MARYLAND
GEOLOGICAL SURVEY

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QUEEN ANNE'S COUNTY

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Also with the coöperation of several members of the scientific bureaus of the National Government and Carnegie Institution.

LETTER OF TRANSMITTAL

To His Excellency Albert C. Ritchie, *Governor of Maryland,*

Sir:—I have the honor to present herewith a report on The Physical Features of Queen Anne's County. This volume is the ninth of a series of reports on the county resources, and is accompanied by large scale topographical, geological, and agricultural soil maps. The information contained in this volume will prove of both economic and educational value to the residents of Queen Anne's County as well as to those who may desire information regarding this section of the State, I am,

Very respectfully,

Edward Bennett Mathews,
State Geologist.

Johns Hopkins University,
Baltimore, *July, 1926.*

CONTENTS

ILLUSTRATIONS

PREFACE

This volume is the ninth of a series of reports dealing with the physical features of the several counties of Maryland.

The *Introduction* contains a brief statement regarding the location and boundaries of Queen Anne's County together with its chief physical characteristics.

The Physiography of Queen Anne's County, by Benjamin L. Miller, comprises a discussion of the surface characteristics of the county, together with a description both of the topographic forms and of the agencies which have produced them.

The Geology of Queen Anne's County, by Benjamin L. Miller, deals with the stratigraphy and structure of the county. An historical sketch is given of the work done by others in this field to which is appended a complete bibliography. Many stratigraphical details are presented, accompanied by local sections.

The Mineral Resources of Queen Anne's County, by Benjamin L. Miller, deals with the economic possibilities of the various geological deposits of the county. Those which have been hitherto employed are fully discussed, and suggestions are made regarding the employment of others not yet utilized.

The Soils of Queen Anne's County, by Messrs. Bennett, Tharp, Lyman, and Westover of the Bureau of Soils, contains a discussion of the leading soil types of the county and their relation to the several geological formations. This investigation was conducted under the direct supervision of Professor Milton Whitney, Director of the Bureau of Soils of the U. S. Department of Agriculture.

The Climate of Queen Anne's County, by Roscoe Nunn, is an important contribution to the study of the climatic features of the county. Mr. Nunn is Section Director in Baltimore of the U. S. Weather Bureau.

The Hydrography of Queen Anne's County, by B. D. Wood, gives a brief account of the water supply of the county, which, as in the

case of the other Coastal Plain counties, affords but little power for commercial purposes. The author of this chapter is a member of the Division of Hydrography of the U. S. Geological Survey.

The Magnetic Declination in Queen Anne's County, by L. A. Bauer, contains much important information for the local surveyors of the county. Dr. Bauer has been in charge of the magnetic investigations since the organization of the Survey and has already published two important general reports upon this subject. He is the Director of the Department of International Research in Terrestrial Magnetism of the Carnegie Institution.

The Forests of Queen Anne's County, by F. W. Besley, is an important contribution and should prove of value in the further development of the forestry interests of the county. Mr. Besley is State Forester of Maryland.

The State Geological Survey desires to extend its thanks to the several national organizations which have liberally aided it in the preparation of several of the papers contained in this volume. The Director of the U. S. Geological Survey, the Chief of the U. S. Weather Bureau, and the Chief of the Bureau of Soils of the U. S. Department of Agriculture have granted many facilities for the conduct of the several investigations and the value of the report has been much enhanced thereby.

THE

PHYSICAL FEATURES

OF

QUEEN ANNE'S COUNTY

THE PHYSICAL FEATURES OF QUEEN ANNE'S COUNTY

INTRODUCTION

Queen Anne's County lies to the east of Chesapeake Bay and forms a part of what is known as the "Eastern Shore" of Maryland. It is included between the parallels of 38° 50′ and 39° 16′ north latitude and 75° 44′ and 76° 24′ west longitude. It embraces an area of 379.7 square miles.

Queen Anne's County, although not erected until 1706, includes within its borders the earliest settlement of Europeans along the Eastern Shore of the Chesapeake Bay. The early trading port of William Claiborne was established on Kent Island in 1631, and settlements were made on the mainland about 1647, a few years prior to the agreement with the Indians which was made in the summer of 1652, and allowed the establishment of white settlements on either side of Chesapeake Bay as far south as the Choptank and Patuxent rivers.

The early settlements of Queen Anne's County were included first in Kent and subsequently in Talbot counties until the Maryland inhabitants had been so thoroughly distributed over the entire Eastern Shore as to make it advisable to take up with more care the division of the territory into counties. After several petitions had been presented to the Assembly of 1704 and referred to the next succeeding session, the General Assembly of 1706 enacted a law which was approved April 18, 1706 entitled:

> "An act for the dividing and regulating several counties on the eastern shore of this province, and constituting a county, by the name of Queen Anne's County, within the same province."

When this law was enacted there had been already erected on the Eastern Shore the counties of Cecil, Kent, Talbot, Dorchester, and

Somerset, the latter two embraced all the territory south of the Choptank, while the first four covered the territory north of that river. By the law of 1706 the region between the Sassafras on the north and the Choptank on the south was divided into three counties, the third being the new county of Queen Anne's.[1]

Queen Anne's County at first included that portion of Caroline County lying between Tuckahoe Creek and the Choptank River but this was cut off in 1773 when the General Assembly passed a law creating Caroline County from portions of Dorchester and Queen Anne's counties.

The county lies entirely within the Atlantic Coastal Plain and its physical features are characteristic of that physiographic province. Tide-water estuaries and bays bound it on the west and north and many of them penetrate the country for many miles. The greatest elevation in the county is slightly more than 90 feet above sea level, and almost one-fourth of the county is less than 25 feet above sea level.

The transportation facilities are good as two lines of railroad, the Pennsylvania, and the Maryland, Delaware, and Virginia, extend across the county while two steamboat lines from Baltimore make regular trips to various wharves on the Chester River and to Love Point on Kent Island. In addition sailing vessels pass up many of the other tide-water streams during the seasons when fruit, vegetables, and grain are being shipped to market and a great portion of the produce of the county is transported in such vessels.

Farming is the chief occupation of the inhabitants and most of the land is under cultivation. The many well kept farms and attractive farm buildings that are to be seen in all parts of the county indicate the prosperity of the inhabitants. The waters which wash the shores of the county abound in oysters, fish, and crabs, and the capture and care of these furnish employment to many people. Within

[1] Mathews, E. B. The Counties of Maryland, Md. Geol. Survey, Vol. VI, pt. 5, p. 534, 1906.

recent years the attractions of Queen Anne's County have drawn many people to its borders during the summer season and numerous homes and hotels have been erected along the shores to accommodate those who delight in boating, bathing, and fishing.

Centerville, the county seat, and the largest town in the county, is a prosperous enterprising town of several thousand inhabitants. It is on the line of both of the railroads that enter the county. Chuch Hill, Queenstown, Winchester, Stevensville, Sudlersville, and Crumpton are other important towns while there are several other smaller villages throughout the county.

DEVELOPMENT OF KNOWLEDGE CONCERNING THE PHYSICAL FEATURES OF QUEEN ANNE'S COUNTY, WITH BIBLIOGRAPHY

BY

BENJAMIN L. MILLER

Historical Review.

The location of Queen Anne's County on navigable waters and its early settlement are responsible for it being mentioned in many publications over a period of nearly 300 years. Naturally the first references are vague and consist merely of geographic notes or of maps on which the geographic features of the region are portrayed. For this reason it is considered advisable to divide the discussion of the literature references into two classes: those which are primarily of geographic interest and those which pertain to the description of the geologic features of the region.

THE HISTORY OF GEOGRAPHIC RESEARCH.

Chesapeake Bay was probably entered and explored by Ayllon, a Spaniard, in 1526 and perhaps by Gomez, another Spaniard, a few years later. The maps prepared as the result of these voyages are vague and general but there are some who believe that an indentation in the ocean shore is supposed to represent Chesapeake Bay. Until the English settlement at Jamestown these maps were accepted as authoritative and were reproduced in the works of several different writers.

In the summer of 1608, one year after the establishment of the English colony at Jamestown, Captain John Smith with fourteen companions started out to explore Chesapeake Bay. They went up

the Bay as far as the Patapsco River and then returned to Jamestown, having been away less than three weeks. Later in the summer Smith again headed another party for the same purpose and this time went to the head of the Bay. His map and notes indicate that he made no close-range observations along the Eastern Shore between the Nanticoke and Sassafras rivers as he kept close to the western shore in that portion of the Bay. However, he attempted to delineate the characteristics of the entire Bay on his map. He made the mistake, natural in taking observations at that great distance, of supposing that three large islands occurred in that portion of the Bay. These he named the "Winstone Islands." They evidently represent Kent Island, the peninsula of Talbot County lying between the Miles and Choptank rivers, and the western portion of Dorchester County.

Smith's map was published in England in 1612 and served as the source of information for almost all the maps of this region which were published during the next fifty years. The Lord Baltimore map, published in 1635, reproduces the same errors made by Smith in delineating the outlines of the shores. The map is interesting in that conical-shaped hills, or mountains, are represented in the area now included in Queen Anne's, Talbot, and Caroline counties.

A map drawn by Virginia Farrer and published in 1651 is greatly distorted and is less reliable than some of the earlier maps, yet it crudely represents the Choptank and Chester rivers.

In 1666 a fifth map of Maryland, by George Alsop, was published. This is interesting in that it represents the Eastern Shore cut into a number of peninsulas of approximately the same size and shape by the Choptank, Wye, Chester, "Sassafrix," "Elke," and two other unnamed rivers that all flow almost due west, are of equal size and empty in "———piacke Bay" along a straight north and south line.

In 1660 Augustine Herman offered to make a map of Maryland in return for a manor along Bohemia River and on the acceptance of

the offer by Lord Baltimore moved his family to Maryland and began the work. He was engaged in the work for ten years and it was not until 1673 that the map was finally published. The map is remarkably good and for the first time the configuration of the Eastern Shore counties was correctly shown. Most of the names which appear on the map are those still in use. "Talbot" is written on that portion of territory lying between the Chester and "Choptanck" rivers and extending from "The Great Bay of Chesapeake" to "Delawar Bay." Just as Smith's map served as the basis for later maps for many years so did Herman's map appear in many volumes and in many forms during the next century.

In 1735 Walter Haxton in a "Mapp of the Bay of Chesepeacke" added many details that were lacking from Herman's map. On this map nearly all the points and inlets along the Bay shore were correctly shown, and many observations on the depths of the water are given as the map was intended for the use of mariners.

After Haxton's map appeared there was little to be added so far as the Eastern Shore was concerned and the only other maps worthy of mention here are the maps by Dennis Griffith in 1794, by J. H. Alexander 1834-1840, and by S. J. Martinet in 1865. These contained much new information on the political boundaries, towns, and roads, but in the representation of natural features were practically copies of the earlier maps.

The last map to be mentioned is the one accompanying this report and which has been prepared by the United States Geological Survey in co-operation with the Maryland Geological Survey. The details shown, when compared with Smith's map, furnish decisive evidence of the continual progressive development that the Eastern Shore has undergone during the past 300 years, as well as showing the great improvements which have been made in the art of map making and map publishing.

THE HISTORY OF GEOLOGIC RESEARCH.

General.

The first paper on the Geology of North America worthy of especial consideration was published by William Maclure in 1809 and republished in more complete form in 1817, 1818, and 1826. In this report and on the accompanying map all the Atlantic Coastal Plain was supposed to be composed of a single geologic unit which was called the "Alluvial Formation." It received the name from the unconsolidated condition of the materials which suggested to him an alluvial origin. The boundary between the Coastal Plain and the Piedmont Plateau or between what he called the "Alluvial" and "Primitive" formations, was drawn with a high degree of accuracy. This first contribution by Maclure, although extremely general, nevertheless possesses great value as it was the impetus needed to stimulate systematic geologic investigation.

In 1820 Hayden objected to Maclure's explanation of the origin of the Coastal Plain materials and stated that they were not alluvial in character but marine and were brought to their present position by an ocean current that swept over the eastern part of the country.

The Tertiary Formations.

The first attempt to differentiate the various formations of which we now know the Coastal Plain to be composed were made in 1824 by John Finch, an Englishman, who traveled in this country during the preceding year. He recognized the presence of Secondary (Cretaceous) and Tertiary formations which he provisionally correlated with similar formations in Europe. Some of the correlations which he made were incorrect yet his contribution was of great value in that he showed that it would be possible to divide the beds of unconsolidated materials into several formations on the basis of the fossils which they contained.

T. A. Conrad was the first paleontologist of importance to engage in the investigation of the Tertiary fossils of Maryland. He pub-

FIG. 1.—VIEW OF THE CHESTER RIVER FROM NEAR QUEENSTOWN.

FIG. 2.—VIEW OF STREAM VALLEY CUTTING WICOMICO-TALBOT ESCARPMENT BETWEEN CENTERVILLE AND QUEENSTOWN.

lished his first article on this subject in 1830 and two years later, he divided the Coastal Plain deposits into six formations. Conrad continued to study Coastal Plain fossils and numerous articles from his pen were published from 1830 to 1867. To him much credit is due for the accurate determination of the major groups of strata composing the Coastal Plain. He divided the Tertiary into the Eocene and Miocene, although Isaac Lea was the first person to apply the term "Eocene" to any deposits in this country.

The first Geological Survey of Maryland, under the direction of Ducatel, the State Geologist, and Alexander, the State Engineer, contributed much to our understanding of the geology of the State and their reports issued from 1834 to 1842 contain the results of careful, systematic investigations prosecuted in all parts of the State.

Several writers between 1830 and 1860 emphasized the value of the shell and general marls of the Coastal Plain for fertilizing purposes and their contributions contain much information in regard to the Tertiary deposits of this region. They seem to have exaggerated the importance of the marls yet there can be no question but that the marls do possess some value. Pierce, Purvis, Ruffin, Higgins, and Tyson were the men who were most active in recommending to farmers that they make use of the easily accessible marl deposits while in the adjoining states of Delaware and Virginia, Booth and W. B. Rogers were equally active in urging similar action on the residents of their states.

In the further study of the Tertiary deposits the work has been done almost entirely by Heilprin and members of the Maryland Geological Survey and United States Geological Survey. The contributions of Clark, Dall, Shattuck, and Martin are of the greatest importance.

The Quaternary Formations.

In general, the early geologic investigators either entirely ignored the surficial deposits or else merely referred to them incidentally.

Chester in 1884 and 1885 described the surface gravels of the Eastern Shore and gave an explanation of their origin. McGee, however, was the first one to make systematic observations of these materials over extended areas of the Coastal Plain and in several papers published during the years 1886 to 1891 presented much valuable information. He proposed the name "Columbia" for the Quaternary deposits and divided them into fluviatile and interfluviatile phases which he considered contemporaneous. Although McGee's deductions are not all accepted his observations were carefully made and served as the basis for later work.

Darton continued McGee's work and early divided the surficial Quaternary deposits into two formations which he designated "Earlier Columbia" and "Later Columbia." The latest important contribution was made by Shattuck, who in 1901 divided the Columbia deposits into three formations which he named the "Sunderland," "Wicomico," and "Talbot." This is the classification that is used in this report.

BIBLIOGRAPHY

1612.

SMITH, JOHN. A Map of Virginia with a Description of the Country, the Commodities, People, Government, and Relegeon. Written by Captaine Smith, sometime Governour of the Countrey. Oxford, printed by Joseph Barnes, 1612. 4 to, 174 pp.

The map imperfectly represents the Bay shore features of Queen Anne's County.

1624.

SMITH, JOHN. A Generall Historie of Virginia, New England, and the Summer Isles, etc. London, 1624. (Several editions.)

This work contains many interesting notes on the physiography of Chesapeake Bay and its tributaries, and briefly described the clays and gravels along their shores. For a reproduction and discussion of Smith's map see Md. Geol. Surv., Vol. II, pp. 347-360.

1635.

ANON. A Relation of Maryland; Together With a Map of the

Countrey, The Conditions of Plantation, His Majestie's Charter to the Lord Baltimore, translated into English. London, 1635.

(Repub.) Sabine's Reprints, 4 to., ser., No. 2, New York, 1865, pp. 1-65, with appendix pp. 67-73.

The map accompanying this report is similar to that made by Smith but, in addition, conical hills or mountains are represented in the area now included in the Eastern Shore counties of Queen Anne's, Talbot, and Caroline.

1651.

Farrer, Virginia. A mapp of Virginia discovered to ye Hills, and in it's Latt: From 35 deg: & ½ neer Florida, to 41 deg: bounds of New England. John Goddard sculp. Domina Farrer Collegit. Are sold by I. Stephenson at ye Sunn below Ludgate: 1651.

Includes a greatly distorted representation of the Chesapeake Bay region.

1666.

Alsop, George. A Character of the Province of Maryland.

(Repub.) Gowan's Bibliotheca Americana, New York, 1869, No. 5.

Contains a generalized map in which the Eastern Shore rivers and peninsulas are represented as being very regular.

1673.

Herman, Augustine. Virginia and Maryland As it is Planted and Inhabited this present year 1670.

This is a very good map of the two colonies and the first accurate one of the Chesapeake Bay region ever prepared.

1735.

Haxton, Walter. To the Merchants of London Trading to Virginia and Maryland. This mapp of the Bay of Chesapeack with the Rivers Potomack, Patapsco, North East and part of Chester, Is humbly dedicated & presented by Walter Haxton 1735.

The map correctly represents most of the topographic features of the Bay shores.

1817.

Maclure, Wm. Observations on the Geology of the United States of America, with some remarks on the effect produced on the nature and fertility of soils by the decomposition of the different classes of rocks. 12 mo., 2 pls., Phila., 1817.

Is an elaboration of an article published in 1809 in Trans. Amer. Phil. Soc., O. S., Vol. VI, pp. 411-428. Repub. in Trans. Amer. Phil. Soc., N. S., Vol. I, 1818, 191 pp.

This work is classic as it was the first attempt to treat the geology of the entire country and it contains the first published geological map of the United States. The whole Coastal Plain constitutes the "Alluvial" formation and the Piedmont Plateau, the "Primitive."

1818.

MITCHELL, SAMUEL L. Essay on the Theory of the Earth by M. Cuvier to which are now added Observations on the Geology of North America by Samuel L. Mitchell. 8 vo., 431 pp., 8 pls. New York, 1818.

Reports the finding of "the grider of an elephant" which "was dug out of the ground by the side of a marsh, in Queen Anne's county." "The depth of this tooth is nine inches; the length of the grinding surface nine; breadth four and a half." p. 394. "Its weight.....is more than ten pounds. p. 395.

Two views of this tooth are given, pl. VI, figs. 3 and 6.

He believes that the fossil remains in this region "afford proofs.....of a deposite from inland floods since the oceanic strata were formed." p. 395.

1820.

HAYDEN, HORACE H. Geological Essay; or An Inquiry into some of the Geological Phenomena to be found in various parts of America, and elsewhere. 8 vo., 412 pp. Baltimore, 1820.

The writer contends that the unconsolidated deposits bordering the Atlantic Ocean are not alluvial materials but have been brought to their present position by an ocean current that swept over the eastern part of the country in a southwesterly direction. The rise of the ocean is believed to have been caused by an increase of water due to the melting of the polar ice produced by a shifting of the earth's axis.

"In Queen Anne's county, an enormous grinder of the Asiatick elephant was likewise dug up, on the plantation of Mr. Carmichael, enveloped in a stiff blue clay." p. 121.

1824.

FINCH, JOHN. Geological Essay on the Tertiary Formations in America.

(Read before Acad. Nat. Sci., Phila., July 15, 1823.) Amer. Jour. Sci., Vol. VII, pp. 31-43, 1824.

Objection is made to the term "Alluvial formation" of Maclure and others on the ground that the deposits are for the most part not of alluvial origin and also as used, the term includes a number of distinct formations that can be correlated with the "newer secondary and tertiary formations of France, England, Spain, Germany, Italy, Hungary, Poland, Iceland, Egypt, and Hindoostan." The writer makes some provisional correlations with European formations which are now known to be incorrect. He admits, however, that the data at his disposal are insufficient for accurate correlation.

1826.

PIERCE, JAMES. Practical remarks on the shell marl region of the eastern parts of Virginia and Maryland, etc; extracted from a letter to the Editor.

Amer. Jour. Sci., Vol. XI, pp. 54-59, 1826.

Mentions the occurrence of shell marl of marine origin in the "alluvial" district of Maryland on both sides of Chesapeake Bay and discusses its value as a fertilizer in the renovation of exhausted soils.

1834.

DUCATEL, J. T. and ALEXANDER, J. H. Report on the Projected Survey of the State of Maryland, pursuant to a resolution of the General Assembly. 8 vo. 39 pp. Annapolis, 1834. Map. Several editions.

Amer. Jour. Sci., Vol. XXVII, 1835, pp. 1-39.

"Two varieties of shell marl, one composed principally of clam shells imbedded in clay; the other consisting of pectens (scallop shells) enveloped by an indurated ferruginous clay" are reported to occur on Corsica Chreek.

1835.

CONRAD, T. A. Observations on the Tertiary Strata of the United States.

Amer. Jour. Sci., Vol. XXVIII, 1835, pp. 104-111, 280-282.

He considers the Miocene absent in this region, the Older Pliocene resting directly upon the Eocene. The beds containing *Perna maxillata* are referred to the Older Pliocene and the St. Mary's river beds to the Medial Pliocene.

DUCATEL, J. T. and ALEXANDER, J. H. Report on the New Map of Maryland, 1834. Annapolis, 1835(?). 8 vo. 591 pp. Two maps and one folded table. Contains Engineer's and Geologist's Reports which were also issued separately. Md. House of Delegates, Dec. Sess. 1834.

Ducatel says that he believes the shell marl deposit underlies the Eastern Shore but is not exposed south of the Choptank River. He gives the dip as 5° to the southwest. He also says that the surface of the marl undulates. He describes deposits of shell marl at the head of Southeast Creek in the vicinity of Church Hill, on the northeast side of Corsica Creek, at many places on the southwest side of Corsica Creek extending to the head of the branch south of Centreville, at the head of Reed's Creek, on Back Wye River, and on Chew's Island. Sixteen analyses of these marls are given. The soils of the county are described and the value of the shell marls as fertilizers is discussed as well as methods of working and applying the material. Bog iron ore of good quality is reported at the head of Hamilton and South East creeks. A chalybeate spring is said to be located on the farm of Mr. Levi Paccault near Wye Mills.

1836.

DUCATEL, J. T. and ALEXANDER, J. H. Report on the new Map of Maryland, 1835. 8 vo. 84 pp. Maps. Annapolis, 1835.

Md. Pub. Doc., Dec., Sess., 1835. Engineer's Report pp. 1-34, Geologist's Report, pp. 35-85.

Both reports also published separately. Contains analyses of four samples of shell marl from Queen Anne's County ranging from 15 to 50 per cent $CaCO_3$ (p. 82).

PURVIS, M. On the Use of Lime as a Manure.

Translated for the Farmer's Register, Shellbanks, Va., 1835. Reviewed in Amer. Jour. Sci., Vol. XXX, 1836, pp. 138-163.

Mention is made of the use of greensand as a fertilizer.

1837.

DUCATEL, J. T. Outline of the Physical Geography of Maryland, embracing its prominent Geological features.

Trans. Md. Acad. Sci. and Lit., Vol. I, Pt. I, 1837, pp. 24-55 with map.

A general description of the physiography and geology of the entire state is given with many details of local features. It is a general summary of information previously published in various places. Mention is made of the covering of boulders and coarse gravel near the inner edge of the Secondary (Cretaceous) rocks while farther out the sands and clays of the Secondary and Tertiary formations are uncovered. The whole county is said to be underlain by Tertiary deposits though no reference is made to any particular locality in the county.

1838.

CONRAD, T. A. Fossils of the Medial Tertiary of the United States. No. 1, 1838.

[Description on cover: 1839 & '40], 32 pp., pls. I-XVII. Repub. by Wm. H. Dall, Washington, 1893.

A general description of the distribution and characteristics of the Miocene of the Atlantic Coastal Plain is given. The Miocene is called the Medial Tertiary or Older Pliocene and the Eocene is called Lower Tertiary.

1840.

CONRAD, T. A. Fossils of the Medial Tertiary of the United States. No. 2, 1840.

[Description on cover: 1840-1842], pp. 33-56, pls. XVIII-XXIX. Repub. by Wm. H. Dall, Washington, 1893.

Astarte cuneiformis from Wye Mills is described and figured.

1841.

VANUXEM, LARDNER. On the Ancient Oyster Shell Deposits observed near the Atlantic Coast of the United States. (Read April 7, 1841.)

Proc. Assoc. Amer. Geol. and Nat., pp. 21-23.

The writer agrees with Ducatel in the view that the deposits were made by the Indians, though he admits that Conrad has some evidence to prove that they were formed by natural agencies. He believes that possibly the deposit at Easton is due to natural causes as the valves seem to be together there, while elsewhere they are separated.

1842.

CONRAD, T. A. Observations on a portion of the Atlantic Tertiary Region, with a description of new species of organic remains. 2d Bull. Proc. Nat. Inst. Prom. Sci., 1842. pp. 171-192.

The Miocene and Eocene are said to not be connected by a single fossil common to both periods while three forms found in the Upper Secondary are found in the Eocene. The Medial Tertiary (Miocene) is said to appear near Chestertown and Wye Mills.

1843.

DUCATEL, J. T. Physical History of Maryland.

Abstract, Proc. Amer. Phil. Soc., Vol. III, 1843, pp. 157-158.

"The Eastern Shore is shown to consist of something more than arid sand-hills and pestilential marshes; and the Western Shore not to depend exclusively upon the rich valleys of Frederick and Hagerstown for its supplies."

1844.

ROGERS, H. D. Address delivered at the Meeting of the Association of American Geologists and Naturalists.

Amer. Jour. Sci., Vol. XLVII, 1844, pp. 137-160, 247-278.

The article consists of a resumé of the geological work done up to that time in the entire United States.

1850.

HIGGINS, JAMES. Report of James Higgins, M. D., State Agricultural Chemist, to the House of Delegates. 8 vo. 92 pp. Annapolis, 1850.

Contains detailed descriptions and many analyses of the various kinds of soils found on the Eastern Shore of Maryland. The greensand and shell marl deposits of the counties lying north of the Choptank River are discussed at length. Reference is made to several localities in Queen Anne's county where they occur.

1851.

BAILEY, J. W. Miscellaneous Notes. Fossil Infusoria of Maryland.

Amer. Jour. Sci., 2d ser., Vol. XI, 1851, pp. 85-86.

The infusorial bed of Petersburg, Va., and the western shore of Maryland is reported "at Wye on the eastern shore of Maryland, where the infusorial stratum reappears with all its usual characteristic species." (p. 86).

1852.

Fisher, R. S. Gazateer of the State of Maryland compiled from the returns of the Seventh Census of the United States. New York and Baltimore, 8 vo. 1852, 122 pp.

Contains numerous descriptions of the geography and geology of the various portions of the State.

1860.

Tyson, Philip T. First Report of Philip T. Tyson, State Agricultural Chemist, to the House of Delegates of Maryland. January, 1860. 8 vo. 145 pp. Maps. Appendix. Mineral Resources of Md. 20 pp. Annapolis, 1860.

The report is accompanied by a colored geological map which shows the distribution of the various formations. The Coastal Plain formations represented are the Cretaceous, Tertiary, and Post-Tertiary, while the iron-ore clays of the Cretaceous are separated from the other Cretaceous deposits. A brief description of each formation is given. Greensand marl of Eocene age is reported to occur along the Chester River. The Miocene shell marls of Queen Anne's County are said to have been used with excellent results.

1862.

Tyson, Philip T. Second Report of Philip T. Tyson, State Agricultural Chemist, to the House of Delegates of Maryland. January, 1862. 8 vo. 92 pp., Annapolis, 1862.

An artesian well at Centerville "after passing no great depth through the tertiary stratam was continued down into the greensand to a depth of 390 feet of the surface. It should be continued into the oölite beds in order to secure a full supply of good water rising to or very near the surface of the ground."

1867.

Higgins, James. A Succinct Exposition of the Industrial Resources and Agricultural Advantages of the State of Maryland. 8 vo., 109+III pp.

Md. House of Delegates, Jan. Sess., 1867, (DD).

Md. Sen. Doc., Jan. Sess., 1867, (U).

Contains descriptions of the soils and physiographic features of each of the counties of the State.

1880.

HEILPRIN, ANGELO. On the Stratigraphical Evidence Afforded by the Tertiary Fossils of the Peninsula of Maryland.

Proc. Acad. Nat. Sci., Phila., Vol. XXXII, 1880, pp. 20-33.

After a careful examination of the fossils found along the Patuxent, Choptank, and St. Mary's rivers and the Calvert Cliffs, the author proposes the separation of the Miocene into the Older and Newer periods. The beds at Fair Haven are typical Older Miocene and the St. Mary's lower Patuxent and Choptank river beds belong to the Newer Miocene.

1882.

———————On the relative ages and classification of the Post Eocene Tertiary Deposits of the Atlantic Slope.

Proc. Acad. Nat. Sci., Phila., Vol. XXXIV, 1882, pp. 150-186.

Asbtract: Amer. Jour. Sci., 3d ser., Vol. XXIV, 1882, pp. 228-229.

Amer. Nat., Vol. XVII, 1883, p. 308.

From a comparison of faunas the Eocene deposits of Maryland are correlated with the Eo-Lignitic of Alabama, and the Miocene beds of the State are grouped in a division called the Marylandian which is supposed to be older than any other Miocene beds of this country, with the possible exception of the basal Miocene beds of Virginia which may be contemporaneous.

1884.

CHESTER, FREDERICK D. The quaternary Gravels of Northern Delaware and Eastern Maryland, with map.

Amer. Jour. Sci., 3d ser., Vol. XXVII, 1884, pp. 189-199.

