse-power. The power afforded by many of the smaller creeks of the area is utilized in the operation of small grist mills, among which may be mentioned Smith's, Rowland's, Moore's, and Crawford's mills, in the Petersburg quadrangle.

VEGETATION.

A view from a high knoll or divide in the Amelia quadrangle shows forests in all directions, and it is estimated that 50 per cent or perhaps more of the area is covered with timber. Almost all the steep slopes and rugged surfaces are forest clad, but the divides have generally been cleared and are occupied by small farms, and some of the wider flood plains have been brought under cultivation. The trees of the divides and the higher land within the Piedmont Plateau comprise chiefly the hardwood, deciduous kinds, among which are many species of oak, hickory, chestnut, black locust, maple, and walnut, but there are some evergreens, principally scrub and short-leaf pine and cedar. The commoner trees along the valley bottoms and near the streams are elm, sycamore, tulip, black gum, sweet gum, linden, beech, birch, and willow.

The forests of the Coastal Plain occupy considerable areas of the level upland, especially where the lands are poorly drained, and they cover most of the slopes and bottoms of the valleys. All the more broken land along the principal streams is heavily timbered, and even some of the uplands that were once flourishing farms have been allowed to revert to their former forested condition. A large percentage of the forest on the upland is a second or third growth. The principal trees on the divides in the Coastal Plain are loblolly, scrub, and short-leaf pines, cedar, several species of oak, hickory, walnut, sweet gum, and black gum. Although many of the species are the same as those found in the Piedmont Plateau, the Coastal Plain forest, because it contains a much larger proportion of pine, is strikingly different in aspect from that of the Piedmont. The trees of the valley bottoms, outside of the swamps, comprise elm, sycamore, tulip, maple, linden, willow, sweet gum, and hackberry. The swamps along the streams are wooded, as a rule, and are largely characterized by the peculiar bell-butted cypress and tupelo gum, both of which have kneelike growths from their roots. The knees of the cypress form tall peaks; those of the tupelo gum are much lower and more gradually rounded. The magnolia, linden, pine, cedar, certain species of oak, tulip, elm, maple, and hackberry are also found in the swamps, and in places there are dense cane thickets.

Prior to 1917 the counties in Virginia near Petersburg produced annually between 550,000,000 and 600,000,000 feet of lumber, of which more than 500,000,000 feet was classed as "yellow pine," a name that includes loblolly, short-leaf, and scrub pine. Recently considerable concern has been felt regarding the adequacy of the timber supply in the Petersburg-

Hopewell area, and, according to R. Chapin Jones, State Forester of Virginia, the future supply depends entirely on the manner in which the owners of the woodland care for and manage their property.

ROUTES OF TRANSPORTATION.

Transportation in the Coastal Plain is effected by highways, railroads, and water. In the country about Petersburg there are few improved roads, and as a result travel during wet weather is difficult—in fact, the roads in places become almost impassable, on the uplands as well as in the valley bottoms. Mud holes persist into succeeding dry periods, and even after the mud disappears ruts and holes remain to interfere with pleasure travel and hauling of heavy loads. Some of the roads are very sandy, and travel over such roads in dry seasons is difficult and expensive. Most of the roads in the Coastal Plain would be satisfactory for travel the year round if they were kept well graded and crowned in the middle, or if gravel were added to their surface, or if the roads in sandy regions were well oiled.

The railroad facilities of this part of the Coastal Plain are generally good. Lines radiate from Petersburg in several directions, making that city readily accessible from all the larger centers of population in eastern Virginia. The estuary of James River is navigable by vessels of deep draft to City Point, above which vessels of lighter draft may go as far as Richmond and Petersburg.

Several railroads cross the Amelia quadrangle, connecting all the larger centers of population. The Piedmont Plateau is also well intersected with wagon roads, but they are for the most part of inferior grade, improved roads being few in number and widely separated. Many of the roads are sandy, and in dry weather the hauling of heavy loads on them is difficult. The roads are more sandy on the lowlands than on the divides or uplands, for the sand tends to "drift" down to the lower levels. The best roads are on the divides, and if kept crowned they would remain well drained and in good condition, for they dry rapidly after rains, whereas the roads that lie within the valleys tend to remain wet for long periods. In wet weather these roads are very muddy, but the mud is not so sticky as to impede progress seriously.

CLIMATE.

In the Virginia Coastal Plain and adjacent parts of the Piedmont Plateau the precipitation is high, averaging about 46.5 inches a year. This

means many cloudy days with a murky atmosphere. The precipitation is fairly uniform in its distribution throughout the year, the variation from month to month being too slight to be of any economic importance. Droughts are about as likely to occur in one season as in another. Throughout the year there is usually enough water flowing in the rivers for the development of power, and as navigation is limited to tidewater it is not interrupted by using the actual flow of the rivers above the tidal reaches for this purpose. It is hardly possible to give any maxima or minima of rainfall applicable to a period of years, yet there is a rather well-defined late summer maximum, usually in August, a minimum in October or November, a secondary maximum in March, and a secondary minimum in April.

