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MAPS OF THE TERRITORY INCLUDED WITHIN THE STATE OF MARYLAND, ESPECIALLY THE VICINITY OF BALTIMORE.

By Professor George H. Williams.

WITH AN INTRODUCTORY NOTE BY PRESIDENT GILMAN.

INTRODUCTORY NOTE.

The Johns Hopkins University, since its organization, has endeavored (so far as the means at its command and the other duties required from members of its faculty would permit) to study the region in which the University is placed, and to give to the public the results of its studies. The region in its narrowest sense means Baltimore,—but as it is here interpreted it means Maryland, and in a still broader sense the upper portion of the territory which is drained by the Patapsco, the Potomac, the Gun-powder and other streams that flow into the Chesapeake Bay. One of the earliest steps to be taken was in recognition of the value of a good map of the region. Accordingly the head of the United States Coast and Geodetic Survey, Professor Julius E. Hilgard, by invitation of the Trustees, delivered in the Winter of 1876-7 a course of twenty lectures upon the principles and methods of topographical surveys, leading up to the study of Baltimore and its vicinity. To illustrate what might be done on a larger scale he prepared and exhibited a model in relief of a portion of the city—Druid Hill Park, if the writer remembers correctly. The object of these lectures was to enlighten the public as to the importance of good maps, and to show how they might be secured. A few years later Dr. W. K. Brooks, one of the naturalists of the University, undertook to study the marine life of the Chesapeake. The Maryland Fish Commission and the United States Fish Commission, for a time, cooperated in this work, and the organization was consequently called the Chesapeake Zoological Laboratory, although the observations soon extended far beyond this bay. It was then that Dr. Brooks became especially interested in the study of the Oyster, and made those researches which are now widely known. His report was published by the State, and after the edition was exhausted a shorter and more popular story of the Oyster was published by the University. A printed study of the red-bellied Slider Terrapin, by Drs. Martin and Moale, was also published. Meanwhile the Naturalists' Field Club was organized by Professor Martin. It was made up partly of members of the University and partly of other students of nature, resident in Baltimore, most or all of whom were members of the Maryland Academy of Sciences. These gentlemen began to make collections of the minerals, and of the mammals, birds, fishes, insects and plants that grow in this region. They brought together many specimens, and Mr. Sollers, with the aid of Dr. Barton and others, undertook to make a complete flora of the region. The Field Club cooperated also in affixing labels to the trees in Druid Hill Park.

When Dr. G. H. Williams began his duties as geologist, he made a careful study of the interesting Gabbro region which lies to the west of the city, and published several papers which attracted the attention of geologists. Inspired by these researches, the Trustees encouraged these gentlemen to prepare an excursion map of the environs of Baltimore, so that all who are walking or driving in this vicinity might have a trustworthy guide to the streams, roads, heights, and landmarks of the neighborhood. Two editions of this map were quickly disposed of. It was more and more important that altitudes should be indicated on the local map, and at length the cooperation of the U. S. Geological Survey, under the direction of Major J. W. Powell, was secured, and the beautiful map lately given to the public was prepared under his direction by accomplished engineers and assistants. The map appears in two forms, hypsometrical, indicating the heights by contours, and geological, indicating the structure by colors. Two relief models in plaster of the region around Baltimore have been prepared on a large scale (4 inches to the mile) for the Real Estate Exchange and for the University. They measure 5½ by 4½ feet and give a graphic idea of the topography.

Still another attempt to study the natural characteristics of the State is made by the Weather Service, conducted at the Physical Laboratory under the joint auspices of the State of Maryland, the Government Weather Bureau, and the University. Cooperation is secured from intelligent and faithful observers in all parts of the State, and a monthly bulletin is published giving to the public the recorded results. A book describing the natural resources of the State and its industries, with accounts of its various institutions, is now in preparation for the World's Fair Commission of Maryland.

Finally, in order that all who are interested in these important enquiries may know what data are at command, the following paper is now prepared by Professor Williams, to whom, and to Professor Clark, the grateful acknowledgments of the public are certainly due.

PROFESSOR WILLIAMS ON MAPS OF MARYLAND.

Within the past few years so much has been done in the way of constructing accurate topographical and geological maps and relief models of various portions of Maryland's territory that, with a view of giving a general description of these new acquisitions, it has also seemed of interest to prepare a brief account of all the previous cartographic work carried on within the confines of the State. What is here recorded are maps containing the results of original surveys or such as offer the best and most
reliable sources of present information. Thanks for assistance in collecting the material are due to Professor T. C. Mendenhall, Director of the U. S. Coast and Geodetic Survey; Mr. Henry Gannett, Chief Topographer U. S. Geological Survey; Mr. Henry Thompson, Mr. John W. M. Lee, Dr. Wm. Hand Browne, Professor P. R. Uhler, Professor Basil Sollers, Mr. A. B. Hoen, Mr. Wm. Lucas, Mr. B. H. Griawold, of Baltimore, and others. The maps of Maryland might be arranged as follows:

1. Maps of early explorers and settlers.
2. Surveys of boundaries.
3. Topographical and geological surveys authorized by the State.
4. Charts published by the U. S. Coast Survey.
5. Private surveys (railroads, canals, counties, etc.)
6. Recent work published or in preparation by the U. S. Geological Survey, the Johns Hopkins University, and the Maryland World's Fair Commission (1884-1893).

1. MAPS OF EARLY EXPLORERS AND SETTLERS.

The first map of this region was published in London, 1624, by Capt. John Smith. In his "A general Historie of Virginia, New England and the Summer Isles." This has often been reproduced, notably in the facsimile edition of Smith's works (English Scholar's Library, Birmingham, 1884) and in Scharf's History of Maryland, Vol. I.

Smith, of course, gave the Chesapeake as a part of Virginia. The first map of this region as the province of Maryland is that published by Lord Baltimore, in his "Relation of Maryland," printed in London in 1635, with instructions to emigrants and accounts of the country calculated to attract settlers. This map is entitled "Nova Terrae-Mariae Tabula," and is interesting in still calling the Atlantic ocean "Mare orientalis." The map is reproduced in Sabin's facsimile of the "Relation." New York, 1665, and in De Jarnette's Report on the Boundary between Md. and Va., Richmond, 1873.

The most important of the early maps was, however, that made during the decade succeeding 1660 for Lord Baltimore by Augustine Herman, and first published in 1670. (Facsimile H.) Herman was a remarkable character. Born at Prague, he was educated as an engineer, and came from Holland to New Amsterdam with the Dutch. Peter Stuyvesant sent him south to help settle a boundary dispute, and he arrived in Maryland in 1660. He was so pleased with this country that he determined to remain here, and proposed to Lord Baltimore to make for him a new map of his domains in return for a large tract of land at the head of the Bay in Cecil Co. This offer was accepted, and Herman named his estate Bohemia Manor, in honor of his birthplace.

Herman's map was engraved by Faithorne and published in London in four folio sheets. Its title is "Virginia and Maryland as it is planted and inhabited this present year 1670; surveyed and exactly drawn by the only labors and endeavors of Augustin Herman, Bohemienissis." It contains a fine portrait of Herman. Its scale is 12 English miles to the inch. It names eight Maryland counties as well as the rivers "Sassquahanna," "Gunpowder," "Patapako," "Seavorn," "Potuxen," and "Palowmek." The idea then prevalent that the Appalachians formed the central ridge of the American continent finds expression on Herman's map as follows:

"These mighty high and great Mountains trenches N. E. and S. W. and is supposed to be the very middle Ridge of Northern America and the only natural cause of the severities and extreme stormy cold winds that comes N. W. from thence all over this Continent. And as Indians report from the other side westward doe the Rivers take their original issuing out into the west sea, especially first discovered a very great River called the Black Mingequan River out of which above the Susquehanna Fort. . . ."

"Certain it is that as the Spaniards is possess of great Store of Minerals at the other side of these mountains the same Treasures they may in process of time afford so also to us here on this side when occupied which is Recommended to Posterity to Remember."
the two colonies. To this deed was attached a small map with the boundaries indicated in red, known as "Lord Baltimore's Map." This map was printed by Franklin.

After twenty-eight years of further controversy, a second and final deed was executed in 1769. In 1768 the Penns and Lord Baltimore secured the services of two London surveyors, Mason and Dixon, who, between Nov. 15, 1768, and Sept. 20, 1767, completed the survey as far west as Dunkard's Creek, within 36 miles of its western limit. Here they were stopped by Indians. The bounding parallel was fixed by this survey as N. 39° 42' 26", instead of 40°, as was stated in Lord Baltimore's original patent of 1632. Mason and Dixon's map, with the final award of the Joint Commission and their report on parchment, is in the Maryland Historical Society.

The disagreement regarding the Maryland-Virginia boundary is as to whether it should follow the North or South Branch of the Potomac. The original charter of Maryland defined this boundary as extending along the south bank of the Potomac river to the fountain-head of whichever branch was the longer, and thence north by a meridian to the 40th parallel of latitude. Which branch was the longer was not for some time known, although it is distinctly shown on the map made by Col. T. Cresap as early as 1754. See "Report of the Committee on the Western Boundary of Maryland," 1890. (Maryland Historical Society Fund Publication No. 29.)

The De Jarllette Report on the Maryland-Virginia Boundary (1873) is accompanied by a volume of ten maps reproduced from originals in Europe.

3. Topographical and Geological Surveys Authorized by the State.

After Maryland became one of the states of the Union over fifty years elapsed before serious thought was given to a new survey of her territory.

In December 1832 the Maryland House of Delegates appointed a special committee to prepare a "Report relative to the Expediency of procuring a Map of the State." This report was printed at Annapolis in 1833 (80, 10 pp.). As a result of this report the General Assembly passed a resolution appointing an engineer and a geologist "to make the necessary examinations preliminary to a general survey of the territory of the State." J. H. Alexander and J. T. Ducatell were appointed to these positions May 25th, 1833. Their "Report on the Projected Survey of the State of Maryland" was printed in Annapolis in 1834 (80, 39 pp.). It is dated December 27, 1833, and contains a preliminary sketch map of the State.

In consequence of this report the General Assembly passed an act arranging "to make a perfect and complete map of the State according to the plan and drawing," and Gov. Thomas appointed Alexander and Ducatell engineer and geologist to carry out its provisions.

This first of Maryland maps was continued till 1841. During this period annual reports were prepared by Professor Ducatell and published. The first three of these also contain topographical reports by Professor Alexander. This most accomplished engineer and versatile man, however, found the State appropriation so inadequate for the thorough trigonometrical survey which he had in mind, that he recommended a postponement of the work until it could be undertaken in connection with the U. S. Coast and Geodetic Survey, whose director, Professor Hassler, was his warm personal friend.

The operations of the Coast Survey were being rapidly extended southward from New York, but before they reached Maryland waters the State survey had been discontinued. Professor Alexander did not therefore draw his salary as State Engineer, but during the early years of the survey he prepared an admirable topographical map of the State by compilation, and located upon it the boundaries of the geological formations and localities for the following useful mineral products: iron, chrome, copper ores; alunclay and pyrite; potters' clay; soapstone and stone paint; granite, syenite and gneiss; marble, hydraulic limestone; slate, sandstone, coal. This map was never published in full size, but exists in two MS. copies beautifully executed by Alexander himself. One of these is in Annapolis and the other in possession of his son, Mr. J. J. Alexander, of Baltimore, to whose courtesy I am indebted for permission to examine it. This map is 6 ft. 7 in. by 3 ft. 5 in. Its scale is 1:200,000, with 50 ft. contour lines east, and 100 ft. contour lines west of the Monocacy river. A full list of authorities is given on the margin, together with ten profiles. There is stated to have been a report which is not stated, but it must have been about 1836. It was published in much reduced form with Professor Ducatell's paper on the Physical Features of Maryland, in the Transactions of the Maryland Academy of Science, 1857. It was also published in part in the Reports of the State Geologist as follows: Contour map of part of Eastern Shore and St. Mary's Co., Report for 1855; Hachure map of the Chesapeake between the Magogty and Patuxent rivers (1:150,000), and ditto of Dans Mt. (1:84,480) in Report for 1859; Hachure map of Cecil and part of Kent Co. (1:150,000), and ditto of Montgomery Co. (1:120,000) in Report for 1877; Hachure map of Frederick Co. (1:200,000), and ditto of Baltimore, Harford, and part of Carroll Co. (1:200,000) in Report for 1839; Hachure map of Washington and Allegheny Co. (1:200,000) in Report for 1840. This map of Alexander's was so much the best one extant during the war that shortly after the 19th of April, 1861, General Scott ordered Mr. Bates, of the Coast Survey, to have an exact tracing made of it. This was accordingly done in Mr. Alexander's house, and the tracing taken to Washington. Professor Alexander's last communication relative to the map of Maryland was a report on "The Trigonometrical Survey for the New Map," dated Feb. 5, 1841 (80, 8 pp.). He states that the triangulation can shortly be commenced with the cooperation of the Coast Survey, but this was never done.