The author believes that the peninsula of Eastern Maryland and Delaware was covered with gravels, clay and sand brought down by the Delaware River during the Ice Age and deposited in an estuary.

HEILPRIN, ANGELO. The Tertiary Geology of the Eastern and Southern United States.

Jour. Acad. Nat. Sci., Phila., Vol. IX, pt. 1, pp. 115-154, map. 1884.

The distribution of the Tertiary strata of the State is given approximately. The Eocene is correlated with the base of the Buhrstone or the Eo-lignitic of Alabama and with the London Clay. The Miocene of the State is divided into two formations, the older or Marylandian which is regarded as possibly Oligocene is age, and the newer or Virginian. The former is exposed in Anne Arundel, Calvert, and Charles counties and the latter at Easton, on the Choptank River and in St. Mary's County.

———————————Contributions to the Tertiary Geology and Paleontology of the United States. 4 to, 117 pp. 1 map. Phila., 1884.

Contains a number of articles all but one of which was previously published in the Proceedings or Jour. of the Philadelphia Academy of Sciences. Some of these articles are listed on preceding pages.

Swank, James M. History of the Manufacture of Iron in all Ages. Phila., 428 pp.

Later edition, 1892.

"In 1762 Robert Evans, Jonatham Morris,, and Benjamin Jacobs built Unicorn forge at a place called Nasby, in Queen Anne's County. The castings for the forge were procured at 'Bush River furnace,' which appears to have been then operated by Isaac Webster. The firm of Evans, Morris, and Jacobs was not long in existence." (pp. 193-194, earlier edition, p. 253, second edition).

1885.

Chester, Frederick D. The gravels of the Southern Delaware Peninsula.

Amer. Jour. Sci., 3d ser., Vol. XXIX, 1885, pp. 36-44.

The gravels, sands, and clays of the entire peninsula of Eastern Maryland and Delaware are said to have been brought down by the Delaware River and spread out by estuaries and marine currents. In the northern part the materials were deposited in an estuary but in the southern part in the open ocean. Boulders carried by icebergs are found throughout the entire area, some of which are of large size.

1888.

McGee, W. J. Three Formations of the Middle Atlantic Slope.

Amer. Jour. Sci., 3d ser., Vol. XXXV, 1888, pp. 120-143, 328-331, 367-388, 448 466, plate II.

The three formations discussed are the Potomac, (now divided into four formations), the Appomattox (Lafayette, later Brandywine), and the Columbia, (now divided into three formations). These are described in far greater detail than had ever been done before and the conclusions reached vary little from the views held at the present time.

———————————The Geology of the Head of Chesapeake Bay.

7th An. Report U. S. Geol. Surv., Washington, 1888, pp. 537-646.

(Abst.) Amer. Geol., Vol. I, 1887, pp. 113-115.

Contains a general discussion of the Pleistocene deposits of the State.

———————————The Columbia Formation.

Proc. Amer. Assoc. Adv. Sci., Vol. XXXVI, 1888, pp. 221-222.

The Columbia formation overlying unconformably the Cretaceous and Tertiary deposits of the Atlantic Coastal Plain is said to consist of series of deltas and terraced littoral deposits. It is said to pass under the terminal moraine to the northward. The Columbia materials are supposed to have been laid down during a period of glaciation long preceding the glacial epoch during which time the terminal moraine was formed.

UHLER, P. R. Observations on the Eocene Tertiary and its Cretaceous Associates in the State of Maryland.

Trans. Md. Acad. Sci., Vol. I, 1888, pp. 11-32.

Many details concerning the distribution, lithologic characteristics, and fossil content of the Eocene deposits of Queen Anne's County are described.

1889.

———————Additions to Observations on the Cretaceous and Eocene Formations of Maryland.

Trans. Md. Acad. Sci., Vol. I, 1889, pp. 45-72.

This paper contains many descriptions of Eocene strata in Queen Anne's County together with a general description of these formations as represented in the entire state. A list is given of all Eocene fossils recognized up to that time.

1891.

CLARK, WM. BULLOCK. Correlation Papers—Eocene.

Bull. U. S. Geol. Surv. No. 83. Washington, 1891. 173 pp., 2 maps.

(Abst.) Johns Hopkins Univ. Cir. No. 103, Vol. XII, 1893, p. 50.

Contains a discussion of all the literature concerning the Eocene of the United States published up to that time. The distribution and characteristics of the Maryland Eocene deposits are briefly described.

DARTON, N. H. Mesozoic and Cenozoic Formations of Eastern Virginia and Maryland.

Bull. Geol. Soc. Amer., Vol. II, 1891, pp. 431-450, map, sections.

(Abst.) Amer. Geol., Vol. VII, 1891, p. 185; Amer. Nat., Vol. XXV, 1891, p. 658.

Contains a description of the Potomac, Severn (marine Cretaceous), Pamunkey (Eocene), Chesapeake (Miocene), and Appomattox (Brandywine) formations as known at that time.

MCGEE, W. J. The Lafayette Formation.

12th Ann. Rept. U. S. Geol. Survey, pt. I, 1890-91, Washington, 1891, pp. 347-521.

The general characteristics of the entire Coastal Plain and of each of the formations composing it are discussed at length.

Woolman, Lewis. Artesian Wells and water-bearing horizons of Southern New Jersey (with a "Note on the extension southward of diatomaceous clays, and the occurrence of flowing artesian wells").

N. J. Geol. Survey, Rept. State Geol. for 1890, Trenton, 1891, pp. 269-276.

"Outcrops of clay containing diatoms have been found at Broad Creek, on the eastern side of Chesapeake Bay, opposite Annapolis." (p. 275.)

1892.

Clark, Wm. Bullock. The Surface Configuration of Maryland.

Monthly Rept. Md. State Weather Service, Vol. II, 1892, pp. 85-89.

Contains a general summary of the physical features of the State.

Dall, Wm. H. and Harris, G. D. Correlation Papers: Neocene.

Bull. U. S. Geol. Survey No. 84, 1892, 349 pp., 3 maps, 43 figs.

House Misc. Doc., 52d Congress, 1st sess., Vol. XLIII, No. 337.

Contains a full discussion of all the literature of the Miocene and Pliocene of the United States published up to that time. Tentative correlations are made.

Scharf, J. Thomas. The Natural Resources and Advantages of Maryland, being a complete description of all of the counties of the State and the City of Baltimore. Annapolis, 1892.

Contains much general information concerning each county of the State.

1893.

Clark, Wm. Bullock. Physical Features (of Maryland).

Maryland, its Resources, Industries, and Institutions. Baltimore, 1893, pp. 11-54.

Contains short descriptions of the topography, climate, water supply, and water resources of the State.

Whitney, Milton. The Soils of Maryland.

Md. Agri. Exper. Station, Bull. No. 21, 58 pp., map. College Park, 1893.

The principal soils of the State are described and their adaptability to different kinds of crops are discussed. A map is given showing their general distribution.

———————————Description of the Principal Soil Formations of the State (Maryland).

Maryland, its Resources, Industries, and Institutions. Baltimore, 1893, pp. 181-211.

The writer describes the soils of the State, gives their distribution, and discusses their origin and adaptability.

Williams, G. H. and Clark, Wm. Bullock. Geology of Maryland.

Marlyand, its Resources, Industries, and Institutions. Baltimore, 1893, pp. 55-89.

The different geological formations of the State are briefly discussed.

1894.

Clark, Wm. Bullock. The Climatology and Physical Features of Maryland.

First Bien. Rept. Md. State Weather Service for years 1892 and 1893. Baltimore, 1894.

Contains a general discussion of the topography, geology, soils, and climate of the State.

Darton, N. H. Artesian Well Prospects in Eastern Virginia, Maryland, and Delaware.

Trans. Amer. Inst. Min. Eng., Vol. XXIV, 1894, pp. 372-396, pls. 1 and 2.

Contains a general description of the Atlantic Coastal Plain formations with records of some of the important artesian wells of the region and a discussion of artesian water conditions throughout the area.

————————Outline of Cenozoic History of a Portion of the Middle Atlantic Slope.

Jour Geol., Vol. II, 1894, pp. 568-587.

Contains a description of the formations of the Atlantic Coastal Plain and a resumé of the geologic history of the region.

Harris, G. D. On the Geological Position of the Eocene Deposits of Maryland and Virginia.

Amer. Jour. Sci., 3d ser., Vol. XLVII, pp. 301-304 figs. 1-3.

The writer correlates the Eocene of Virginia and Maryland with the Bell's Landing substage of Alabama.

1896.

Clark, Wm. Bullock. The Eocene Deposits of the Middle Atlantic Slope in Delaware, Maryland, and Virginia.

Bull. U. S. Geol. Survey No. 141, 1896, 167 pp. 40 pls.

An exhaustive study of the Eocene strata in which the stratigraphy and paleontology of the deposits are discussed in detail.

———————The Potomac River Section of the Middle Atlantic Coast Eocene.

Amer. Jour. Sci., 4th ser., Vol. I, 1896, pp. 365-374.

The writer states that "the middle Atlantic slope Eocene represents in a broad way all or the major part of the Lignitic, Buhrstone, and Clairborne of Smith..... and perhaps even more."

Darton, N. H. Artesian Well Prospects in the Atlantic Coastal Plain Region.

Bull. U. S. Geol. Survey No. 138, 1896, 232 pp., 19 pls.

Contains a brief description of the Coastal Plain formations of the State with a discussion of their water-bearing properties. Records are given of many deep wells.

1897.

Clark, Wm. Bullock. Outline of the Recent Knowledge of the Physical Features of Maryland, embracing an Account of the Physiography, Geology, and Mineral Resources.

Md. Geol. Survey, Vol. I, 1897, pp. 141-228, pls. 6-13.

Contains a description of each of the geologic formations of the State recognized at that time.

Abbe, Cleveland, Jr. General Report of the Physiography of Maryland.

Md. Weather Service, Vol. I, pp. 41-216, pls. 3-19, figs. 1-20. Baltimore, 1899.

Contains a full description of the physiographic features of the State.

1900.

———————The Physiographic Features of Maryland.

Bull. Amer. Bur. Geog., Vol. I, pp. 151-157, 242-248, 342-355, 2 figs. 1900.

A concise description of the important physical features of each of the three physiographic provinces of the State.

Woolman, Lewis. Artesian Wells.

N. J. Geol. Survey. Ann Rept. for 1899, pp. 53-139. 1900.

Contains the record of a 665-foot artesian well at Centerville. (pp. 81-84).

1901.

CLARK, WM. BULLOCK. Maryland and its Natural Resources.

Official publication of the Maryland Commissioners to the Pan-American Exposition. 38 pp., map. Figs. Baltimore, 1901.

A brief account of the physical features and economic resources of the State.

————————and MARTIN, G. C. Eocene Deposits and Paleontology of Maryland.

Md. Geol. Survey, Eocene. 1901, pp. 21-92.

Describes the general stratigraphic relations, distribution, origin of the materials and lithologic and paleontologic characteristics of the Eocene strata of the State.

SHATTUCK, GEORGE BURBANK. The Pleistocene Problem of the North Atlantic Coastal Plain.

Johns Hopkins Univ. Circ., Vol. XX, 1901, pp. 69-75; Amer. Geol., Vol. 28, 1901, pp. 87-107.

The views of McGee, Darton, and Salisbury concerning the Pleistocene deposits are summarized and compared with the writer's views. The wave-built terrace deposits are referred to four different formations, the Talbot, Wicomico, Sunderland, and Lafayette, the first three of which constitute the Columbia group. These formations are said to be separated by erosional unconformities.

1902.

DARTON, N. H. Preliminary List of Deep Borings in the United States. Part I, Alabama-Montana.

U. S. Geol. Survey, Water-Supply and Irrigation Paper No. 57. 60 pp. 1902.

Gives data concerning a deep well at Centerville.

RIES, HEINRICH. Report on the Clays of Maryland.

Md. Geol. Survey, Vol. IV, 1902, pp. 203-505, pls. 19-69.

Contains full description of the clay deposits and clay industries of the State.

1903.

————————The Clays of the United States East of Mississippi River.

U. S. Geol. Survey, Prof. Paper No. 11, 1903, pp. 134-149.

Describes the clay-bearing formations of Queen Anne's County and gives analyses and physical characteristics of the most important clays.

1904.

MARTIN, G. C. et al Systematic Paleontology of the Miocene Deposits of Maryland.

Md. Geol. Survey, Miocene, 1904, pp. 1-508 pls. 10-135.

Contains descriptions and illustrations of all Miocene fossils recognized in Maryland up to that time. Many forms from Queen Anne's County are included.

1906.

CLARK, WM. BULLOCK and MATHEWS, E. B. with the collaboration of others.

Md. Geol. Survey, Vol. VI, pp. 27-259, pls. 1-23, figs. 1-18, 1906.

Contains a full account of the physical features, geologic formations, and mineral products of the entire State.

MATHEWS, EDWARD B. The Counties of Maryland; their Origin, Boundaries, and Election Districts.

Md. Geol. Survey, Vol. VI, pp. 417-572, pls. 36-57, 1906.

Gives much valuable information concerning the boundaries of each of the counties of the State.

MILLER, BENJAMIN L. Description of the Dover Quadrangle (Delaware-Maryland-New Jersey).

U. S. Geol. Survey, Geol. Atlas No. 137, 10 pp., 1 fig., 2 maps. Washington, 1906.

The Dover quadrangle includes the northern portion of Queen Anne's County. The writer describes the physiographic features, the occurrence, character, and relations of the Cretaceous, Tertiary, and Quaternary formations, the geologic history and the economic geology of the quadrangle.

SHATTUCK, GEORGE BURBANK. The Pliocene and Pleistocene Deposits of Maryland.

Md. Geol. Survey, Pliocene and Pleistocene. pp. 21-137, 1906.

Contains a full description of the surficial deposits of the State with many local details.

1909.

CLARK, WM. BULLOCK and others. Report of the Conservation Commission of Maryland for 1908-1909. 204 pp., 13 pls., 13 figs.

Contains descriptions of the mineral and water resources and the agricultural soils of the State.

1918.

CLARK, WM. BULLOCK. The Geography of Maryland.

Md. Geol. Survey, Vol. X, pt. 1, 1918, 127 pp.

———————MATHEWS, E. B., and BERRY, E. W. The Surface and Underground Waters of Maryland, including Delaware and the District of Columbia.

Md. Geol. Survey, Vol. X, pt. 2, 372 pp. 1918.

THE PHYSIOGRAPHY OF QUEEN ANNE'S COUNTY

BY

BENJAMIN L. MILLER

Queen Anne's County lies entirely within the Atlantic Coastal Plain and it is therefore advisable to first discuss the general characteristics of this entire phsiographic province.

Outline of the Geography and Geology of the Atlantic Coastal Plain.

Boundaries and Limits.—The Atlantic Coastal Plain province borders the entire eastern part of North America and in essential particulars is distinctly separated from the provinces on either side. Its eastern limits are marked by the well-defined edge of the continental shelf, at the summit of an escarpment varying in height from 5000 to 10,000 feet. This scarp edge lies at a general depth of 450 to 600 feet below sea level, but commonly the 100-fathom line is regarded as the boundary of the continental shelf. The descent from that line to the greater ocean depths is abrupt; at Cape Hatteras there is an increase in depth of 9000 feet in 13 miles, a grade as steep as that found in many places along the flanks of the greater mountain systems. In striking contrast to this declivity is the comparatively flat ocean bed, which stretches away to the east with but slight differences in elevation. Seen from its base the escarpment would have along the horizon the appearance of a high mountain range with a very even sky line. Here and there notches, produced, perhaps, by streams which once flowed across the continental shelf, would be seen, but there would be no peaks nor serrated ridges.

The Piedmont Plateau, composed of highly metamorphosed crystalline rocks, forms the western boundary of the Atlantic Coastal

Plain. Most of the larger streams and many of the smaller ones, as they cross the western margin of the Coastal Plain, are characterized by falls or rapids, and the name "fall line" is given to this boundary on that account. Below the fall line the streams show a marked decrease in the velocity of their currents. In the middle Atlantic region tide-water estuaries, the continuations of the larger streams, extend inland to the fall line, which thus marks the head of navigation. The position of the fall line near the head of navigation or near the source of water power has been one of the very important factors in determining the location of many of the towns and cities of the Atlantic coast, New York, Trenton, Philadelphia, Wilmington, Baltimore, Washington, Richmond, etc. being located along it. A line drawn through these places would approximately separate the Coastal Plain from the Piedmont Plateau.

Divisions.—The Atlantic Coastal Plain province is divided by the present shore line into two parts—a submerged portion, known as the continental shelf or continental platform, and a subaerial portion, commonly called the Coastal Plain. In some places the division line is marked by a sea cliff of moderate height, but usually the two parts grade into each other with a scarcely perceptible change, and the only mark of separation is the shore line. The areas of the respective portions have changed frequently during past geologic time owing to the shifting of the shore line eastward or westward and even at the present time such changes are in progress. Deep channels that are probably old river valleys, the continuations of valleys of existing streams, have been traced entirely across the continental shelf, at the margin of which they have cut deep gorges. The channel opposite the mouth of Hudson River is particularly well marked and has been shown to extend almost uninterruptedly to the edge of the shelf, over 100 miles southeast of its present mouth. A similar channel lies opposite the mouth of Chesapeake Bay. The combined width of the submerged and subaerial portions of the Coastal Plain province is nearly uniform along the eastern

boundary of the continent, being approximately 250 miles. In Georgia the subaerial portion is over 150 miles wide, while the submerged portion is narrower and along the eastern shore of the peninsula of Florida is almost absent. To the north the submerged portion gradually increases in width and the subaerial portion becomes narrower. Except in the region of Cape Hatteras, where the submerged belt becomes narrower, with a corresponding increase in width of the subaerial belt, this gradual change continues as far as the southern part of Massachusetts, beyond which the subaerial portion disappears altogether through the submergence of the entire Coastal Plain province. Off Newfoundland the continental shelf is about 300 miles in width.

Relief.—From the fall line the Coastal Plain has a gentle slope to the southeast, generally not exceeding 5 feet to the mile, except in the vicinity of the Piedmont Plateau, where the slope is in places as great as 10 to 15 feet to the mile, or even more. The submerged portion is monotonously flat, as deposition has destroyed most of the irregularities that were produced by erosion when this portion formed a part of the land area. The slight elevation of the subaerial portion, which in few places reaches 400 feet and is for the most part less than half that height, has prevented the streams from cutting valleys of more than moderate depth, and throughout the greater portion of the area they flow in open valleys at a level only slightly lower than that of the broad, flat divides. Here and there, however, the country along the stream courses shows noticeable relief, though the variations in altitude amount to only a few hundred feet.

Drainage.—The land portion of the Coastal Plain province—that is, the subaerial division—is marked by the presence of many bays and estuaries representing submerged valleys of streams, carved during a time when the belt stood at a higher level than at present. Chesapeake Bay, which is the old valley of Susquehanna River; Delaware Bay, the extended valley of Delaware River; and

the tide-water portions of Patuxent, Potomac, York, and James rivers are examples of such bays and estuaries, and there are many others of less importance. The streams of this area which rise in the Piedmont Plateau or farther west are almost invariably turned in a direction roughly parallel to the strike of the formations as they pass out upon the Coastal Plain. With this exception the structure of the formations and the character of the materials have had little effect on stream development, except locally.

Structure.—The structure of the Coastal Plain is extremely simple, the overlapping beds having almost universally a southeasterly dip of a few feet to the mile.

Character of Materials.—The materials which are found at the surface of the Coastal Plain are boulders, pebbles, sand, clay, and marl, mostly loose or locally indurated. In age the formations range from Cretaceous to Recent. Since the oldest formations of the province were laid down there have been many periods of deposition alternating with intervals of erosion. By reason of local variations in uplift and submergence, the sea advanced and retreated to different lines in different parts of the region, so that few of the formations can now be traced by outcropping beds throughout the Coastal Plain. Different conditions therefore prevailed in different areas of the province during each period and great variability in the character and thickness of the deposits has been thus produced.

Topographic Description of Queen Anne's County.

The most prominent features of the topography of Queen Anne's County are the numerous tide-water bays and estuaries that indent the land and divide the western portion into a series of peninsulas and islands.

The relief of the county is slight, there being only a little more than 90 feet difference between the lowest and highest portions. From tide level, to which the land descends on the north and west sides, there is a gradual ascent to the uplands forming the stream

FIG. 1.—VIEW ON WICOMICO PLAIN 1½ MILES NORTH OF CENTERVILLE.

FIG. 2.—VIEW ON TALBOT PLAIN NEAR STEVENSVILLE.

divides where the greatest elevations occur. As shown on the topographic map, there is one small area with an elevation slightly exceeding 90 feet above sea level. This is located about two miles southeast of Ewington.

TOPOGRAPHIC FEATURES.

Within Queen Anne's County three different topographic features worthy of especial attention may be distinguished, namely, the tide marshes, the Talbot plain, and the Wicomico plain. These present many different characteristics but are unlike principally in the elevations at which they are found.

Tide Marshes.—The first of these topographic features to be described consists of the tide marshes that are commonly present at the heads of the estuaries or at the mouths of tributary streams. They also border the shores of Chester River, Eastern Bay, and Chesapeake Bay in some places. They lie at an elevation so low that they are sometimes inundated by unusually high tides. The most extensive marshes of this kind in Queen Anne's County are in the narrow peninsula uniting Kent Island and the mainland. The small streams that empty into many of the estuaries meander through these marshes, which are rapidly encroaching on them. These swamps are filled with a growth of sedges and other marsh plants, which aid in filling up the depressions by serving as obstructions to retain the mud carried in by streams and by furnishing a perennial accumulation of vegetable débris.

Talbot Plain.—The term plain is used in this discussion in a somewhat specialized sense, to include the terraces along the stream valleys and their continuation over the interstream areas, where they are true plains.

The Talbot plain borders the tide marshes and extends from sea level to an altitude of about 45 feet. This plain is present throughout the county along the larger streams, and also along the bay shore. It is most extensively developed in the western part of the

county where Kent Island and Wye Island exhibit its characteristics in an admirable manner. It forms a continuous band from one-half to three miles in width, extending up Chester River almost to the Delaware line. Originally the Talbot plain everywhere sloped gently to the water but wave erosion in exposed places has worn away most of the lowest-lying portions so that the bodies of tide water are now almost everywhere bordered by low wave-cut cliffs from 4 to 18 feet in height. This wearing action of the waves is almost continually in operation and with only a moderate breeze the water near the shore becomes murky, due to the many fine particles washed from the land and held in suspension. Thus the shores are being continually worn back and the transported materials dropped in the widening estuaries. The northwest winds of the winter season seem to be most effective in this destructive work and under normal conditions the headlands exposed on that side wear away most rapidly.

Except along the shores of the bays and estuaries the Talbot plain has been only slightly affected by stream action. This is because of the low elevation of the plain and the comparatively short period of time that has elapsed since it emerged from beneath the waters of Chesapeake Bay.

Wicomico Plain.—The Wicomico plain lies at a higher level than the Talbot, from which it is in many places separated by an escarpment varying in height from a few feet to 10 or 12 feet. At some places this escarpment is absent, so that there seems to be a gradual passage from the Talbot plain to the Wicomico. It is present, however, at so many different places that there is little difficulty in determining the line of separation between the two plains. The base of the escarpment lies at an elevation of about 40 feet. From that height the Wicomico plain extends upward to an elevation of about 100 feet where, in certain places on the west side of Chesapeake Bay, it is in turn separated from the next higher plain by an escarpment.

Facing Chesapeake Bay the Talbot-Wicomico escarpment is especially well defined on the Eastern Shore throughout Kent, Queen Anne's, and Talbot counties. In Queen Anne's County it has an almost due north and south course extending from near Rocky Point on Corsica River to near Wye Narrows on Wye Neck. Throughout this distance it is everywhere distinct except where cut into by westward-flowing streams. In the Chester River valley it is less pronounced yet it can easily be recognized at many points, especially at short distances to the north and northwest of McGinnes. The escarpment is an old wave-cut cliff worn by the waves of Chesapeake Bay and the Chester River when they were larger than at present and naturally the larger body of water would favor greater erosive action along its shores.

The Wicomico plain slopes gently toward Chesapeake Bay and also is somewhat lower in the southern part of the county than in the northern.

The Wicomico plain is older than the Talbot and has suffered more erosion. The streams which cross it have cut deeper valleys than those in the Talbot plain and have widened their basins to such an extent as to destroy, in great measure, the original continuity of its level surface near its western and northern margins. In the eastern part of the county, however, it is so level that in certain places it becomes necessary to resort to artificial drainage.

DRAINAGE.

The drainage of Queen Anne's County is comparatively simple, as a result of the simple structure of the Coastal Plain formations and the contiguity of the region to Chesapeake Bay. The greater part of the land of the area is naturally drained. In some places this is effected principally through underground drainage, as on the broad flat divides between the tributary streams in the western portion of the county. In the eastern portion of the county the land is so level over large areas that the water is drained from the land very slowly and it is necessary to ditch crop lands.

Tide-Water Estuaries.—The lower courses of almost all the larger streams are estuaries through submergence which has permitted tide water to pass up the former valleys of the streams. In the early development of the country these estuaries were of great value, as they are navigable for many miles from their mouths and thus afford means for ready transport of the produce of the region to market. Even the advent of railroads has not rendered them valueless and much grain and fruit are now shipped to market by water.

Chesapeake Bay and its tributary estuaries also furnish good fishing grounds, and during certain seasons they are frequented by wild waterfowl in such numbers that they have long been known to sportsmen as among the finest in the country.

The channel of Chesapeake Bay along Queen Anne's County varies from 60 to 126 feet in depth except in the vicinity of Love Point where it shoals to about 36 feet. Steamboats from Baltimore pass up the Chester River as far as Chestertown while smaller vessels can go practically to the head of tide water. Similar conditions prevail in Wye and Corsica rivers and the various less important estuaries.

The water in the estuaries is decidedly brackish in the lower portions but almost fresh near the head of tide water in all cases where there are incoming fresh-water streams. There is seldom any distinct current in the estuaries except such as is due to the incoming and outgoing tides and this appears to be nearly as strong when moving up stream as when moving in the opposite direction.

Minor Streams.—Besides the estuaries which form so prominent a feature in this county, there are numerous minor streams which flow into them. At the head of almost every estuary there is a small stream which in most cases is shorter than the estuary itself. In this county these streams are all of small size and yet are of great importance in the drainage of the region.

Water Power.—The fall of the streams is so slight that little water power can be obtained in the county. However, in a few places the minor streams have been dammed and the power utilized to run small mills. All such streams head in the Wicomico plain and flow across the Talbot plain to tide level. The streams that are entirely in the Talbot plain do not have sufficient fall to be of any importance.

Topographic History.

The history of the development of the topography as it exists today is not complicated and covers several different periods, during all of which the conditions must have been very similar. It is merely the history of the development of the plains already described as occupying different levels, and of the present drainage channels. The plains of Queen Anne's County are all plains of planation and deposition which have been more or less modified by the agencies of erosion. Their deposition and subsequent elevation to the height at which they are now found indicate merely successive periods of depression and uplift. The drainage channels have throughout most of their courses undergone many changes; periods of cutting have been followed by periods of filling and the present valleys and basins are the result of these opposing forces.

Wicomico Stage.—When the Pleistocene Coastal Plain had been above water for a considerable interval a gradual submergence occurred, so that the ocean waters encroached on the land. This submergence seems to have been about equal in amount throughout a large portion of the district, showing that the downward movement was without tilting. The sea did not advance on the land so far as during the previous submergences. The waves beat against the shore and in many places cut cliffs into the older deposits. Throughout many portions of the Coastal Plain these old sea cliffs are still preserved as escarpments, some of them 10 to 15 feet in height. Where the waves are not sufficiently strong to cut cliffs it

is somewhat difficult to locate the old shore line. During this time nearly all of the Eastern Shore and a considerable part of the Western Shore of Maryland were submerged. The earlier deposits were largely destroyed by the advancing waves and redeposited over the floor of the Wicomico sea, though those portions lying above 90 to 100 feet were for the most part preserved. Deposition of materials brought down by streams from the adjoining land also took place.

Although the Wicomico submergence permitted the silting up of the drowned stream channels, yet the deposits were not thick enough to fill them entirely. Accordingly in the uplift following the Wicomico deposition the larger streams again reoccupied their former channels, with perhaps only slight changes. New streams were also developed and the Wicomico plain was more or less dissected along the water courses, the divides being at the same time gradually narrowed. This erosion period was interrupted by the Talbot submergence, which carried part of the land beneath the sea and again drowned the lower courses of the streams.

Talbot Stage.—The Talbot deposition did not take place over so extensive an area as had that of the Wicomico. It was confined to the old valleys and to the low stream divides where the advancing waves destroyed the Wicomico deposits. The sea cliffs were pushed back as long as the waves advanced and now stand as escarpments to mark the boundaries of the Talbot sea and estuaries, forming the Talbot-Wicomico scarp line previously described. In some places the deposits were so thick in the old stream channels that the streams in the succeeding period of elevation and erosion found it easier to excavate new courses. Generally, however, the streams once more reoccupied their former channels and renewed the corrasive work which had been interrupted by the Talbot submergence. The Talbot plain has now in many place been rendered somewhat uneven by this erosion, yet it is less irregular than the remnants of

the Wicomico and earlier plains, which were subjected to denudation for a much longer period of time.

Recent Stage.—The land probably did not long remain stationary with respect to sea level before another downward movement was inaugurated. This last subsidence is probably still in progress. Before it began the Chester and Wye rivers, instead of being estuaries, were undoubtedly streams of varying importance lying above tide and emptying into the diminished Chesapeake Bay west of their present mouths. Whether this downward movement will continue much longer or not cannot be determined, but there is sufficient evidence with respect to Delaware River to show that this movement has been in progress within very recent time and undoubtedly is still going on. Many square miles that had been land before this subsidence commenced are now beneath the waters of Chesapeake Bay and its estuaries and are receiving deposits of mud and sand from the adjoining land.