In summer thunderstorms are frequent and violent and are often accompanied by high wind and hail, with very heavy precipitation. The first thunderstorm of the year usually occurs late in March or early in April, and the last late in November or early in December. The average number of thunderstorms each year is 27.

Practically all the precipitation in this region is in the form of rain. The greatest rainfall in 24 hours as recorded in Richmond was 5.33 inches on April 17-18, 1910.[1]

The total snowfall for the winter is commonly less than 24 inches, the average being about 12 inches. Snow enough for sleighing is a rarity, and the light snows usually linger on the ground only a few hours after falling. The first snowfall of autumn comes about November 15; the last snow of spring usually early in April. The average snowfall for December is 2 inches; January, 3.8 inches; February, 6.2 inches; March, 2.2 inches; April and November, less than 1 inch. A single snowfall to a depth of more than 7 inches has occurred only a few times in this region. At Richmond the greatest snowfall on record for 24 hours was 17.2 inches on December 22-23, 1908. The average seasonal precipitation for this region is as follows: Winter, 3.32 inches; spring, 4.04 inches; summer, 4.76 inches; autumn, 3.43 inches.

The region is one of mild temperature. Sudden and decided changes to warmer or colder weather are not often experienced, and both the daily and the yearly range of temperature lie within moderate limits. The summers are not excessively hot; the cold "snaps" of winter are of short

[1] Many of the statements given here are based on data furnished by the local office of the United States Weather Bureau at Richmond.

duration. Most of the winter days are mild. The following figures give the normal monthly averages in degrees Fahrenheit:

January	36.8
February	40.0
March	45.2
April	55.9
May	66.0
June	74.2
July	78.4
August	75.3
September	69.0
October	57.1
November	46.3
December	39.3

The average number of days each year with maximum temperature above 90° is 28; with minimum temperature below 32°, 55. At Richmond the average maximum temperature for June is 83.1; July, 88.1; August, 85.4; December, 48.3; January, 47.5; February, 46.1. The average minimum temperature for June is 64.1; July, 69.3; August, 67.8; December, 30.7; January, 30.3; February, 28.4. The highest temperature recorded is 102° on August 11, 1900; the lowest temperature recorded is —3° on February 10, 1899.

The first killing frost of the autumn occurs about the first of November, and the last killing frost of spring late in March.

The prevailing direction of the wind for this area is northeast. Winds blowing at the rate of 25 miles or more an hour are uncommon, and such velocities usually precede or accompany severe thunderstorms late in summer.

The mild winters do not favor the production of ice on the rivers to any great extent, hence the navigable streams are open to boats throughout the winter. Ice may form along the banks of the streams and on inlets along the estuaries, but it is generally too thin to interfere with navigation.

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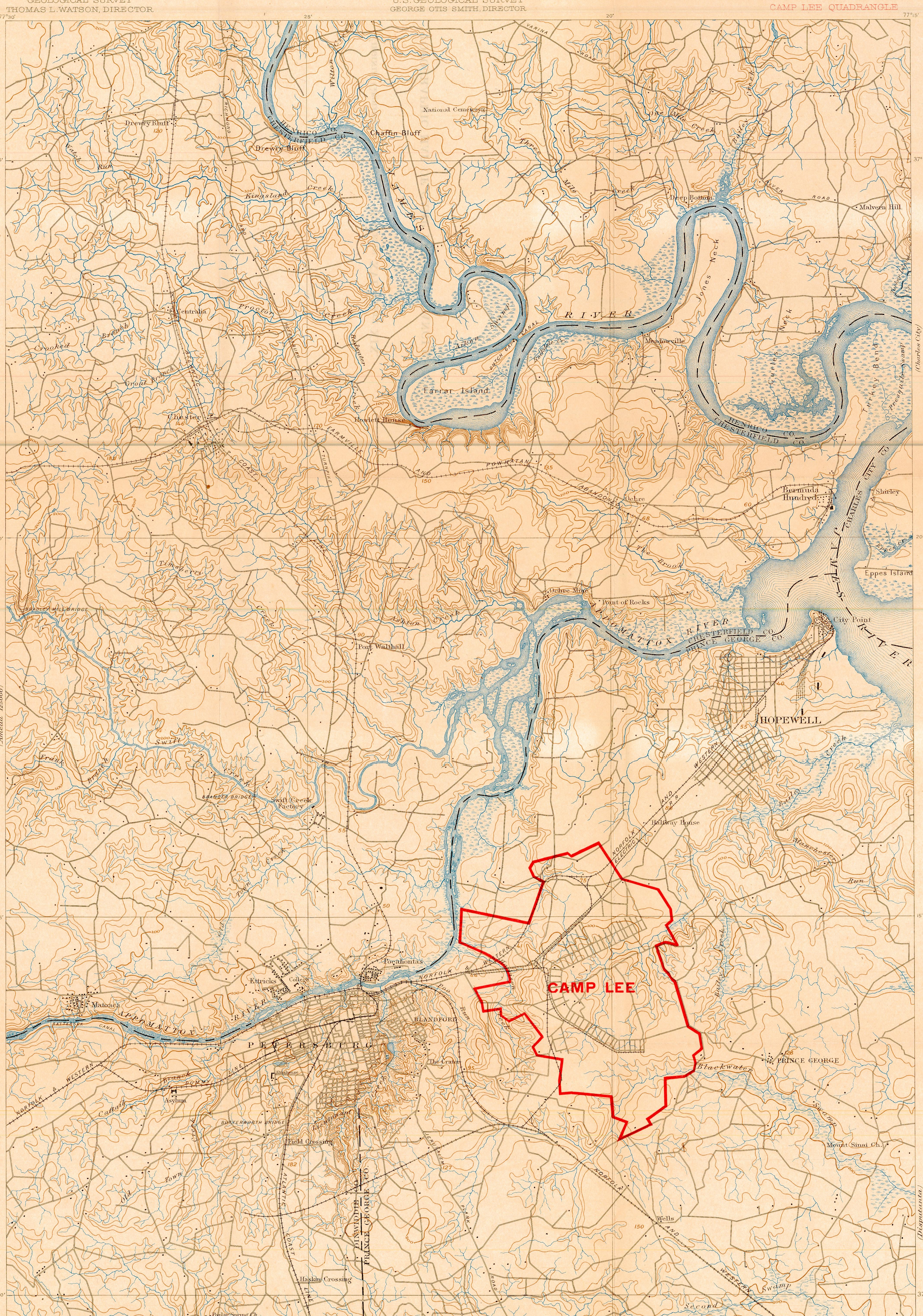