The two succeeding attempts of the State to have her natural resources systematically explored were directed by two so-called "State Agricultural Chemists," J. Higgins (1858-58) and P. T. Tyson (1860-62). Neither of these surveys ever contemplated the preparation of a new topographic map, although a new compilation was prepared on about the same scale as Alexander's map (1:200,000) by Aug. Fail for P. T. Tyson in 1866. The MS., which was never published, belongs to the Maryland Academy of Science and is at present preserved in the Peabody Library.

4. Operations of the U. S. Coast and Geodetic Survey.

The first really accurate survey of Maryland territory, based upon an elaborate system of triangulation, was made by the U. S. Coast and Geodetic Survey. At the request of the writer, Professor T. C. Mendenhall, the present Director, has very kindly prepared assistant J. W. Donn the following complete statement of all the operations of the Survey in Maryland, and especially those carried on in the immediate vicinity of Baltimore.

This narrative is illustrated by a complete historic sequence of published charts and tracings of the triangulation in successive years. This material will be deposited in the library of this University.

U. S. COAST AND GEODETIC SURVEY OFFICE, WASHINGTON, D. C., December 164, 1892.

DR. T. C. MENDENHALL, Superintendent, U. S. Coast and Geodetic Survey.

Sir:—I have the honor to submit the following memoranda relative to the history of the Coast Survey operations in the vicinity of Baltimore, Maryland, giving dates of triangulation, successive charts, &c.

In the early years of the Coast Survey a topographical survey of Baltimore, incidental to that of the State of Maryland, became a subject of interest. A letter of Professor Hassler, the first Superintendent of the Coast Survey, dated January 7, 1844, to the Secretary of the Treasury, remarks: "It is proper for me to get more information upon the views of the survey of a map of the State of Maryland upon which Professor Ducatell had corresponded with me last summer." He writes under date of January 9: "In the course of last summer, Professor D. informed me that he and Mr. Alexander had been appointed by the Legislature of Md. to make a topographical map of the State and its junction with the Coast Survey." In April, 1844, Professor Hassler, in another letter to the Secretary of the Treasury, writes: "Upon your favor of the 5th, relative to the junction of the survey of Maryland with the Coast Survey, authorizing me to make the proper arrangement to put the measure into execution, I shall make the appropriate agreements with Mr. Ducatell and Mr. Alexander, combine with them and then give you details upon the plans agreed upon mutually."

Three months later Mr. Hassler reports to the Secretary the indefinite postponement of the proposed work, the Maryland committee not being ready to perform its part. A period of ten years then elapsed before any steps were taken for surveys in Baltimore or the Patapsco River. Professor Hassler had in the meantime been succeeded by Professor A. D. Bache. December 23, 1844, in a Report of Professor Bache, mention is made of the beginning of the secondary triangulation in the Patapsco River under the direction of Assistant F. H. Gerdes. The triangulation in the near vicinity of Baltimore was done by Assistant
Ferguson, who determined the positions “Bowman,” five miles from the centre of the city, near the Old Frederick Road, and “Flinzy,” several miles farther in a northeasterly direction. These points were important factors in the several triangulations made in after years; and the work had been in progress for some time. Topographical surveys were in progress in charge of Assistant Geo. D. Wise, at the entrance of the Patapcso River.

In his report of December, 1845, Professor Bache states: “Materials for a chart of the Patapcso River and Baltimore Harbor will, it is confidently expected, be ready for use this winter, and the chart will be put in the hands of the engraver.” The topography has been examined by Assistant Geod. Hasler, Wise, and Curtis. Sheets Nos. 6 and 8 are completed, and on No. 9 considerable progress made. No. 8 includes Baltimore City and adjacent country. In about No. 8, Mr. Metcalf remarks: “Having found it impossible to reconcile the measured distance with a printed plan of the city (Poppleton’s Map presumably), it was found necessary to make a detailed survey, especially of the part near the water.”

During 1845 the hydrography of the Patapcso River and Baltimore Harbor was begun and completed. Topographical work was continued in the same localities during this year and 1846.

In 1847 engraving of the chart of the localities above named was begun. In 1848 Magnetic observations were made at Fort McHenry.

Report of Professor Bache, December 27th, states: “Map of Baltimore Harbor, &c., still in hands of engravers.”

During 1853 Assistant H. L. Whiting was engaged in verification of topography of the Patapcso shores.

1854–A surveyor of part of the Patapcso River entrance was made by request of the Engineer Department, U. S. A.; no considerable changes were developed. With this the record of field operations by the Coast Survey in the vicinity of Baltimore, prior to the Civil War, closes.

In July, 1869, by request of the Military authorities at Baltimore, a topographical survey of the city and its approaches was begun. The triangulation, in charge of Sub-Assistant C. H. Boyd, based upon such data as could be availed of or discovered (the primary and secondary points of the work of 1844) was extended over the whole area designated. The points determined by Assistant Boyd included the following objects, whose identification could be secured by reference to established ground-marks. The Super-intendent of the Coast Survey, and the U. S. Engineer in charge of Harbor and River improvements, in letter of the 21st inst. made the following request in the matter of the Port Warden line established at Henderson’s point, Woodall’s Ship Yard (Locust Point), Bolton’s Wharf (Canton), and at Whang’s Dock in the Patapcso River. The request recorded at the 18th February, 1869, during the period of flood and ebb, and in the usual tides, simultaneous observations were made to determine differences of period of maximum of flood and ebb. These differences were found to be less than 18 seconds of time, the maximum observed being 18.4 seconds. At the mean of the tides observed, the difference of period was 16 seconds.

On June 1, 1871, the survey was resumed at Spring Garden and in the Patapcso (main branch) between the drawbridge and Brooklyn, west of the bridge. The recorded details show that in the course of the survey 1,000 soundings were made and 148 angles measured for determining the position of the boat while sounding in midwater. The positions at ends of lines were determined by the plane-table. Principal lines of soundings were laid parallel to the meridian. Cross or check lines intersected at angles of about 60 degrees. Lines of levels were laid off at such intervals that the height of Henderson’s, Bolton’s, and Woodall’s, but no appreciable differences of plane were found. The same result was obtained by simultaneous observation of tide at the several stations mentioned.

In March, 1881, Mr. Charles Junken, U. S. Coast and Geodetic Survey, made a re-survey of the whole of the Patapcso lying between Fort Carroll and the line of Marine Hospital Lazearte.

Observations and Experiments by Mr. C. S. Peires at Baltimore, Md., in 1850 and 1881.

Experiments were made to study the effect on the rate of chronometers, consequent upon the time of winding. Observations of the oscillation of a pendulum swinging on rollers were made to determine the effect on the time of oscillation. The decrement of the arc of oscillation during long and short swings was also studied and measures were made for the length of the pendulums employed. Some time was also devoted to comparing the length of the meter with the wave length of light.

Survey of 1886.

In June, 1886, at the request of Mr. N. H. Hutton, Engineer of the Harbor Board, the work of 1876 was supplemented by a verification of the triangulation and its adjustment to more recent computations made at Washington by the Computing Division of the Coast and Geodetic Survey Office of the triangulation of the Chesapeake Bay. The purpose of the request was to make a more careful triangulation of the Harbor than had been done before. Mr. Hutton’s request, however, was the tracing upon the ground of the Port Warden line established by the Commission of 1876 and its connection with the triangulation in such a way that its identification could be secured by reference to established ground-marks. The Superintendent of the Coast and Geodetic Survey was engaged for this work. Mr. Tittman, copies of the original plane-table sheets of the special survey of 1876 were possessed of the Port Warden line of the Harbor after due consultation with the Engineer of the Board. In conformity with the suggestions of Mr. Hutton, Mr. Tittman confined part of his work to tracing the bridge-line instead of the Harbors—upper bridge-head in certain places only being marked.

The method pursued was to transfer the Port Warden line to the original sheets. These sheets were then used by the in field and in general the points of division of these lines were identified by means of the plane-table. They were then referred by distance measurements and deflection angles to stations planted in the streets or sidewalks of the city, except where no streets had been located, over the middle branch of the Patapcso River. The lines were then connected by the plane-table to the stations proposed and the expense attending their occupation, it was decided to obtain by observation the measurements of the base line and its introduction into the triangulation. A section of about one mile in length having been selected on Fort Avenue, the measurements were made with the four metre contact slide apparatus and a correction found and applied to the previously accepted distance, Bayview-Monument. One hundred and seventeen geographical positions were determined, of which all but eleven were new.
In the scheme of triangulation carried out by Assistant Tittman, many points of the work of 1857 were included. Of the one hundred and eleven geographical positions determined, nearly all can be identified and made available for future surveys. The prominent new positions added to the previous lists are: "Grace Methodist Church Spire," "St. James' Church Spire," "Johns Hopkins Hospital," "City Hall," "Holy Cross Church Spire," and "Canton Elevator." At the end of March, 1897, Major Hutton applied for the assignment of an officer of the Survey to execute certain work supplementary to that accomplished by Assistant Tittman, and Sub-Assistant W. I. Vinal was assigned for that purpose. In connection with the soundings made, some miscellaneous measurements of streets and wharves along the water front were included in his work.

**Survey of Sparrows' Point, 1891.**

In May, 1891, a closely detailed topographical survey of the locality of the works of the Maryland Steel Company at Sparrows' Point, Patapsco River, and the hydrographic survey of its water front to the Baltimore ship channel, and Bear Creek to the railroad bridge, were made by Assistant J. W. Donn.

The following supplementary report shows in a partly tabulated form the work of the Coast Survey in the State of Maryland and District of Columbia between the years 1882 and 1892.

**Triangulation.**

In 1844—45—46 the primary triangulation was carried across from the Delaware Bay to the head of the Chesapeake and down to the Kent Island baseline, established during this period by Assistant Edward Blunt and James Ferguson. In the latter year the work was extended to the District of Columbia, and in 1847 had reached Point No Point and Hooper's Island. In 1848 the entrance of the Potomac River was included in the lines. The secondary triangulation progressed with the primary, but incidental to topographic work was continued over the Chesapeake and its Maryland tributaries during the entire period closing with 1870.

Primary triangulation was begun in 1854—55 by Assistant J. A. Sullivan, in Western Maryland, as a part of the tran-continental scheme. Afterward this was continued by Assistant C. O. Boutelle. At the present time the stations Maryland Heights and Sugar Loaf Mountain are connected with the work of Chesapeake Bay and the work passing over Western Virginia. The position of Rockville, Md., has also been determined as described by Assistant Edwin Smith, in Bulletin No. 25, which accompanies this record.

**Astronomy.**

A Stations were established and observations made in 1844—45—46 at the following principal points. Osborne's River (head of Bush River), Taylor (near Severn River), Marriott (near West River), S. Base (Kent Island), Poole's Island, Head of Elk River, Ellis Bay, Wicomico River, Manokin River, and Fishing Bay.

**Hypsometry.**

Leveling operations between Annapolis, Md., and Washington, D.C., in 1875, 1880, 1884.

**Topography.**

The following is the list of all topographic surveys made within the limits of Maryland by the U. S. Coast and Geodetic Survey, with their scales, dates and surveyors:

<table>
<thead>
<tr>
<th>Description</th>
<th>Date</th>
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<tbody>
<tr>
<td>Big and Little Annamissix River, vicinity of Crisfield, and entrance of Potomoke River</td>
<td>1849</td>
</tr>
<tr>
<td>Manokin River, Deal's Island, vicinity of St. Simons Island, Tanger Sound and Smith's Inlet</td>
<td>1850</td>
</tr>
<tr>
<td>Money Bay, Wicomico River, Nanticoke River, and Fishing Bay</td>
<td>1849</td>
</tr>
<tr>
<td>Hoop River, Tar Bay</td>
<td>1849</td>
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<tr>
<td>Little Choptank River and Tarril Island</td>
<td>1849</td>
</tr>
<tr>
<td>Choptank River</td>
<td>1849</td>
</tr>
<tr>
<td>Sharp's Island, Tilghman's Island, Peale Island and Harris Creek</td>
<td>1846—47</td>
</tr>
<tr>
<td>Meeke's Creek, and entrance of Miles River</td>
<td>1851</td>
</tr>
<tr>
<td>Eastern Bay, St. Michael's River, Tredhaven Creek, Frost and Back Wyre Rivers</td>
<td>1849</td>
</tr>
<tr>
<td>Upper Shore of Kent Island</td>
<td>1844</td>
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<tr>
<td>Inner Shore of Kent Island</td>
<td>1844</td>
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<tr>
<td>Chester River</td>
<td>1848</td>
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<tr>
<td>Chester River, including Woren's Point, including Poole's Island</td>
<td>1849</td>
</tr>
<tr>
<td>Woren's Point to mouth of Elk River</td>
<td>1849</td>
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<tr>
<td>Entrance of Sassafras River</td>
<td>1858—59</td>
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<tr>
<td>Sassafras River, including Belvedere Island</td>
<td>1858—59</td>
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<tr>
<td>Head of Elk River</td>
<td>1859</td>
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<tr>
<td>Elk River</td>
<td>1859</td>
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**Hydrography.**

Outer Shore from Delaware and Maryland boundary to West End of Assateague Bay.