THE GEOLOGY OF QUEEN ANNE'S COUNTY

BY

BENJAMIN L. MILLER

Introductory.

The geologic formations represented in Queen Anne's County range in age from Eocene to Recent. Deposition has not been continuous, yet none of the larger geologic divisions since Cretaceous time is entirely unrepresented. Periods of deposition over part or the whole of the region are separated by other periods of greater or less duration in which the entire region was above water and erosion was active. Aside from the Pleistocene formations the deposits are similar in many respects. With a general northeast-southwest strike and a southeasterly dip, each formation disappears by passing under the next later one. In general, also, the shore line in each successive submergence evidently lay a short distance to the southeast of its position during the previous submergence. Thus, in passing from northwest to southeast, one crosses the outcrops of the successive formations in the order of their time of deposition. There are a few exceptions to this, however, that will be noted in the descriptions which follow.

GEOLOGIC FORMATIONS OF QUEEN ANNE'S COUNTY.

System	Series	Group	Formation
Quaternary	Recent	.....	Beach sand and marsh deposits
	Pleistocene	Columbia	Talbot
			Wicomico
Tertiary	Miocene	Chesapeake	Calvert
	Eocene	Pamunkey	Aquia

The Eocene Formations.

THE PAMUNKEY GROUP.

The Aquia Formation.

Name.—The Aquia formation receives its name from Aquia Creek, a tributary of the Potomac River in Virginia, where deposits belonging to this horizon are characteristically developed. The name was proposed by Wm. Bullock Clark in 1905.*

Areal Distribution.—The Aquia is exposed throughout a narrow belt along the Chester River from a short distance above Chestertown to Corsica River. Beneath the cover of Talbot materials it undoubtedly extends all along the Chester River from Roundtop Wharf to its mouth. To the southeast it disappears beneath the deposits of the Calvert formation. In its wider distribution the Aquia formation extends from Virginia northeastward across Maryland to Delaware.

Character of Materials.—This formation consists usually of loose sand in which there is a considerable admixture of glauconite, the latter in places making up the body of the formation. Where the material is fresh it has a dark-green color but in regions where it has been exposed to weathering for a considerable time it has a reddish-brown to light-gray color. Sometimes the weathered material resembles a mixture of pepper and salt. The beds are in most places unconsolidated, although locally some have become very firmly indurated by oxide of iron. The iron oxide, in such cases, has been formed through the decomposition of the glauconite and the combination of the iron of that mineral with oxygen from the atmosphere. Examples of such sandstones can be seen at the mouth of South East Creek, and still better illustrations occur on the Kent County side of Chester River opposite Rolphs.

* Clark, Wm. Bullock. Johns Hopkins Univ. Circ., 1895, p. 3.

SECTION AT DEEP POINT, CHESTER RIVER.

			Feet
Pleistocene.			
	Talbot.	Sandy loam containing some gravel.....	2
Eocene.			
	Aquia.	Ferruginous sandstone filled with fossil impressions, the upper 9 feet loosely consolidated, the lower 3 feet firmly indurated. Exposed to water.....	12
			14

Paleontologic Character.—The Aquia formation contains fossils in large numbers and belonging to various species. One hundred and seventy species of fossils have been described and illustrated from the Aquia of Maryland and Virginia in the report on the Eocene issued by the Maryland Geological Survey. Along the Chester River the following forms are most abundant:

Panopea elongata
Dosiniopsis lenticularis
Protocardia lenis
Venericardia planicosta var. regia
Crassatellites alaeformis
Pecten choctavensis
Pecten dalli
Glycymeris idoneus
Cucullaea gigantea

Strike, Dip, and Thickness.—The Aquia formation in Maryland is about 100 feet thick. In Queen Anne's County the outcropping beds do not represent a thickness of more than 25 to 30 feet. To the southeast, however, beneath the Miocene cover, the formation is much thicker. It has a northeast-southwest strike and dips to the southeast at the rate of about 10 to 12½ feet to the mile.

Stratigraphic Relations.—The Aquia formation includes the oldest strata exposed in this county so that one must go elsewhere to find the underlying strata. In Kent County and on the Western Shore the formation is seen to overlie the Monmouth formation of the Cretaceous. The Aquia is overlain by the Calvert formation in this county, except in the vicinity of outcrop where it is covered by

the surficial deposits belonging to the Talbot and Wicomico formations, but in Anne Arundel, Prince George's, and Charles counties a later Eocene formation, the Nanjemoy, lies between the Aquia and Calvert.

Subdivisions.—The Aquia formation has been subdivided into two members, or substages, known as Piscataway and Paspotansa, which are distinguished from each other by their contained fossils. These are described in the Eocene report previously mentioned. All the beds exposed in Queen Anne's County belong to the latter member, the Paspotansa.

The Miocene Formations.

THE CHESAPEAKE GROUP.

The Calvert Formation.

Name.—This formation receives its name from Calvert County, Maryland, where, in the well-known Calvert Cliffs bordering Chesapeake Bay, its typical characters are well shown. The name was proposed in 1902 by G. B. Shattuck.*

Areal Distribution.—The Calvert formation extends from New Jersey in a southwesterly direction to southern Virginia where it disappears through an overlapping of later formations. It is best developed in Maryland and northern Virginia. In the latter state it presents excellent exposures in the prominent Nomini Cliffs along the Potomac River.

In Queen Anne's County the Calvert formation outcrops in the valleys of almost all the streams that head in the Wicomico plain and especially near the margin of this plain. These streams in their destructive work have removed the overlying Pleistocene materials exposing the older beds. The erosive action of the waves has also cut low cliffs bordering the estuaries and exposing the Calvert strata. Such cliffs are always low and the Miocene is only exposed where the surficial deposits are thin. Along the Wye River and

* Shattuck, G. B. Science, n.s., Vol. XV, 1902, p. 906.

CHARACTERISTIC EOCENE FOSSILS IN QUEEN ANNE'S COUNTY.

1. Turbinolia acuticostata Vaughan. 2. Carpolithus marylandicus Hollick. 3. Meretrix ovata var pyga Conrad. 4. Modiolus alabamensis Aldrich. 5. Ostrea compressirostra Say. 6. Globigerina bulloides d'Orb. (greatly enlarged). 7, 8. Crassatellites alaeformis (Conrad). 9. Strepsidura subscalarina Heilprin. 10. Calyptraphorus trinodiferus Conrad var. 11. Corbula aldrichi Meyer. 12. Venericardia planicosta var regia Conrad. 13. Pleurotoma tysoni Clark & Martin. 14. Dosiniopsis lenticularis (Rogers). 15. Cucullaea gigantea Conrad. 16. Turritella mortoni Conrad.

Chester River in the vicinity of Queenstown the Calvert is thus exposed in many places at the base of the low cliffs. The formation is present over practically the entire county except a narrow band along the Chester River and the northern part of Kent Island. In most places within the county it is concealed beneath the Pleistocene formations.

Character of the Materials.—The materials of the Calvert formation are blue, drab, and yellow clay, yellow to gray sand, gray to white diatomaceous earth, and calcareous marl. Between these all gradations exist. The diatomaceous earth gradually passes into fine sand by the increase of arenaceous material, or into a clay by the addition of argillaceous matter. In a similar way a sand deposit with little or no clay grades over into a deposit of clay in which the presence of sand cannot be detected. Notwithstanding this variety of materials a certain sequence is commonly observed; the basal portions of the formation in most places consisting largely of diatomaceous earth, and the upper portions chiefly of sand, clays, and marls. This difference in materials has led to a subdivision of the formation into two members, which are described below.

In Queen Anne's County the Calvert is predominantly sandy, the sand being especially fine and loose, and consisting of pure quartz grains. In these mealy sand strata are many layers of fossil shells, which are usually entire although so greatly decayed that they readily crumble. These fossiliferous strata have been worked in many places and the materials spread on the fields for fertilizing purposes. The following sections are characteristic of the formation in this county:

SECTION JUST BELOW EARLE COVE ON CORSICA RIVER.

		Ft.	In.
Pleistocene.			
Talbot.	Yellowish-brown loamy sand containing some gravel, poorly exposed	6	
Miocene.			
Calvert.	Buff to yellowish-brown, loose, fine sand	6	6

	Fossil layer, shells greatly decayed in matrix of loose fine sand. *Pecten madisonius, Melina maxillata, Chama congregata,* and *Arca marylandica* especially abundant...	1	6
	Impure sandy diatomaceous earth containing some fossil impressions, exposed to water	6	
	Total.....	20	

SECTION EXPOSED ON WEST SIDE OF WYE ISLAND.

		Ft.	In.
Pleistocene.			
Talbot.	Surface clay loam containing vegetable material	1	6
	Yellowish-brown, sandy clay becoming more sandy at base.....	5	
	Pebble band, pebbles about 1 inch in diameter		1–½
	Compact, light-drab clay.....		10
	Unconformity.		
Miocene.			
Calvert.	Ferruginous brown sand.....		10
	Indurated fossiliferous rock consisting of sand cemented with calcium carbonate; *Ostrea compressirosta* and *Balanus concavus* especially abundant.....		3
	Fine buff quartz sand containing few specimens of *Ostrea compressirosta*.....	1	8
	Sand similar to above containing many shell fragments; material indurated in places..	1	6
	Fine buff sand containing many fossils; *Pecten* n.sp. especially abundant.....	5	
	Firmly indurated rock consisting of quartz sand cemented with calcium carbonate and containing many fossil impressions and casts. Exposed to water.....	1	6
	Total.....	18	2–½

PALEONTOLOGIC CHARACTER.—The Calvert formation of Maryland has yielded an abundance of fossils which have been described in two volumes on the Miocene published by the Maryland Geological Survey. In those volumes the following forms from the Calvert formation have been described and figured:

Mammalia	22 species
Reptilia	7 "
Pisces	24 "

Arthropoda	33	"
Gastropoda	110	"
Cephalopoda	1	"
Amphinema	1	"
Scaphoda	4	"
Pelecypoda	119	"
Brachiopoda	1	"
Bryozoa	8	"
Vermes	1	"
Hydrozoa	3	"
Anthrozoa	1	"
Radiolaria	21	"
Foraminifera	18	"
Diatomaceae	28	"

Altogether 402 species are included and the list is not by any means exhaustive. The diatom list is far from complete while many new forms of mollusca have been recognized since the publication of the volumes. Except in the diatomaceous earth beds where diatoms and radiolaria occur in countless millions and form the main mass of the material, the pelecypods and gastropods are the most abundant fossils and numerous specimens of both these groups are found wherever fossiliferous strata occur. The most common Calvert fossils of the Eastern Shore are the following which have been found in many places in Queen Anne's and Talbot counties:

Turritella plebeia
Turritella aequistriata
Caecum patuxentum
Polynices duplicatus
Polynices heros
Ecphora quadricostata
Crucibulum costatum
Cadulus thallus
Arca (Scapharca) staminea
Arca (Barbatia) marylandica
Astarte obruta
Astarte thisphila
Pecten madisonius
Melina maxillata
Ostrea compressirostra
Venua plena
Venus campechiensis

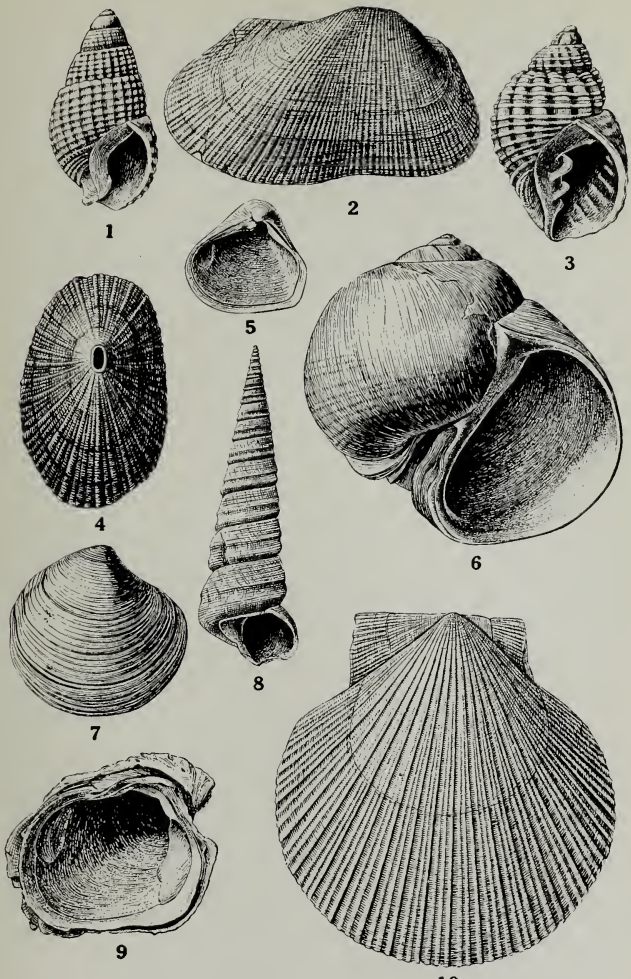
Dosinia acetabulum
Corbula idonea
Corbula inaqualis

Strike, Dip, and Thickness.—The strike of the Calvert formation is in general from northeast to southwest but in some places varies to an almost north-south direction. In flat regions, such as prevail in many places on the Eastern Shore, the line of outcrop is approximately parallel to the strike but naturally this is not the case in a region of irregular topography.

The dip of the Calvert formation is from 9 to 11 feet to the mile toward the southeast. This varies a few degrees, however, depending upon local irregularities of deposition. Since few single beds can be traced any considerable distance the exact determination of the dip is difficult. In the region of outcrop on the Eastern Shore, the thickness of the Calvert formation is about 75 feet. The full thickness does not outcrop, however, due to the overlapping strata of the Choptank formation concealing the upper beds. In a deep well at Crisfield, Somerset County, the Calvert seems to be about 300 feet thick.

Stratigraphic Relations.—In Queen Anne's County the Calvert formation rests unconformably upon the Aquia. In Talbot County it passes beneath the Choptank formation which is a later Miocene member, but in this county it is overlain by Pleistocene strata belonging to the Wicomico and Talbot formations.

Subdivisions.—The Calvert formation has been divided into two members known as the Fairhaven diatomaceous earth and the Plum Point marls. These are fully described in the report on the Miocene of Maryland issued by this Survey. On the western side of Chesapeake Bay, particularly in Calvert County, these members can readily be distinguished but are much less distinct on the Eastern Shore and no attempt has been made to differentiate them in Queen Anne's County.



CHARACTERISTIC MIOCENE FOSSILS OF MARYLAND.

1. Nassa trivittatoides (Whitfield). 2. Arca (Barbatia) marylandica Conrad. 3. Cancellaria alternata Conrad. 4. Fissuridea griscomi (Conrad). 5. Corbula elevata Conrad. 6. Polynices heros (Say). 7. Phacoides trisulcatus (Conrad). 8. Turritella æquistriata Conrad. 9. Chama congregata Conrad. 10. Pecten marylandicus Wagner.

The Pleistocene Formations.

THE COLUMBIA GROUP.

The Pleistocene formations of the Atlantic Coastal Plain were at one time supposed to constitute a stratigraphic unit and were described under the name of the Columbia formation. Later, however, it was found that the Pleistocene deposits were divisible into several formations and the names Sunderland, Wicomico, and Talbot were applied to the separate formations. They possess many characteristics in common due to their similar origin, and consist of gravels, sand, and loam.

The Columbia group in Queen Anne's County is represented by the Wicomico and Talbot formations, the older higher-lying Sunderland strata having never been deposited in this County. They appear as the facings of different plains or terraces, possessing very definite physiographic relations as described under the heading "Topographic features."

On purely lithologic grounds it is impossible to separate the three formations composing the Columbia group. The materials of all have been derived mainly from the older formations which occur in the immediate vicinity, but include more or less foreign material brought in by streams from the Piedmont Plateau or from the Appalachian region beyond. The deposits of each of these formations are extremely varied, their general character changing with that of the underlying formations. Thus deposits belonging to the same formation may, in different regions, differ far more lithologically than deposits of two different formations lying in proximity to each other and to the common source of most of their material. Cartographic distinctions based on lithologic differences could not fail to result in hopeless confusion. At some places the older Pleistocene deposits are more indurated and their pebbles more decomposed than those of the younger formations, but these differences cannot be used as criteria for separating the formations, inasmuch as loose

and indurated, fresh and decomposed materials occur in each of them.

The fossils found in the Pleistocene are far too meager to be of much service in separating the deposits into distinct formations, even though essential differences between some of them may exist. It is the exceptional and not the normal development of the formations that has rendered the preservation of fossils possible. These consist principally of fossil plants that were preserved in bogs, but in a few places about Chesapeake Bay local Pleistocene deposits contain great numbers of marine and estuarine mollusks.

The Columbia group, as may be readily seen, is not a physiographic unit. The formations occupy wave-built terraces or plains separated by wave-cut escarpments, their mode of occurrence indicating different periods of deposition. At the bases of many of the escarpments the underlying Cretaceous and Tertiary formations are exposed. The highest terrace is occupied by the oldest deposit, the Sunderland; while the lowest is covered with Talbot materials.

At almost every place where good sections of Pleistocene materials are exposed the deposit from base to top seems to be a unit. At some places, however, certain layers or beds are sharply separated from the underlying beds by irregular lines of unconformity. Some of these breaks disappear within short distances, showing clearly that they are only phenomena in the same formation, the result of contemporaneous erosion by shifting shallow-water currents. Whether all these breaks would thus disappear if sufficient exposures occurred to permit the determination of their true nature is not known. An additional fact which indicates the contemporaneous erosive origin of these unconformities is that in adjoining regions they seem to have no relation to one another. Inasmuch as the Pleistocene formations lie in a nearly horizontal plane it would be possible to connect these separation lines if they were subaerial unconformities due to an interval of erosion. In the absence of any

definite evidence that these lines are stratigraphic breaks separating two formations, they have been disregarded. Yet it is not improbable that in some places the waves of the advancing sea in Wicomico, and Talbot time did not entirely remove the beds of each preceding period of deposition over the area covered by the sea in its next transgression. Especially would materials laid down in depressions be likely to persist as isolated remnants which later were covered by the next mantle of Pleistocene deposits. If this is the case each formation is probably represented by fragmentary deposits beneath the later Pleistocene formations. Thus in certain sections the lower portions may represent an earlier period of deposition than that of the overlying beds. In regions where pre-Quaternary materials are not exposed at the bases of the escarpments each Pleistocene formation near its inner margin probably rests upon the attenuated edge of the next older formation. Inasmuch as lithologic differences afford insufficient criteria for separating these deposits, and as sections are not numerous enough to furnish distinctions between local interformational unconformities and widespread unconformities resulting from an erosion interval, the whole mantle of Pleistocene materials occurring at any one locality is referred to the same formation. The Sunderland is described as overlying the Cretaceous and Tertiary deposits and as extending from the base of the Brandywine-Sunderland escarpment to the base of the Sunderland-Wicomico escarpment. The few deposits of Brandywine materials which may possibly underlie the Sunderland are disregarded because they are unrecognizable. Similarly the Wicomico is described as including all the gravels, sands, and clays overlying the pre-Brandywine deposits and extending from the base of the Sunderland-Wicomico escarpment to the base of the Wicomico-Talbot escarpment. Perhaps, however, materials of Brandywine and of Sunderland age may underlie the Wicomico in places. In like manner the Talbot may here and there rest upon deposits of the Brandywine, Sunderland, and Wicomico.

The Wicomico Formation.

Name.—This formation receives its name from Wicomico River, in southern Maryland. The name was proposed by G. B. Shattuck in May, 1901.* The Wicomico represents the upper part of the Later Columbia of McGee and Darton and a part of the Pensauken of Salisbury. The presence of ice-borne boulders furnishes evidence for its contemporaneity with the ice invasion, although the particular drift sheet with which the formation should be correlated has not yet been determined.

* Amer. Geol. Vol. 28, 1901, pp. 87-107.

Areal Distribution.—The Wicomico formation is co-extensive with the Wicomico plain previously described and forms a broad area extending through the eastern portion of the county. At one time it covered a still greater area but erosion has removed much of it, and, at the present time, many streams are actively engaged in pushing their headwaters farther into the plain and removing the Wicomico materials that conceal the Tertiary formations, and eventually the formation will be represented by isolated areas of small extent lying between the streams. This has already happened in many places on the western side of Chesapeake Bay where erosion has been more active.

Character of Materials.—The materials which compose the Wicomico formation consist of clay, sand, gravel, and ice-borne boulders. As explained above, these materials as a rule do not lie in well-defined beds, but grade into each other both vertically and horizontally. The coarser materials, with the exception of the ice-borne boulders, have in the main a cross-bedded structure but the clays and finer materials are either developed in lenses or horizontally stratified. The erratic ice-borne blocks are scattered through the formation and may occur in the gravel, sand, or loam. The coarser material throughout the formation tends to occupy the

lower portions, but the transition from one to the other is not marked by an abrupt change, and at many places the coarse materials are present in the surface loam and the finer materials are below, in the gravel.

In the Potomac Valley near Washington boulders carrying glacial striae have been found in the Wicomico formation. The great size of these boulders, however, and their occurrence with much finer materials furnish evidence of their transportation by floating ice.

The amount of loam present in the Wicomico is exceedingly variable. Wherever the loam cap is well developed the roads are very firm and the land is suitable for the production of grass and grain; but where the loam is present in small quantities or absent altogether the roads are apt to be sandy.

SECTION NEAR GEARY MILLPOND.

		Feet.
Pleistocene.		
Wicomico.	Gray sandy loam	2
	Pebble layer, small quartz pebbles few exceeding 1 inch in diameter	3
	Coarse gray sand with some pebbles and a layer of angular sandstone boulders, some of which are over a foot in diameter, at base	2
	Laminated drab, brick-red, and yellowish-brown clay, very sandy in places, exposed	5
	Total	12

Paleontologic Character.—The fossils of the Wicomico formation are limited to some plant remains and a few vertebrate bones preserved in old bogs. In Queen Anne's County, however, no fossils have been found in deposits of this age.

Strike, Dip, and Thickness.—As a whole the formation occupies approximately a horizontal position with very slight dip toward the main drainage channels. In Queen Anne's County the dip is toward the west or northwest but so slight in amount that it is difficult to determine it on account of local irregularities. The

thickness of the Wicomico formation is not at all uniform, owing to the uneven surface upon which it was deposited. It ranges from a few feet to 50 feet or more. The formation dips into the valleys and rises on the divides, so that its thickness is not so great as might be supposed from the fact that the base is in many places as low as 30 feet while the surface rises locally to 90 feet above sea level. The average thickness of the formation in this county is about 20 feet.

Stratigraphic Relations.—In this region the Wicomico rests unconformably upon portions of the Aquia or Calvert formations. As previously stated, there may be small portions of the Wicomico underlying the Talbot strata in certain places but it is difficult to prove that such is the case. Wherever the Wicomico has been definitely recognized it is exposed at the surface and has never been overlain by later deposits.

The Talbot Formation.

Name.—Talbot County, Maryland, where the formation occupies a broad terrace bordering numerous estuaries, has furnished the name for this formation. It was first given by G. B. Shattuck in 1901 (op. cit.) The Talbot represents the lower part of the Later Columbia described by McGee and Darton and corresponds approximately to the Cape May formation of Salisbury. Its Pleistocene age is proved by the fossils found at Cornfield Harbor and by its contemporaneity with a part of the ice invasion of the northern portion of the country, as shown by the numerous ice-borne boulders found in its deposit.

Areal Distribution.—The Talbot formation is co-extensive with the Talbot plain previously described and is the surface formation in the entire western portion of the county and covers the discontinuous low-lying terrace that extends up the valley of Chester River almost to the Delaware state line. It is dissected by many estuaries and in some places the waves have worn away the thin cover of Talbot materials exposing the underlying Miocene strata.

Character of Materials.—The materials which compose the Talbot formation consist of clay, peat, sand, gravel, and ice-borne boulders. As in the Wicomico deposits, these materials grade into each other both vertically and horizontally, and the formation exhibits the same tendency toward a bipartite division, with the coarser materials beneath and the finer materials above. There is, on the whole, much less decayed material in the Talbot than in the preceding formation and as a result it has a much younger appearance. In this county the most abundant material in the Talbot formation is drab compact clay that is distinctly sandy in places and commonly stained by limonite. Such materials are especially noticeable in the bluffs along the shores of Chesapeake Bay and near the mouths of the larger estuaries. Iron oxide is a common constituent of the Talbot and locally it is abundant enough to constitute a firm cementing material.

Old peat bogs are found in many places about Chesapeake Bay in the Talbot formation. In this county there are no good ones exposed yet there are several that show the characteristic features and mode of formation. These occur at Deer Landing, Booker's Wharf, and just above the mouth of Wolsey Creek on the Chester River. They contain partially lignitized stems and twigs in a matrix of clay. In places the material is an impure peat.

SECTION ON WEST SIDE OF KENT ISLAND, JUST BELOW MOUTH OF BROAD CREEK.

		Feet.
Pleistocene.		
Talbot.	Brown sandy clay loam	5
	Drab clay, very hard and compact when dry	3
	Loose brown sand containing a few pebbles and small boulders and some lignite	6
	Gravel and cobble bed, exposed	2
	Total	16

Paleontologic Character.—The Talbot formation in Maryland has yielded plant remains from the old peat bogs, marine invertebrates from a few localities in St. Mary's, Baltimore, and Caroline

counties, and vertebrate bones from many places. So far as known no plant or invertebrate remains of this age have ever been collected from Queen Anne's County. Mitchell in 1818, and Hayden in 1820 refer to the finding of a grinder of an elephant that was dug up on the estate of a Mr. Carmichael of this county.

Strike, Dip, and Thickness.—The thickness of the Talbot formation is extremely variable, ranging from a few feet to 40 feet or more. The unevenness of the surface upon which it was deposited has in part caused this variability. The proximity of certain regions to the mouth of streams during the Talbot submergence also accounts for the increased thickness of the formation in such areas. The deposits occupy a nearly horizontal position, having only a slight slope toward Chesapeake Bay and its estuaries.

Stratigraphic Relations.—The Talbot rests unconformably, in different portions of the region, upon the older formations of the Eocene or Miocene. It may in places rest upon deposits of Wicomico age, although no positive evidence has yet been found to indicate such relations. The Talbot passes beneath the waters of Chesapeake Bay and its estuaries where it is covered by Recent deposits now in process of formation.

The Recent Deposits.

In addition to the two terraces already discussed, a third is now being formed by the waters of the rivers and the waves of the estuaries. This terrace is everywhere present along the water's edge, extending from a few feet above tide to a few feet below. It is the youngest and topographically the lowest of the series. Normally it lies beneath and wraps about the margin of the Talbot terrace, from which it is separated by a low scarp that as a rule does not exceed 15 to 20 feet in height. Where the Talbot formation is absent, the Recent terrace may be found at the base of the other terrace. In such places, however, the scarp which separates them is much higher. Peat, clay, sand, and gravel make up the formation

FIG. 1.—VIEW ON THE WICOMICO-TALBOT ESCARPMENT BETWEEN CHURCH HILL AND CHESTERTOWN.

FIG. 2.—VIEW IN MATURE PINE-HARDWOOD FOREST ON CORSICA NECK, 5 MILES WEST OF CENTERVILLE.

and these materials are deposited in deltas, flood plains, beaches, bogs, dunes, bars, spits, and wave-built terraces. Fossils, if the recently buried organic remains can be so called, are very common, but consist almost exclusively of vegetable débris covered by swamp deposits, and of brackish-water animals of living species entombed in the muds of Chesapeake Bay and its estuaries.

Interpretation of the Geologic Record.

Almost all the formations which occur within Queen Anne's County have a much more extensive development beyond its borders. If study were confined to the area of this county alone many of the conclusions drawn from such investigations might be unsatisfactory and erroneous. The geologic history of the county, which is here outlined, has been based on work done not only in this area but also throughout the North Atlantic Coastal Plain from Raritan Bay to Potomac River and in certain localities in Virginia and the Carolinas.

A study of the geologic history of Queen Anne's County shows that it has been long and complicated. This is indicated by the many different kinds of strata represented and by the relations which they bear to one another. There are deposits that were formed in fresh or brackish water; others that show evidence of their deposition in marine waters; while breaks in the conformity of the different strata indicate that from the time of the formation of the earliest beds down to the present day the region has undergone many elevations and subsidences.

Sedimentary record of the pre-Eocene rocks.

In Queen Anne's County the oldest rocks exposed at the surface belong to the Aquia formation. From deep-well borings and from observations made elsewhere in the State we know, however, that many older rocks lie beneath the Eocene strata. Those directly below belong to the Cretaceous period while beneath them is the floor of crystalline rocks which appears at the surface west of a

line passing through Wilmington, Baltimore, and Washington and constitute the Piedmont Plateau. The time represented by these rocks involves many millions of years. The crystalline rocks are so greatly folded and crushed and have been altered from their original condition to such an extent that it is difficult to definitely determine their history. It is believed, however, that they represent shales, sandstone, and limestones, with some igneous rocks that have subsequently been metamorphosed to form marbles, schists, and gneisses.

The rocks lying directly upon the crystalline rocks belong to the Cretaceous which seems to prove that the region had remained as a land mass for a very long period of time prior to the Cretaceous period or if the region were beneath the water at any time during that interval and deposits formed they were later wholly removed. During the Cretaceous the region was elevated and depressed many times and deposits of estuarine and of marine origin were lain down.

SEDIMENTARY RECORD OF THE EOCENE FORMATIONS.