CAMP LEE
PETERSBURG
HOPEWELL
City Point
Bermuda Hundred
Shirley
Eppes Island
Malvern Hill
Deep Bottom
Meadowville
Farrar Island
National Cemetery
Chaffin Bluff
Drewry Bluff
Centralia
Chester
Howlett House
Ochre
Ochre Mine
Point of Rocks
Port Walthall
Swift Creek Factory
Halfway House
Pocahontas
Ettricks
College
Matoaca
Asylum
Almshouse
BLANDFORD
The Crater
PRINCE GEORGE
Mount Sinai Ch.
Wells
Field Crossing
Haskin Crossing
Poplar Spring Ch.
Six Mile Crossing
Youngblood's Store
Baxter Crossing
Smiths Mill
Academy
JAMES RIVER
APPOMATTOX RIVER
HENRICO CO.
CHESTERFIELD CO.
PRINCE GEORGE CO.
DINWIDDIE CO.
CHARLES CITY CO.
(Charles City)
(Amelia 1/125000)
(Disputanta)
NORFOLK AND WESTERN
ATLANTIC COAST LINE
NORFOLK ELECTRIC
Swift Creek
Blackwater Swamp
Second Swamp
Bailey Creek
Manchester Run
Kingsland Creek
Proctor Creek
Redwater Creek
Three Mile Creek
One Mile Creek
Old Town Creek
Hatcher Run
Arthur Swamp
Jones Neck
Curles Neck
Turkey Bend
77°30′
77°15′
37°25′
37°10′
25′
20′
15′
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CONVENTIONAL SIGNS

- City
- Village
- Roads and buildings
- Railroads
- Electric railroad
- Bridges
- County line
- Camp boundary
- City line
- Figures (*showing heights above mean sea level instrumentally determined*) — 170
- Contours (*showing height above sea, horizontal form, and steepness of slope of the surface*)
- Streams
- Canal
- Lake or pond
- Marsh

METER SCALE 1:62500
0 METERS 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
1 DIV=50 M 1 DIV=100 M

From U.S. Geological Survey maps of the Bermuda Hundred and Petersburg quadrangles.
Surveyed in 1892.

Names of maps of adjoining areas published by U.S. Geological Survey are printed on the margins.

BERMUDA HUNDRED
PETERSBURG

Scale $\frac{1}{62500}$

1 ½ 0 1 2 3 4 Miles

1000 500 0 1000 2000 3000 4000 5000 6000 7000 Yards

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 10 feet.
Datum is mean sea level.

TRUE NORTH
MAGNETIC NORTH
4°
APPROXIMATE MEAN DECLINATION, 1918

Edition of 1918

CAMP LEE

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VIRGINIA
AMELIA QUADRANGLE

ENGRAVED JUNE 1897 BY U.S.G.S.

Henry Gannett, Chief Topographer.
H. M. Wilson, Chief Geographer in charge.
Control by C. M. Yeates.
Topography by A. M. Walker.
Surveyed in 1895.

Scale $\frac{1}{125000}$

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 50 feet.

Datum is mean sea level.

Edition of Aug. 1897, reprinted 1918.

AMELIA