<table>
<thead>
<tr>
<th>Description</th>
<th>Date</th>
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<tbody>
<tr>
<td>Bloodworth Island to Cove Point</td>
<td>1848</td>
</tr>
<tr>
<td>Cove Point to Tilghman's Island</td>
<td>1848</td>
</tr>
<tr>
<td>Sandy Point to Pool's Island</td>
<td>1848</td>
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<tr>
<td>Pool's Island to Old Woman's Island</td>
<td>1848-49</td>
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<tr>
<td>Old Woman's Gut to Turkey Point</td>
<td>1848</td>
</tr>
<tr>
<td>Turkey Point Light to Havre de Grace Light</td>
<td>1848</td>
</tr>
<tr>
<td>Part of Pocomoke Sound</td>
<td>1853</td>
</tr>
<tr>
<td>Pocomoke River Entrance to Edgewood</td>
<td>1848</td>
</tr>
<tr>
<td>Part of Tangier Sound</td>
<td>1853</td>
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<tr>
<td>Part of Tangier Sound</td>
<td>1853</td>
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<tr>
<td>Little Annamesis River and Crisfield Harbor</td>
<td>1866—69</td>
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<td>Big Annamesis River</td>
<td>1888—89</td>
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<tr>
<td>Little Annamesis River</td>
<td>1888—89</td>
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<tr>
<td>Union Bay</td>
<td>1888—89</td>
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<tr>
<td>Wicomico River</td>
<td>1888—89</td>
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<tr>
<td>Ellis Bay</td>
<td>1888—89</td>
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<tr>
<td>Nanticoke River and Fishing Bay</td>
<td>1888—89</td>
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<tr>
<td>Little Choptank River and Tributaries</td>
<td>1871</td>
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<tr>
<td>Little Choptank River Entrance</td>
<td>1871</td>
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<tr>
<td>Little Choptank River to Wing's Landing</td>
<td>1871</td>
</tr>
<tr>
<td>Choptank Creek Tributaries</td>
<td>1871</td>
</tr>
<tr>
<td>Choptank River, Wing's Landing to Dumfries</td>
<td>1871</td>
</tr>
<tr>
<td>Choptank and Great Choptank Tributaries</td>
<td>1871</td>
</tr>
<tr>
<td>Tredhaven Creek Tributaries</td>
<td>1871</td>
</tr>
</tbody>
</table>
No. 240. Map of the Patapaco River, issued 1:60,000, 1849.

Historical record of the operations of the Coast Survey in and adjacent to the City and Harbor of Baltimore, Chesapeake Bay and the Potomac River are provided.

- Potomac River, upper end of Washington Channel, E. W. Harding, 1870
- Potomac River, from Piney Point to Blackiston's Island, E. W. Harding, 1882
- Patuxent River, to Annapolis Roads, S. P. Lee, U.S.N., 1848
- Patuxent River, Drum Point to Satterlies Point, S. P. Lee, U.S.N., 1848
- Potomac River, from Head of Patapaco River to Entrance to Popomoke Sound, E. W. Harding, 1870
- Patuxent River, from Baltimore to Popomoke Sound, E. W. Harding, 1870
- Annapolis Roads, S. P. Lee, U.S.N., 1845
- Annapolis Roads, N. E. Cotman, U.S.N., 1844
- Annapolis Roads, E. W. Harding, 1870
- Annapolis Roads, G. M. Bache, U.S.N., 1844
- Eastern Bay, Wye and Miles Rivers, W.P. MeArthur, 1847
- Eastern Bay, from Bush River to Old Point Comfort, S. P. Lee, U.S.N., 1848
- Eastern Bay, from Bush River to Old Point Comfort, W. W. Harding, 1870

5. Private Surveys

As the population of Maryland increased it was natural that conditions should be constantly arising which called for more or less extensive and detailed private surveys. Such surveys have been made during the present century in great numbers. It is here necessary to mention only those which embraced considerable areas and included the results of new work. Detailed property surveys and maps which are purely compilations have been very frequently made, but these will not be considered.

The most energetic promoter of private surveys throughout the entire State was Mr. Simon J. Martenet, who died in November, 1892, at the age of sixty. He succeeded to the business of Thomas P. Chifflle, City Surveyor, in 1855, and at once began the preparation of a new map of the State. This was carried on by counties. It was not based on a triangulation of the area, but it nevertheless resulted in the collection of much new information. This survey was carried on between 1857 and 1865, when the first edition of the State map was published, although various county maps had been issued previously.

The private surveys may be arranged under four heads:

1. State Maps
2. County Maps
3. City Maps
4. Railroad and Water Supply Maps

The titles of the most important of these maps are here given, with the dates of their appearance.

State Maps

Chart of Chesapeake and Delaware Bays, by Fielding Lucas, Jr., 1882

Map of Maryland, illustrated by state surveys, and compiled from the best authorities, by Fielding Lucas, Jr., 1882.

Nearly 6 miles to the inch.

Maps of Maryland, atlas and wall editions, with scientific and statistical descriptions, and map of the State, with sections by E. T. Tyson, Zoology by Cope, and Climatology, with map, by L. Blodget, 1871.

(6 miles to the inch.)

Maps of Maryland, by Simon Martenet, 1858. 1 mile = 1 inch.

Map of Baltimore, and adjacent counties, by Simon Martenet, 1858. 1 mile = 1 inch.


Map of Maryland, with charts of the Seaboard and Virginia, West Virginia and Delaware, by Simon Martenet, from new surveys, 1865-1866. (3/4 miles to the inch.) Last edit., 1866. Outline and drainage map of the State, drawn by U.S. Geological Survey for Maryland and Delaware. Weather service. 8 miles = 1 inch. 1892.

County Maps

Map of City and County of Baltimore from original surveys by J. C. Sidney and J. P. Browne, 1851. 1 mile = 1 inch.

Maps from actual surveys, by R. J. Taylor, 1857. 1 mile = 15/16 inch. (P).

Map of Howard County, by Simon Martenet, 1858. 1 mile = 15/16 inch.

Map of Cecil County, by Simon Martenet, 1858. 1 mile = 15/16 inch.

Map of Harford County, by Simon Martenet, 1858. 1 mile = 15/16 inch.

Map of Carroll County, by Simon Martenet, 1862. 1 mile = 15/16 inch.

Map of Kent County, by Simon Martenet, 1860. Scale 1 mile = 1 inch.

Map of Montgomery County, by Simon Martenet, 1860. Scale 1 mile = 1 inch.

Map of Anne Arundel County, by Simon Martenet, 1860.

Map of Allegany and Garrett Counties, by S. J. Martenet, 1864. 1 mile = 1 1/2 inch. M.S. never published.

Map of Frederick County, by John Boud, 1858. 1 mile = 1 inch.

Map of Caroline County, by Dyer.

Map of Queen Anne County, by Strong.


Atlas of Montgomery County, including Prince George's County, by G. M. Hopkins, Philadelphia, 1878.

University Circulares.


Atlas of Kent and Queen Anne Counties, by Lake, Griggs and Stevenson, 1877.

Atlas of Talbot and Dorchester Counties, by Lake, Griggs and Stevenson, 1877.

Atlas of Cecil County.

City Maps.

Exact Plat of Baltimore town (MS.), 1765. Framed (H).

Plan of Baltimore, by G. G. Preborey (MS.), 1785. Framed (H).

Plan of Baltimore and Environs, by J. P. Pendel, 1782. Framed (H).

Plan of Baltimore (printed), 1789. Framed (H).

Plan of City and Environs, by Warner and Hanse, 1801. Framed (H).


Same corrected to 1831 (Nov.). (Hoen lith.)

Map of Baltimore, 100 perches = 158 inches, by Fielding Lucas Jr., 1822.

Scott's Map of the City of Baltimore, from Surveys by Martind. 500 ft. = 1 inch. 1856.

Map of Baltimore and Vicinity, by E. Robinson, 1855. (84 Nassau St., N. Y.)


Index Map of Baltimore, by Jno. Rippegay. 200 ft. = 1 inch. New York, 1885.

Railroad Maps.

Map and Profile of the location of the R. & O. R. from Cumberland to Wheeling, with routes surveyed from 1836 to its establishment in 1850, B. H. Latrobe engineer.

(Lith. Hoen.) (P).

Map of the R. & O. R., with its branches and connections, also Profiles. 6 miles = 1 inch. 1867, mail map. (P).

Many special Maps in the various Annual Reports of the R. & O. R., commencing 1827.

Map of the several surveys for the W. & B. R., by G. P. Worcester, engineer. 3 miles = 1 inch. n. d. (Hoen lith.) (P).

Contour Maps of the South Mountain and Blue Ridge, from U. S. Geological and Pa. surveys. 100 ft. contour lines. 2 scales, issued by W. M. B., about 1:100,000, and 1:250,000. 1885.

Maps in 1st and 33 Annual Reports of Metropolitan Railway (Metropolitan Branch of R. & O.), 1854-55, of parts of Montgomery County.

Water Surveys.

Map of the Country through which a Canal to connect the waters of the Chesapeake and Ohio is proposed to pass and of the National Road between Cumberland and Wheeling, with the adjacent Country, from actual Survey by Jos. Shriver. (In Shriver's Account of Surveys Relative to the C. & O. Canal, Baltimore, 1824.)

Map of Baltimore City and part of Baltimore County, including the Valley of the Great Gunpowder River, from Warren Factory to tide, from surveys made in accordance with Resolution of Mayor and City Council of Baltimore, May 11, 1852. Lith. by Hoen. Scale, 200 ft. to inch; vertical, 250 ft. to inch. (P).

Plan of Baltimore and Vicinity, showing proposed routes for bringing water from James', Gwynns Falls, and Patapacs River, directed by James Sade, 1853. 1/2 inch = 1 mile. (P).

6. Recent Topographic Work.

The recent cartographic work, which has provided Maryland with a new and reliable topographic map of so large a portion of her territory, has been carried on by the United States Geological Survey, with the use, of course, of all the data previously collected by the Coast and Geodetic Survey. In 1879 an act of Congress consolidated the four great geological surveys of all the States, together with their topographic data. In 1887 the University had prepared by Mr. L. Sandoz, of Princeton, a large wall map of the physical features of the Chesapeake

During the summer of 1887 Mr. Summer H. Bodfish was sent to make a map of the neighborhood of Baltimore on the same scale. He completed a 1/2 degree sheet (about 220 square miles), with the city of Baltimore in its centre, of which he published an account in the University Circulars, No. 65, p. 72, for April, 1888. In the same season the area in Virginia south of the Potomac and east of Great Falls was surveyed by Mr. Barnard on a two mile to the inch scale, with 50 ft. contours, and the portions of Maryland lying on the other side of the river were mapped in the same way the next season (1888) by Mr. Harrison. During the summers of 1888 and 1889 Mr. Hackett surveyed, on the same scale, the area in Maryland between Catoctin Mountain and Hood's Mills, as far north as parallel 39° 30'.

In the seasons of 1890 and 1891 Mr. A. E. Murlin completed the survey of Southern Maryland, comprising a strip lying between meridians 70° 15' and 77', and parallels 39° 30' and 38°, on a scale of one mile to the inch, with 20 ft. contour lines. This area, which includes about four thousand square miles, could be mapped in so short a time because of the work already done in it by the Coast Survey along the Chesapeake and Potomac, by Hoffman near Washington, and by Bodfish near Baltimore, and because of the comparatively flat and simple character of the country.

As a result of the topographic work of the U. S. Geological Survey between the years 1883 and 1891, the area of Maryland has been surveyed except the Eastern Shore and a strip 15° 20' wide, lying between parallels 39° 30' and the Mason and Dixon line, which extends from Emmitsburg eastward to the Delaware line (15° by 80 miles). The territory already mapped is divided as follows upon the Geological Survey Atlas Sheets of the United States: Territory west of meridian 77° 30' (Catoctin Mountain), on scale of two miles to the inch (1:125,000), with 100 ft. contours. Of this the area north of parallel 39° 30' is drawn and the drawing photographed, but not yet engraved; the areas of Maryland south of this parallel form parts of the four published atlas sheets of North Virginia—*1* Piedmont, *2* Romney, *3* Winchester, and *4* Harper's Ferry. East of meridian 77° 30' is a north-south row of three published atlas sheets, also on the scale 1:125,000, but with 50 ft. contour lines. These are called *1* Frederick, *2* Mt. Vernon,* and *3* Fredericksburg.