At the close of the Cretaceous period the recently deposited sediments were uplifted to form a land mass and sedimentation was succeeded by erosion. In early Tertiary time a depression carried the region again beneath the waters of the ocean and the Eocene deposits were formed. The great amount of glauconite present in these formations indicates that the adjacent land mass must have been low and flat, so that the streams carried in only small amounts of terrigenous material. The water in which this was dropped was doubtless shallow, as glauconite is not produced at great depths. The land-derived materials at the beginning of the Eocene consisted of small, well-rounded pebbles which were deposited in several places in the region; but later the materials carried consisted of fine sand or clay. Many forms of animal life existed in these waters and their remains now compose layers of marl several feet in thickness.

Studies of the fossils found in the Eocene deposits indicate that there were many changes in the fauna during this time. These changes were probably influenced to a greater or less extent by variations in physical environment, yet the character of the deposits themselves gives little evidence of such changes. Instead it seems that the conditions under which the Eocene deposits were produced were remarkably uniform, considering the great length of time involved.

SEDIMENTARY RECORD OF THE MIOCENE FORMATIONS.

Eocene sedimentation was brought to a close by an uplift by which the shore line was carried far to the east and probably all of the present State of Maryland became land. This was followed by a submergence and another cycle was commenced. The deposits of the Miocene were laid down upon the land surface which had just been depressed beneath the water. Sluggish streams brought in fine sand and mud, which the waves and ocean currents spread over the sea bottom. Occasionally leaves from land plants were also carried out to sea and later dropped to the bottom as they became saturated with water.

Near the beginning of the Miocene submergence, certain portions of the sea bottom received little or no materials from the land, and the water in those places was well suited as a habitat for diatoms. These must have lived in the waters in countless millions, and as they died their siliceous shells fell to the bottom and formed the beds of diatomaceous or "infusorial" earth which are so common in the lower part of the Calvert formation. Many Protozoa as well as Mollusca lived in the same waters and their remains are plentifully distributed throughout the deposits. During the Miocene epoch the conditions seem to have been favorable for animal life, as may be inferred from the great deposits of shell marl which were formed.

After the deposition of the Calvert formation the region was again raised and subjected to erosion for a short period, and then sank once more beneath the sea. The Choptank formation which is

present in Talbot County was laid down contemporaneously with the advancing ocean. This formation lies unconformably upon the Calvert. In neighboring regions still farther south and southwest of this county a third Miocene formation, the St. Mary's, was deposited conformably upon the Choptank.

SEDIMENTARY RECORD OF THE PLEISTOCENE FORMATIONS.

At the beginning of the Pleistocene epoch the region was submerged again and received the deposits which constitute the Columbia group. The Sunderland, Wicomico, and Talbot formations, which make up this group, are exposed over a series of terraces lying one above another throughout the North Atlantic Coastal Plain from Raritan Bay to Potomac River, as well as in Virginia and probably still farther south.

After the close of the post-Brandywine erosion period the Coastal Plain was gradually lowered and the Sunderland sea advanced over the sinking region. The waves of this sea cut a scarp against the existing headlands of Brandywine and older rocks. This scarp was prominent in some places and obscure in others, but may be readily recognized in certain localities. As fast as the waves supplied the material, the shore and bottom currents swept it out to deeper water and deposited it so that the basal member of the Sunderland formation, a mixture of clay, sand, and gravel, represents the work of shore currents along the advancing margin of the Sunderland sea; whereas the upper member, consisting of clay and loam, was deposited by quieter currents in deeper water after the shore line had advanced some distance westward and only the finer material found its way very far out. Ice-borne boulders are also scattered through the formation at all horizons.

After the deposition of the Sunderland formation, the country was again elevated above ocean level and erosion began to tear away the Sunderland terrace. In Queen Anne's County it was probably entirely removed, although, as stated on a preceding page,

there may be remnants of it still preserved beneath the Wicomico and Talbot sediments. This elevation, however, was not of long duration and the country eventually sank below the waves again. At this time the Wicomico sea repeated the work which had been done by the Sunderland sea except that it deposited its materials at a lower level and cut its scarp in the Sunderland formation. At this time also there was a contribution of ice-borne boulders which were deposited promiscuously over the bottom of the Wicomico sea. These are now found at many places embedded in the finer material of the Wicomico formation.

At the close of the Wicomico time the country was again elevated and eroded and then lowered to receive the deposits of the Talbot sea. The geologic activities of Talbot time were a repetition of those carried on during Sunderland and Wicomico time. The Talbot sea cut its scarp in the Wicomico formation, or in some places removed the Wicomico completely and cut into the Sunderland or still older deposits. Deposits were made on its terrace, a flat bench at the base of this escarpment. Ice-borne boulders are also extremely common in the Talbot formation, showing that blocks of ice charged with detritus from the land drifted out and deposited their load over the bottom of the Talbot sea.

Embedded in the Talbot formation near the mouth of Wolsey Creek on Chester River there is a lens of drab-colored clay bearing plant remains. The stratigraphic relations of this and similar lenses of clay occurring elsewhere in the Coastal Plain show that they are invariably unconformable with the underlying formation and apparently so with the overlying sand and loams belonging to the Talbot. This relationship was very puzzling until it appeared that the apparent unconformity with the Talbot, although in a sense real, does not, however, represent an appreciable lapse of time and that, consequently, the clay lenses are actually a part of that formation. In brief, the clays carrying plant remains are regarded as lagoon deposits made in ponded stream channels and gradually

buried beneath the advancing beach of the Talbot sea. The clays carrying marine and brackish-water organisms are believed to have been at first off-shore deposits made in moderately deep water, and later brackish-water deposits, formed behind a barrier beach and gradually buried by the advance of that beach toward the land.

SEDIMENTARY RECORD OF THE RECENT FORMATIONS.

The last event in the geologic history of the region was a downward movement, which is still in progress. It is this which has produced the estuaries and tide-water marshes that form conspicuous features of the existing topography. At the present time the waves of the Atlantic Ocean and Chesapeake Bay are at work tearing away the land along their margins and depositing it on a subaqueous platform or terrace. This terrace is everywhere present in a more or less perfect state of development, and may be observed not only along the exposed shores, but also on passing up the estuaries to their heads. The materials which compose it are varied, depending both on the detritus directly surrendered by the land to the sea and on the currents which sweep along the shore. On an unbroken coast the material has a local character, while in the vicinity of a river mouth the terraces are composed of débris contributed from the entire river basin.

Besides building a terrace, the waves of the ocean and bay are cutting a sea cliff along their coast line, the height of the cliff depending not so much on the force of the breakers as on the relief of the land against which the waves beat. A low coast line yields a low sea cliff and a high coast line the reverse, and the one passes into the other as often and as abruptly as the topography changes, so that along the shore of Chesapeake Bay, high cliffs and low depressions occur in succession.

In addition to these features, bars, spits, and other shore formations of this character are being produced. If the present coast line were elevated slightly, the subaqueous platform which is now in process of building would appear as a well-defined terrace of vari-

able width, with a surface either flat or gently sloping toward the water. This surface would everywhere fringe the shores of the ocean and bay, as well as those of the estuaries. The sea cliff would at first be sharp and easily distinguished, but with the lapse of time the less conspicuous portions would gradually yield to the leveling influences of erosion and might finally disappear altogether. Erosion would also destroy, in large measure, the continuity of the terrace, but as long as portions of it remained intact, the old surface could be reconstructed and the history of its origin determined.

THE MINERAL RESOURCES OF QUEEN ANNE'S COUNTY

BY

BENJAMIN L. MILLER

Introductory.

The mineral resources of Queen Anne's County are neither extensive nor especially valuable yet the county contains some deposits that are of considerable economic importance although they have not been very largely worked. Among the most important are the clays, sands, gravels, marls, and diatomaceous earth. In addition the soils contribute most of the value of the region which is primarily an agricultural one, and abundant supplies of water, readily obtainable in almost every portion of the county, form a further part of its mineral wealth.

The Natural Deposits.

THE CLAYS.

Next to the soils, the clays constitute the most valuable economic deposit of Queen Anne's County. As already stated in the discussion of the stratigraphy of the region, several of the formations contain considerable quantities of clay. These argillaceous beds are rather generally distributed throughout the county but, so far as known, have in recent years only been worked in the vicinity of Centerville.

Eocene and Miocene Clays.—Although argillaceous beds occur very commonly in the Eocene and Miocene strata of the county, they are generally too sandy to be of much economic importance. Considerable lime, derived from the numerous fossil shells which are either generally distributed throughout the sandy clay or concentrated in definite shell beds within the formations, also renders these clays of less value.

Pleistocene Clays.—As already stated, the Wicomico and Talbot formations are generally composed of coarse materials at the base of the deposits, with a rather persistent loam cap which marks the last stage of deposition during each period of submergence. This surficial loam, which is very similar in both formations has been extensively used for the manufacture of brick at many places in Maryland, Virginia, and Pennsylvania. It is generally not more than 3 or 4 feet in thickness yet, because of its position, many beds no more than 1 or 2 feet thick can be worked with profit. This loam is widely distributed throughout Queen Anne's County and though not coextensive with the formations of which it forms a part, it is present in almost every locality where the Wicomico and Talbot formations occupy flat divides that have suffered little erosion since their deposition. The Talbot formation, especially, contains much workable brick clay in the broad flat river divides in the western portion of the county. The clay loam of the Wicomico formation has been worked at Centerville and a fair quality of brick produced. The clay is somewhat sandy in certain places but elsewhere is plastic and tough. In color it varies from drab to yellowish-brown.

In general the Pleistocene clays are adapted to the manufacture of the common varieties of brick and tile, but some are suitable for the manufacture of paving brick.

THE SANDS.

Inasmuch as the arenaceous phase predominates in almost every Coastal Plain formation Queen Anne's County contains an unlimited supply of sand. The sand of the Pleistocene formations is used locally for building purposes, but as it is so readily obtainable in all parts of the region no large pits have been opened.

Locally the Pleistocene sands are rich in ferruginous matter, which in some places cements the grains together, forming a ferruginous sandstone. Sands of this character possess a distinct

value for road-making purposes, as they pack readily and make a firm roadbed for light traffic.

In some places the quartz sands of the Miocene seem to be pure enough for glass making, suggesting the Miocene glass sands so extensively exploited in southern New Jersey, although they have never been used in that way in this region. Careful chemical analyses and physical tests, which have not been made, would be required to determine their usefulness in this industry.

THE GRAVELS.

The Pleistocene formations contain numerous beds of gravel widely distributed. These are generally rich in iron, which acts as a cementing agent, thus rendering them of considerable value as ballast for roads. In this county they have been used in very few places.

THE BUILDING STONE.

Although the Coastal Plain formations of the region are composed almost entirely of unconsolidated materials, yet locally indurated beds are not uncommon. In the absence of any better stone these indurated ledges furnish considerable material for the construction of foundations and walls. The best stone of this class is the firmly-cemented Aquia sandstone near the mouth of Southeast Creek and the Calvert fossiliferous rocks outcropping on the west side of Wye Island and in some places along Corsica Creek.

THE MARLS.

Glauconitic Marls.—The Aquia formation is rich in deposits of glauconitic marls, which are of some value as fertilizers. From New Jersey to North Carolina such deposits have been worked spasmodically since the early part of the last century, when their value was first determined, yet their importance in enriching the soil has never been generally recognized. They consist of quartz sand with an admixture of glauconite, a soft green mineral which is essentially a hydrous silicate of iron and potassium. On account

of the glauconite the marls are green in color and are commonly known as "greensand marls." They are rich in calcium carbonate derived from the shells which are abundant in the deposits, and chemical analyses usually show the presence of small amounts of mineral phosphates. The marls thus contain three important plant foods—potash, lime, and phosphates. Altogether these constitute only a small percentage of the entire contents of the deposits, yet wherever the marls can be obtained at low cost, they furnish economic means for increasing soil fertility. Where the glauconite marls have been used it is claimed that their beneficial effect is much more lasting than that obtained by artificial fertilizers. Within Queen Anne's County these marls outcrop in several places along Chester River between Rolph's Landing and the mouth of Corsica River.

Shell Marls.—The shell marls of the Miocene and Eocene formations also possess valuable fertilizing properties for soils deficient in lime. In some places the shells are mixed with so much sand that the lime forms only a small part of the deposit, but in others the amount of lime exceeds 90 per cent. Experiments show that better results have been obtained by the use of shell marl than by that of burned stone lime. The marl acts both chemically and physically and has a beneficial effect on both clayey and sandy soils. In former years these marls were dug in the valley of many small streams in the vicinity of Church Hill, Centerville, and Queenstown.

THE DIATOMACEOUS EARTH DEPOSITS.

As previously stated the Calvert formation of Queen Anne's County contains beds of diatomaceous earth. These are of doubtful value since they are much less pure than similar beds outcropping along the Patuxent River in Anne Arundel County and which have been worked intermittently for many years. Diatomaceous earth, on account of its porosity and compactness, is used in water filters and as an absorbent in the manufacture of dynamite. It is reduced

readily to a fine powder and makes an excellent base for polishing compounds, while its nonconductivity of heat makes it a valuable ingredient in packing for steam boilers and pipes and in the manufacture of safes, the latter being the principal use to which it is put.

THE IRON ORE.

In the early days bog-iron ore was dug in many places on the Eastern Shore of Maryland and used in the manufacture of iron. It is found in the swamps and marshes about the streams where conditions have long been favorable for its accumulation. In Queen Anne's County these deposits are of little economic importance though they were at one time regarded of sufficient value to warrant their investigation. Ducatel in 1835 reported the presence of bog ore at the heads of Hamilton (Hambleton?) and Southeast creeks while Swank states that in 1762 a forge was built at a place called Nasby in this county but it was only operated for a short time. No evidence is available concerning the source of the ore used.

The Water Resources.

The water supply of Queen Anne's County is found in the springs and wells of the district. Many of the streams have been used at various times to furnish power for small mills but little use has been made of them as sources of water supply. Both the private and public water supplies of the towns of the county are derived from wells. There are a few springs but they are of local value only.

SPRINGS.

The moderate elevation of the region and the small amount of dissection of the strata by streams are mainly responsible for the few springs of Queen Anne's County. The most favorbale places for them are where there are outcrops of Miocene strata beneath a rather heavy mantle of unconsolidated Pleistocene materials. The water readily percolates through the overlying stratum and then flows along the contact between it and the less pervious Miocene

materials beneath until it emerges in the valleys of the streams that have cut through the overlying bed. From these springs some of the inhabitants obtain their entire supply of water which is usually of excellent quality. The spring water, as also that in wells, is in places slightly charged with mineral matter, particularly iron and sulphur.

SHALLOW WELLS.

Nearly all the water supply of Queen Anne's County is derived from shallow wells, varying in depth from 15 to 35 feet. The water is contained in the rather coarse sand or gravel bed so commonly forming the basal stratum of the Pleistocene deposits. So generally is this the case that the depth of the shallow wells is usually a very good indication of the thickness of the surficial deposits. The surface water very readily penetrates the rather coarse surface materials until it reaches the less permeable underlying Eocene or Miocene rocks. While some of it continues its downward course into these harder rocks a great deal flows along on their upper surface until it finds its way gradually into the streams. Hence wells sunk to this level are practically assured of a supply of water which, while seldom large, is in seasons of average rainfall capable of furnishing sufficient water for ordinary purposes. Such shallow wells are necessarily dependent almost entirely on the amount of water which percolates through the Pleistocene deposits after rain storms, and are thus apt to be affected by droughts. After periods of heavy rainfall the water may rise in the wells within a few feet of the surface and then is very roily. At other times the wells may become dry, yet this does not often occur because of the fairly equable distribution of rainfall during the year. The supply is less variable over the broad divides or on level ground, where water is always nearer the surface, than in the regions of narrow stream divides, where the water finds an easy exit to the streams. In some places on the narrow divides in proximity to the major streams, it is necessary to sink wells to the depth of 100 feet or more in order to obtain a permanent supply of water.

In this as in the other Eastern Shore counties bordering on the Bay the inhabitants of the low lands of the Talbot terrace obtain abundant supplies of water in the sands of the Talbot formation at depths of from 10 to 15 feet, or sometimes at slightly greater depths. This water has the usual advantages and disadvantages of surficial waters, the ease of reaching the water table being offset by the danger of contamination and the uncertainty of the supply during periods of dry weather. Since the major portion of the county is covered by the deposits of the Wicomico formation, domestic supplies can be obtained from these at depths of from 15 to 45 feet. Sudlersville and Church Hill, both at an elevation of about 65 feet, furnish the records for the deepest Wicomico wells, although they are probably duplicated at a good many other places. At Ingleside, Barclay, Tilghman, etc., the Wicomico supply runs at the more common depth of 18 to 30 feet. The Wicomico water is consistently good, in the absence of direct pollution, and is a very valuable source of potable water.

ARTESIAN WELLS.

Artesian waters are more widely utilized in Queen Anne's County than in Kent County, largely because the former is more thickly settled and the shallow wells are consequently more exposed to contamination. Artesian wells have thus far been almost uniformly successful in procuring good water at no great depths, since the Calvert and the Aquia, as well as the Upper Cretaceous formations, are water bearing. It should be possible to obtain a fair supply at depths of less than 250 feet throughout a large part of the county, and many successful wells are less than 150 feet deep. Deeper wells have been sunk at Centerville and Love Point where large amounts of water were required, but it is not clear that a shallower supply might not have been obtained at the Centerville well from the same horizon that furnishes water for the railroad wells.

The head of the water is not great enough to give flows at more than a few feet above sea level, and hence flowing wells can only be

obtained on the lower portion of the Talbot formation. The water should everywhere rise near enough to the surface to be pumped, and on the Talbot and lower portions of the Wicomico formations suction pumps may be used, though on higher ground deep-well pumps might be necessary. In attempting to obtain water the driller may depend upon the nearest deep wells as a guide, provided allowance be made for the fact that the depth to the water horizon increases toward the southeast at a rate of between 20 and 35 feet per mile.

At Crumpton a well 55 feet deep taps a zone of water in the Calvert formation and flows about 5 gallons per minute. At Queenstown the ice company's wells find a flow of about 6 gallons a minute at 75 feet, also from the Calvert formation, and the wells at the railroad station 90 to 100 feet deep tap the same water zone, but here the water rises to within only 6 to 15 feet of the surface. At the southernmost point in the county, Queen Anne and at Hillsboro in Caroline County, the Calvert formation shows the first evidences of the numerous water zones so conspicuous a slight distance farther to the southeast. At Queen Anne four wells, one at 80 feet, two at 125 feet, and one at 157 feet, are down into the Calvert. All of these wells flow and all yield hard water. About 3 miles northwest of Queen Anne, a well situated at an altitude of 60 feet went down 100 feet to probably the 80-foot bed at Queen Anne. The water in this well does not come to the surface and has to be pumped. The Eocene water seems to be confined to one bed and underlies the county at depths of about 100 feet at Millington to 240 feet at Queen Anne. This horizon contains water that is everywhere hard, a condition noted in Kent County. It has been tapped by wells near Catlin, at Church Hill, Winchester, between Chester and Dominion, Stevensville, Love Point, and at Queen Anne. The well near Catlin passed this horizon at 100 to 132 feet (see log). At Church Hill the water is reported from a black ooze at 140 feet. At Winchester hard muddy water was found at 200 feet, near Chester

it was reached at 160 feet. The Stevensville well struck the same bed at 130 feet and a well at Love Point reached this horizon at 100 feet. At Queen Anne a well 240 feet deep is thought to find water in the Eocene, the doubtful feature being the reported softness of the water, this being the only instance in the county of soft Eocene water. The Eocene water, while not the best in the county, is apparently the most constant both in distribution and quality.

Slightly below the Eocene water a bed has been found in the Monmouth formation of the Upper Cretaceous which supplies the wells at Catlin 223 feet deep, at Stevensville 203 feet deep, and near Chester 227 feet deep. This horizon has been passed in the deeper wells at Churchville and Love Point, but has not been explored to the southeastward. The well at Stevensville is reported to contain sulphurous water, although this does not seem probable. The well near Chester has been abandoned because the water was hard and muddy. A log of the Catlin well is given below. It shows a thickness of almost 150 feet of black and green sand, a condition typical of the basal Eocene and unweathered Monmouth.

It is thought that the sandstone at 52 to 70 feet is at the base of the Calvert formation, and it is worthy of note that this horizon, elsewhere a good source of supply, does not appear to contain much water at this locality.

WELL AT CATLIN.

	Feet
Red-yellow clay with gravel	0–15
Yellow sand and gravel, surface water	15–22
Soft blue clay	22–52
Gray sand	52–70
Red and yellow sand, iron ore, water	70–100
Black sand, water bearing	100–132
Hard sandstone	132–133
Black sand	133–135
Black and gray sand, ferruginous water	135–145
Light-green clay	145–160
Black sand	160–174

Dark-green sandstone	174–205
Green sand	205–216
Hard sandstone	216–217
Black sand, water-bearing	217–223–½

At Centerville deep wells have been successful. The well at the ice factory found water at 343 feet, probably in the Matawan formation, with a head sufficient to bring it within 2 feet of the surface. The log of this well is not detailed enough to warrant its publication, the only significant feature being the bed at 119 to 185 feet of the omnipresent Eocene "black sand." A deeper well was drilled at the Centerville Water Works and the following log was secured by the Survey:

WELL OF CENTERVILLE WATER WORKS.

	Feet
Made ground	0–8
Marsh mud	8–25
Green clay	26–106
Gunpowder stuff "shells"	106–170
Olive-yellow coarse sand, green sand, and white quartz grains	170–220
Olive-colored sand like 170 to 220 feet	240–280
Olive-colored sand, darker than above	280–356
Gray sand	356–360
Olive sand with cementatious concretions of lime	360–365
Shell layer	365–370
Mixture of greensand and yellow quartz sand, varying in color, shells. Water at 428 feet	370–430
Reddish mixture of green and yellow quartz	430–460
Dark olive-colored mixture of clay, green sand and olive-colored quartz and sand	460–480

An important feature of this log is the presence of a water bed at the base of the Magothy 428 feet deep. This horizon was also passed in the 400-foot well at Love Point, a log of which is given below.

WELL AT LOVE POINT.

	Feet
Light-red clay	0–10
Sandy clay, yellow-red	10–22
Sand, gravel, and iron ore (sand from red to black)	22–100

Arenaceous clay (gunpowder)	100–200
Arenaceous clay (gunpowder), water pumped 10 gallons	200–206
Arenaceous clay (gunpowder) but darker and finer than above	206–284
Dark micaceous clay	284–360
Coarse white water-bearing sand, small amount of iron	350–360
Fine reddish sand, water-bearing, volume pumped 40 gallons 15 feet from top of well and 11 feet above tide; water ferruginous	360–382

The agreement between the Love Point well and the deep well at Chestertown is much closer than that of the Centerville well with either of the other two. The Love Point well is just about along the strike with Chestertown, and the similarity of lithology and the correspondence in depth to the water beds is quite marked. At Chestertown the base of the Magothy was marked by coarse white water-bearing sand at 340 feet. In the Love Point section, given above, the same "coarse white water-bearing sand" is found at 350 feet. In the Chestertown well a bed of reddish sand at 390 feet furnished water, and in the Love Point well the "fine reddish sand" at 383 feet pumps 40 gallons a minute.

The deep well at Centerville passed the Magothy water but did not report the water in the "reddish sand." The horizon at the bottom of the Centerville well is the same as that found at Chestertown at a depth of 550 to 581 feet.

THE SOILS OF QUEEN ANNE'S COUNTY

BY

HUGH W. BENNETT, W. E. THARP, W. S. LYMAN
and H. L. WESTOVER

Introductory.

The superficial geology of the county is so comparatively simple and the topography so little varied, that the variation in soil types is not great, and all are derived, for the most part, from the Wicomico and Talbot formations of the Pleistocene.

These soils are among the most productive of the whole Atlantic Coastal Plain. Most of them are easily managed, hold improvements well, and respond quickly to judicious treatment.

The Soil Types.

The chief soil-forming materials of both the Wicomico and Talbot formations are sand and silt, the latter being made up of soil grains ranging in size between very fine sand and clay. The former is the dominant constituent in the northeastern part of Queen Anne's County. Silt is the most prominent constituent in the soils of the "necks" and foreland country and of many areas, especially the flat stretches, in the uplands.

The underlying or substratum materials usually consist of sand or sand and gravel much coarser than the constituents of the overlying mass. Below a depth of about 3 or 4 feet such beds of coarse material frequently alternate or are interstratified with beds of silty clay, fine sand, coarse gravel, etc. In some sectional exposures there are exhibited alternating strata of various thicknesses—from thin seams to 2 or more feet—presenting great variety of texture and color. In vertical exposures of about 15 feet there may be seen some twenty distinct strata, which separately include silty clay, clay loam, silt loam, coarse, medium, and fine gravel, coarse,

medium, and fine sands, sandy loams, fine sandy loams, and gravel and sand mixtures, covering nearly the whole range of soil classes. Cross bedding and interstratification is common in those substrata where sand is the chief constituent. The character of the lower materials does not, as a rule, affect the character of the soil, except as regards drainage conditions.

The source of most of the superficial material undoubtedly is the glaciated region and the region of crystalline rocks to the north. The sand does not have the appearance of being an old sand; it has not suffered an extreme degree of weathering. The quartz grains are subangular or much less rounded, generally, than the worn grains of some of the older Norfolk sand of the Coastal Plain region to the south, and minute mica flakes, grains of feldspar, magnetite, and fragments of dark-colored rocks are fairly abundant. Erratic boulders occur here and there in northern Queen Anne's County, decreasing in number toward the south.

The silt deposits have a marked resemblance to some of the loess of the Mississippi Valley, particularly in structure, texture, and color. This material is of common occurrence at all elevations. There is very little silt in the deep sand deposits that occur along the east banks of the river and larger creeks, but as the distance from the streams increases the silt content of the soils increases.

Erosion, weathering, and drainage have been the most potent factors in the modification of the original material. The rate of erosion has been restricted in a large degree by the general slope of the surface and the original heavy forest growth. Erosion has been limited to a comparatively slow movement or gentle shifting of the superficial materials in the direction of the surface slope. The finer materials are moved faster than the coarser ones, and therefore a tolerably definite relationship exists between the soils and the topography. The lighter soils are found on the slopes, while the heavier soils occur in the more nearly level areas; but the transition from one type to another is always a gradual one. On broad areas of

comparatively level land, where little or no surface wash has taken place, the texture has been determined by the character of the originally deposited material.

The various types are quite regular in profile, uniformity of texture, and structure, irrespective of topography or geological relationship. Generally, the surface foot carries more coarse material and is not as compact as the portion between 12 and 30 inches, and the section below 30 inches is much coarser and more open than the overlying mass. The brown color of the soil and the reddish-brown or reddish-yellow colors of the subsoil tend to give way to grayish in the soil and more nearly yellow in the subsoil toward the south.

Wherever topography and texture have combined to insure good natural surface and underdrainage, the iron content has reached a higher degree of oxidation and the soil grains have been stained brown, reddish yellow, or reddish brown. These colors in the soil and subsoil invariably indicate that condition of mineral and organic constituents which may be considered the normal state of a good, productive soil in this region. Such thoroughly aerated and oxidized soils have very few if any undesirable chemical or physical properties and are well suited to general farming. All the soils of this character have been grouped in the Sassafras series. They are the most productive and easiest managed soils of the county.

Where more or less swampy conditions have prevailed, decaying vegetable matter has accumulated, usually in sufficient quantity to form an appreciable part of the soil mass. As is common in such wet, boggy places, the accumulated vegetable matter is very black and occurs in varying stages of decomposition, from slightly changed to well decayed, mingled with earthy material, so as to make a sponge-like mass. Under natural wet conditions such soils are unsuited to most cultivated crops, but owing to the fact that the organic-matter content is otherwise in good condition, drainage only is required to bring these into good crop-producing soils. Owing

to the saturation of the subsoil, air has been excluded and naturally this lower material is in an unoxidized condition not very unlike that obtaining in the deeper portion of the Elkton soils. These black soils have been assigned to the Portsmouth series.

In those wet and depressed areas where the surface drainage, and generally the underdrainage, has been imperfect, the original material, subjected to intermittent wet and dry stages, has undergone unfavorable structural and chemical changes; the organic matter, though considerable in amount, is in an unfavorable condition, and the soil has turned almost white in color. Through lack of aeration the finer particles have combined rather than granulated, forming a compact, clammy mass. The absence of brown and red colors shows the iron to be in a low state of oxidation. These abnormal processes of weathering have combined to veil the properties of the original material and to bring about changes unfavorable to the development of a good agricultural soil, giving rise to the distinct Elkton soil. This Elkton soil stands between the Sassafras and Portsmouth soils as a transitional series that has been derived from the same material but subjected to different processes, or rather abnormal processes, of weathering.

In this grouping of the soils in series according to their most prominent characteristics of color, drainage condition, organic-matter content, productiveness, structure, etc., no account has been taken of the textural differences due to the various sizes or grades of the constituent soil grains. However, to assist in a more specific and clearer treatment, the several series have been divided into classes—sands, sandy loams, fine sandy loams, loams, silt loams, etc., according to their respective textures or relative content of coarse, medium, and fine sand, silt, and clay, as shown by mechanical separation and weighing of the various constituents of representative samples.

The following classification shows the soils of the area grouped according to processes of weathering or alteration in the original marine sediments:

Soils formed under good drainage conditions	Sassafras gravelly loam.
	Sassafras sand.
	Sassafras loamy sand.
	Sassafras sandy loam.
	Sassafras fine sandy loam.
	Sassafras loam.
	Sassafras silt loam.
Soils formed under intermittent wet and dry drainage conditions	Elkton sandy loam.
	Elkton silt loam.
Soils formed under swampy drainage conditions	Portsmouth sandy loam.
	Portsmouth loam.
Unclassified alluvium and semiswampy upland	Meadow.
Alluvium subjected to tidal overflow	Tidal marsh.