The north-eastern quarter of the Mt. Vernon sheet has also been surveyed on the one mile scale—1:25,000, with 20 ft. contour lines, and published separately as the "West Washington" sheet. This same scale has also been employed for all the territory thus far surveyed to the east, and published three north-south rows of six sheets each.

There are therefore now extant, beside some very important photographs of unpublished maps, six 1/2 degree (the Winchester sheet does not include any part of Maryland), and eighteen 1/2 degree atlas sheets, which are occupied wholly or in part by Maryland's territory. The accompanying map shows the portions of the State included in the new survey and also the boundaries and names of the different atlas sheets.

Several States, like New Jersey, Massachusetts, Connecticut, Rhode Island and New York, have secured or are securing complete topographical surveys of their territory through appropriations to cover one-half of the expense of the map. Maryland has, however, obtained a new survey of so large a portion of her area without the expenditure of one dollar of State funds.

The recent topographic work in Maryland by the U. S. Geological Survey has supplied a long-felt want for a reliable map, especially in the neighborhood of Baltimore. It is therefore not surprising that this data should be put to a variety of uses and give rise to several different representations of the country. The chief agents in the rapid application of the survey results have been the Johns Hopkins University and the World's Columbian Exhibition.

The need of a map of the vicinity of Baltimore has long been felt by the students of the University. An attempt was made to supply this need in 1884 by the compilation of a road map, under the editorship of Mr. A. L. Webster, then a student here. A drawing was made by Mr. Louis Neill, of Washington, of a region twenty-five miles square with Baltimore at its centre, on a scale of two inches to the mile. This was published by the University on a scale of approximately one mile to the inch, and served so good a purpose that a second edition was issued, with corrections, in 1887. This map has been known as the "University Field Club Map," since it was designed primarily to stimulate the study of the natural features of the Baltimore region. The greatest lack of this map was the absence of all topographic data. In 1887 the University had prepared by Mr. L. Sundos, of Princeton, a large wall map of the physical features of the Chesapeake...
Within the past year a great variety of representations, both topographical and geological, of all or portions of Maryland's territory have appeared, or have been projected and are now in course of preparation.

The following list of these is intended to show at a glance in what a number of ways our neighborhood has been represented. It may confidently be asserted that no city in the United States has a more varied series of maps and models of its surroundings than Baltimore. This list may be conveniently arranged under three heads:

Maps, topographical.


Johns Hopkins University Topographic Map of Baltimore and Vicinity. Scale 1: 62,500, embracing over 400 square miles and comprising all the U. S. Geological Survey Sheet Baltimore and parts of the three contiguous sheets, "Relay," "Laurel," and "Ellicott City." 1892.

Maryland Weather Service Map of the State, drawn in Washington on a scale 1: 500,000, and variously reproduced. This gives the boundaries, drainage and principal towns accurately, but has no topography. 1891.

Maps, geological.

The only published geological map of Maryland is the small and imperfect one issued by P. T. Tyson, in his report of 1860, and reprinted, with slight revision, in Martin's New Atlas of Maryland, in 1873.

In August, 1891, the U. S. Geological Survey issued a preliminary and imperfect geological map of Washington and Vicinity for the use of the International Congress of Geologists.

In February, 1892, a preliminary edition of the Baltimore Sheet, geologically colored, was issued by the Survey for the use of the American Institute of Mining Engineers. The coloring of this map was, however, unsatisfactory, and the sheet was reissued, greatly improved in appearance, in August, 1892.

In November, 1892, the Johns Hopkins University issued its topographic map, geologically colored. The scheme of colors adopted for this map is quite independent of that in use by the Geological Survey.

A new geological map of the entire State, on a scale of eight miles to the inch, or about 1: 500,000, is now in course of preparation for the World's Fair Book on the State's resources. This will be based upon the geological work of Darton, Williams, Keith, Geiger, Tyson, and White.

Models.

Aside from the maps, several relief models have been prepared with the use of the new topographic data. A model of the area of the first Baltimore Sheet, with Baltimore at its centre, was made in 1890 by Mr. Cosmos Mindeleff of Washington, on a scale of four inches to the mile, and with no vertical exaggeration. This model was constructed for the Baltimore Real Estate Exchange, and its cost was met mainly by Mr. H. C. Turnbull, by whom it was copyrighted. It is 5½ feet high by 4½ feet broad and is mounted in a heavy oak frame. As the natural vertical scale of this large model rendered it too flat for the purpose intended by the Real Estate Exchange, it has been deposited at the University, and a second one constructed for the Exchange on the same scale, but with a four-fold vertical exaggeration. This model is a very graphic representation of the region about Baltimore.

A large photograph of the second model is now in course of preparation by Cummins.

A geologically colored replica of this model will be exhibited by the Geological Survey in the Government Building at the Chicago Fair.

The Cumberland Valley Railroad had constructed in Philadelphia a relief model of the North and South Mountains between the Susquehanna and Potomac rivers, to show the valley and the course of its road. The original is deposited at Wilson College, Chambersburg, while photographic reproductions adorn the time-tables of the road. A considerable part of Maryland is represented on this model.

The Maryland Board of Managers for the World's Fair have ordered a large relief model of the entire State. This will measure seven by twelve feet, and is now in course of preparation at Washington by Mr. Cosmos Mindeleff.
NOTES IN GEOLOGY.

Edited by Professor George H. Williams and Dr. William B. Clark.

Abstract of a Paper on the Volcanic Rocks of South Mountain in Pennsylvania and Maryland. By George H. Williams.†

[Printed in full with map, plate, and 5 cuts in the American Journal of Science, December, 1892.]

[Read before the National Academy of Sciences, November 2, 1892.]

Object of this paper.—It is the object of the present communication to announce the identification of an extensive area of very ancient volcanic rocks which compose an important part of the South Mountain, south of the Susquehanna River. The brief preliminary description of these rocks, which is all that can now be attempted, will, it is hoped, suffice to show that the hitherto accepted theory of their sedimentary origin has been based on a misinterpretation of the facts which they exhibit.

The rocks in question preserve abundant and convincing evidence—both structural, chemical and petrographical—of their original character and genesis. At the same time they show various phases of alteration by recrystallization and dynamic agencies which render them valuable for the study of many problems of metamorphism.

South Mountain rises about fifteen miles west of Harrisburg, and extends, in a great sickle-shaped curve, to the Maryland line. Here it divides into two parts, known as Catoctin Mountain and the Blue Ridge, which diverge at a small angle and enclose the triangular Middletown valley, north of the Potomac.

During the past summer the writer devoted considerable time to mapping the volcanic rocks of this region and to collecting suitable material for laboratory study. This has at present only been fairly entered upon, so that subsequent communications, giving more detailed results, may be expected. As far as is known to the writer, volcanic rocks have not hitherto been definitely described as such in the Appalachians. The rocks here under consideration have long been known to geologists, but they have before, with the exception of a few of the most massive greenstones, been generally regarded as of sedimentary origin.

The cause of the prevailing misconception regarding the volcanic rocks of South Mountain is not difficult to find. Their accompanying accumulations of tuff beds and breccias, and the fact that they are generally cleaved parallel to the great structure-planes of the mountain, have all been readily interpreted as indications of stratification and conformity. The cleavage in the sandstone has often been mistaken for bedding, while the thin jointing and slaty structure of the lavas, though a secondary feature, have seemed to geologists not very familiar with recent volcanic rocks sufficient proof of sedimentary origin.

In spite of great age and some alteration, however, the volcanic rocks of South Mountain have preserved all the essential characteristics of our recent rhyolites and basalts in such perfection that the proofs of their real nature are, to the student of comparative petrography, overwhelming, while to all who will candidly examine them they must be at least convincing.

Petrographic Character.—Approximately 175 square miles of the area of South Mountain is occupied, between Mt. Holly and the head of the Middletown valley, with volcanic rocks. These belong to two types which exhibit sharp contrasts of color, composition and weathering. One type is inclined to tints of red, pink, blue or purple; is acid in composition; generally porphyritic; and weathers into thin slabs. The other type is almost invariably of a green color; basic in composition; frequently amygdaloidal; and weathers into rough, angular blocks. The rocks of the first type have been called felsite, orthofelsite, porphyry, or petrosilex; those of the second, trap, greenstone, chlorite-slate, or epidote-slate. In view, however, of the perfection with which these rocks have preserved the most characteristic features of their modern equivalents, there is no reason why they should not, like them, be termed rhyolites and basalts. The insignificance of mere age as a factor in rock nomenclature is now so fully recognized that we may with propriety employ the names of our recent lavas for rocks of any geological horizon, when we can prove beyond doubt their identity.

It is, of course, to be expected that many rocks of intermediate character will be found within this volcanic area. Since the petrographical and chemical study has, however, only begun, and since the contrast above noted is so well defined, the distinction of two types may at present be regarded as sufficient.

a). The acid rocks, rhyolites.—The rocks of the acid type occupy somewhat more than two-thirds of the volcanic area of South Mountain. They occur in dykes and flows, forming a body of great thickness; they are accompanied by ashes, tufts and breccias; they are usually porphyritic, though not always so; recrystallization of the substance of recent glassy and half-glassy rocks—flow-structures, perlitic structure, lithophysae, spherulites (in masses, in layers and in chains), axiolites, pumice, amygdaloids, etc., etc.—in hardly less perfection than the specimens which Professor Iddings has so admirably described from the Yellowstone Park.

These structures are preserved, in spite of the recrystallization of the entire rock substance, into a fine mosaic. They are therefore most apparent in hand specimens, especially when brought out by weathering; or, under the microscope, they are better seen in ordinary than in polarized light, as was the case with the old glass breccia recently described by the writer from the Susquehanna bar, 1892.†

The following is an analysis of a rhyolite specimen from the Gladhills, near the Bigham Copper Mine, on the north side of Pine Mountain, made by Mr. C. Hanford Henderson, of Philadelphia, and published in 1884.† This is a quite typical rhyolite analysis. When compared with analyses of our most recent acid lavas, the iron may seem a little high and the alumina a little low, but on the whole the close agreement is a surprise.

\[
\begin{align*}
\text{SiO}_2 & : 73.62 \\
\text{Al}_2\text{O}_3 & : 12.22 \\
\text{Fe}_2\text{O}_3 & : 2.08 \\
\text{FeO} & : 4.03 \\
\text{CaO} & : 0.94 \\
\text{MgO} & : 0.26 \\
\text{Na}_2\text{O} & : 3.37 \\
\text{K}_2\text{O} & : 2.57 \\
\text{Ign.} & : 0.40 \\
\text{Total} & : 99.09
\end{align*}
\]

The macroscopic features of the rhyolite are the best proofs of its true nature, for weathering brings out on the surface of the rock each delicate detail. In this way we discover every characteristic of glassy rocks, though there is no glass now remaining.

The microscopical characters of the South Mountain rhyolites are far too varied to be described in a brief paper like the present. It must suffice to say that, in spite of the recrystallization of the substance, we still find in great perfection all the essential features of the most recent acid lavas. Corroded and skeleton phenocrysts of quartz, micropegmatitic intergrowths of quartz in feldspar phenocrysts, and phenocrysts broken by the flow movement. In the groundmass we find spherulitic tufts, axiolites, elongated vesicles filled with quartz, trichites and globulites in great variety, which bring out each detail of flow-structure. All the particulars of microscopic structure call for extended study and description. For the present purpose, however, which is merely to establish the character of these rocks, what has been said must suffice.

In mineralogical composition the South Mountain rhyolites are quite uniform. When phenocrysts are present, the most abundant are alkali feldspar. Quartz in rounded bipyramids is always to be found with the...
feldspar under the microscope, although it is not so often apparent to the
unaided eye. The groundmass of the rhyolites is for the most part a quartz-
feldspar mosaic of varying grain, much of which is the result of devitrifica-
tion and recrystallization, though some of it is also probably original
microgranite.

Attention has been called by Tyson,† Hunt ‡ and Frazer † to the beauty of the South Mountain porphyries, and to the fact that they are so sus-
sceptible of a high polish as to make them valuable for decorative purposes.
Many of them closely resemble the famous porfro rosso antico of Egypt,
which is largely used by the lapidaries of Rome.

6. The basic rocks, basalt.—The basic lavas of South Mountain occupy
an area about one-half as large as that covered by the acid ones. They
reach their maximum development near the State line, where, along the
southern edge of Pennsylvania and for a considerable distance into Mary-
land, they form the entire width of the volcanic belt. North and south of
this main body, the basic rocks or greenstones are everywhere met with as
narrow bands intersecting the rhyolites and following the general trend of
the mountain. These bands differ much in their width, but seem to be most
developed along the eastern flanks of Green Ridge and Piney Mountain.

These rocks have been more generally shewn into slates than the acid lavas.
The chemical alteration which has gone on in them is also in general
greater. Still large masses of the basic rocks have been but little altered
and remain quite massive. These, which are locally known as “cooper
rock,” are the only members of the volcanic series whose igneous origin has
been heretofore conceded. They are for the most part very fine grained,
vessicular flows, whose original structure is still so well preserved that they
may with propriety be called basalts.

The following analysis, also by Mr. C. H. Henderson, of a massive green-
stone from the Bechtel Copper Shaft, Russell Mine, is published by Dr.
Frazer.‡ This is a normal basalt analysis, indicating as little chemical
change in the basic rocks as the one given above does in the acid rocks.

| SiO₂ | 41.290 |
|-----------------------------|
| Al₂O₃ | 15.480 |
| Fe₂O₃ | 9.440 |
| FeO | 8.200 |
| CaO | 7.040 |
| MgO | 7.486 |
| Na₂O | 3.523 |
| K₂O | 2.208 |
| Ign | 2.740 |
| Total | 100.397 |

Basic volcanic rocks never exhibit so great a variety of structure forms as
characterize the more acid rhyolites. The South Mountain basalts are usu-
ally homogeneous, dark to pale green masses, which rarely show any micro-
scopical phenocrysts and whose most constant feature is amygdaloidal
structure. These cavities vary greatly in size, shape and abundance. They
are often elongated by flow-motion in the lava, and are now filled with
a number of secondary minerals, the most abundant of which are epidote,
chlorite, quartz and zeolites. Traces of original glass or splinteritic struc-
ture and recrystallization, though some of it is also probably original
microgranite.

c. Pyroclastic deposits, tuffs and breccias.—As is generally the case with
large accumulations of surface eruptions, the South Mountain lavas are
accompanied by extensive deposits of pyroclastic material. This includes
course flow- and tuff-breccias, pumiceous bombs and banded accumulations
of fine volcanic ash. Like the massive rocks, this fragmental matter is both
acid and basic in composition.

The most striking and important area of acid tuffs covers about a square
mile in the Buchanan Valley, at the eastern base of Piney Mountain, two
miles north of the Chambersburg turnpike. Here the rock is a breccia whose
component fragments vary from two or three feet in diameter to the finest
ash. All sizes, shapes and colors are heterogeneously mingled, and the result
bears a superficial resemblance to the well-known trissiac breccia (“Poto-
mato’s leather rock” or “callo rock”) of the Frederick Valley. The material in
this case, instead of being limestone, is entirely pyroclastic, and exhibits re-
markable variety of structures and colors. Both flow- and tuff-breccias occur
here, while a portion of the mass has been shewn into a quite fusible slate.
Similar acid tuffs, though of less striking appearance, occur at many other
points (Raccoon Creek, Monterey, Old Furnace Road, etc.), and will doubt-
lessly continue to be discovered as the examination of the region proceeds.

Fragmental deposits consisting wholly of basaltic material abound along
the Western Maryland railroad near Monterey, and farther south. The
finer cementing material is in these almost always altered to epidote. It
is also not uncommon to find conglomerates consisting of both the acid and
basic types of rock, but a careful search has thus far failed to discover any
fragments of sandstone in these pyroclastic beds.

Geological occurrence and relations to the Sandstone.—No evidence is neces-
sary, beyond the petrographical characters above described, to establish the
igneous and volcanic nature of the South Mountain rocks. Additional evi-
dence of a purely geological kind is not, however, wanting. The vicissitudes
through which these ancient rocks have passed, and their present inadequate
exposure, tend to obscure their original relationships. Nevertheless dykes
may be seen at various points, especially at the western end of the railroad
tunnel on Jack’s Mountain, where an amygdaloidal red felsite cuts the
massive and schistose greenstones. Further exploration will doubtless
bring to light many similar occurrences. Successive flows are not now
easy to separate, but the amygdaloidal and fluidal structure of the rocks
indicates that they must have been extruded in this form.

The age of the South Mountain volcanics and their relations to the sandstone in which Mr. Walcott has recently identified the lower Cambrian
fauna, are points of great interest. The hypothesis of the Pennsylvania
geologists that the greenstones and felsites lie above the sandstone is evi-
dently incorrect. It may, however, be regarded as an open question whether
the volcanic rocks represent a much older horizon, which was already eroded
before the sandstone was deposited, or whether they were, in part at least,
contemporaneous with the sandstones.

The entire absence of sandstone as inclusions in the lavas, as well as in
all the accumulations of pyroclastic material; the observations of Keith,
Geiger and Walcott, that the sandstone lies flat or in synclinals; and the
sections made by Miss Bascom across Monterey Peak, Pine Mountain, Jack’s
Mountain, and Haycock near Monterey, all indicate that the sandstone is
altogether above the volcanic rocks, and that it has been only sporadically
left by erosion on the east side of the mountain in Pennsylvania. In Mary-
land the volcanic rocks are flanked both on the east and west by sandstone.
No alternations of relatively thin beds of sandstone and lava have thus far
been observed. The contacts of the sandstone above the porphyry on the
old tampen railroad southwest of Maria’s Furnace, and above the green-
stone in Jack’s Mountain railroad tunnel are both admirable exposures,
but both seem to be thrust-planes and are not contacts of original depo-
sition.

The South Mountain volcanic rocks therefore become, not merely in their
petrographical character and richness in metallic copper, but also in their
stratigraphical position, comparable to the Keewenawan or Nipigon
series of Lake Superior.

Chemical Alteration and Metamorphism.—Extensive chemical changes,
involving devitrification and the formation of new minerals, have gone on in
all the volcanic rocks of South Mountain without destroying the original
structures. In other words, where there has been movement and shearing,
the same rocks have lost both their original minerals and structures by a
process of complete metamorphism. The results are more or less perfectly
fused schists and slates, whose origin can be positively traced to the vol-
canic rocks, and whose present form can be shown to depend upon the
intensity of the dislocation to which they have been subjected.
Comparison with other regions.—The comparative rarity of very ancient volcanic rocks in America as compared with Great Britain and other parts of Europe is doublets due to their not having been recognized, rather than to their actual absence. The opinions entertained by Hunt of rocks like those of South Mountain have greatly retarded, in this country, the appreciation of their true character. Still they are well known on Lake Superior and in Missouri through the writings of Irving and E. Haworth; Wadsworth and Diller have described them in eastern Massachusetts, Shaler in Maine, and the northern continuation of this same belt has been made known by the Canadian geologists, Bailey, Matthew and Ellis, in New Brunswick. Bell has also recently described similar rocks in the Sudbury region.

Similar areas are easily recognizable in Canada and Maine from the writings of Hunt, Jackson and Hitchcock, in spite of the fact that they are not properly interpreted. Volcanic rocks have not before been clearly associated of their true character. Still they are well known on Lake Superior and in Missouri through the writings of Irving and E. Haworth; Wadsworth and Diller have described them in eastern Massachusetts, Shaler in Maine, and the northern continuation of this same belt has been made known by the Canadian geologists, Bailey, Matthew and Ellis, in New Brunswick. Bell has also recently described similar rocks in the Sudbury region.

A New Machine for Cutting and Grinding Thin Sections of Rocks and Minerals. By George H. Williams.

A brief description of a new machine for cutting and grinding rock sections, in which electricity furnishes an economical and satisfactory motive power, may prove acceptable to the constantly increasing number of workers in mineralogy and petrography. This machine was devised for the petrographic laboratory of the Johns Hopkins University over a year ago, and since then it has been in more or less constant use. It has thoroughly established its reputation for accurate and rapid work, while experience has suggested some improvements on the original model.

The accompanying cut of the machine (fig. 1) hardly needs any explanation. It is seen to consist of a substantial table, carrying in its lower part the electric batteries and motor, while upon its upper surface is placed the apparatus for grinding and sawing.

The table is approximately three and one-half feet square and two feet nine inches high. It is constructed, with all of its appurtenances, by the Donaldson-Macrae Electric Company of 215 N. Calvert St., Baltimore, whose storage batteries and electric motors are well known. The price of the machine complete is $130.00, consisting of the following parts:

1. Three two hundred ampére-hour storage batteries, 13 inches high, in portable rubber cases. These batteries stand on a firmly constructed cross-piece from which they may be readily removed for recharging.

2. One one-eighth horse power electric motor of the Donaldson-Macrae pattern (fig. 2). This is fastened to a second cross-piece above the batteries and below the table surface. It is provided with a regular squirrel cage motor by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt. It carries at one end a vertical wheel of solid iron, and connected with the table by a separate belt.

3. The grinding apparatus consists of two circular disks of solid copper, 9 inches in diameter and $\frac{1}{2}$ inch thick, which may be used alternately as different grades of emery are required. They are attached either by a screw or square socket to a vertical iron spindle, which revolves smoothly in a conical bearing. The grinding disk is surrounded when in use by a large cylindrical pan of tin (not shown in the cut), which has an opening in its centre to allow of the passage of the spindle.

4. The sawing apparatus consists of a horizontal counter-shaft, placed on a different part of the table from the grinding disk, and connected with the motor by a separate belt. It carries at one end a vertical wheel of solid iron, and at the other an attachment, level-table and guide for the diamond saw. A small water-can and spout (not shown in the cut) is suspended over the level table to keep the edge of the saw wet when it is in use.

Under some circumstances it may be found advantageous to obtain electricity for this motor by a direct wire from an electric light or power company. Considerable inquiry has been made, however, that in Baltimore the storage batteries are more convenient, safe and economical. A single charging lasts the needs of a laboratory of ten students for a month. The batteries are removed by the electric company and returned with little or no delay at a cost of $3.75 for recharging.

Note on Quartz-Bearing Gabbro in Maryland. By Ulysses Sherman Grant.

In the description of the gabbros of the region around Baltimore the normal type was found to be a pure hypersthene gabbro, or hyperite, with very few accessory minerals and not a trace of original quartz in any facies of the rock. However, several specimens of a quartz-bearing phase of this gabbro have been recently discovered. These occurrences are of special interest when considered in connection with the extensive development of quartz in the gabbros to the northeast of Baltimore, near Wilmington, Delaware; and at the suggestion of Prof. Williams the following note has been prepared.

*Admirable saws—circular tin disks 8 inches in diameter, with one inch center aperture, whose edge is provided with diamond dust secured by cement, may be had of Wm. Kerr, No. 290 Westminster St., Providence, R. I., for $2.00 per half dozen.


‡ F. D. Chester: The Gabbros and Associated Rocks in Delaware; Bull. U. S. Geol. Survey No. 69, 1890.
The first locality where quartz gabbro was noticed in Maryland is in Harford County, just north of Priest's Ford bridge over Deer Creek, on the road to Darlington. Here, and in the immediate vicinity, Prof. Williams in 1886 found this facies of gabbro quite common. The rock is of medium grain and the quartz is in large irregular grains, which vary in color from blue to milky white. Under the microscope the rock is seen to have been more or less highly altered; most of the pyroxene has changed to green hornblende, the plagioclase is breaking down, and the large quartzes show decided undulatory extinction and often fissuring. In the decaying plagioclase are many small limpid areas of quartz, to all appearances of secondary origin; these do not, as a rule, show any signs of undulatory extinction. The large areas of quartz are clouded by innumerable dust-like inclusions similar to those described in the plagioclase of the Baltimore gabbro. On account of the altered character of the rock, it would be unsafe to draw any positive conclusions as to the primary nature of these large quartz grains, although they certainly seem to be original and similar to the quartzes found in the Baltimore gabbro (to be mentioned below); and, concerning these last, there appears to be very good evidence for considering them as original constituents of the rock. The quartz gabbro of the Baltimore area is very fresh and unaltered, and for this reason it will be treated more in detail.

Thus far quartz gabbro has been seen at only one locality in the Baltimore area. The first specimen was found in the high wall of the Mt. Hope Asylum by Mr. Wm. S. Hunnell in 1890, who noticed but one boulder of this facies of the rock, and this showed microscopic grains of quartz over only a part of its surface. Another similar loose block was found by the writer on the road connecting the Reisterstown turnpike with the Mt. Hope railway station. Both of these blocks are remarkably fresh, and have evidently not been moved far from their original location; in all probability they came from the cut of the Western Maryland railway just north of Mt. Hope station. These specimens present macroscopically the appearance of the typical unaltered hypersthene gabbro common to this locality, except that here and there are seen limpid blue quartz grains, sometimes with a diameter of nearly a quarter of an inch. These grains are not, as a rule, scattered through the rock at approximately equal distances from each other, but are collected in certain irregular and ill defined areas, which at first suggest a secondary origin, as though the quartz has been deposited in small cavities formed by the fissuring of the rock or by the disappearance of certain other mineral grains. Microscopically the rock is seen to be a granular aggregate of rather medium grain, consisting of plagioclase (bytownite), quartz and hypersthene, with accessory magnetite, apatite and very little hornblende, which is all of a secondary nature. The plagioclase, hypersthene and hornblende, which occurs only in narrow rings around the hypersthene and magnetite, have already been exhaustively described,† and so need not be further mentioned here. The mineral of interest is the quartz, which in the eight slides examined makes up from one-tenth to one-quarter of the entire area. The only amphibole seen in the sections is confined to very narrow areas of secondary hornblende having been formed. In fact, the only amphibole seen in the sections is confined to very narrow areas of secondary hornblende which might have originated from diagenesis, the rock being exceedingly fresh and unaltered and very little secondary hornblende having been formed. In the small clear prisms in the plagioclase are apatite crystals.