The local names of soils have been brought out in their proper relationship to the several types in so far as these names are sufficiently definite to admit proper correlation in this detailed soil classification.

The Sassafras soils are confined largely to the upland plain, although several members of the series occur in small areas in the lower foreland. The Portsmouth soils are confined almost entirely to the uplands, and occur chiefly in the southeastern portion of the county. The Elkton soils are found throughout both the low forelands and the upland country. The extent and location of the various types are shown on the accompanying map made on a scale of 1 inch to the mile. The general lay of the land is also shown on the map by contour lines drawn through points of equal elevation above sea level, and thus, besides showing the character, extent, and location of the several soils, the topographic relief of the entire country, the direction of natural drainage, and the proper location for artificial drainage ways are indicated.

SASSAFRAS SAND.

The surface soil of the Sassafras sand to a depth of 5 to 10 inches is a dull-brown sand, with a predominance of the coarse and medium grades. The subsoil is a reddish-yellow, sometimes an orange-yellow, sand which generally becomes slightly loamy and coarser toward the lower portion, frequently being underlain at about 32 inches by a reddish-yellow or reddish-brown sandy loam or sticky coarse sand. The underlying substratum is quite variable in its texture and profile features. Generally it consists of a succession of strata and seams of silty clay, coarse, medium, and fine, loose, or very compact sands or gravelly sands, and fine, medium, and coarse gravel, which vary in thickness from an inch to about 3 feet and in color from light and bluish gray to a deep reddish brown. Although in its mineralogical composition the soil material is mainly quartz, close examination reveals the presence of other minerals. Generally the finer particles cling to the larger grains in a way that tends to impart more coherence between the constituents than in case of the loose, incoherent Norfolk sand which covers extensive areas in other parts of the Coastal Plain. The Sassafras sand has not been so thoroughly reworked and washed as the latter soil and, therefore, is not so clean a sand. However, the grains have suffered considerable abrasion and are more or less rounded.

In small areas quartz gravel is interspersed throughout the soil mass, but not in sufficient quantity to change the character of the soil materially.

The Sassafras sand occurs chiefly in comparatively narrow belts along the south side of the Chester River, approximately from the Chestertown bridge to the Delaware line. Isolated areas occur here and there in the uplands. Along the streams it varies from flat forelands nearly on a level with tidewater to a gently rolling topography on the slopes. The upland areas occur as ridges and knolls. The water table lies quite near the surface. There are numerous pot holes or small, rounded depressions in which poor drainage has

favored the development of small areas of Portsmouth soils, which owing to their inconsiderable size were included with Sassafras sand.

Wind action may have aided in the formation of these ridges and knolls by assorting and blowing the sand from surrounding areas which supported less vegetation probably during dry periods long before the present wet conditions had appeared. The original material of the type was transported by water from the region of crystalline rocks north of Maryland.

The forested areas support a growth of shortleaf pine with a sprinkling of oak near the boundaries of the heavier soils.

The Sassafras sand is a well-drained, warm, early soil, well adapted to vegetables, especially early market-garden varieties. Excellent tomatoes, asparagus, Irish and sweet potatoes, garden peas, turnips, melons, and cucumbers can be easily grown. The yields depend largely upon the organic-matter content. There are very few soils that respond more quickly to applications of barnyard manure and the turning under of green crops, particularly legumes, such as cowpeas and crimson clover. Incorporations of such vegetable manures should be made at frequent intervals and in considerable quantities, as the soil is so thoroughly aerated and well drained that the decomposition of organic matter takes place at a comparatively rapid rate. Excellent crops of rye can be made after turning under cowpeas or crimson clover as green manures and applying moderate quantities of phosphate potash fertilizer. An application of about 35 bushels of air-slaked lime in conjunction with the turning under of heavy crops of vegetation, such as cowpeas or crimson clover, would materially assist in improving the structure of this soil by binding together the soil particles, so as to make it less open and porous. Although the type in its average condition of fertility gives rather moderate yields of the general farm crops, in years of normal rainfall very fair wheat and good corn returns can be obtained. Where the humus content has been

kept up, as high as 20 bushels of wheat and 40 bushels of corn per acre have been made under conditions of fair soil treatment. Although the grasses do not do well, heavy crops of cowpeas, crimson clover, and sorghum can be made. This is a good soil for growing cowpeas for seed. Dewberries do well and strawberries fairly well. Cultivated chestnuts seem to find an especially favorable environment on this soil.

The soil is very easily tilled and can be kept in fair condition by applying barnyard manure and turning under green legumes once every two or three years. Crops are inclined to suffer from drought in dry seasons. This type of soil can be bought for less than the heavier soils.

The following table gives the average results of mechanical analyses of samples of the Sassafras sand:

Mechanical analyses of Sassafras sand.

Number.	Description.	Fine gravel %	Coarse sand %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17908, 17923, 17925	Soil	2.5	35.9	30.5	22.8	1.0	3.9	3.3
17909, 17924, 17926	Subsoil	2.2	35.8	30.7	23.3	.6	3.8	3.7

SASSAFRAS SILT LOAM.

The Sassafras silt loam to a depth of 8 or 10 inches is a friable silt loam. A dry sample rubbed between the fingers breaks into a soft, pulverulent mass in which little or no medium sand can be detected. A perceptible quantity of fine sand is present, consisting in part of minute mica flakes. When wet such a sample is somewhat plastic, mulches easily, and shows little tendency to adhere. On drying it becomes crumbly, the fragments being weak and porous.

The soil yields readily to tillage, and the cultivated land has a soft, loamy surface. A considerable portion of the first 2 or 3 inches will be almost pulverulent if the field has been harrowed or rolled when in a slightly moist condition. If clods form at all, they are generally small, porous, and break under a light pressure.

The color of the moist soil is usually a yellow brown. It becomes lighter as the moisture content decreases and not infrequently approaches a buff or very light yellowish brown. An exposed section in a roadside cut generally shows, beneath an inch or two of grayish surface loam, a light-yellowish soil grading downward to a reddish yellow or dull reddish brown, which is usually the color of the subsoil.

The subsoil contains more clay than the soil and is usually rather compact. Between the depth of 15 and 30 inches it is somewhat granular. On drying it breaks into roughly angular fragments. The granulation is not strongly developed and is easily destroyed by manipulation when the material is moist.

This soil is found chiefly in the southeastern and southern parts of Queen Anne's County. It ranges in altitude from 10 to 70 feet above sea level and attains its typical development on the gently undulating interstream divides. On the "necks" this type is confined to those portions which have relatively good drainage. Where the surface has little or no relief the Sassafras silt loam gradually passes into the Elkton silt loam. Wherever the surface is more rolling some of the lighter soils are generally found.

The drainage is usually good. The sandy substratum gives excellent underdrainage and prevents any undue accumulation of water where the surface is slightly depressed.

The color of the subsoil is a reliable indication of the average moisture conditions. Where the color is brown or approaches a reddish yellow the drainage is effective and the soil mass has good aeration. Where the drainage is not as thorough as it should be or is somewhat sluggish the soil usually is of a pale-yellow shade.

In some of the depressions which occur in this type the soils have a texture, structure, and color so different from that of the Sassafras series that they belong to the Elkton series. The areas are usually too small or ill defined to be shown on a map of the scale used.

All of this type was originally forested. It seems to be a congenial soil for numerous species of trees and shrubs. Most of it is now under cultivation, but in the forested portions almost every variety of tree common to this section of country may be found, excepting those confined to marshy soils.

The Sassafras silt loam is well adapted to grass, forage crops, and wheat. The average yields of grain are quite as high as upon any other type in the area. Its texture admits of the preparation of an ideal seed bed, and the average moisture content is favorable for winter wheat. Its structure admits of only a minimum loss through leaching of the fertilizer applied. Twenty-five to 30 bushels of wheat per acre is not an uncommon yield in favorable seasons, but the average is nearer 18 or 20 bushels.

Clover and timothy do well. It is sometimes difficult to secure a good stand of clover, but this trouble is due to cultural practices or seasonal extremes rather than any condition peculiar to the type.

The yields of corn in favorable seasons average from 50 to 60 bushels per acre. The yield could be improved by liberal applications of organic matter. The usual supply of barnyard manure and the frequent changes to grass fail to give the needed quantity of humus. The fact is frequently overlooked that a high organic matter content, besides assisting in the maintenance of moisture, also improves the physical condition of the soil. In this instance it would tend to prevent the "running together" of the surface soil after each heavy rain.

This is the heaviest well-drained soil in the county. It should be restricted to those crops which require a long growing season and for which a continuous moisture supply is of first importance.

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

Mechanical analyses of Sassafras silt loam.

Number.	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
16988, 17011, 17939	Soil	0.6	2.8	2.7	4.3	8.9	71.9	8.6
16989, 17012, 17940	Subsoil	Tr.	1.1	1.5	2.9	9.7	65.1	19.4
17013	Lower sub soil.	3.6	18.3	12.4	8.3	0.5	45.8	11.6

A determination of the organic matter gave the following percentages: No. 16988, 1.02 per cent; No. 17011, 1.07 per cent; No. 17939, 0.92 per cent.

SASSAFRAS LOAMY SAND.

The Sassafras loamy sand represents a transition between the sand and sandy loam of the Sassafras series. In agricultural value it is much inferior to the normal sandy loam of the series, but is much more productive than the sand. It presents variations which are apparent even upon casual examination, and which are of considerable importance from an agricultural standpoint. These are determined for the most part by the distribution, or location, in the soil profile of the silt and clay. In the greater proportion of this soil the fine material is found largely between the depths of 15 and 30 inches.

The soil to a depth of 6 to 8 inches is a dull-brown loamy sand. All grades of sand are found, but medium to coarse grains usually form a considerable part of the whole and give a coarse, gritty character to the material. There is some small quartz gravel, which with the larger sand grains is quite conspicuous on the surface after a rain. The proportion of fine material is usually sufficient to cause the sand to cohere feebly if a moist sample is pressed in the hand. When dry it is quite loose, but not so incoherent as the Sassafras sand.

The upper part of the subsoil has about the same texture and structure as the soil. It is much lighter in color, usually a pale yellow. At a depth of 15 inches there is a perceptible increase in the percentage of fine materal. This lower part of the subsoil is a moderately heavy sandy loam. If moist it is somewhat sticky; when dry the fine material binds the sand grains in a rather friable mass.

Unless exceptionally coarse it possesses good capillarity. This part of the soil section is essentially the moisture reservoir of the soil.

The surface of most of this phase is gently undulating. Some areas of considerable size are nearly level or have a low but very uniform slope toward the nearest stream. Slight inequalities of the surface frequently indicate differences in the agricultural value of the land, the high ground usually having the heavier subsoil. Not infrequently small elevations are much lighter in texture, but in general this type passes into the Sassafras sandy loam along the higher contour lines.

In some places the surface assumes a grayish tint when dry, while the subsoil approaches pale yellow in color. This indicates poor drainage. This condition is not always due to topographic position, for some of this phase is underlain by a thin clay stratum similar to that found under the Elkton silt loam. It frequently occurs at a depth of 40 or 50 inches, but seems to be local in its development.

Where drainage is necessary the proper location of ditches is somewhat difficult to determine. The depth to the clay substratum and the direction of its slope should be taken into consideration. In most instances the ditch should be dug along the upper side of the tract to be drained instead of being located in the middle or lower part.

The native timber growth comprises most of the oaks common to this region and sweet gum, dogwood, and pine, with a few birch, beech, and hickory. Alder and huckleberry are abundant undergrowths. Crabgrass commonly takes possession of neglected fields, followed later by loblolly pine.

The Sassafras loamy sand is easily cultivated and responds well to fertilization. Since all of it is very deficient in humus, the organic matter content should be increased. It would also be of benefit to have some cover crop during the winter. This prevents to some extent the excessive leaching to which these light soils are

subject. An acreage application of about 30 bushels of lime in conjunction with a green crop, preferably cowpeas or clover, would improve the structure; that is, bind the soil particles into such an arrangement as would make the soil less open and droughty.

Much of this soil is now used for general farm crops. The yields of corn and wheat are low and often severely affected by dry weather. It is better adapted to truck crops and an increasing acreage is being planted. Melons, cantaloupes, tomatoes, and sweet potatoes are successfully grown. Buckwheat, crimson or scarlet clover, and cowpeas do well and many small fields of the crops are grown. Peach orchards might well be located on the well-drained portions of the soil.

The market value of all the areas of this soil is steadily advancing. Small tracts well located with regard to shipping points or near a cannery command a much higher price than those not so favorably situated. More of the Sassafras loamy sand can be utilized profitably in the production of early vegetables and tomatoes.

The following table gives the average results of mechanical analyses of the Sassafras loamy sand:

Mechanical analyses of Sassafras loamy sand.

Number	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17048, 17902	Soil.....	1.6	20.5	22.4	28.2	1.7	18.3	5.9
17049, 17903	Subsoil.....	1.5	22.3	21.8	30.2	2.6	15.3	5.7

SASSAFRAS SANDY LOAM.

The Sassafras sandy loam in its typical development to a depth from 9 to 13 inches is a grayish-brown or brown moderately heavy sandy loam, consisting of a fairly even distribution of the coarse, medium, and fine grades of sand with a relatively high proportion of silt which coheres to the sand grains so as to impart a distinctly loamy character to the soil, especially when dry. The soil always has a more pronounced sandy feel when wet, owing to a weakening

of the binding power of the finer material which is given freer movement by the excess of moisture. There are some areas very much lighter than the general average as described above. The absence of very fine sand is everywhere noticeable.

The subsoil consists of a reddish-yellow or reddish-brown sandy loam or heavy sandy loam which at 26 to 30 inches generally passes into a reddish-brown coarse light sandy loam to sticky coarse sand, with small quartz gravel sometimes quite compact. The tendency is toward a slightly lighter and coarser textured subsoil, more compact and more nearly red with increasing depth. Sometimes the upper portion of the subsoil is pale yellow and siltier than the average, while in the more nearly level and poorer drained areas the pale yellow may extend as far downward as the change in the substratum. As a rule the subsoil is only slightly heavier than the surface soil, and like it carries considerable silt and little very fine sand.

Generally the well-drained soil becomes lighter in color as the organic-matter content diminishes, but fields often are spotted with gray in slight depressions, where the soil approaches the Elkton sandy loam, and may contain considerably more organic matter than the surrounding better drained and more productive soil. The better drained brown phase of the northern part of the county tends to give way to a lighter colored and somewhat less productive phase accompanying a moderation in the surface relief toward the south. Occasionally small areas are quite gravelly, especially on stream slopes. A more nearly red subsoil is found in the better drained areas. The type is locally styled "red clay bottom" or "medium light loam."

On account of the coarser substratum excellent underdrainage obtains throughout the larger proportion of the type, which feature, coupled with the good texture of the overlying material, makes the type a thoroughly aerated soil, capable of maintaining a supply of moisture favorable to healthy plant development.

Under fair treatment the soil is tilled easily under widely different moisture conditions, yielding most readily to treatment of all the extensive general purpose soils. However, continuous cultivation without restoring vegetable matter, especially where closely grazed through all sorts of weather, is apt to induce a compact structure resistant to plowing and favorable to excessive loss of moisture in dry spells by surface evaporation.

The Sassafras sandy loam occurs throughout the county and is largely confined to the uplands. It is conspicuously absent from the lower forelands. It sometimes follows the slopes of the inland stream valleys nearly to tide level, thus occupying all variations in land surface from broken stream slopes to moderately rolling and nearly flat upland country. In some sections the surface configuration is interrupted by small poorly drained depressions, some of which contain bodies of Portsmouth or Elkton soils too small to be outlined on the map.

The type has been derived from sediments of marine deposition brought down from the region of crystalline rocks to the north of Maryland and Delaware. The sand particles are generally less round than those of the Sassafras sand, showing that the material has been subjected in a less degree to reworking by water and wind. Since the elevation of the sedimentary material above the sea considerable weathering has taken place to a depth of 3 feet or more. This weathering mainly consists in the oxidation and consequent change in color of the material and the accumulation of organic matter in the surface. There has been considerably less washing out of the fine materials and leaching than in the Norfolk sandy loam, a much less productive soil occurring extensively in other parts of the Coastal Plain.

The Sassafras sandy loam is adapted to a wider range of crops than any other type of the area. The principal crops are corn, wheat, tomatoes, and grass. Under favorable conditions of weather and soil management, and accordingly as the crop is grown on the

lighter or the heavier phase, wheat yields from 15 to 30 bushels, corn from 35 to 65 bushels, hay from 1 to 2 tons, and tomatoes from 4 to 12 tons per acre.

This is the best tomato and strawberry soil of the county. Excellent returns were secured from a large acreage of tomatoes put out in 1907, averaging 5 tons per acre, and a considerable acreage of strawberries was also very profitable.

Irish potatoes, sweet potatoes, cantaloupes, watermelons, cucumbers, and asparagus do well, as do all kinds of forage crops suited to this climate. Pears, peaches, chestnuts, dewberries, raspberries, and blackberries find the soil well suited to their needs. In view of the ease with which good crops of cowpeas and crimson clover can be secured, and the readiness with which the soil responds to applications of barnyard manure, these legumes should be more generally grown in connection with an extension of the live-stock industry. Some claim that the soil is not well enough adapted to grass to yield satisfactory returns in stock raising, but by growing forage crops, excellent yields of which can be obtained, any such deficiency can be offset. A ton or two per acre of hay, however, is not considered poor even in the most prosperous stock raising sections.

Turning under green crops of cowpeas or clover grown in rotation with wheat, corn, tomatoes, or grass, or any other rotation, in conjunction with applications of 25 to 40 bushels of lime per acre every four or five years, is the most economical method of improving and maintaining the productivity of the type. Two excellent rotations are corn with cowpeas or crimson clover, wheat, grass, wheat, cowpeas, or clover to be turned under and limed, then corn; and corn, with cowpeas or crimson clover, tomatoes, wheat, grass and clover, corn. The same fertilizers are used upon this soil as upon the other soils of the area.

The following table gives the average results of mechanical analyses of the soil and subsoil and the results of a single determination of the lower subsoil of the Sassafras sandy loam:

Mechanical analyses of Sassafras sandy loam.

Number	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17014, 17917	Soil	2.9	20.9	15.4	17.7	2.7	35.2	5.1
17015, 17918	Subsoil	2.9	18.5	11.9	14.1	3.0	35.7	13.9
17919	Lower subsoil.	1.3	19.2	19.3	26.1	3.9	17.5	12.2

A determination of the organic matter gave the following precentage: No. 17917, 1.05 per cent.

SASSAFRAS FINE SANDY LOAM.

The surface soil of the Sassafras fine sandy loam is a grayish-brown to yellowish-brown, quite silty fine sandy loam which grades into a pale-yellow material of the same texture a few inches beneath the surface. At about 20 inches the soil portion is underlain by a reddish-yellow, compact, rather clammy light silty loam, which in turn is underlain at 28 to 36 inches by an orange-yellow, reddish-yellow or reddish-brown, light, fine to medium sandy loam. Wherever the relief is sufficient to insure good drainage the subsoil is quite friable, admitting of good aeration and circulation of moisture. On the other hand, the subsoil of the flat bodies lying in swales or near the water level is inclined to be mottled in color, clammy, and insufficiently aerated on account of poor drainage. The productiveness of the Sassafras fine sandy loam depends largely upon the drainage.

The type is confined largely to the necks and water fronts lying below the 25-foot contour line. The most important areas are those on Piney Neck and on Kent Island. The topography is about equally divided into an undulating to slightly ridgy surface with good natural drainage and a nearly flat surface with poor underdrainage.

The type is fairly easy to cultivate, especially where the drainage is good, although in dry weather the soil is inclined to bake and

harden in a way that makes fall breaking quite difficult, requiring considerable harrowing and rolling to bring it into a good tilth.

About 50 per cent of the Sassafras fine sandy loam is under cultivation, the remainder being forested mainly with pine, white oak, chestnut, sweet gum, black gum, and dogwood. It is devoted to general farming, including the production of wheat, corn, grass, and tomatoes. The yields of corn and wheat are about the same as on the Sassafras sandy loam, but the yields of timothy are thought to be better. Although the type does not have the texture of a typical truck soil, very fair yields of tomatoes of good quality are grown. Alfalfa seeded in the fall would do well on the better drained phase. Like the Sassafras loam, it requires regular applications of vegetable manure, barnyard manure, or legumes turned under in order to maintain favorable structural conditions.

The poorer drained areas are so situated that very effective drainage systems could be installed with inconsiderable outlay. Good results could be had with deep open ditches through the lower depressions; but much more satisfactory results would be obtained by installing lateral tile drains to discharge into main open ditches.

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

Mechanical analyses of Sassafras fine sandy loam.

Number.	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17927	Soil	0.1	2.0	14.3	29.2	10.1	35.6	8.7
17928	Subsoil	.2	1.6	12.8	28.0	8.0	25.9	13.8
17929	Lower subsoil.	.0	1.4	20.0	41.6	10.0	15.2	12.1

SASSAFRAS LOAM.

The surface soil of the Sassafras loam consists of a brown or yellowish-brown moderately heavy loam from 8 to 16 inches deep. The typical subsoil is a reddish-yellow heavy loam carrying about

the same amount of silt but a little more clay than the soil. It becomes reddish brown in the lower portion, passing at 26 to 32 inches into a reddish-brown coarse sandy loam to sticky coarse sand with fine quartz gravel. Often the subsoil is pale yellow or yellow in the upper part of the profile, but always tends toward a reddish color with increase in depth. As a general thing the better the drainage the more nearly reddish brown becomes the subsoil. The type is locally called "red clay" or "medium stiff loam."

Not infrequently small quartz gravel is distributed throughout the soil mass, but never in sufficient quantity to influence materially the moisture-holding capacity. Minute flakes of mica can be seen distinctly in the subsoil in some places, though not so generally as to be a distinguishing feature.

Although the texture of the Sassafras loam is quite uniform, it requires close observation to determine the exact boundary between its lightest phase and the heavier Sassafras sandy loam, and, on the other hand, the gradation into the lighter phase of the Sassafras silt loam is also very insensible.

Both soil and subsoil have an ideally well-balanced texture; that is, the constituent particles of sand, silt, and clay are so proportioned and arranged as to constitute a soil capable of maintaining moisture in the most favorable quantity for the healthy growth of plants. However, where the organic content has been allowed to run down through continuous cropping without replenishment of vegetable matter, and where the land has stood long without cultivation—especially if cattle have been permitted to graze it closely and pack it during all kinds of weather—the soil assumes a hardened, compact structure unfavorable to cultivation, especially in dry falls. Such fields break up in clods and repeated rolling and harrowing are required to restore a good tilth. If the supply of humus is kept up and due attention is paid to moisture conditions in their relation to plowing and grazing, the soil can be kept in the best condition of tilth.

The Sassafras loam is confined largely to the uplands of Queen Anne's County. A small percentage occurs in the lower foreland country, and it is even found along the steeper slopes. Its topography is quite like that of the Sassafras sandy loam, though generally somewhat less rolling. Where the relief has favored erosion the surface soil has been removed from small spots, revealing the yellowish-red subsoil in such a way as to give fields a spotted appearance. These spots, owing to the higher content of clay, are a little more difficult to cultivate than the true surface soil. They are sometimes called "clay hills."

While the texture affords good natural drainage, an occasional flat or depressed area will need main outlet ditches and tiling.

The Sassafras loam owes its origin to the weathering of marine deposits under good drainage conditions. It has since its uplift undergone about the same degree of weathering as the Sassafras sandy loam.

This is the best general farming soil of the area, being ideally adapted to wheat, corn, grass, clover, and forage crops and quite well suited to certain truck crops like tomatoes, beans, and cabbage. Wheat yields from 18 to 35 bushels, corn 40 to 75 bushels, and grass 1 ton to 2½ tons per acre. Where the soil is kept up to a good state of productiveness, as under a five-year rotation of corn, wheat, grass, wheat, grass, applying barnyard manure and 40 bushels of lime to the broken grass sod preceding corn and about 300 pounds of good commercial fertilizer to wheat, average yields of 60 bushels of corn, 20 bushels of wheat after corn and 28 bushels after grass, and 1½ tons of hay per acre are readily secured. If occasional crops of cowpeas or clover, to be turned under in conjunction with 40 bushels of lime per acre, should be introduced into the above general scheme of rotation, the most worn fields of the type could be brought quickly up to a point of equal productiveness or even better. Alfalfa does well when seeded properly; that is, in the fall, on a thoroughly prepared seed bed.

A large acreage of tomatoes is grown on this type, the average yield being about 4 tons per acre. Strawberries, cantaloupes, asparagus, beans, and buckwheat do well. Peaches, pears, and raspberries grow rapidly and bear well. In view of the good yields of hay and forage crops stock raising should be extended. Dairying and sheep raising could also be made quite profitable. There is no excuse for other than good average yields on the Sassafras loam, as it is easily improved and kept in good condition.

The following table gives the average results of mechanical analyses of samples of the Sassafras loam:

Mechanical analyses of Sassafras loam.

Number	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17003, 17933	Soil	2.3	13.7	9.9	12.7	3.2	50.1	8.4
17004, 17934	Subsoil	1.3	10.0	9.5	13.9	4.3	46.1	14.3
17005, 17935	Lower subsoil.	5.2	25.2	17.4	21.8	3.1	14.1	12.5

SASSAFRAS GRAVELLY LOAM.

The Sassafras gravelly loam consists of a loamy soil resembling the Sassafras loam, through which from 10 to 25 per cent of small and medium rounded quartz gravel is distributed.

The type occurs as narrow strips along stream slopes or as small patches on upland slopes. It owes its origin largely to a partial removal of the soil mass by wash, so as to expose the more gravelly material beneath.

There are throughout the county quite a number of these gravelly spots of limited extent and irregular occurrence. Only the larger areas are shown. The type is most frequently seen in the northwestern part of Queen Anne's County. It is suited to the same crops as the Sassafras loam and where not too sloping for easy cultivation it makes profitable yields.

ELKTON SILT LOAM.

The soil of the Elkton silt loam is a very light-gray to almost white silt loam. In a field in good tilth it is lose and floury, the

light color and fine texture being its most marked characteristics. It contains very little medium and practically no coarse sand. The percentage of fine sand is usually low, and there is only a moderate quantity of clay. The chief constituent is silt, which forms from 60 to 80 per cent of the soil body. When wet it is yielding under foot, in some instances quite miry, but not particularly adhesive. On drying it coheres in a firm mass which may have minute cavities interspersed through it.

The organic matter content appears to be low. In the virgin soil of the woodland there is usually 2 or 3 inches of darker colored soil slightly stained by humus, but immediately below this the material is white and powdery.

In most places there is no well-defined line of contact between the soil and subsoil. The latter has about the same texture to a depth of 12 or 15 inches, below which there is an increase in the clay content. This difference in composition is most apparent between the depths of 18 and 30 inches. It is usually observable in an exposed section and is very apparent on digging or boring into the subsoil. The subsoil forms a compact stratum, very hard when dry, and, when wet, somewhat more sticky or plastic than the soil.

The subsoil at a depth of about 3 or 4 feet frequently changes to a grayish sand, medium to coarse in texture and usually saturated. This stratum varies from 1 to 2 feet in thickness and is usually underlain by a heavy bed of clay. Frequently the sandy stratum has a thin layer of soft, white, unctuous clay in it. This stratum seems to be nearly or quite impervious and is probably the cause of the saturated condition of the overlying sand.

The subsoil proper is of a grayish color somewhat darker than that of the soil. It is generally mottled with yellow and brown iron stains, especially if pockets or seams of sandy material are present. The heaviest part of the subsoil is usually a bluish-gray color with very little mottling.

The largest areas of this soil are found in the peninsulas lying between the estuaries. The central portions of most of these necks are nearly level, and the sluggish surface drainage, together with the character of the material, accounts for the formation of this type. Smaller areas are found in the uplands wherever similar conditions prevail.

The type is associated with the Sassafras silt loam and is derived from the same kind of material. The differentiation is due entirely to drainage conditions. While the two soils are very distinct in color, organic matter content, and general agricultural value, the change from one to the other is frequently so gradual that it is difficult to draw an exact boundary.

The original vegetation consisted chiefly of white oak, and the land is now locally termed "white oak land." A mixed forest now occupies uncleared fields, and loblolly pine, which came in when the original white oaks were removed, is a common species and attains good size. Other kinds of oak trees, with gum, soft maple, beech, and dogwood, are very commonly found on this type.

Much of this soil is under cultivation. It is somewhat difficult to manage, especially in wet seasons. After a rain the soil tends to run together, and on drying forms a smooth, hard surface. When slightly moist it yields very readily to tillage.

The Elkton silt loam is well adapted to timothy and excellent crops are grown. The acreage planted to this crop is rather limited, and could be increased with profit. Red clover does not grow on this soil well, probably on account of a somewhat acid condition. In fields which have reasonably good surface drainage scarlet clover is successfully grown. A large proportion of the tillable area of this type is annually sown to wheat. The same cultural methods are generally practiced as on the Sassafras silt loam. In seasons which are not excessively wet the average yields compare well with those of the Sassafras soil. In some seasons a good crop of corn is

secured, but this land is too cold, wet, and deficient in humus to be well adapted to this cereal.

The improvement of many of the small areas in the highland country requires ditches of sufficient capacity to remove promptly the excess water. Ditches should be located near the upper margin, so that the water will be intercepted and not saturate the lower lying soil, as is the case where the main ditch is placed near the center of the area. It is highly essential that the ditches be deep enough to lower the water table to 2½ or 3 feet below the surface, so that the subsoil may be aerated.

The permanent improvement of the larger areas, particularly those on the "necks," is a more difficult problem. They are larger and so flat that it is sometimes expensive to construct ditches with an adequate outlet.