Second, the quartz could have been deposited in small cavities formed by a fracturing of the rock. If this were the case, we should expect the rock to show decidedly cataclastic structures, as the cracking and fracturing of the different grains and peripheral granulation of the same; but such is not the case. The only evidence of dynamic action in the rock is shown by the more or less marked undulatory extinction of some of the quartz grains,—which, of course, must have been caused by pressure acting after the quartz was formed,—accompanied in a few cases by slight fissuring; but in no case has the action been intense enough to produce peripheral granulation of the grains. So it seems impossible to consider the quartz as anything but an original constituent of the rock.

None of the sections from Mt. Hope contain any diagenesis, although the normal specimens of the Baltimore gabbro show both diagenesis and hypersthene; nor are there in the rock any areas of secondary hornblende which might have originated from diagenesis, the rock being exceedingly fresh and unaltered and very little secondary hornblende having been formed. In fact the only amphibole seen in the sections is confined to very narrow green rings partially surrounding some of the hypersthene and magnetite grains. Thus, while the normal type of the Baltimore gabbro is a true hypersthene gabbro or hypidiomorphous, the quartz-bearing facies of it is a quartz norite.

Sections cut out from parts of the blocks found at Mt. Hope, in which no trace of quartz could be seen with the unaided eye, showed under the microscope considerable quantities of this mineral in fine particles. Further examination may show that the quartz is disseminated in microscopic grains in other portions of the Baltimore gabbro area, although a large number of thin sections from other parts of this area have been studied and no trace of this mineral was found.

The occurrence of quartz in gabbro as an unimportant accessory mineral is not very unusual, but it seldom comes to be an essential constituent of this rock over any large area. This, however, is the case in the gabbro around Wilmington, Delaware, where quartz is decidedly abundant and universally present. Here the acid gabbro is found to grade into what have been termed "gabbro granites,"† towards the southwest, in Harford County, Md., quartz is not nearly as common in the gabbro; but in places it becomes quite abundant, and Professor Williams has here found this facies of the rock grading into augite granites. Still farther southwest is the Baltimore gabbro area where quartz must be regarded as an extremely rare accessory mineral and its occurrence may be considered as

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† Ibid., pp. 19-24.

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† Ibid., p. 19.
very sporadic. It is true in all probability that the gabbros of Delaware and Maryland, while not connected at the present surface, are of like age and are genetically the same. In this connection it is of interest to note the gradual increase of the basic character of the rock-mass from Wilmington towards Baltimore.

Notes of Minerals recently obtained from the Quarries of Jones' Falls. By S. L. Powell.

Since the publication of “Notes on the Minerals occurring in the neighborhood of Baltimore,” by Dr. G. H. Williams, in 1887, and an appendix to this, “Contributions to the Mineralogy of Maryland,” by Dr. Williams and A. C. Gill, in 1889, published in this Circular, No. 75, the quarries at Jones' Falls have been in active operation. And owing to the fact that they have been carefully watched by the students of the University, unusually fine specimens of the minerals occurring there have been obtained. As this communication is intended as an appendix to the papers named above, in which the majority of the minerals of this locality are described, mention will be made of only such matter as may be new or of special interest. The minerals siderite, haydite, stilbite, and laumontite, are of frequent occurrence, and have all been found in well developed crystals. They, however, offer nothing worthy of note beyond what has already been described. Apatite, barite, orthoclase, muscovite, epidote, occur sparingly, and frequently well crystallized.

The minerals of this locality occur in two distinct associations: the one in druses and pockets in the gneiss, due to local alteration, and the other in veins of coarse pegmatite penetrating the gneiss.

Calcite has long been observed in the form of Iceland spar, but not in crystals until recently. Two cavitites were found in the gneiss containing well defined transparent crystals, showing the prisms of the first and second orders in combination with the rhombohedron and basal plane. They are from two to four millimeters in diameter, and from five to thirteen millimeters in length. The carbonates range from pure calcium carbonate (Iceland spar) on the one hand to carbonate of iron (siderite) on the other. Ankerite, a subspecies intermediate between calcite, magnesite and siderite, occurs in semi-transparent rhombohedrons, and globular forms, built up of sub-individuals, frequently passing into beautiful subdodecagonal forms, some of which attain to an inch in diameter. It occurs in druses associated with the zeolites.

Perfectly developed crystals of muscovite and orthoclase have recently been found in pockets in the gneiss, associated with siderite, calcite and laumontite. The muscovite occurs in sharply defined hexagonal plates, with well developed prismatic planes. They are from three to ten millimeters in diameter. They sometimes have a green coating, in which are imbedded minute crystals of pyrite. The orthoclase occurs in short, stout, white, opaque crystals, showing the forms: 001, 010, 110, 110. Heretofore these two minerals have not been observed to occur in association with the zeolites.

The crystals of beaumontite so far surpass any previously found in the perfection of their planes, that measurements were made upon them. In the following table the averages of a number of independent measurements of corresponding angles made upon the most perfect crystal are given and compared with the angles of heulandite. The position and lettering of the planes are those of E. S. Dana, instead of those of von Rath used in the former description of this species in the “Notes on Baltimore Minerals.” While these angles vary considerably from those formerly obtained by Gill and Burton, the measurements agreed so closely among themselves that we must conclude that the angles of beaumontite are subject to wide variation.

<table>
<thead>
<tr>
<th>Beaumontite</th>
<th>Heulandite</th>
</tr>
</thead>
<tbody>
<tr>
<td>201:201 (t)</td>
<td>130° 57' 22&quot;</td>
</tr>
<tr>
<td>110:110 (m)</td>
<td>134° 50' 10&quot;</td>
</tr>
<tr>
<td>116:27</td>
<td>111° 58'</td>
</tr>
<tr>
<td>201:001 (t)</td>
<td>117° 56' 40&quot;</td>
</tr>
</tbody>
</table>

The second mode of occurrence of specimens of mineralogical interest at the Jones' Falls Quarries is as constituents of the coarse pegmatite veins or dykes, which form a characteristic member of the Baltimore gneiss series. Microcline, albite, quartz, lepidolite, muscovite, garnet, black tourmaline and apatite are the common original minerals in these veins.

In April 1892 a pegmatite vein was exposed which exhibited three varieties of feldspar in sharp contrast. One of these was the usual flesh-colored microcline; the second, a dark grayish green feldspar having also the appearance of microcline, while the third was a white striated feldspar resembling albite. These three feldspars were analyzed by Mr. W. F. Hillebrand of the U. S. Geological Survey with the following results:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>65.06</td>
<td>64.36</td>
<td>63.72</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>18.41</td>
<td>16.11</td>
<td>22.26</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.45</td>
<td>0.29</td>
<td>0.00</td>
</tr>
<tr>
<td>MgO</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>CaO</td>
<td>1.17</td>
<td>1.17</td>
<td>0.00</td>
</tr>
<tr>
<td>Na₂O</td>
<td>0.25</td>
<td>0.23</td>
<td>0.39</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>H₂O below 10° C.</td>
<td>0.04</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>H₂O above 10° C.</td>
<td>0.25</td>
<td>0.35</td>
<td>0.45</td>
</tr>
</tbody>
</table>

I. is the flesh-colored microcline.

II. is the green microcline; its only difference in composition is its small percentage of iron. Its higher percentage of SiO₂, causing a lower percentage of other constituents, is due to the associated quartz not having been completely separated.

III. is an albite-oligoclase, having the composition Ab:An = 4:1.

The two microclines were seen in some crystals to merge gradually into one another. The green color may be due to secondary infiltration of some iron salt.

The albite-oligoclase is peculiarly interesting on account of showing highly developed twinning striations on both the basal and brachypinacoidal cleavage faces. The former are exactly parallel to the cleavage and are due to the ordinary albite law; the latter are produced by the pericline law, the composition face being the rhombic section which in this case is inclined 104° in a positive direction to the basal cleavage. This angle was measured on sections cut parallel to the brachypinacoid. Polysynthetic twinning according to the pericline law has recently been shown by Penfield and Sperry to occur in many cases where it has before been overlooked. (Am. Journal of Science, Vol. 34, November, 1887, p. 380.) The albite-oligoclase of Jones’ Falls furnishes an addition to the list of occurrences given by these authors.

The mica of the coarse pegmatite veins encloses large red garnets of the isometric type, which show a well marked parting or cleavage parallel to the faces of the rhombic dodecahedron. This feature manifests itself in striations parallel to the longer diagonal of the faces of the isometric form, which is strongly marked by thefaces of the rhombic dodecahedron appear to have developed into a pyramid by the addition of successively smaller plates, the result of which is to form the isometric tetrahexahedron. These garnets appear in all respects to be like those from Arendal in Norway described by O. Mügge. (N. J. B., 1889, Vol. I, p. 235.)

One of these pegmatitic veins was observed which has undergone complete alteration, resulting in a large development of calcite and chlorite, together with a considerable amount of epidote. The tourmaline, contained in the pegmatite, remains imbedded in the calcite and chlorite. The alteration appears to be due to the action of water, as larger veins of pegmatite in the same quarry, through which water is seen to percolate, exhibit a tendency to the same process of alteration. The calcite enclosing large flakes of dark brown mica, penetrating it in every direction, which is but slightly altered. Where these flakes of mica pass from the calcite into the chlorite, or occur altogether in the chlorite, they are very much altered, breaking down into chlorite and calcite. The chlorite is the variety to which Volger gave the name Helminth. It is light green in color and occurs in small hexagonal plates, which arrange themselves in rosettes, fan-shaped, and peculiar forms of great variety. The crystals of tourmaline, mentioned above, vary from microscopic dimensions to four inches in length. They are considerably bent and broken, and are imbedded in the chlorite in such a manner as to show that the bending occurred previous to the alteration of the pegmatite. Cross-sections of the crystals show a zonal structure with a light blue centre, an intermediate zone of very dark blue, and an exterior one of dark olive brown, shading into gray on the margin. The epidote
The Eocene of the United States.*  

By William B. Clark.

The publication of a series of Correlation Essays upon the geological formations of the United States has been inaugurated by the Director of the U. S. Geological Survey, and already several reports have appeared while others are in press or in preparation. A special division of the Geological Survey has been established to superintend the work, and is known as the Division of Geologic Correlation. Professor G. K. Gilbert was appointed chief of this Division and will prepare a general essay on the principles of correlation. The reports that have already appeared are the Cambrian, by Professor C. D. Walcott; the Devonian and Carboniferous, by Professor H. S. Williams; the Cretaceous, by Dr. C. A. White; and the Neocene, by Dr. W. H. Dall and G. D. Harris.

The report prepared by the writer deals with the Eocene of the United States. Upon stratigraphical and geographical grounds it is considered under three divisions:

- The Atlantic and Gulf Coast Region.
- The Pacific Coast Region.
- The Interior Region.

Under each head there is an historical sketch in which a full review of the literature occurs, followed by a detailed discussion of the stratigraphical and palaeontological characteristics of the various formations in the several districts. In each instance, at the close of the descriptive portion, an attempt is made to correlate the deposits of the different portions of each district with one another and with similar deposits in the other districts and in foreign lands. Wide correlations of the deposits are, however, deprecated on the ground of inadequate knowledge of the strata, which does not admit of satisfactory comparisons even within narrow limits.

For important reasons the deposits of each district are discussed in different ways, those of the Atlantic and Gulf Coast Region by States, while those of the Pacific Coast and Interior Regions are treated by formations. In the former instance the writers have been so numerous and have so commonly considered the deposits of each State independently, that the stratigraphy can best be treated by political districts, although such division of the strata is not warranted on geological grounds. In the case of the Pacific Coast and Interior Regions the investigations have not usually been conducted with reference to the political boundaries, so that in general less confusion exists as to the views of geologists upon the stratigraphy.

Atlantic and Gulf Coast Region.—The Eocene of the Atlantic and Gulf Coast Region extends as a narrow band, with occasional breaks, from New Jersey to Texas, and holds a nearly central position in the Coastal Plain. Upon stratigraphical and palaeontological grounds it is divided into Lower, Middle, and Upper members, although it is often difficult to refer local deposits to a definite position in this series.

The following table will show the geological range of the Eocene in the several States:

<table>
<thead>
<tr>
<th></th>
<th>LOWER</th>
<th>MIDDLE</th>
<th>UPPER</th>
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<tbody>
<tr>
<td>New Jersey</td>
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<td>Delaware</td>
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<td>Virginia</td>
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<tr>
<td>North Carolina</td>
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<tr>
<td>South Carolina</td>
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<td></td>
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<tr>
<td>Georgia</td>
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<td>Florida</td>
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<td></td>
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<tr>
<td>Alabama</td>
<td></td>
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<td></td>
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<tr>
<td>Mississippi</td>
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<td>Tennessee</td>
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<tr>
<td>Kentucky</td>
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<td>Missouri</td>
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<td>Arkansas</td>
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<td>Louisiana</td>
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<td></td>
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<tr>
<td>Texas</td>
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</table>


The lithological and palaeontological characteristics of the deposits vary greatly in the different portions of the Atlantic and Gulf Coast Region. It is probable, however, that many of the differences will become much less pronounced, even if they do not entirely disappear, upon a fuller understanding of the strata and their fossils. On account of these marked differences in deposits and organic remains, it seems essential to the writer to provisionally establish the four following provinces, viz.: New Jersey Province, Maryland-Virginia Province, Carolina-Georgia Province, and Gulf Province.

The New Jersey Province contains a fauna that has few, if any, forms in common with other Eocene areas. It is closely related to the underlying Cretaceous in the character of its sediments.

The Maryland-Virginia Province has some species of fossils in common with the more southern Eocene areas, but the majority are distinctive of the region. Its deposits are almost exclusively greensand, and although probably representing in part Lower and Middle Eocene, are hardly as old as the New Jersey strata, with which they have evidently no forms in common.

The Carolina-Georgia Province has a much fuller representation of the entire Eocene series, a more extensive fauna and a greater variety in its deposits. It is more closely related to the Gulf Province, which it approaches in many particulars.

The Gulf Province, extending from Florida to Texas and including the Mississippi embayment, presents certain characteristic features that separate it, both lithologically and palaeontologically, from the Atlantic Coast provinces. The wide development of lignitic strata throughout the Gulf Province must have required peculiar conditions for their accumulation that did not exist along the Atlantic Coast. Moreover, these conditions were not confined exclusively to the earlier stages of the Eocene, although there predominating, but frequently recurred throughout the entire period.

The Lower Eocene of the Gulf Province, commonly known as the Lignite, attains great prominence, and in the region of the Mississippi embayment reaches its most marked development. In its geographical extent it is the leading member of the Eocene. It becomes much less lignitic in the eastern portion of the region than in the central and western; its faunal characteristics are more marine and the beds more calcareous.

The Middle Eocene in its two divisions, the Buhstone and Claiborne, presents a characteristic series of deposits that acquire their most marked individuality in the State of Alabama, where a varied fauna characterizes the upper of the two horizons.

The Upper Eocene, with its widely developed White Limestone beds, affords a sharp contrast to the other members of the Eocene series. In the western portion of the area the White Limestone, so typically developed in Alabama, is frequently interstratified with beds of arenaceous deposits containing bands of lignite.

The fauna of the various horizons of the Eocene in the Gulf States is vastly richer than on the Atlantic Coast, and affords many species that do not exist in the latter region.

As an appendix to the Atlantic and Gulf Coast Region, the Brandon Formation is discussed and doubt expressed as to the contemporaneous origin of all the lignitic deposits that have been so classed. In short, the Eocene age of any of the strata is called in question.

Pacific Coast Region.—Concerning the Eocene of the Pacific Coast, relatively little is known at the present time. Its occurrence at a number of points in California, Oregon and Washington has been established, but its boundaries have never been traced.

Two phases have been recognized—one marine, the other brackish-water in character. The former is known as the Tejon Group, having been so named by Prof. J. D. Whitney from Fort Tejon, California, near which point strata of Eocene age were early found. The latter is called the Puget Group by Dr. C. A. White, from its occurrence near Puget Sound, Washington.

The Tejon Group has been recognized in California, Oregon and Washington. It is conformable to the underlying Chico group, which has a decidedly Cretaceous fauna, including numerous characteristic ammonite and lamellibranchiate types. Although some of the fossils of the Tejon are identical with the Chico and indicate Cretaceous conditions, yet the majority are different, some specifically identical with Eocene species from other localities. Deposition was undoubtedly continuous during the Chico-Tejon period, and as the conditions changed but slightly, certain forms continued to live on from Cretaceous into Eocene time. Most geologists agree to-day as to the Cretaceous age of the Chico and the Eocene age of the Tejon. The Tejon is in turn conformably overlain by the Miocene, but still less is known in regard to the latter than the former on the Pacific Coast.
The Puget Group has only been recognized in Washington, where it occurs of great thickness in the Puget Sound Basin and in the Cascade Mountains. The deposits are brackish-water in origin, so that the faunal relations of the Tejon and Puget groups cannot be determined, and at the same time nothing is apparently known of their stratigraphical relations.

A few species of fossil plants have been considered identical with forms from the Laramie Formation of the Interior and the lignite of the Gulf, so that the Eocene age of the Puget group is held to be established.

Interior Region.—The Eocene of the Interior region covers an extensive area on the eastern and western flanks of the Rocky Mountains. Though largely found in broad, continuous tracts, it is not infrequently occurs in narrowly circumscribed basins that extend from Colorado on the east to Nevada on the west, and from Montana on the north to Texas on the south. Within these limits similar conditions largely prevailed. From an open sea of Cretaceous age, in which the life was marine, a gradual change took place to great fresh water lakes in which the typical Tertiary deposits of the Interior were accumulated. Although the marine and fresh-water divisions present marked palaeontological differences, they are still linked together by a series of brackish-water deposits that afford many points for comparison with both the older and younger horizons. Whether these intervening beds should be referred to the Cretaceous or the Eocene, or considered to represent portions of each, has been widely discussed, and no problem in American geology has perhaps furnished so extensive a literature. It is the opinion of the writer of these deposits, collectively known under the name of the Laramie group, should be referred partly to the Cretaceous, partly to the Eocene, although an investigation of the deposits has thus far failed to reveal any satisfactory evidence as to the exact position of the dividing line. The Laramie strata contain sandstones, shales and lignites that indicate the shallow-water conditions which prevailed during their formation. It has been generally held that most of the lithic strata of the Interior are of approximately identical age, and by many the Laramie group has been made to include them all. Certain local deposits have been thought by some to be of very different age, viz.: the Fort Union beds have been considered Tertiary, though perhaps synchronous with a part of the Laramie series; the Bear River Estuary beds are held to be earlier than the oldest Laramie, while the Arapaho and Denver beds are considered later.

The other members of the Interior Eocene are all fresh-water deposits, and their position in the series will be shown in the accompanying table:

<table>
<thead>
<tr>
<th>Cretaceous</th>
<th></th>
<th>Eocene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uinta group</td>
<td>Upper</td>
<td></td>
</tr>
<tr>
<td>Bridger group</td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Huerfano group</td>
<td></td>
<td>Middle</td>
</tr>
<tr>
<td>Wind River group</td>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>Arapaho beds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wasatch group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puerco beds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denver beds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arapaho beds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laramie group</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is impossible in this short review to enter into a description of each group. The most typical section of the fresh-water Eocene series is found in the vicinity of the Uinta Mountains, where the strata of the Wasatch, Green River, Bridger and Uinta groups are found in conformable sequence. The report contains a map of the United States, upon which is shown the distribution of the Eocene in the several regions. A bibliographic list of the important articles and special treatises upon Cretaceous of the United States.

The need of a systematic study of American fossils is nowhere more apparent than among the Echinodermata. Almost nothing is known of the Mesozoic and Cenozoic representatives of this class, the publications being few in number and widely scattered, some in fact wholly inaccessible to the general student of palaeontology.

The present report is intended as an exhaustive treatment of the Mesozoic Echinodermata, and already much work has been done toward the completion of the report upon the Cenozoic representatives of this class.

Not alone new species, but old as well, are fully described and figured. Fifty plates of illustrations accompany the text, and altogether there are 420 figures.

Nearly all the species described from the Jurassic are new, as are also many from the Cretaceous. Many of the old forms were so imperfectly described and figured, that in some instances it has been very difficult to distinguish them with certainty.

Most of the available material in the country has been studied, including that from the U.S. National Museum, Philadelphia Academy of Natural Sciences, American Museum of Natural History, New York, Boston Society of Natural History, Texas Geological Survey, and many private collections, the most important of which is that of Professor R.T. Hill.

The following is the list of species, with their geological horizons:

*Ustacrinus socialis* Grinnell.

*Cretaceous* (Niobrara Group); Utah, Kansas.

*Bouvycterus alabamensis* de Loriol.

*Cretaceous* (Ripley Formation); Alabama.

*Pentacrinus asteriscus* Meek and Hayden.

*Jurassic*; Dakota, Montana, Colorado, Idaho.

*Pentacrinus Bryani* Gabb.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Pentacrinus Whitei* Clark.

*Triassic*; Nevada, Utah.

*Ophioglyphus bradybrensis* (Meek).

*Cretaceous*; Montana.

*Goniusaster mamilatus* Gabb.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Asterias dumas* Whitfield.

*Jurassic*; Dakota.

*Cidaris splendens* (Morton).

*Cretaceous* (Middle Marl Bed); New Jersey.

*Cidaris Wolcottii* Clark.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Cidaris texana* Clark.

*Cretaceous* (Washita Formation of Comanche Series); Texas.

*Cidaris toyonensis* Clark.

*Jurassic*; California.

*Cidaris californiensis* Clark.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Lenticularia heringii* (Shumard).

*Cretaceous* (Washita Formation of Comanche Series); Texas.

*Safangia tenuis* Credner.

*Cretaceous* (Washita Formation of Comanche Series); Texas.

*Solenia tumidula* Clark.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Solenia bellula* Clark.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Hemicrinerus texana* Clark.

*Jurassic*; California.

*Gidaris californicus* (Shumard).

*Cretaceous* (Fredericksburg Formation of Comanche Series); Texas.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Pseudocentrodon tenuis* (Roemer).

*Cretaceous* (Fredericksburg Formation of Comanche Series); Texas.

*Diplopodia texana* (Roemer).

*Cretaceous* (Ripley Formation of Comanche Series); Texas.

*Diplopodia Hillii* (Clark).

*Cretaceous* (Austin Chalk); Texas.

*Coptosoma Mortonii* (de Loriol).

*Cretaceous* (Rotten Lime Stone); Mississippi.

*Coplosoma spinum* Clark.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Geontopora Zolotii* Clark.

*Cretaceous* (Fredericksburg Formation of Comanche Series); Texas.

*Pemmechirus cinquantius* Clark.

*Cretaceous* (Middle Marl Bed); New Jersey.

*Polinopsis Pondii* Clark.

*Cretaceous* (Austin Chalk); Texas.

*Stoenechinus Hyatti* Clark.

*Jurassic*; California.

*Holotypos planatus* Roemer.

*Cretaceous* (Washita Formation of Comanche Series); Texas.

*Pyrina Parryi* Hall.

*Cretaceous* (Washita Formation of Comanche Series); Texas.

*Brachyechinus alabamensis* Clark.

*Cretaceous* (Ripley Formation); Alabama.
Echinobrissus exsanguis Clark.
Cretaceous (Ripley Formation); Alabama.

Echinobrissus texanus Clark.
Cretaceous (Ripley Formation); Texas.

Emballaster californicus (Morton).
Cretaceous (Ripley Formation); California.

Emballaster texanus (Roemer).
Cretaceous (Washita Formation of Comanche Series); Texas.

Emballaster obliquatus Clark.
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.

Emballaster vettii (Shumard).
Cretaceous (Shumard).

Hemihaster californicus Clark.
Cretaceous (Colorado Group); Colorado.

Hemihaster ungula (Morton).
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster stella (Morton).
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.

Hemihaster texanus Roemer.
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster porrectus Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster sumard (Morton).
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster texanus Roemer.
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster porrectus Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster sumard (Morton).
Cretaceous (Middle Marl Bed); New Jersey.

Hemihaster texanus Roemer.
Cretaceous (Middle Marl Bed); New Jersey.

Echinocorynus banfieldi (Morton).
Cretaceous (Middle Marl Bed); New Jersey.

Enallaster texanus.
Cretaceous (Middle Marl Bed); New Jersey.

Echinodermata are important type fossils, but they are generally few in individuals as well as in species.

Report of Progress

By W. B. Clark.

The following statement submitted to the President of the University, and published in his annual report, will afford a brief account of the progress of the State Weather Service during the past year. The data have been furnished by Dr. C. P. Cronk, the meteorologist in charge.

Although the Maryland State Weather Service was organized in May, 1891, under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College and the U. S. Weather Bureau, results of its work during the remaining months of that year were meagre and incomplete, as there was no fund available for the publication of reports.