The nature of the strata underlying the subsoil has already been briefly described. It seems probable that the structure of the deeper subsoil is the same for much of the Elkton soil of the "necks" and for the Sassafras silt loam adjoining these areas. The roadside cuts on the slopes leading down from the upland often show a light-colored clay with sandy material between the subsoil and the deeper subsoil. Any excess of water in the soil of the higher ground tends to follow the sandy stratum to the lower levels. Where no natural drainage line intervenes between the higher ground and that somewhat lower a positive upward pressure of the ground water may exist in the latter. This is probably why the subsoil of the Elkton silt loam remains saturated long after surface conditions would indicate a normal moisture content.

The present artificial drainage consits of surface ditches. They are usually shallow—only a foot or two in depth. These serve to remove the excess of rainfall, but fail effectually to drain or prevent a waterlogged condition of the subsoil. It is highly desirable that the lower soil be so drained as to have comparatively free access of air.

It cannot be positively stated, however, that even thorough drainage alone will result in an immediate improvement of this soil. It has been so long subject to intermittent saturation that its constituents have undergone important changes. The soil has quite lost the property of granulation as is evidenced in its lifeless, putty-like feel when moist and its firm cementation when dry.

The frequent unsatisfactory crop yields from well-drained land which has been given good culture indicates a poor structural condition or the presence of injurious substances. There are very few iron concretions. The ferruginous material is seldom further concentrated than in small, soft grains and thin streaks of limonite, or other compounds of iron, and these are not abundant in the heaviest phases of this soil where aeration is least active. It is probable that the decaying organic matter under the moisture condition which usually prevails renders soluble much of the iron forming ferrous carbonate, a substance injurious to cultivated plants. Under similar conditions the phosphoric acid of the soil combines with the iron in an insoluble form, thereby becoming unavailable for crops.

Experience has shown that a heavy application of coarse manure often gives surprisingly good results. There should be an abundance of organic matter incorporated with the soil, which can be most cheaply done by plowing under some green crop. This should be done in early fall or precede by some months the time of planting the next crop, so that partial decay may take place. Otherwise more harm than good may be done the first crop. Complaint is made sometimes that saturating rains following deep fall plowing cause the soil to run together in such a way as to give rise to the formation of an almost glasslike smooth surface, which bakes and hardens with subsequent sunshiny weather. This trouble would be lessened by the incorporation of coarse manures, the application of lime, and general improvement of the drainage condition.

Lime should be liberally applied (30 to 40 bushels an acre), not only for the favorable chemical effect it has on this soil, but that flocculation of the clay may be favored. Turning under green vegetation should be done always in conjunction with an application of from 25 to 50 bushels of lime per acre.

After the physical condition of the soil has been improved in the manner thus outlined, its further fertilizer requirements depend upon the crop to be grown or the method of farming practiced. It will probably be found that little or only moderate amounts of commercial fertilizer are needed. In case fertilizer is found to be necessary, one containing a high percentage of phosphoric acid would be of benefit, especially to wheat.

Where it is impracticable to drain land of this kind it seems that such crops as timothy and redtop offer the best means of utilization.

The following tables gives the average results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Elkton silt loam.

Number	Description	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
16990, 17900	Soil	0.2	2.3	2.5	4.8	2.6	77.5	10.0
16991, 17901	Subsoil	.2	3.2	3.2	5.1	2.9	63.7	23.0

A determination of the organic matter gave the following percentages: No. 16990, 3.55 per cent; No. 17900, 1.42 per cent.

ELKTON SANDY LOAM.

The surface soil of the Elkton sandy loam consists of 6 to 10 inches of dark-gray, clammy, rather silty sandy loam which becomes light gray in the lower portion. The subsoil is a clammy, medium heavy sandy loam to loam carrying considerable silt. The upper portion is a light-gray to drab, frequently slightly mottled with reddish-yellow streaks, while the lower portion is generally intensely mottled with grayish, reddish-yellow, and reddish-brown colors. Strata of clayey material are quite common in the lower portion.

and at a depth of about 30 inches occurs a substratum of compact, light-gray or mottled, sticky, medium to coarse sand which is always saturated with water.

The type occurs as small bodies in depressions and as low, flat land around the heads of small streams. The drainage is very poor, the water table generally standing very near the surface. The surface configuration of those areas found near the heads of streams is usually interrupted by small saucerlike depressions holding dark-colored material high in organic matter and generally in a semi-marshy condition. There are a few small bodies throughout the uplands of the county many of which are so small as to necessitate their being included with other types.

The Elkton sandy loam is derived from the same material that gives rise to the Sassafras sandy loam. The original material, subjected to intermittent wet and dry stages, has undergone unfavorable structural and probably chemical changes and has accumulated a small amount of organic matter in an apparently stagnant, unhealthy condition.

Most of the Elkton sandy loam is forested with sweet gum, white oak, maple, black gum, dogwood, scattered pine, and a thick undergrowth of shrubbery. Under present conditions of drainage it is hard to manage and comparatively unproductive. Buckwheat, strawberries, and dewberries do fairly well where the drainage is best. By deepening, strengthening, and extending the natural drainage-ways and by putting in close lateral tiles or even open ditches, most of the type could be brought into pretty good condition without a prohibitive outlay of money. Many of the small depressions can be drained simply by a deep outlet ditch. Wheat, strawberries, dewberries, and grass would do quite well. Coarse barnyard manure plowed under improves the aeration considerably, under fair conditions of drainage. The type is not as desirable as soil as the Portsmouth sandy loam.

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

Mechanical analyses of Elkton sandy loam.

Number	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17892, 17894	Soil	1.7	14.9	14.2	26.1	5.0	31.8	6.3
17893, 17895	Subsoil	1.4	12.8	12.8	29.2	5.3	25.2	13.1

A determination of the organic matter gave the following percentage: No. 17892, 1.56 per cent.

PORTSMOUTH SANDY LOAM.

The Portsmouth sandy loam is a very dark-gray to black medium sandy loam of high organic-matter content, varying in depth from 8 to 12 inches. The subsoil to about 28 inches is a gray sandy loam with a slightly higher silt and clay content and much lower organic-matter content than the soil. The subsoil frequently is mottled with reddish yellow and in the lower portion may carry strata and pockets of sandy clay. It usually passes into a light-gray or nearly white, compact, coarse sand to sticky sand, which also may contain pockets and thin strata of sandy clay. This sandy substratum is always saturated, except where thoroughly drained. It is sometimes washed out into open ditches, filling the bottoms and causing the banks to cave. In some places the soil may consist largely of organic matter mixed with just enough earthly material to give it the characteristics of Muck. Again, small areas may consist, from a few inches to a foot or more, of bog iron ore, occurring on top or at any position in the profile.

Uncleared areas support a growth of sweet gum, black gum, beech, maple, and scattering pine, with a dense undergrowth of whortle-berry, gallberry, and other bushes.

The Portsmouth sandy loam is confined to the eastern portion of Queen Anne's. It occupies level areas and small, basinlike depressions. The extensive flat areas are interrupted by ridges and

knolls of the lighter Sassafras soils. In these lighter types occur numerous small depressed bodies, many of which were of too limited extent to indicate on the map.

The soil is almost entirely lacking in natural drainage. All of it, however, can be reclaimed. While some substantial, effective ditches were put in years ago and some are still being dug in a few places, thus reclaiming considerable areas, the work has not been pushed persistently, and at present the type on the whole is too poorly drained to admit of profitable cultivation. Ditches too frequently have been allowed to fill. Some of the farmers, by keeping the main ditches cleaned out and extending laterals, have reclaimed limited tracts. Individual effort cannot cope successfully with the problem in the larger bodies. There must be substantial main ditches, the construction of which is feasible only through the concerted action of landowners, assisted possibly by the county or the State, and by drainage laws opening the way for outlets.

The type is derived from the same material that gives rise to the Sassafras and Elkton sandy loams. The topography has induced wet, swampy conditions which have favored accumulation and preservation of a large quantity of spongy vegetable matter in the soil, at the same time retarding subsoil weathering.

When thoroughly drained the Portsmouth sandy loam proves a very productive soil. Excellent yields of strawberries, corn, and dewberries are made. Owing to a tendency of the soil upon freezing to heave, the type is not especially suited to fall-sown crops. Wheat and grass are particularly likely to suffer in this way. It is claimed, however, that wheat grown on this soil is of the good hard quality preferred by millers. Buckwheat and oats would do well, as would onions and celery also. Tomatoes do only fairly well.

Rather heavy applications of lime—from 40 to 60 bushels per acre—at frequent intervals are required to bring the soil up to its maximum producing capacity. Deep plowing is said to be quite beneficial.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Portsmouth sandy loam:

Mechanical analyses of Portsmouth sandy loam.

Number	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17910	Soil	1.2	24.2	26.0	26.5	1.9	12.5	7.3
17911	Subsoil	1.1	16.4	20.8	35.5	5.1	12.7	7.7
17912	Lower subsoil.	2.0	17.0	20.7	45.6	5.0	7.0	2.7

A determination of the organic matter gave the following percentage: No. 17910, 3.48 per cent.

PORTSMOUTH LOAM.

The Portsmouth loam consists of a rather spongy black loam so high in organic matter as very frequently to approach quite nearly the characteristics of a Muck soil. Small areas of Muck occur here and there. At 12 to 24 inches the soil passes into a dark-gray sandy loam carrying strata and pockets of clayey material, and this in turn at 30 to 36 inches generally passes into a grayish, compact, sticky coarse sand or sandy loam. The type is not extensive and occurs closely associated with the Portsmouth sandy loam having the same topography as well as being the result of the same processes. The most important area is that along Long Marsh Branch—the boundary line between upper Caroline and Queen Anne's counties. This area has been effectively drained and is producing good crops of corn. The other bodies are largely in a semiswampy condition. The type when drained is well suited to strawberries, corn, dewberries, and buckwheat.

The following table gives the results of mechanical analyses of the soil and subsoil of the Portsmouth loam:

Mechanical analyses of Portsmouth loam.

Number	Description.	Fine gravel. %	Coarse sand. %	Medium sand. %	Fine sand. %	Very fine sand. %	Silt. %	Clay. %
17915	Soil	4.0	9.5	10.7	27.4	5.3	28.4	15.1
17914	Subsoil	3.6	26.4	22.3	23.0	1.1	16.3	7.6

MEADOW.

Wet alluvial bottom land having no uniformly definite texture and those areas near the heads of streams subjected throughout the year to standing water and swampy conditions have been classed as Meadow. A considerable proportion of the alluvial phase is susceptible to easy reclamation, and some of it is under cultivation. The upland bodies can be reclaimed by clearing, straightening, and extending the natural drainage ways. A few small areas are found along the water front just above tidal overflow. Generally every stream and drainage way has a narrow strip of Meadow from its mouth to its source. When thoroughly drained Meadow produces excellent corn and, where the organic-matter content is not too high, good grass and wheat.

TIDAL MARSH.

The areas of marshy land lying near water level and subject to tidal overflow are classed as Tidal marsh.

This land is a black or brown slimy loam, clay loam, or ooze, which is generally underlain at about 2 feet by a sandy or clayey material. The mass is pretty thoroughly interspersed with the roots of coarse grasses and cattails and decomposing vegetable matter. The whole remains saturated the year around. Considerable hydrogen sulphide is developed in the lower portion by decomposing vegetable matter. The odor can be very distinctly detected in the freshly exposed material, particularly in those areas touching salt water.

Tidal marsh occurs as narrow fringes along the larger bodies of water. The most extensive areas are found along the arm of Chesapeake Bay between Kent Island and the mainland.

The material is sedimentary in origin, having been deposited by rivers or built up by tides and waves. It can be reclaimed only by diking to keep out the tides. It supports a rank growth of coarse grasses and cattails. The grass is sometimes cut for hay.

The Agricultural Conditions.

Since its earliest settlement Queen Anne's County has been preeminently agricultural in its pursuits. In the early days little more corn and wheat were produced than sufficed to supply the wants of the colonists, and in unfavorable seasons there were periods of distress from short crops.

At first tobacco was grown almost to the exclusion of other crops, and was long the medium of exchange. With the beginning of the nineteenth century the tobacco acreage had enormously decreased, and warehouses were little used. The larger planters shipped their tobacco to England, but the smaller planters traded with the local representatives of English houses. Warehouse receipts representing the quantity of tobacco stored, like tobacco, passed as money.

The Revolutionary war hastened a change in agriculture by cutting off the export trade with the mother country and creating a demand for cereals to feed the Provincial army. Prior to this, however, farmers had begun to realize that their lands were being impoverished by cultivation to one crop and were increasing the acreage of wheat. Clover and timothy were coming into favor and were rotated with cereals. It was about this time that the present three-field system of cropping appeared. Flax was grown for the fiber until some time before the civil war. Sweet potatoes have been produced on a small scale since the earlier days. Peaches began to be a crop of considerable importance about sixty-odd years ago. Cultivation of tomatoes for canning purposes began about 1872.

From 1859 the production of oats decreased until 1879, since when the crop has not had an important place in general agriculture. This crop too often has suffered from unfavorable weather conditions in June and July, filling out poorly.

There were very few large plows in the county prior to the early seventies. Up to that time ridging for corn had been the practice.

Since the introduction of the large chilled plows the practice has largely disappeared and the soils have been prepared deeper and more thoroughly. The three-field system, corn, wheat, and grass, had been the prevailing rotation up to the time of the introduction of this plow. The farmers are slowly growing less corn and wheat and practicing more diversification. More stock is being raised, more grass and forage crops grown, and more corn cut for shredding. The heavier, better drained soils are so well adapted to wheat that the crop continues to hold an important place. Farms are gradually being reduced in size, a fact which in itself points toward more intensive methods of farming.

At present the dominant system of agriculture practiced over a very large part of the county is general farming in connection with more or less trucking. On most farms situated within 4 or 5 miles of a cannery or boat landing, tomatoes are grown as an important crop, and often sugar corn, garden peas, and pears are grown for canning, while peaches, pears, asparagus, strawberries, and dewberries are grown for market. In some localities trucking is equally as important, or even more so, than general farming.

There are no farms devoted exclusively to dairying, although a number of farmers sell milk at the local markets or at the few creameries. A small number of the farmers are using separators, selling the cream to the creameries or shipping it and feeding the skimmed milk to hogs.

Hogs are raised to supply the home and local market demands. Poultry and sheep are considered important additions to general farming, especially in certain localities like Kent Island. Most of the draft animals are raised on the farm.

Of the total acreage of land cultivated to crops in Queen Anne's County, about 55 per cent is seeded to wheat and 35 per cent to corn, with grass and miscellaneous vegetables next in importance, in the order named: About 65 per cent of the total acreage cultivated to miscellaneous vegetables is used for tomatoes. The bulk

of this crop is sold to local canneries, although a considerable quantity is shipped by boat to outside canneries. The variety most generally grown is the Stone—a medium large, uniformly ripening, prolific variety, possessing the red color and fleshiness desired for canning purposes.

Considerable quantities of garden peas, sugar corn, and Kieffer pears are handled at the canneries. The Kieffer, the most successful pear grown, and a wonderful producer, is better suited to canning than marketing. Strawberries, raspberries, and dewberries of excellent quality do well on the lighter soils. The strawberries grown have a good reputation in northern markets. The crop proves immensely profitable in years of short crops of strawberries elsewhere, and on the average a good margin of profit is realized. The Lucretia dewberry proves very successful especially on the lighter soils. Wild huckleberries thrive on the light soils and considerable quantities are gathered for market. Good sweet and Irish potatoes are obtained on the light types.

For many years the peach crop was very profitable throughout the county, but owing to ravages of disease, particularly the "yellows," the industry has declined. The trees, unless diseased, make a rapid growth and produce abundantly in favorable years. Some orchards have not been injured—those near the water front seem especially resistant to disease. The crop is yet of considerable importance and orchards are still being set out. The Elberta appears to be the favorite variety at present, although numerous varieties are grown. Farmers should watch their orchards closely and burn, root and branch, every tree as soon as the first indications of the "yellows" are noticed.

Some good varieties of summer apples are grown for home use. Of the late varieties the Winesap, Ben Davis, and York Imperial have proved well suited to the soils and climate. It is believed that the Stayman Winesap, which is being successfully grown on similar

soils in Delaware, would prove a profitable variety on the Sassafras loam and sandy loam.

Scarlet clover is grown as a soil renovator and occasionally for seed. More cowpeas should be grown for seed, especially on the lighter Sassafras soils.

Notwithstanding that the better crop adaptations of soils are pretty clearly understood, there is too little specialization to accord with soil variation. Farmers everywhere recognize that the Elkton silt loam is a poor corn and tomato soil, though a fair soil for wheat and grass, yet all these crops are indiscriminately grown on it. Although average yields of corn on this type are poor, in favorable seasons the crop does well, and it is with the expectation of such a season that farmers put in a considerable acreage every year instead of increasing the acreage of wheat and grass and keeping more stock.

The Sassafras loam and silt loam are admirably suited to wheat, corn, and grass, while the Sassafras sandy loam averages excellent yields of these crops. An inferior quality of wheat—small kernels—is expected on some of the poorer drained phases of these types. It is claimed, however, that the quality of that grown on the Elkton and Portsmouth soils is generally very good. Tomatoes do best on the Sassafras sandy loam, although the Sassafras loam makes good average yields, while the Sassafras silt loam makes a fairly good late crop. In growing tomatoes for canning there is no particular purpose in getting an early crop, except to head off frost. The canneries begin in August and run until the crop is canned. Strawberries and dewberries do best on the Sassafras sandy loam, Portsmouth sandy loam, and Portsmouth loam, and these types when available are generally selected for these crops. The Sassafras sand and loamy sand are particularly suited to garden peas, asparagus, turnips, early tomatoes, and Irish and sweet potatoes. Cultivated chestnuts do well on these soils.

The clovers do best on the better drained heavy soils. Red clover frequently dies out and is being replaced by crimson or scarlet

clover and alsike. Timothy does well on the heavier soils, but should be grown in rotation with other crops. The well-drained, heavier Sassafras soils produce good crops of alfalfa. The subject of crop adaptation is taken up more in detail under the heads of the different soil types.

While most farmers practice some system of rotation, there are others who grow corn or wheat on the same land several years in succession. Under this treatment some of the fields have decreased in yield, but only a small proportion of the county has been subjected to such injudicious treatment.

The prevailing schemes of crop succession—the old three and five field systems—are very well suited to the Sassafras loam, sandy loam, and silt loam. These systems include the following rotations: Corn, wheat, and grass for the three-field system, and corn, wheat, grass, wheat, and grass for the five-field system. The grass consists of timothy and red clover or timothy alone, and is usually cut once and then left for grazing. Tomatoes fit in well after corn and are followed by exceptionally good yields of wheat on account of the excellent physical and moisture conditions induced in the soil by the shading of the vines and the good manurial properties of the vines and refuse fruit. It is estimated that wheat following tomatoes or a timothy-clover sod will yield an average of one-third more than if it follows corn. Tomatoes do not do so well after tomatoes. Rotations on all the types except, perhaps, the Portsmouth soils, should include crops of cowpeas or clover to be turned down green in conjunction with applications of 25 to 50 bushels of lime per acre once every three to six years, according to the condition of the soil and its power to retain organic matter. On account of the more thorough aeration of the lighter types, like Sassafras sand and loamy sand, the organic matter is likely to be depleted rapidly owing to rapid oxidation, and it is therefore necessary to grow frequent crops of cowpeas, but not so much lime is required as on the heavier soils. Good results are secured by liming grass in the fall preceding

FIG. 1.—VIEW OF MATURE FOREST OF LOBLOLLY PINE ON CORSICA NECK.

FIG. 2.—VIEW OF LOBLOLLY PINES ALONG THE "CAUSEWAY" LEADING TO THE HERMITAGE.

breaking for corn or wheat. Direct applications of lime to grass should be light (20 bushels to the acre), for the reason that too rapid decomposition of the turned-under vegetation results from large applications. In case large amounts of lime are used, the applications should be made to the broken soil so as to keep the lime from direct contact with the vegetable matter. A good many farmers are beginning to sow cowpeas or crimson clover in corn or crimson clover in tomatoes at the last cultivation, turning these under before planting wheat.

Much trouble in getting good crops by employing the old method of seeding red clover on wheat in late winter is experienced. The young, tender plants, suddenly exposed to hot sunshine by cutting off the wheat close to the ground, seem to be unable to withstand the change and gradually die out. In seasons with plenty of moisture and no protracted hot spells succeeding harvesting, good crops are secured. Contrasting the clover yields obtained in the earlier days by sowing with wheat, and the good crops now obtained on the newly cleared peach orchards, with the crops obtained on other soils, it appears that the latter may have come into an unhealthy condition with respect to this crop. However, with an increased yield of wheat and consequent heavier growth and denser shading, the young plants are crowded nearer together and probably are less strong upon removal of the grain than formerly was the case Some attribute the failures to toxic effects coming from continued use of acid-phosphate fertilizers. On the other hand there are many instances where good crops have been secured by seeding alone in the fall on thoroughly prepared limed ground. Many farmers claim they have no trouble in getting good crops by liming after breaking sod land, sowing wheat, topdressing with good barnyard manure, and then sowing the clover on the wheat in late winter or early spring. Scarlet clover can be grown with ease on most of the types, but the hay is not considered as good as red clover hay. Cowpeas can be grown on all soils, even those too light for crimson clover, and always im-

prove the land, whether cut, grazed off, plowed under, or left as a winter cover crop. Alsike clover, which is rapidly coming into favor, will prove a valuable crop for this region. By growing cowpeas land too light for clover can be brought up to good condition for that crop.

Large quantities of commercial fertilizers are used. The fertilizers for tomatoes, potatoes, asparagus, and corn vary considerably in analysis, running generally from a "10-5" phosphate potash to about a "8-2-4" brand:

As a general rule, readily soluble, "quick-acting" fertilizers which produce an early growth and early ripening of the crop are most desirable. If nitrogen is needed, nitrate of soda is perhaps the best form in which it can be applied. It acts quickly but not through a long period, and for that reason is very desirable where short-season crops are concerned. In many cases it is found an advantage to apply the nitrate at two periods rather than all at once. It is well to make one application when the plants are set in the field and a second about the time the fruits begin to color. Fertilizers containing nitrogen in a slowly available form, such as cotton-seed meal or coarse, undecomposed stable manure, which do not stimulate an active growth until late in the season, are not desirable for this crop. Such fertilizers are too slow for a short-season crop like the tomato, which needs something to stimulate it at the very time it is transplanted to the field. Such fertilizers also tend to stimulate late growth of vine at the expense of the maturity of the fruit. Potash and phosphoric acid are more conducive to the development of fruits than is nitrogen, except in th form of nitrate of soda.

Heavy dressings of stable manure tend to produce too much vine, and are seldom or never employed. If stable manure is used it is at a moderate rate, usually not more than one or two shovelfuls to a plant. This, if well decomposed and thoroughly incorporated with the soil, is very stimulating to the young plant and consequently very beneficial.

Any fertilizer used should be applied, in part at least, at the time the plants are transplanted to the field.*

Very little sodium nitrate is used. Kainit is used frequently on the Elkton soils to prevent "frenching." About twenty years ago considerable "black residuum" was used to prevent "frenching," and it is claimed with good results. This material, composed of charred leather, undecomposed scrap iron, and traces of muriate of potash,

* Farmers' Bulletin No. 220, p. 12.

the residuum left in the manufacture of potassium prussiate, probably improved the structure of the soil and acted as an absorbent. It is said that phosphates help ripen crops and even force out a large number of "underlings" or stool stalks.

Fertilizers are applied at the average rate of about 300 pounds an acre for wheat, 200 pounds for corn, and 400 pounds for tomatoes. Heavier applications are made for crops like asparagus, garden peas, etc. Although commercial fertilizers are not as generally used for corn as for wheat, the bulk of barnyard manure is used for corn.

Experience of the most successful farmers shows that fertilizers are more lasting and beneficial when applied in conjunction with vegetable manure. Nitrogen, the most expensive ingredient of fertilizers, should be secured by growing cowpeas and clover, which crops gather atmospheric nitrogen through the action of bacteria living in the root nodules of these legumes. Alfalfa also stores up nitrogen in the soil. Too little home mixing of the fertilizer ingredients is done. Farmers generally buy from agents for future delivery.

Barnyard manure is the best fertilizer for general use on the soils of this section. Moderate amounts are made by using wheat straw as bedding material, though generally not enough to cover the land intended for corn. Considering the excellent quality of this form of manure and the ease with which heavy yields of forage crops can be produced, it seems strange that stock raising has not been carried on on a more important scale. A large extension of the stock industry undoubtedly would prove profitable. It should be the object to feed the bulk of corn and increased quantities of hay and forage crops to stock, carefully preserving the manure and returning it to the land. By establishing more cooperative creameries at convenient points throughout the county, butter making could be introduced on a profitable and permanent basis.

Farmers frequently claim that the soils are not well enough adapted to grass for profitable dairying. The yields of hay from the heavier types—from 1 to 2½ tons per acre—compare favorably with those of some of the most prosperous butter-making sections, and further, there could not be found anywhere soils better adapted to forage crops. It is not necessary to have a large acreage of pasture land where such yields of these can be secured. Silos, a comparatively small acreage of mixed grasses for pasturage, and a large acreage in cowpeas, clover, sorghum, timothy, etc., would solve the problem of feeding.

For wheat, breaking begins on stubble and sod land in late July and in August, and "corn land" is broken as soon as the crop can be removed. After breaking to a depth of 4 to 6 inches with a walking moldboard plow drawn by two or three horses, according to soil conditions, the ground is rolled with heavy iron rollers, then run over several times in opposite directions with spike-tooth and spring-tooth harrows and occasionally with a smoothing, an acme, or a disk harrow, then rolled again and seeded. It is a good idea to get the soil sufficiently pulverized for a hoe-drill to do good work, although it is not necessary to use this kind of a drill. Sometimes farmers get behind to such an extent that there is not sufficient time for giving corn land thorough preparation. Fairly good results are obtained by simply disking and seeding. Such land, however, is more inclined to run together and harden the following spring.

Most of the wheat crop is put in during the first half of October, although seeding sometimes begins as early as the middle of September and continue up to about the 1st of November.

Land for corn is plowed to an average depth of about 5 inches, rolled and prepared about as for wheat, then planted in checks, generally between April 20 and the middle of May. The heavier soils could be put in better condition by breaking in the fall, so as to expose the soil to the action of freezes and thaws. Especially is this beneficial for sod that has been packed by grazing or is in an un-

favorable structural condition through depletion of its organic matter. However, such fall preparation for corn sometimes conflicts with the seeding of wheat and care of the late crops of tomatoes. Corn is cultivated comparatively deep the first two or three times with a "buggy cultivator" or walking cultivator, then shallower with a walking cultivator. This frequent flat cultivation is sufficient for all needs of the crop. There is a custom of cultivating every other middle in going over a field after surface roots begin to form. The object is to avoid retarding growth by leaving one-half the surface roots uninterfered with until those in the cultivated middle have time to recuperate. Corn is either cut and shocked in the field or stripped of the lower blades and topped, leaving the ears to be pulled. The wide corn-shock rows are sometimes seeded to oats in late winter or early spring. Very little wheat is stacked, thrashing being done from the shock.

Tomato land is prepared and the crop cultivated about the same way as corn. The general plan is to set the plants close enough to allow them to mat and completely shade the land, thus protecting the soil and fruit from the hot sun. Fall plowing would be the better plan, except on the Sassafras sand and loamy sand. Strawberries are cultivated in matted rows. The middles are cultivated shallow in July or August, while weeds and grass are removed by hoeing and by hand.

Whenever possible fall plowing should be practiced for all crops on all soils, except the Sassfras sand and sandy loam, which would not be particularly benefited except by turning under vegetable matter. The depth of plowing should vary and should be generally increased to 7 to 10 inches, care being taken not to increase the depth more than an inch or two in one season. When more than this amount of the under soil is turned to the surface injury is sometimes done succeeding crops, owing to the fact that the lower soil or subsoil does not have time to weather out and get in good condition during winter. This is especially true with the Elkton soils and

the poorer drained phases of the heavy Sassafras types. There are instances where suddenly turning up a large quantity of the subsoil has injured land for years. The depth of plowing should not be increased materially in the spring with the intention of growing a crop that season. Applications of lime immediately following deep plowing hasten improvement in the exposed subsoil material.

About 40 per cent of the farms of Queen Anne's County are operated by owners, the remainder being cultivated largely by share tenants. The share tenant pays one-half the fertilizer and seed bill and receives one-half of the crops. Land is rented for one year. Landlords generally have a voice as to the acreage that shall be planted to different crops. Wheat and corn are by agreement more exclusively planted. Too often the grass area is restricted and the number of stock kept too limited for the production of a reasonable quantity of manure. A considerable number of rented farms could be managed more providently with respect to soil improvement. This is sometimes neglected, owing to the lack of interest on the part of the tenant or because the landlord is too interested in immediate returns in wheat or corn. The average size of farms in 1899 was about 153 acres for Queen Anne's. The price of land has increased considerably in recent years. Acreage valuation varies widely according to the character of the soil, state of improvements, and locality. Land can be bought at low figures on some of the poorer drained or deep sandy soils not within easy reach of shipping points.

Summary.

With its delighful climate and well distributed rainfall, its tidal waters abounding in shellfish and water fowl, its good roads system and water and rail transportation, Queen Anne's County offers many inducements to persons looking for soils adapted to special lines of farming, general farming, or the two in conjunction with stock raising. Butter-making should also be profitable.

For wheat the heavier Sassafras soils equal and frequently exceed the production of the fertile "black lands" of the northwestern wheat States. From 1 to 2½ tons of good hay can be produced on the heavier soils, while large yields of forage crops can be secured from all the types. There are no better tomato and trucking soils in the country than the lighter Sassafras soils.