The University had given the services of one of its Faculty as Director, besides office room for the accommodation of the central station of the system; the Agricultural College had given the services of one of its Faculty as Secretary and Treasurer; the U. S. Weather Bureau had given the services of a Meteorologist in charge, increased the force of the central station by the addition of two assistants, furnished nearly all of the voluntary observing stations with instruments, all of them with the necessary forms, stationery and franked envelopes, and more than one hundred individuals, representing the different sections of the territory embraced by the Service, volunteered as meteorological observers, crop reporters, or displaymen.
AN ACT TO ESTABLISH A STATE WEATHER SERVICE, AND TO MAKE AN APPROPRIATION THEREFOR.

SECTION 1. Be it enacted by the General Assembly of Maryland, That there is hereby established a State Weather Service, which shall be under the control and management of the Johns Hopkins University, the Maryland Agricultural College and the United States Weather Bureau; the officers of said service shall be a Director, designated by the President of the Johns Hopkins University, a Secretary and Treasurer, designated by the President of the Maryland Agricultural College, and a Meteorologist in Charge, designated by the Chief of the United States Weather Bureau; they shall be commissioned by the Governor, and be duly qualified as officers of the State; the said officers shall constitute a Board of Government, under the direction of the institutions from which they are appointed, and shall receive no compensation for their services as such officers.

SEC. 2. The central station and office of said Service shall be at the Johns Hopkins University; the Board of Governors shall establish, if practicable, one or more voluntary meteorological stations in each county in the State, and supervise the same, co-operating with the Chief of the United States Weather Bureau for the suitable location of such stations, in order that the greatest usefulness may result to the State and National services; the said officers are authorized to print weekly and monthly reports of the results and operations of said Service, and to distribute the same in such a manner as they shall deem most serviceable to the people of the State.

SEC. 3. The sum of two thousand dollars* annually, or so much thereof as shall be necessary, is hereby appropriated out of any funds of the Treasury not otherwise appropriated, for the purpose of carrying out the provisions of this Act, to be paid to said officers, or to their order, by the Treasurer, upon the warrant of the Comptroller, and upon the vouchers of said officers; provided, however, that no part of said sum shall be paid for salaries for any officer or officers, but a reasonable compensation may be paid for printing and other necessary and proper expenses of said officers.

SEC. 4. The said officers shall report to the Legislature at its regular sessions their expenditures under the provisions of this Act, and such information as said officers may deem desirable, or as the Legislature may require.

SEC. 5. And be it further enacted, That this Act shall take effect from the date of its passage.

Approved April 7, 1892.

In the securing of the enactment of the law establishing the Service, too high an estimate cannot be placed upon the interest and zeal displayed by many prominent citizens of the State. Special mention should be made of the names of Messrs. John C. Legg, Harry F. Turner, Louis Müller and Lloyd L. Jackson. Without the support of these gentlemen, the needful legislation would have failed and Maryland would be without that which the most sparsely settled territory of the United States does not lack. Every State and Territory of the Union is now included within a State Weather service.

The work of the Maryland State Weather Service is similar to that carried on by like services in other States. The voluntary observers of the State organization are also observers of the National Bureau, and the results of each observer’s work are tabulated monthly in the Monthly Weather Review, published in Washington under the direction of the Chief of the Weather Bureau.

The publication of each State Service is chiefly devoted to a discussion of the climate of the territory covered by its observations, the effect of the meteorological conditions upon the products of the soil, and the special advantages to be enjoyed by the inhabitants.

The Board of Control of the Maryland Service has reason to be satisfied with the results accomplished. On account of the varied climate of Maryland, the difference in its soil formation, and its extensive coast-line, the agricultural and commercial interests of the State are important and many. The charts of monthly temperature and rainfall beautifully exhibit, in the curves of the isotherms and the distribution of the rainfall, the influence of the bay in the east and the mountains in the west, and open vistas of future usefulness to the State.

The sum appropriated by the State Government, though small, has enabled the printing of monthly reports, extending throughout the year, and of weekly reports, extending throughout the growing and harvesting seasons. That these reports are appreciated by the people of the State is evidenced from the hearty support they have given in rendering reports of the weather and of the crops, and by the general and complete publication of reports by the newspapers of the State. Two thousand copies of each of the monthly reports and about five hundred copies of each of the weekly reports have been distributed. They are sent to the meteorological observers of the Service (who for the most part are agriculturists), into other States, and to prominent institutions. A few copies are sent abroad. It is intended to add to the list of foreign institutions receiving the reports.

During the year meteorological reports have been received from thirty stations in Maryland, the District of Columbia and Delaware (the territory covered by the service), and crop reports have been received from sixty reporters, principally agriculturists. There are, also, thirty weather signal display stations attached to the service.

During the past year the central office in the physical laboratory of this University has been designated as a station of the first class, and is being fully equipped with the latest improvements in the barograph, thermograph, sunshine recorder and other self-registering instruments. Telegraphic reports in cipher, to avoid numerals and unnecessary expense, are received each morning from about 140 stations throughout the United States. These reports include atmospheric pressure, temperature (exposed, and maximum and minimum), direction and velocity of wind, state of weather, precipitation, dew-point, clouds, and any special phenomena which may be necessary. These reports are plotted upon a map dotted with the location of the stations; isotherms and isobars are drawn, and forecasts are made after a consideration of the general and local conditions. The general forecast received from Washington is also circulated. Though the Washington weather map (which doubtless is the most complete and finished map of the kind made in any country) is received, posted and circulated in Baltimore, a large blackboard weather map from which the local forecast is drawn is made at the Corn and Flour Exchange under the supervision of Dr. Cronk, the Meteorologist in charge of the State Service. The observations throughout the United States and Canada are taken at 8 A.M., 75th meridian time, and the map is usually completed before 10 A.M. The precedence of Weather Bureau business over other telegraphic matter accounts for the early receipt of the messages.

Chief-Assistant Wilson and Assistants White and Brewer have rendered valuable aid in the preparation of reports.

The approval of the President of the University in the work done, the kindness of Professor Rowland in providing convenient and comfortable office rooms for the central station, the encouraging support of Professor Williams, and the generous help of Mr. Murray, to whose advice the attractive form of the monthly report is due, are gratefully acknowledged.

THE ANNUAL EXPEDITION OF THE STUDENTS IN GEOLOGY, 1892.

By William B. Clark.

During the last five years annual geological expeditions have been conducted by the writer into those portions of the Coastal Plain bordering the Middle Atlantic slope. In this manner extensive areas in Maryland, Virginia and New Jersey have been visited and large collections of fossils and rocks brought back by those who have taken part.

The expeditions were primarily undertaken as part of the work of the geological department, but other persons were invited to participate, so that often those from outside exceeded in number the members of the University. Representatives of other educational institutions, including both teachers and students, as well as members of the scientific bureau in Washington, have availed themselves of the opportunities that have been thus afforded.

On account of the inadequate means of transportation and accommodation in the regions visited, the expeditions, previous to the present one, have always...
been made by boat. A schooner or steamboat suitable for the accommodation of the party was arranged for, and, since the country is deeply indented by tidal estuaries, most points could be approached by water. The expedition of 1891 was made vessels of the Maryland Oyster Navy, under the authorization of the Board of Public Works, and was participated in by twenty-five persons, representing the University and other institutions. The objective point of this expedition was Southern Maryland.

This last year it was deemed advisable to visit, in part, areas that could not be reached by water, so that the usual means of travel were abandoned. Longer time was spent at stated points and special provision made for the same. Two widely distant portions of the Coastal Plain were visited: 1st, the basin of the York and James Rivers, Virginia, and 2d, Eastern New Jersey.

**Virginia Expedition.**—Arrangements were made in advance by which permanent accommodations were obtained at Yorktown for the entire party. From this point the highly fossiliferous Miocene deposits exposed in the banks of the York and James Rivers were visited. The long bluff below Yorktown was carefully examined and large collections made from the various horizons. The section *found* here is recorded in the account of an earlier expedition to the same point. The bluff had been extensively cut into by the waves since the previous visit, and the beach was strewn with the washed out Miocene shells.

Above Yorktown the bluff at Bellefield is very rich in Miocene fossils, and some time was occupied in collecting at this point. Many other localities were visited, both above and below Yorktown.

From Yorktown an excursion was made across the isthmus to Carter's Grove, near Grove Wharf, on the James River, which affords one of the richest collecting points in the Virginia Miocene. There is practically no limit to the amount of material that can be there obtained. The section *found* here is recorded in the account of an earlier expedition to the same point. Nothing older than the Miocene was examined on this expedition, and very little was collected from any other horizon.

**New Jersev Expedition.**—Special arrangements were made with the railroads and hotels so that satisfactory rates and accommodations were provided for in advance. The afternoon and night of the first day were spent in Philadelphia, where an opportunity was given to examine the Museum of the Philadelphia Academy of Natural Sciences, which contains large collections of New Jersey fossils, including many of the types of Morton, Conrad, Gabb and others who early described the rich fauna of the Green-sand miers.

Early the second day the party went to Vincentown, where collections were made from the Upper Marl Bed, in which extensive pits have been dug, as well as from the limestone horizon of the Middle Marl Bed, which affords numerous remains of Bryozoa and Echinoderma. Later Birmingham was visited, and near the dam across Bancoc Creek, as well as in the large pits beyond, the Terebratula layer of the Middle Marl Bed was found. The pits are chiefly opened in the Greensand layer beneath.

The third day was passed in New Egypt and vicinity, where an opportunity was given to collect from the vast fossiliferous marl pits of the Lower Marl Bed below the town on Crosswick's Creek, as well as from the Cephalopod seminaria and Terebratula Horraria layers of the Middle Marl Bed. Some distance above New Egypt the Upper Marl Bed is found with characteristic fossils.

On the morning of the fourth day the party went to Perth Amboy, where they examined numerous clay and sand pits of the Raritan formation in the vicinity and along the highway to Woodbridge. The glacial deposits of the region also received attention. From Woodbridge the train was taken to Sayreville, from which place the section along the railroad to Keyport was examined during the afternoon. The sands of the upper portion of the Raritan formation which pass gradually through alternating layers of sand and clay into the still clay deposits of the Clay Marl were observed beyond South Amboy. In the great excavations opposite Keyport thin seams of greensand were found interstratified with the clays.

The fifth and sixth days were passed in the Navesink Highlands at Atlantic Highlands and vicinity. There is a grand section on the bluff facing the Raritan Bay, of Clay Marl, Lower Marl Bed and Red Sand. The Lower Marl Bed is here rich in fossils, and great numbers were collected by the party. Extensive landslides have taken place, so that the Red Sand is at several points carried down to the level of the water.

Upon the New Jersey expedition the leading divisions of the Cretaceous were seen and a large number of fossils collected from the most important localities in the State.

**The Annual Expedition of the Students in Geology, 1893.**

*By George H. Williams. Announcement.*

Until last year it has been customary to offer each year to the Geological Students of the University, and to others from a distance desiring to take part in them, two geological excursions of some length. One of these was designed for the examination of the later formations of the Coastal Plain in New Jersey, Maryland or Virginia, and the other for the study of the more ancient and folded strata of the Appalachians. Experience has, however, shown that each of these regions offers too much to be satisfactorily examined if the time available in one season is divided between them. It has therefore been deemed advisable to arrange these two extended excursions for alternate years, and thus to secure for each a longer time than would otherwise be possible.

A brief account of the trip made last spring into the Tertiary and Cretaceous formations of Virginia and New Jersey is given above by Professor Clark. During the coming spring it is proposed to take an excursion of similar length (ten days) across the Piedmont Plateau and Appalachians. The exact date of this trip cannot now be definitely fixed, but it will probably be between May 20th and June 10th. The route will also be subject to revision, but the general plan is to go by the Western Maryland Railroad from Baltimore to Monterey, Pa., for the examination of the ancient volcanics and Cambrian sandstones of South Mountain; thence by the same road to Chambersburg, above which, at Raccoon Creek and Caledonia Furnace, the volcanic rocks exhibit their most interesting features. From Chambersburg it is proposed to cross the Cumberland Valley to Cherry Run on the Potomac, and to examine there the great fault between the upper and lower Silurian strata. Above this place the section of Silurian and Devonian beds exposed near Hancock will be visited, whence the party will proceed by train (B. & O. R.) to Cumberland. This place offers unrivalled opportunity for a study of the Paleozoic sequence from the base of the Medina to the top of the Upper Coal measures within the limits of a day's walk.

On the return journey down the Potomac an opportunity will be offered to study the Blue Ridge between Harper's Ferry and Point of Rocks, especially the relation of the granite to the green schists of the Middle-town valley.

Any persons desiring to participate in this excursion can obtain further particulars by applying to the writer. It is desirable to know the entire number of those going at least ten days before the start is made.

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