Named in the order of importance, wheat, corn, tomatoes, and hay comprise the general farm crops. A number of specialties like sugar corn and garden peas for canning, and strawberries, asparagus, cantaloupes, peaches, dewberries, and peas are grown for market. Cowpeas, alsike, crimson clover, and alfalfa are coming into use for forage and for improving the land.

The rotations commonly practiced are the three and five field systems, the former being corn, wheat and grass, and the latter corn, wheat, grass, wheat, and grass. Tomatoes, clover, and cowpeas can be introduced into the system profitably. It is a frequent and advisable practice to sow cowpeas or crimson clover in corn at the last cultivation. Wheat averages nearly one-third more after a clover-timothy sod and after tomatoes than after corn. It is not advisable to grow tomatoes after tomatoes.

Large quantities of commercial fertilizer are used. The grades for wheat, corn, and grass average something like 1-9-2 in analysis.

The Sassafras sand is a light, well-drained, and naturally warm soil especially adapted to truck crops like garden peas, asparagus, and early Irish potatoes. It is kept in best condition by turning under crops of cowpeas and crimson clover and applying barnyard manure at frequent intervals.

The Sassafras loamy sand is a gently rolling, light loamy sand well suited to sweet and Irish potatoes, strawberries, asparagus, dewberries, and sometimes producing fair crops of corn. It also requires the addition of considerable vegetable manure.

The Sassafras sandy loam is the most extensive and widely distributed type of the area, occurring throughout the uplands. It

is an excellent general farming soil and the best tomato soil of the area. It is also especially suited to strawberries, potatoes, asparagus, peaches, pears, dewberries, and other small fruits. Under favorable conditions of weather and soil management, wheat yields from 15 to 30 bushels, corn from 35 to 65 bushels, hay from 1 to 2 tons, and tomatoes from 4 to 12 tons per acre. The type is easily handled.

The Sassafras loam is the best all-around general farming soil of the county, producing under favorable conditions 18 to 35 bushels of wheat, 40 to 75 bushels of corn, 1 to 2½ tons of hay, and an average of about 4 tons of tomatoes per acre. It is the best wheat and corn soil of the area. Peaches, pears, cantaloupes, and all kinds of forage crops yield well.

The Sassafras silt loam is an excellent soil. The surface is generally flat and sometimes requires ditching to remove surface water. It is the best grass soil and gives excellent yields of wheat and corn as well. The type is not particularly suited to truck crops, although tomatoes, cabbage, and some other vegetables do fairly well.

The Sassafras fine sandy loam is confined largely to the lower flat lands. The larger areas are found along the water front of Queen Anne's county. Where the drainage is good the yields approximate those of the Sassafras sandy loam. It is, however, probably a better grass soil than the Sassafras sandy loam.

The Elkton sandy loam is a flat or depressed poorly drained soil that makes poor yields under present conditions. It needs to be drained and limed. The total area is not very extensive.

The Elkton silt loam produces good wheat and grass, but poor average crops of tomatoes and corn. The soil has the same texture and is derived from the same materials as the Sassafras silt loam, but poorer drainage has given rise to an unfavorable structure in the soil and an unhealthy, stagnant condition in the subsoil. The soil is benefited by turning under coarse manures and applying from 40 to 50 bushels of lime per acre to grass sod every three to five

years. This soil should be used largely for growing grass and forage crops in connection with stock raising.

The Portsmouth sandy loam and Portsmouth loam are black, spongy soils of high organic matter content. When drained they produce excellent strawberries, dewberries, and corn. Winter crops, like wheat and grass, are apt to heave during alternate freezes and thaws. Many areas could be reclaimed by deepening, straightening, and extending ditches and natural drainage ways.

Meadow comprises the low, wet strips of land along streams and the flat, semiswampy bodies around the heads of streams. All of the latter and many of the strips along water courses could be reclaimed. Excellent corn can be grown on this type.

Tidal marsh includes the marginal fringes along the shore line and larger streams subject to tidal overflow. The material generally consists of oozy sediments interspersed with roots of coarse marsh grass. In order to reclaim this type diking would be necessary to keep out tide water.

THE CLIMATE OF QUEEN ANNE'S COUNTY

BY

ROSCOE NUNN

Introductory.

Queen Anne's County, like the other counties of the Eastern Shore, trends southwest-northeast. Its southwestern extremity is in latitude north 38° 50′ and its northeastern extremity touches 39° 16′; in longitude, west, it extends from 75° 44′ to 76° 24′. The northeastern end of the county is almost directly east of Baltimore, while its south-central portions and its western extension (Kent Island) are centered nearly east of Annapolis. The county is of medium area (379.7 square miles) as compared with neighboring counties. Its topography is rather uniform, the surface elevations ranging from sea level to not higher than about 100 feet and mostly under 75 feet. Its shore lines are extensive, with Chester River on the north and northwest, Chesapeake Bay on the west, and the Wye River on the south-central border. Kent Island, in Chesapeake Bay, is an important division of the county.

Climatic Data Available.

Weather records have been kept at only two stations in Queen Anne's County. Both of these stations were near the border lines. The first station, Queenstown, was opened in March, 1898, and the other station, Sudlersville, was opened in October, 1898. Queenstown is near the western shore of the central mainland of the county, while Sudlersville (the station, to be exact, was about three miles north of Sudlersville) is in almost the extreme northeastern part of the county.

The entire record at Queenstown, April, 1898, to April, 1903, was made by Dr. William Kennedy Carroll. The Sudlersville record was kept by Mr. J. S. Barwick, October, 1898, to May, 1906; by Mr. James E. Higman, October, 1906, to January, 1912, and by Mr.

Henry L. Higman, February, 1912, to December, 1922. The first of January, 1923, Mr. Henry L. Higman having removed to Millington, about two miles north (but in Kent County), the station was transferred to that point, where Mr. Higman has continued the observations.

These two stations are favorably located to represent the climate of the mainland of Quen Anne's County, but the Queenstown records are for too brief a period to be comprehensive. The Queenstown records represent the marine aspect of the climate of the southwestern, or Bay shore, portions of the county, where the influence of the water areas of the lower Chester River and Chesapeake Bay, which lie to the westward and windward, is perceptible. The Sudlersville records represent the inland and more elevated portions of the county, showing the effects of distance from water areas and increased height above sea level.

The records at Queenstown are for only five years and are somewhat broken. They are too short to give satisfactory means, although valuable as far as they go. The Sudlersville record, as has already been stated, comes from the northeastern corner of the county. It is therefore deemed well to consider in this discussion of the climate of Queen Anne's County the records made at Rock Hall, near the Kent-Queen Anne's line, and those of Easton, about 12 miles south of the Queen Anne's-Talbot line. The records at Ridgely, near the Caroline-Queen Anne's line, will give good information for southeastern Queen Anne's County when they have been kept long enough, but at present only four years of these records are available, the Ridgely station having been established July 1, 1922.

By using these outlying stations, in addition to the stations within the county, we may come close to the facts pertaining to the climate of Queen Anne's County in its various parts and as a whole. Yet, it is regretted that no actual records are available for Kent Island, which is an important part of Queen Anne's County. Kent

Island is the largest of the Chesapeake Bay islands and is a rather unique and favored area. If practicable, a climatological station should be established at a well-chosen point on the island.

Climatic Features.

After comparing the records at Queenstown, years 1898 to 1903, with the records at Rock Hall and Easton for the same period, it appears that the average variation of Queenstown records from the means derived from the combined records of Rock Hall and Easton is slight, and we may let the means of these two stations represent the Queenstown area and the southwestern third of Queen Anne's County. Therefore, in the two-line tables (I to IX) the data given for Queenstown are derived as above explained. These brief tables summarize the climatic statistics for Queen Anne's County. But it is desirable to exhibit the whole record of monthly and annual temperatures and precipitation for at least one station in the county, and we therefore publish tables X, XI, and XII, giving the entire records of monthly and annual mean temperatures, monthly and annual precipitation, and dates of last killing frost in spring and first in autumn, for Sudlersville. From these tables the fluctuations, means, ranges, and extremes of temperature and precipitation and of the beginning and ending of the growing seasons, for a period of 24 years, may be seen.

Graphs of temperatures experienced at Sudlersville are given in Fig. 1. The lines represent the averages of daily maximum temperatures, the mean daily temperatures, and the averages of lowest daily temperatures. the trend of the seasons is shown by these lines; also the average daily range of temperature. The coldest part of the year is the last of January and the first part of February, on an average; the warmest days come about the middle of July. In mid-winter the daily range of temperature runs, usually, from a minimum of about 25 to a maximum of about 42, while in mid-summer the usual minimum is around 65 and the usual maximum around 86.

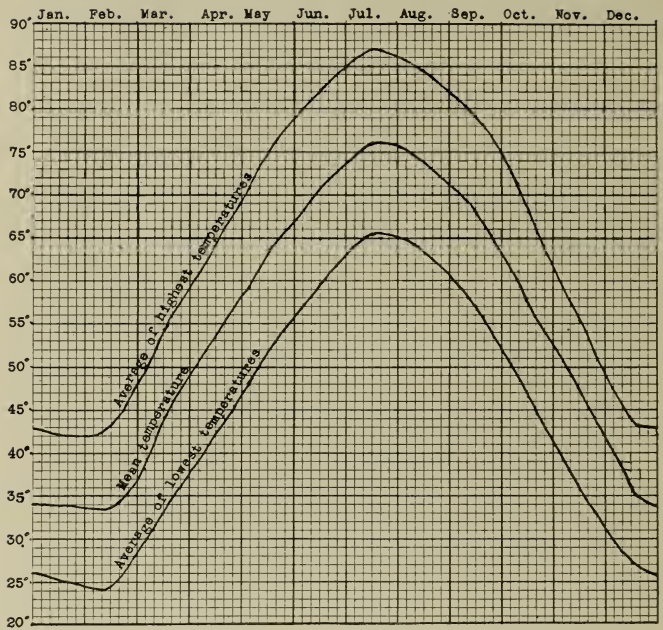


Fig. 1. Average temperatures throughout the year at Sudlersville.

Figure 2 presents the means and extremes of precipitation by months. In January, for example, the least monthly amount ever received was 1.87 inches, the general average for the month is 3.46 inches, and the greatest amount ever received was 5.26 inches.

The tables and graphs, however, do not give certain details that are essential to a thorough description of the climate. We there-

fore compile the facts contained in the following paragraphs by careful examination of the daily records of the several stations in and adjacent to Queen Anne's County.

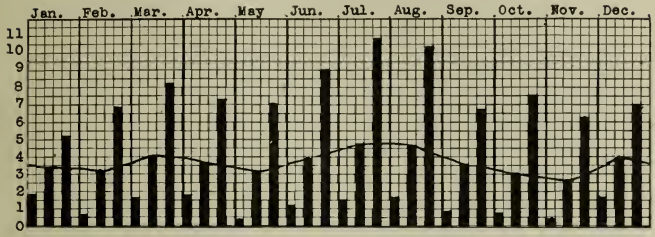


Fig. 2. Monthly means and extremes of precipitation in Queen Anne's County.

Temperature, Frequency of Certain Extremes.—The average number of days in the year with maximum temperature as high as 90° or above is 26; with minimum temperature as low as 32° or below, 97; with minimum as low as 14° or below, 11. Temperatures of zero, or lower, seldom occur; at Sudlersville, zero or lower was registered in nine years of the twenty-four years record. On an average, zero temperatures occur once in three or four years.

Length of Growing Season.—The average date of the last killing frost (freezing temperature) in spring, for Sudlersville, is April 16, and for the Bay shore region of the county, about April 10. In autumn, the first killing frost comes, on an average, at Sudlersville, October 24, and on the Bay shore, October 29. This gives an average growing season of 191 to 202 days. The extremes of killing frost dates are as follows: Earliest date of last in spring, March 19; latest date of last in spring, May 12. Earliest date of first in autumn, October 8; latest date of first in autumn, November 15.

Sunshine and Cloudiness.—The average number of days in the year with clear sky is 114, partly cloudy, 132; cloudy, 119.

Humidity.—While the Queen Anne's County stations were not equipped for making observations of relative humidity, and no actual records are available, it is evident from the records of the nearest regular Weather Bureau stations, especially Baltimore, that the average relative humidity for the region is about 70 per cent. This is slightly lower humidity than prevails on the immediate Atlantic coast and slightly higher than that of the Piedmont and Mountain regions of Maryland.

Excessive Rainfall.—Records of daily rainfall show the number of occurrences of excessive amounts (that is, 2.50 inches or more within 24 hours). It appears that falls of 2.50 inches or more in a day may be expected less than once a year, on an average. At Sudlersville such excessive falls occurred 18 times in 24 years. In eight years of the twenty-four there was no excessive fall, while in two years of this period there were two occurrences each. Excessive rains occur principally in the summer months, with thunderstorms; but some occur in connection with the Atlantic coast storms of September and October. The greatest amount on record for 24 hours is 6.00 inches. Amounts exceeding 4.00 inches in 24 hours seldom occur.

Thunderstorms.—The average number of thunderstorms per year is 36. They are distributed through the year as follows: March, 1; April, 3; May 4; June, 7; July, 9; August, 7; September, 3; all other months, 2. Thunderstorms occur nearly three times as often in portions of Florida and twice as often in southern Georgia, Alabama, and the middle Gulf region.

Prevailing Winds.—During the winter and spring the winds come mostly from the northwest or southwest. In the summer south and southwest winds predominate strongly. During the autumn southwest winds predominate, closely followed by north, northwest, and south. The least frequent winds are those from easterly quarters, but the easterly winds are particularly notable because they

are so often attended by cloudiness and precipitation, and, in summer, by lowered temperature.

Droughts.—The records show that the rainfall is well distributed through the year. The three months, June-July-August, receive more than any other three months, as a rule. Disastrous droughts are almost unknown in this region. Only two or three times in the last thirty years have very serious droughts occurred during the crop growing season. Droughts occur more often in the autumn, but at that season they cause no great damage.

Conclusions.

From the foregoing exhibits of climatic data, and by comparison with the data for other parts of the United States, it will be seen that Queen Anne's County enjoys an unusually equable and well-rounded climate. It is free from great extremes of any kind; yet it is characterized by such variations during the year as to be mildly stimulating. It meets all the requirements of a varied agriculture. It is excellent for the growing of fruits and vegetables.

Means and Extremes of Temperature and Precipitation.

TABLE I.
Mean Temperature.

Stations	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual
Queenstown	33.8	33.7	44.4	53.2	62.9	72.0	76.6	74.6	68.8	58.2	46.0	36.6	55.1
Sudlersville	33.7	33.1	44.1	53.5	63.6	71.0	76.2	73.9	68.3	57.6	47.2	35.5	54.8

TABLE II.
Mean Maximum Temperature.

Queenstown	42.2	42.2	54.1	63.5	73.4	81.9	86.0	84.0	78.6	68.4	55.2	44.8	64.5
Sudlersville	42.2	42.0	54.4	64.6	75.4	82.2	87.1	84.4	79.3	68.7	55.4	43.9	65.0

TABLE III.
Mean Minimum Temperature.

Queenstown	25.2	25.2	34.7	42.7	52.6	62.0	66.9	65.3	59.0	48.1	37.2	28.8	45.6
Sudlersville	25.2	24.1	33.8	42.4	51.8	59.7	65.4	63.2	57.0	46.6	35.6	27.1	44.4

TABLE IV.
Highest Temperature.

Queenstown	71	71	89	93	96	100	101	101	96	89	78	70	101
Sudlersville	74	72	90	94	97	102	105	103	95	89	78	70	105

TABLE V.
Lowest Temperature.

Queenstown	−8	−13	8	15	33	44	49	48	37	27	16	−1	−13
Sudlersville	−10	−12	2	23	32	42	49	47	34	26	16	−4	−12

TABLE VI.
Average Precipitation, Inches.

Queenstown	3.09	3.17	3.55	3.30	3.32	3.65	4.58	4.36	3.46	2.64	2.7	3.04	40.88
Sudlersville	3.46	3.29	4.00	3.56	3.16	3.90	4.75	4.58	3.51	2.97	2.5	3.90	43.67

TABLE VII.
Average Number of Days With Precipitation (.01 Inch or More).

Queenstown	9	8	10	9	10	9	10	9	7	6		8	94
Sudlersville	10	8	11	9	10	9	10	10	7	7	8	9	108

TABLE VIII.
Greatest 24-Hour Rainfall, Inches.

Queenstown	2.40	3.06	2.65	2.40	2.53	6.00	3.76	5.02	4.62	5.13	2.67	2.04	6.00
Sudlersville	1.90	2.50	2.92	2.65	2.30	2.66	5.45	4.16	4.06	3.50	2.32	2.00	5.45

TABLE IX.
Average Snowfall, Inches.

Queenstown	5.6	7.0	2.6	0.8						0.2	0.3	2.4	18.9
Sudlersville	6.9	6.5	3.6	1.0						0.1	0.4	5.3	23.8

TABLE X.
SUDLERSVILLE
MEAN TEMPERATURE.

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual
1898.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56.5	45.2	38.5	.....
1899.....	35.3	28.0	44.2	53.9	63.0	73.1	75.1	73.2	66.0	58.6	47.6	39.0	54.8
1900.....	37.5	35.1	40.2	53.9	62.9	70.4	76.3	75.9	71.5	61.8	50.0	37.5	56.1
1901.....	35.4	29.0	44.8	50.6	62.2	72.6	80.4	77.3	69.8	55.8	40.6	34.9	54.4
1902.....	30.8	29.0	46.4	54.3	65.0	71.8	77.4	73.4	67.7	59.2	51.4	34.9	55.1
1903.....	33.2	38.5	51.6	54.0	64.9	67.0	76.7	72.4	67.4	58.6	42.2	31.6	54.8
1904.....	26.6	27.5	41.6	51.4	66.4	71.2	75.0	74.6	69.4	54.9	***42.0***	30.0	52.6
1905.....	29.3	25.6	46.4	53.4	66.4	72.6	77.6	74.6	69.2	58.0	43.8	38.6	54.6
1906.....	40.0	35.3	39.0	55.2	66.1	***73.0***	***75.0***	***76.0***	***72.0***	56.6	45.0	36.6	55.9
1907.....	35.5	27.4	46.2	47.8	58.5	65.2	75.5	72.4	69.9	52.0	45.0	39.2	53.0
1908.....	34.3	31.0	46.6	55.0	64.7	72.2	78.4	71.9	66.7	58.9	45.4	36.2	55.1
1909.....	36.0	42.8	40.6	52.7	63.1	73.0	73.8	71.0	67.2	52.5	48.8	31.0	54.4
1910.....	32.0	35.0	49.0	57.2	61.9	69.2	76.8	72.8	70.8	59.4	41.5	28.9	54.5
1911.....	36.9	35.2	41.1	49.8	68.7	72.2	78.2	75.7	70.4	56.7	43.6	40.8	55.8
1912.....	24.9	30.2	40.7	53.6	64.1	69.8	75.2	72.8	69.9	58.4	46.7	38.8	53.8
1913.....	42.5	35.1	48.6	55.0	63.0	72.1	76.6	73.4	67.6	58.8	46.8	39.2	56.6
1914.....	36.8	30.1	37.8	52.3	65.4	72.7	75.4	76.0	65.2	60.0	44.7	33.3	54.1
1915.....	35.9	38.5	38.4	58.0	61.6	70.0	76.4	73.6	70.2	58.4	44.2	34.0	54.9
1916.....	38.8	32.8	36.4	52.2	64.8	68.2	76.4	75.9	66.6	56.8	46.2	34.0	54.1
1917.....	34.0	32.1	42.2	53.3	57.4	71.9	76.0	74.4	62.6	52.4	41.5	28.1	52.2
1918.....	22.6	33.0	45.2	52.7	67.6	69.0	74.0	76.1	63.5	59.3	44.9	40.4	54.0
1919.....	36.2	35.8	47.2	52.4	63.2	71.4	75.8	72.4	67.8	62.4	46.2	30.6	55.1
1920.....	27.3	31.1	43.0	52.0	58.4	70.2	73.6	73.9	67.9	60.4	45.2	38.7	53.5
1921.....	36.0	38.0	55.2	58.8	62.0	72.4	78.6	71.6	***72.5***	55.6	47.8	35.6	57.0
1922.....	30.9	37.4	45.0	54.5	65.0	73.5	75.2	72.6	68.2	58.6	46.8	36.2	55.3
Average...	33.7	33.1	44.1	53.5	63.6	71.0	76.2	73.9	68.3	57.6	47.2	35.5	54.8

TABLE XI.
SUDLERSVILLE
TOTAL PRECIPITATION, INCHES.

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual
1898.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1899.....	3.30	5.54	4.78	1.77	2.68	2.56	4.24	5.15	3.58	1.65	2.17	1.59	39.01
1900.....	3.73	6.39	3.41	2.13	2.02	1.48	4.93	2.81	5.82	2.01	2.26	2.41	39.40
1901.....	3.12	0.64	2.68	5.11	2.83	***1.40***	8.01	***6.75***	4.38	1.47	2.11	7.00	45.50
1902.....	4.25	6.85	3.30	3.90	2.28	9.00	***3.75***	1.57	6.68	4.97	3.68	6.21	56.44
1903.....	3.08	4.71	6.35	3.75	1.41	4.39	4.32	5.27	1.61	5.36	1.27	3.30	44.82
1904.....	2.89	2.80	3.58	2.57	2.25	3.81	4.08	3.70	4.47	2.88	***2.10***	4.16	39.29
1905.....	4.14	3.66	3.78	3.02	3.79	4.38	7.84	3.92	3.88	1.83	1.35	4.04	45.63
1906.....	2.66	3.83	6.73	2.51	2.19	***6.00***	***7.00***	***6.50***	***1.75***	4.78	2.19	3.57	49.71
1907.....	2.33	2.50	2.58	3.82	6.32	5.79	3.05	1.68	6.28	2.68	6.32	4.23	47.58
1908.....	3.14	3.77	2.21	2.63	7.00	2.33	5.67	4.21	2.38	2.72	1.30	4.67	42.03
1909.....	3.17	3.62	4.26	2.74	3.02	5.01	2.61	1.61	5.71	1.35	2.87	5.46	41.43
1910.....	4.80	1.24	1.89	4.19	2.49	6.53	3.51	2.78	0.88	4.67	4.26	3.08	40.32
1911.....	4.41	2.49	3.42	4.13	0.39	4.46	2.39	9.82	2.15	3.24	5.67	3.97	46.54
1912.....	3.78	1.99	8.16	2.84	4.18	2.31	2.72	1.67	6.43	3.93	2.17	5.25	45.43
1913.....	3.57	1.53	4.44	7.28	2.66	3.34	1.50	6.05	4.01	5.14	2.10	2.82	44.44
1914.....	3.91	2.95	3.44	3.07	2.33	1.35	4.28	4.04	1.49	1.63	2.16	5.01	35.66
1915.....	5.26	4.80	1.58	3.07	3.23	4.21	2.44	7.64	2.81	4.37	1.28	3.13	43.82
1916.....	1.87	3.94	4.11	3.56	3.08	4.85	5.62	2.06	2.19	1.59	2.39	5.51	40.77
1917.....	3.03	1.98	5.48	2.25	2.92	3.73	6.47	4.63	2.40	7.51	0.42	2.61	43.43
1918.....	4.54	1.04	5.38	5.58	4.14	2.78	5.14	4.24	4.37	1.00	2.19	3.38	43.78
1919.....	3.64	2.44	4.22	4.55	5.88	2.38	10.89	9.33	2.05	2.96	3.61	3.32	55.27
1920.....	2.57	3.58	3.20	4.94	2.61	4.96	2.99	8.32	2.12	1.32	3.71	3.07	43.39
1921.....	2.25	2.94	2.49	3.95	3.73	1.18	3.22	4.19	5.24	0.73	4.03	2.02	35.97
1922.....	3.55	3.83	4.45	1.99	2.37	5.35	7.40	1.94	1.55	1.42	0.60	3.77	38.22
Average...	3.46	3.29	4.00	3.56	3.16	3.90	4.75	4.58	3.51	2.97	2.59	3.90	43.67

TABLE XII.
SUDLERSVILLE
FROST.

Year	Latest date temperature 32° or lower in spring	Earliest date temperature 32° or lower in autumn	Interval in days
1898	April 28	October 28	183
1899	April 10	October 22	195
1900	April 11	November 6	209
1901	April 4	October 26	205
1902	April 4	October 30	209
1903	April 5	November 7	216
1904	April 20	October 8	171
1905	April 19	November 2	197
1906	April 3	October 12	192
1907	April 20	October 15	178
1908	April 20	October 13	176
1909	April 12	October 17	188
1910	April 14	October 30	199
1911	April 18	October 29	194
1912	April 9	October 17	191
1913	May 12	October 22	163
1914	April 14	October 28	197
1915	April 5	November 6	215
1916	April 11	October 11	183
1917	April 15	October 7	175
1918	April 7	October 23	199
1919	April 25	November 7	196
1920	May 6	November 13	191
1921	April 12	October 14	185
1922	April 29	October 19	173
Average	April 16	October 24	191

THE HYDROGRAPHY OF QUEEN ANNE'S COUNTY

BY

B. D. WOOD

Chesapeake Bay with Wye and Chester rivers form all of the eastern and part of the northern and western boundaries of the county, and both streams are in the influence of tide which ranges about 2 feet.

With the exception of limited areas, the elevation of the county does not exceed 50 feet. Therefore the slope of the various streams is small and many are in the influence of tide water nearly to their source. Many of the streams rise in large swamp areas.

No measurements have been made of the flow of the various streams within the limits of the county, but judging from their size, as shown on the map, and the mean annual rainfall, which is 45 inches at Sudlersville and 44 inches at Chestertown, the total flow must be small. Therefore the power possibilities are limited.

The following is a gazetteer of the streams of the county, not including the tidal estuaries. This gives a brief description of each stream as taken from the general county map published by the Maryland Geological Survey in cooperation with the United States Geological Survey.

Adler Branch.[1]—Rises in the central part of Centreville township, at altitude about 50 feet above sea level; flows westward into Corsica River (tributary to Chester River, which discharges to Chesapeake Bay) at Green Point; about 2 miles long.

Andover Branch.—Rises in a marshy area near Carsons Corners in the eastern part of the county at altitude somewhat less than 70

[1] Except where otherwise stated the only authority for the descriptions given is the county map. The gazetter does not include the so-called creeks and rivers which are merely tidal estuaries.

feet above sea level; flows somewhat east of north about 5 miles, then, in general, northwestward 6 miles to its junction with Chester River, which discharges into Chesapeake Bay; marshy throughout much of its course; principal tributary, Sewell Branch.

Blockston Branch.—Rises in the western part of Ruthsburg township, at altitude about 70 feet above sea level; flows southeastward into Geary Mill Pond on Mason Branch (tributary through Tuckahoe Creek to Choptank River, which discharges to Chesapeake Bay).

Browns Branch.—Formed in the northeastern part of Church Hill township by the union of two small intermittent streams, which rise at altitude about 80 feet above sea level; flows south of west into Southeast Creek, which discharges through Chester River to Chesapeake Bay; length to head of the southern branch, about 5 miles.

Chester River.—Formed on the boundary between Kent and Queen Anne's counties, by the junction of Andover and Mill branches; flows in general southwestward into Chesapeake Bay; altitude at the junction of the upper tributaries about 15 feet; tidal throughout most of its course; principal tributaries in Queen Anne's county, Andover, Unicorn, Red Lion, and Foreman branches, and Southeast Creek.

Corsica River.—Rises in the western part of Ruthsburg township, at altitude about 70 feet above sea level; flows northwestward into Chester River, which discharges to Chesapeake Bay; below Centerville Landing this river is a tidal estuary.

Foreman Branch.—Rises in the southern part of Crumpton township, at altitude about 80 feet above sea level; flows in general, northwestward to its junction with Chester River, which discharges to Chesapeake Bay; length, about 5 miles; marshy in lower course.

German Branch.—Formed in the northwestern part of Ruthsburg township by a number of branching tributaries; the head-water stream draining the largest area rises in the southeastern part of

Church Hill township at altitude about 70 feet above sea level and flows southwestward 4 miles; the creek then flows east of south 4½ miles to its junction with Mason Branch (tributary through Tuckahoe Creek to Choptank River, which discharges to Chesapeake Bay); lower course, marshy.

Granny Finley Branch.—Rises in the southwestern part of Church Hill township in a marshy area, at altitude about 60 feet above sea level; flows northwestward about 6 miles to its junction with Island Creek (tributary through Southeast Creek to Chester River, which discharges to Chesapeake Bay).

Hambleton Creek.—Rises in the southwestern part of Crumpton township, at altitude about 70 feet above sea level; flows westward into Chester River, which discharges into Chesapeake Bay; length, about 4 miles; fall in the mile and a half at head, in which part of its course it is intermittent, 60 feet.

Island Creek.—Rises in the eastern part of Centerville township at altitude about 45 feet above sea level; flows northwestward 4 miles, then northeastward 3½ miles into Southeast Creek (tributary to Chester River, which discharges to Chesapeake Bay); principal tributary, Granny Finley Branch; tidal at mouth.

Mason Branch.—Forms part of the boundary between Queen Anne's and Caroline counties; gathers the waters of a number of intermittent streams in Ruthsburg township and flows in general southwestward and unites with German Branch to form Tuckahoe Creek (tributary to Choptank River, which discharges to Chesapeake Bay); only three tributaries in Queen Anne's County are named on the map, German Branch, Blockston Branch, and Norwich Creek; marshy through much of its course; it receives also the water of Beaverdam and Long Marsh ditches.

Norwich Creek.—Rises in the southeastern part of Centerville township, at altitude 70 feet above sea level; flows southeastward 5½ miles; discharges into Mason Branch (tributary through Tucka-

hoe Creek to Choptank River, which discharges to Chesapeake Bay) in Talbot County, about half a mile southwest of Hillsboro.

Pearl Branch.—Rises in Crumpton township at altitude about 80 feet above sea level; flows northward 2-½ miles into Chester River, which discharges to Chesapeake Bay.

Reed Creek.—Rises in the southwestern part of Centerville township at altitude about 45 feet above sea level; flows northwestward into Chester River, which discharges into Chesapeake Bay; about 4 miles long; the lower 2-½ miles is a tidal estuary.

Red Lion Branch.—Formed near Dudley Corners by the union of the two branches, one rising in the marshy area east of Barclay and flowing northwestward, and the other rising about a mile northeast of Tilghman and flowing to the east of north; below Dudley Corners the stream flows somewhat west of north to Crumpton where it enters Chester River, which discharges to Chesapeake Bay; dammed about half a mile below the upper forks and again 1-½ miles farther down stream; the upper dam forms a pond, half a mile long; the lower dam, a much smaller pond.

Sewell Branch.—Rises in a marshy area in the western part of Kent County; flows westward along boundary between Queen Anne's and Kent Counties to its junction with Andover Branch (tributary to Chester River, which discharges into Chesapeake Bay); length, in Queen Anne's County, about 2 miles; marshy.

Southeast Creek.—Rises in the southeastern part of Church Hill township, at altitude about 80 feet above sea level; flows northwestward and westward to its junction with Chester River, which discharges to Chesapeake Bay; length, about 9 miles; lower part of course, a tidal estuary; principal tributaries, Browns Branch, Island Creek, and an unnamed stream which rises near Tilghman and enters the creek above the pond at Church Hill.

Tuckahoe Creek.—Formed in Queen Anne's County by Mason and German branches, which unite at altitude 20 feet above sea level, about 2 miles above Geary Millpond; flows in general south-

ward into Choptank River, which discharges into Chesapeake Bay; marshy; forms boundary between Talbot and Caroline counties. County maps, Queen Anne's and Talbot counties; Barclay and Denton sheets, U. S. G. S.

Unicorn Branch.—Formed by several tributaries which rise in marshy areas in the eastern part of the county at altitude about 70 feet above sea level; flows northwestward to its junction with Chester River, which discharges to Chesapeake Bay; length, about 10 miles; marshy throughout the upper 7 miles; 2-½ miles above its mouth, at altitude 31 feet above sea level, flows through a small pond formed by a dam, and a dam about a mile above its mouth backs water up about three-fourths mile forming another lake.

Wye River.—Rises in the southern part of Centerville township, at altitude about 55 feet above sea level; flows southwestward through Wye River to Eastern Bay, the branch of Chesapeake Bay lying between Kent Island and the main land; forms the boundary between Queen Anne and Talbot counties; below Wye Mills the river is a tidal estuary; a dam at Wye Mills backs the water up about three-fourths mile.

THE MAGNETIC DECLINATION IN QUEEN ANNE'S COUNTY

BY

LOUIS A. BAUER

Introductory.

Values of the magnetic declination of the needle, or of the "variation of the compass," as observed by the Maryland Geological Survey and the United States Coast and Geodetic Survey at various points within the county are given in Table I.

For a general description of the methods and instruments used, reference must be made to the "First Report upon Magnetic Work in Maryland" (Md. Geol. Survey, vol. I, pt. v, 1897). In the Second Report (Md. Geol. Survey, vol. V, pt. i, 1905) the various values collected are reduced to January 1, 1900; they are now given also for January 1, 1910 and 1925. The First Report gives likewise an account of the phenomena of the compass needle and discusses fully the difficulties encountered by the surveyor on account of the many fluctuations to which the compass needle is subject. To these reports the reader is referred for any additional details.

TABLE I.

Magnetic Declinations in Queen Anne's County.

Stations	Latitude North	Longitude West of Greenwich	Date when observed	Magnetic Declinations (West)						Observer
				Value observed	Reduced to					
					1900.0		1910.0		1925.0	
	° ′	° ′		° ′	° ′		° ′		° ′	
Kent Island, South base	38 53.9	76 22.0	1897.5	5 21.4	5	29	6	11	7 10	L. A. Bauer
Centerville, Academy	39 02.5	76 03.7	1897.1	5 52.4	6	01	6	43	7 46	L. A. Bauer
Centerville, E S E monument	39 04.0	76 04.0	1897.4	5 53.9	6	02	6	44	7 47	L. A. Bauer

Explanation: The date of observation is given in years and tenths; January 1, 1900 would accordingly be expressed by 1900.0 and similarly with regard to subsequent dates. See also Table II.

Meridian Line.

In compliance with instructions from the County Commissioners, February 26, 1897, L. A. Bauer of the Maryland Geological

Survey established a true surveyor's line on May 27, 1897, at the countyseat, Centerville. On account of the lay of the Court House grounds and owing to surrounding conditions, it was necessary to plant the marking stones on a true west-northwest and east-southeast line. By allowing for the angle of 22°½, a true meridian line can then be readily obtained. Approved astronomical methods and instruments were employed and the line as established is correct within one minute.

The monuments * marking the end of the line are granite posts, 6x6 inches square and 4 feet long. They were imbedded in several courses of concrete and were allowed to project out of the ground about 5 inches. They were set so that the letters on them (N M on the E. S. E. stone and S M on the W. N. W. one) would show approximately the true meridian. In the top of each is leaded and countersunk a one-inch brass bolt 3 inches long, and the line passing through the center of the crosses cut on the brass bolts is the true east-southeast and west-northwest line. The year 1897 appears on each stone.

The east-southeast monument is 85 feet from the southwest corner of the Court House and 109 feet from the southeast corner. The west-northwest monument, at the suggestion of the Clerk of the Board of County Commissioners, was placed 336.5 feet from the east-southeast one, near the church. Owing to its exposed position it was recommended that it be protected by placing over it a strong wooden box or cap. For further information see Table I. An official report was supplied for the Court House files for reference as may be necessary.

Descriptions of Stations.

Kent Island, South Base, 1897.—Near the so-called South Base station of 1845. The 1897 station is in the field west of old dwelling

* Under date of March 17, 1925, S. Chester Coursey, County surveyor, Centerville, informed the United States Coast and Geodetic Survey that the monuments could not now be found, as they had been covered up when grading was being done.

house on the old Price farm. The farm is now owned by the National Bank of Centerville, and the tenant in 1897 was Mr. Palmer. The precise point is 100 paces southwest of the present entrance to the dwelling house, 39 paces from southwest corner of garden fence, and 45 paces north of row of three pear trees. The site of the monument marking the South Base station in 1845 is now about one half or three-fourths mile in the Chesapeake Bay.

[The granite pillar marking the South Base geodetic station when it was on the point of being washed away was removed by Mr. Alfred Price and put in his front yard and used as a carriage step. In 1897 I found it still there, the inscription on one side being "U. S. Survey of the Coast," on the other side "1844" is given. The copper plug in the top had been removed by some one and the top of the stone mutilated, a corner being broken off. I also found a large slate stone with a copper bolt in the corner which was being used as a kitchen step. Likewise as a step to the front entrance (porch) was a small, smooth, granite stone about 10-12 inches square at the base and the top tapering to a point. The apex of the stone was about 10 inches. Mr. Norman, 65 years of age, told me that he sat on the S. B. stone in 1860 waiting for the "Great Eastern" to come up the Bay. The stone was then about 25 yards from the water. L. A. B., July 19, 1897.]

Centerville, 1896 and '97.—In the grounds of the Centerville Academy for boys, about one-eighth of a mile east of Court House, 62 feet south of south corner of Academy, and 44 feet west of young sycamore tree. Soil, sand and clay.

Centerville, E S E Monument,* 1897.—The observations were made over the east-southeast monument marking the true surveyor's line running from west-northwest to east-southeast. This place owing to its unfavorable location is subject to artificial local disturbing influences though at the time (1897) the magnetic declination was about the same as at the Academy station. (See Table 1).

* See footnote, p. 156.

TABLE II.

SHOWING THE CHANGE IN THE MAGNETIC DECLINATION AT CENTERVILLE FROM 1700 TO 1925.

The following table is reproduced from page 482 of the First Report cited without change except that it is extended to 1925 with the aid of the data supplied by the United States Coast and Geodetic Survey.

Year (Jan. 1)	Needle Pointed	Year (Jan. 1)	Needle Pointed	Year (Jan. 1)	Needle Pointed	Year (Jan. 1)	Needle Pointed	Year (Jan. 1)	Needle Pointed
	° ′		° ′		° ′		° ′	° ′	° ′
1700	6 13 W	1750	3 22 W	1800	1 16 W	1850	2 56 W	1900	6 01 W
05	6 02	55	3 02	05	1 16	55	3 14	05	6 19
10	5 51	60	2 44	10	1 17	60	3 34	10	6 43
15	5 37	65	2 28	15	1 21	65	3 53	15	7 03
20	5 20	70	2 10	20	1 28	70	4 14	20	7 24
25	5 02	75	1 54	25	1 38	75	4 34	25	7 46 W
30	4 42	80	1 42	30	1 50	80	4 54		
35	4 23	85	1 32	35	2 04	85	5 12		
40	4 03	90	1 24	40	2 22	90	5 30		
45	3 43 W	95	1 20 W	45	2 38 W	95	5 48		

The declination is west over the county and at present is increasing at the average annual rate of 4 minutes.

With the aid of the figures in Table II the surveyor can readily ascertain the amount of change of the needle between any two dates. For practical purposes, it will suffice to regard the change thus derived as the same over the county. It should be emphasized, however, that when applying the quantities thus found in the re-running of old lines, the surveyor should not forget that the table cannot attempt to give the correction to be allowed on account of the error of the compass used in the original survey.

To reduce an observation of the magnetic declination to the mean value for the day of 24 hours, apply the quantities given in the table below with the sign as affixed:

Month	6 A.M.	7	8	9	10	11	Noon	1	2	3	4	5	6 P.M.
	′	′	′	′	′	′	′	′	′	′	′	′	′
January	−0.1	+0.2	+1.0	+2.1	+2.4	+1.2	−1.1	−2.5	−2.6	−2.1	−1.3	−0.2	+0.2
February	+0.6	+0.7	+1.5	+1.9	+1.4	−0.1	−1.5	−2.1	−2.5	−2.0	−1.2	−0.8	−0.4
March	+1.2	+2.0	+3.0	+2.8	+1.6	−0.6	−2.5	−3.4	−3.7	−3.3	−2.3	−1.2	−0.5
April	+2.5	+3.1	+3.4	+2.6	+0.8	−2.1	−4.0	−4.1	−4.2	−3.6	−2.3	−1.2	−0.2
May	+3.0	+3.8	+3.9	+2.6	+0.1	−2.4	−4.0	−5.0	−4.5	−3.6	−2.3	−0.9	+0.1
June	+2.9	+4.4	+4.4	+3.3	+1.1	−2.0	−3.6	−4.5	−4.5	−3.8	−2.6	−1.2	−0.2
July	+3.1	+4.6	+4.9	+3.9	+1.8	−1.2	−3.4	−4.4	−4.7	−4.2	−2.8	−1.3	−0.3
August	+2.9	+4.9	+5.4	+3.7	+0.4	−2.8	−4.7	−5.1	−4.9	−3.7	−1.9	−0.6	+0.3
September	+1.8	+2.8	+3.4	+2.5	+0.3	−2.7	−4.4	−4.6	−4.2	−4.0	−1.4	−0.3	−0.1
October	+0.5	+1.6	+3.1	+2.8	+1.4	−1.0	−2.7	−3.3	−3.4	−2.4	−1.3	−0.4	−0.4
November	+0.5	+1.2	+1.7	+1.8	+1.1	−0.5	−2.0	−2.7	−2.6	−1.8	−1.0	−0.2	+0.2
December	+0.2	+0.3	+0.8	+1.8	+1.8	0.0	−1.6	−2.4	−2.3	−1.8	−1.1	−0.3	+0.1

ANGLE.

The angle between the true west-northwest and east-southeast line and the nearest edge of window sill of last window on first floor of church was, at the east-southeast stone, 3° 13′, hence true bearing of window sill was 70° 43′ west of north.* (See official report.)

The latitude of the Court House may be taken to be 39° 04′ and the longitude 76° 04′ W. of Greenwich or 56′ east of Washington. To obtain the true local mean time, or solar time, subtract from Eastern or Standard time, 4 minutes and 16 seconds.

* See footnote, p. 156.

THE FORESTS OF QUEEN ANNE'S COUNTY

BY

F. W. BESLEY

Introductory.

Queen Anne's County is a highly developed agricultural region in which the forests occupy a relatively small percentage of the land area. The elevation varies from 10 feet along the tidal rivers to nearly 100 feet in the east central part of the county, giving a gentle rolling topography, with a variety in soil conditions and consequently of the forest growth.

A detailed forest survey of the County, made in 1909, showed that 26 per cent of the total land area is wooded. There has been very little change in the wooded area since this report was made, and it is believed that on the whole the clearing away of forest for field crops in certain sections has been more than offset in other sections by the reversion to forest of lands once cleared, but no longer used for cultivated crops.

The lands of the county are classified, as follows:

	Acres	Per cent
Improved land in farms	163,915	70
Wooded area	58,773	25
Waste land	8,032	4
Salt marsh	2,880	1
	233,600	

The county is well provided with good highways, railroads and important waterways, bringing all the timbered areas within easy reach of good markets. Most of the timber is consumed locally, the demand far exceeding the supply, reflected in increasing prices, so that timber growing is certain to become an important use of the land. Practically, all of the woodland is held by farmers, but un-

fortunately, it is not managed with the same skill employed in the production of field crops. Conditions, however, are rapidly improving, and under a more intensive system of management that is certain to obtain in the near future, timber crops will be given much more important consideration.

Distribution of the Forests.

Queen Anne's County marks the southern extension of the pure hardwood forest which is characteristic of central Maryland. With the exception of Kent Island, on which pine predominates, the forests are almost entirely hardwood. Of the original forest, very little is left—less than one per cent—and this consists of a few tracts of considerable size that have been preserved largely through sentimental reasons. Practically all of them have been cut over,—some of them as many as four times in the last fifty years. The forest areas are rather uniformly distributed over the county. The Queenstown District has the smallest percentage of forest land—nineteen per cent, while the Dixon District in the northeastern part contains the highest percentage of forest—thirty-four per cent. There are a few swampy areas, the only ones of any extent occurring in the northeastern part of the county, where the prevailing swamp hardwoods,—red maple, red gum, black gum, and other species in smaller proportion, are found. The principal timber trees of the county are white oak, black oak, Spanish oak, pin oak, red oak, red maple, red gum, black gum, and hickory. The white, red, and black oaks, and hickory are found on the better drained soils and furnish the greater bulk of the timber growth. Originally there was a small quantity of chestnut in the northern part of the county, reaching here, practically, its southern limit of distribution on the Eastern Shore Peninsula. In recent years, however, the chestnut blight has practically eliminated the chestnut from the county.

WOODED AREA, STAND AND VALUE OF SAW TIMBER BY ELECTION DISTRICTS.

District No.	Total Land Area	Wooded Area	Per Cent Wooded	Stand of Saw Timber in thousand Board Feet			Stumpage Value		
	Acres	Acres	%	Hardwood M Bd. Ft.	Pine M Bd. Ft.	Total M Bd. Ft.	Hardwood $9.00 per M.	Pine $10.00 per M.	Total
1	46,750	15,992	34	16,337	.....	16,337	$147,032	.....	$147,032
2	33,200	6,500	20	8,261	131	8,392	74,350	1,310	75,660
3	47,200	12,859	27	16,130	874	17,004	145,170	8,740	153,910
4	11,100	2,522	23	572	6,397	6,969	5,148	63,970	69,118
5	35,150	6,731	19	8,050	5,709	13,759	72,450	57,090	129,540
6	36,700	9,349	26	12,318	3	12,321	110,862	30	110,892
7	23,560	4,820	26	3,891	1,427	5,318	35,018	142,70	49,288
The County	233,600	58,773	25	65,559	14,541	80,100	$590,030	$145,410	$735,440

It will be noted that the estimated stand of saw timber is something over 80,000,000 feet, board measure, of which hardwoods constitute about 82 per cent, and pine 18 per cent. The value of the standing timber is estimated at $735,440. This is a net value, representing what the trees of saw timber size are worth, as they stand in the forest, and is only a small part of the total value of all the woodlands. These forests are made up in a large part of areas upon which there is no timber of sufficient size, or enough of it per acre, to justify logging operations, but comprising valuable young growth, much of which in a few years will attain merchantable size. The species of trees represented in the county are for the most part of high commercial value, and under a proper system of forest management, the forests can be made very productive.

NATIVE TREE SPECIES.

CONIFERS.

Scientific Name	*Common Name*
Juniperus virginiana L.	Red Cedar
Pinus echinata Mill.	Short Leaf Pine
Pinus rigida Mill.	Pitch Pine
Pinus taeda L.	Loblolly Pine
Pinus virginiana Mill.	Spruce Pine

BROAD LEAVES.

Acer negundo L.	Ash-Leaved Maple
Acer rubrum L.	Red Maple

Acer saccharinum L.....Silver Maple
Ailanthus altissima Swing.....Ailanthus
Alnus maritima Nutt.....Swamp Alder
Amelanchier canadensis Med.....Service
Aralia spinosa L.....Hercules Club
Asimina triloba Dunal.....Paw Paw
Betula nigra L.....River Birch
Carpinus caroliniana Walt.....Blue Beech
Castanea dentata Borkh.....Chestnut
Celtis occidentalis L.....Hackberry
Cercis canadensis L.....Red Bud
Cornus florida L.....Dogwood
Crataegus coccinea Sargent.....Scarlet Thorn
Diospyros virginiana L.....Persimmon
Fagus grandifolia Ehrh.....Beech
Fraxinus americana L.....White Ash
Fraxinus pennsylvanica Marsh.....Red Ash
Gleditsia triscanthos L.....Honey Locust
Hamamelis virginiana L.....Witch Hazel
Hicoria alba L.....White Hickory
Hicoria glabra Mill.....Pignut Hickory
Hicoria minima Britt.....Bitternut Hickory
Ilex opaca Ait.....Holly
Juglans cinerea L.....White Walnut
Juglans nigra L.....Black Walnut
Liquidambar styraciflua L.....Red Gum
Liriodendron tulipifera L.....Tulip Poplar
Magnolia virginiana L.....Sweet Bay
Morus rubra L.....Red Mulberry
Myrica cerifera L.....Wax Myrtle
Nyssa sylvatica Marsh.....Sour Gum
Paulownia tomentosa Stend.....Empress Tree
Platanus occidentalis L.....Sycamore
Populus alba L.....Silver Poplar
Prunus americana Marsh.....Wild Plum
Prunus pennsylvanica L.....Fire Cherry
Prunus serotina Ehrh.....Wild Black Cherry
Prunus virginiana L.....Choke Cherry
Quercus alba L.....White Oak
Quercus coccinea Muench.....Scarlet Oak
Quercus lyrata Walt.....Overcup Oak
Quercus marilandica Muench.....Black Jack Oak
Quercus michauxii Nutt.....Basket Oak
Quercus stellata Wang.....Post Oak
Quercus nigra L.....Water Oak
Quercus palustris Muench.....Pin Oak

FIG. 1.—VIEW OF TYPICAL SECOND GROWTH BORDERING CULTIVATED FIELD, 3 MILES SOUTH OF CENTREVILLE.

FIG. 2.—VIEW SHOWING SECOND GROWTH WHITE AND RED OAK, SWEET GUM AND LOBLOLLY PINE, 3 MILES NORTH OF QUEENSTOWN.

Quercus phellos L.....Willow Oak
Quercus bicolor Willd.....Swamp White Oak
Quercus montana L..... Chestnut Oak
Quercus borealis maxima Ashe .....Northern Red Oak
Quercus rubra L.....Southern Red Oak
Quercus velutina Lam.....Black Oak
Rhus typhina L.....Stag Horn Sumac
Robinia pseudacacia L.....Black Locust
Salix alba var. vitelina L.....White Willow
Salix discolor Muehl.....Pussy Willow
Salix nigra Marsh.....Black Willow
Sambucus canadensis L.....Elder
Sassafras sassafras Karst.....Sassafras
Toxylon pomiferum Rafn.....Osage Orange
Ulmus americana L.....White Elm
Ulmus fulva Michx.....Slippery Elm

Important Forest Products.

Lumber.—There are fourteen saw-mills operating in different parts of the county, converting timber of saw size into lumber and railroad ties. These mills are mostly of the small portable type, moving from place to place wherever standing timber can be obtained. There has been a marked decrease in lumber production in the past five years, due to shortage of timber of sawing size. The most reliable estimates indicate that the annual cut is less than 3,000,000 feet board measure, of which 80 per cent is hardwood. The principal hardwood species are oaks, gum, maples, and hickory, while the softwood species are almost exclusively loblolly pine, and to a less extent spruce pine.

Railroad Ties.—The fifty-four miles of railroad in the county draw largely from the local timber supply for its tie material, using oak almost exclusively. All but a small percentage are sawed ties, —the relatively small number of hewed ties are gotten out by farmers and small timber operators.

Pulpwood.—There is an increasing quantity of pulpwood cut due to the greater demand and higher prices paid as compared with other forest products, but there is a relatively small quantity of

timber suitable for the purpose. Red gum and pine are about the only species in the county suitable for pulpwood.

Piling.—Is gotten out in considerable quantity at times when there is a local demand. Some is shipped out to distant points. Long straight stems of oak and pine are used almost exclusively for the purpose.

Mine Props.—Pine props are occasionally cut and shipped out of the county, but because of a lack of suitable material and uncertain demand at the coal mines, this product has been of little importance in recent years.

Poles.—When chestnut was abundant in the northern part of the county, prior to the advent of the chestnut blight, the production of telephone, telegraph, and electric light poles was an important local use of the forests. Now with the chestnut practically extinct, poles even for local lines are brought in almost entirely from distant points, since there is no other species that is a satisfactory substitute for chestnut.

Cordwood.—It is estimated that the annual consumption of fuelwood is about a cord per capita in sections of the Eastern Shore similar to Queen Anne's County. This would require 16,000 cords of wood annually, for the county, which is believed to be a conservative estimate of the amount so used. It is, therefore, the largest use of the forest measured by volume, but of less value than the other products combined.

Destructive Agencies.

The forests of the county have suffered seriously from different destructive agencies which account in a large measure for their poor condition at the present time. These are chiefly forest fires, destructive cutting methods, grazing, and the chestnut blight.

forest fires.

Since the woodlands for the most part are split up into relatively small areas, individual fires are not so destructive as is the case in the mountain section of the state, where large areas are exposed to

danger by a single fire. Then, too, since the forest lands are a part of the farm acreage, a fire cannot get under very much headway, before it is discovered by someone. The chances of bringing it under control with a minimum damage is thereby greatly increased. But even small fires often do a large amount of damage. The effects of fire are: (a) the burning of the leaves and litter on the ground which are needed to conserve the moisture, to protect the seed, and to fertilize the soil; (b) the destruction of the seed, and young seedings that have already started, and which are so essential for the renewal of the forests; (c) the burning of the cambium, or living wood, of young trees, on the side most exposed to fire, causing the bark to peel off, thus exposing the wood to decay. The tree becomes stunted, decay enters the wood and gradually works its way up into the trunk, rendering the tree practically worthless; (d) a severe fire in the spring often kills all the trees, entailing a total loss of growing stock; (e) the protective cover for game is consumed and frequently much wild life is destroyed. A single fire may destroy the growth of twenty years, and in addition bring about such conditions as will make a satisfactory renewal of the forest impossible for many years to come. Practically all fires are the result of carelessness and are, therefore, preventable if everybody who goes into the woods is careful with fire.

The chief causes of fires are brush burning, hunters, and the railroads. There are fifty-four miles of railroad in the county, exposing a considerable frontage of forest land. The Railroad Safety-Strip law, enacted by the Legislature of 1924, requires the railroads to clear, annually, a strip of 100 feet from their tracks of inflammable material, dead trees, brush, and leaves. This has been found an effective means of preventing railroad fires. Unfortunately, the Senator from Queen Anne's County insisted on his county being exempt from the operation of this safety-strip law, hence it is deprived of its benefits and railroad fires must continue to be a serious menace.

GRAZING.

The dairy interests of Queen Anne's County are important, and a large number of cattle are pastured. Frequently, the farm woodlands are included in the pasture and are subject to severe grazing. Where this is the practice and is followed successively for a number of years, the woodlands suffer serious damage. The injury is caused by the cattle browsing on the young seedlings that have started in openings and which are needed for the perpetuation of the forests. The soil is packed by the tamping of the cattle, so that it becomes hard and dry, often destroying the seed bed necessary for developing young trees, making it impossible to secure a satisfactory reproduction of the forests to take the place of the trees that are taken out from time to time. This leads, eventually, to an open, understocked forest, incapable of producing a full timber crop. Woodland is poor pasture at best and grazing causes irreparable damage. If pasturing is permitted at all, it should be only when the young trees have grown to a height when the tops are beyond the reach of cattle.

CHESTNUT BLIGHT.

Chestnut blight is a fungus disease, which became established in the county in 1910. It attacks only the chestnut, but is the most destructive tree disease that has ever occurred in the State. Chestnut never was an abundant tree in the county, but there were some very good stands in the northern section. These, however, have been completely destroyed and there seems no hope of the reestablishment of chestnut in Queen Anne's County. The disease has swept over the entire state, and it seems to be only a question of a few years when, the chestnut will be practically eliminated, even in the western mountain forests of Garrett County, which is the only remaining section of the state where the chestnut has not been almost completely destroyed. Even there, the disease is firmly established, and it is only a matter of a few years before chestnut in Maryland will become practically extinct.

FIG. 1.—VIEW SHOWING RESULT OF FIRES IN SECOND GROWTH OAK STAND, 3 MILES SOUTH OF CENTERVILLE.

FIG. 2.—SAW MILL OF A. W. DUKES, 3 MILES NORTH OF QUEENSTOWN.

Rebuilding the Forests.

The misuse of the forests for the last hundred years has brought about a steady decrease of their productive capacity. In the past, when timber had little value, only the best trees of the best species were cut. With repeated cutting of this character, where the best was taken and the poorer material left to occupy the ground, the forests have deteriorated. As timber increased in value, more of the lower grade material was used, but there was no thought of selective cuttings, with the idea of maintaining a proper proportion of the different species and of protecting the young growth, as the basis of a new crop. Timber mining was the order of the day, and no thought was given to timber growing. This practice has been carried to such an extent and the forests have been so badly abused that it will take many years of careful forest management to bring them back to their full productive capacity. This must be done, however, and there is every inducement to change the old methods in favor of new ones to meet the constantly increasing demands upon the forests to supply local needs.

Forest fires and other destructive agencies must be eliminated, or at least, greatly reduced. Timber cutting must be regulated by the woodland owner, so as to maintain his forests in a productive condition. Trees to cut will fall in two classes: first, those that have reached maturity; and second, those that by reason of their form or species have no prospective value, and should be eliminated in favor of more promising trees. In one class saw-timber is obtained and in the other fuel-wood, or other small size material. In cutting saw logs it does not pay to utilize small trees. They produce only low-grade product and have reached a point where a few years' additional growth will mean a large increase in their value. The crooked and defective trees and trees of the poorer species can be utilized for fire wood, or other material needed on the farm, and by removing their competition with more valuable specimens the character and composition are improved. If this practice is continuously

followed it will result, in a few years, in rebuilding the forest and assuring its highest productiveness. It is safe to say that its productive value can be easily increased 100 per cent by the application of these simple, common-sense methods of handling the woodlands for timber growing, treating them as crop producing areas, such as is the case where field crops are grown.

A large percentage of the farms in the county are operated by tenants who are permitted a general use of the woodlands. The tenant cannot possibly have the viewpoint of the owner in cutting firewood, fencing, and other material from the woodlands. His tenure is limited and he is not interested in the future of the woodlands. It is, therefore, important that the landowner have a very definite understanding with the tenant as to his use of the woodlands on the farm, with a view to maintaining it in a highly productive condition. Cutting permitted by the tenant should, generally, he limited to dead and down trees, or such as are marked for cutting by the owner or his agent. Early in the winter the tenant's wood requirements should be ascertained and a definite plan worked out for securing the wood supply.

With excellent native tree species, good soils for timber growing, an assured market, and excellent transportation system timber is certain to be a profitable crop on land not suited for other cultivation. The original forests of the county were made up of as fine stands of hardwood as could be found anywhere and there is no reason why high quality timber cannot be grown again.

Forest Planting.

There are small waste areas on nearly every farm which should be planted in timber. Lands along ravines, steep slopes, or overflow lands, that are not suited to field crops are capable of producing good timber. This calls for forest planting. No matter what may be the condition of the land, unless it be a salt march, suitable tree species are available, and generally the only productive use of such

land is in timber growing. Small trees, suitable for forest planting, are not expensive and the work can be done at a reasonable cost, with the assurance that waste land may be reclaimed and made productive.*

Use of Windbreaks.

The woodlands have been cleared away to such an extent and there are so few natural barriers that the cold winter winds sweep across the country with unabated force. This results in increased discomfort to home dwellers and added costs of heating houses as well as unnecessary hardships to farm stock. A few rows of trees on the northwest side of farm buildings are a great protection against the prevailing strong fall and winter winds, and will not retard the cool south and southwest breezes of summer. The effectiveness of a wind-break depends upon its density and height. Its influence will be felt for a distance, at least, ten times its height. A single row of evergreen trees of Norway spruce or pine will afford considerable protection, but three or four rows are more effective. The outer row, facing the wind, should be low branching, sturdy trees of moderate height, like Norway spruce or hemlock, with inner rows of pine, either Scotch or loblolly, that attain greater height, thus diverting the wind upward as it passes over the windbreak.

* The State Department of Forestry maintains a forest nursery from which suitable trees may be obtained at nominal cost for forest planting.

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