ART. L.—*The Magothy Formation of Northeastern Maryland;* by N. H. DARTON, U. S. Geological Survey.

CONTENTS: *Introductory. General relations. The Magothy Formation.* Distribution. General features. East of Chesapeake Bay. Magothy River region. Severn River region. Odenton region. Patuxent River region. Original extent and thickness. Definition. Synonomy. Economic Geology. History.

Introductory.

IN this paper there is described an arenaceous formation not heretofore discriminated, lying between the Potomac and Severn formations in the upper Chesapeake Bay region.

Up to 1891, when I published my memoir on the Mesozoic and Cenozoic formations of eastern Virginia and Maryland,† I had given but little attention to the details of the geology of northeastern Maryland and believed that there was but one physical gap between the Potomac and Severn formations. Later studies in this region have led to the discovery that a series of sands and brown sandstones which I formerly supposed to be a local upper member of the Potomac formation, is separated from it by a continuous erosion plane, and constitutes a distinct formation.

As this formation is excellently exposed on the Magothy River, and partly for want of a better name it has been designated the Magothy formation. The general features of its distribution in Maryland are shown on the accompanying map. In the course of a few weeks a geological map of Maryland will be published by the State on which the lower boundary of this formation will be represented on a larger scale, and later its distribution west of Chesapeake Bay will be shown in detail on atlas sheets now in course of publication by the U. S.

* Rumpf, Ueber krystallisirte Magnesite aus den nordöstlichen Alpen, Tschermak's Min. Mittheil., 1873, p. 271.

† Geological Society of America, Bull., vol. ii, pp. 431–450, pl. 16.

Geological Survey. Finally, I will describe the formation more fully in a Monograph on the Geology of the Chesapeake Bay region now in preparation.

General Relations.

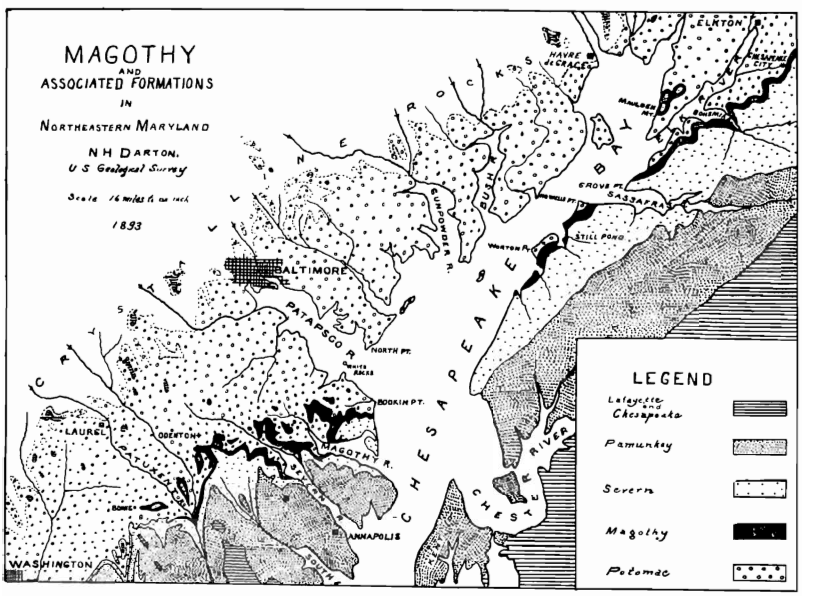
The coastal plain of eastern Maryland is underlain by a series of later Mesozoic to Pleistocene deposits lying on an east sloping floor of crystalline rocks. These deposits are widely extended sheets of sands, clays, and marls inclined and thickening to the southeast and separated into formations by erosion breaks. In the following table there is given a list of these formations and breaks, an explanation of their age and a brief description of their general characters:

	Formation.	Characters.	Paleontologic position.
Pleistocene.	*Columbia*	Loams, sands, and gravels. On terraces.	
		Erosion interval. Development of outlines of present topography.	———
Neocene.	*Lafayette*	Gravels, sands, and loams	Pliocene?
		Erosion interval. Base levelling over Coastal plain and westward	———
	Chesapeake	Sands, clays, infusorial earths, and marls	Miocene.
Eocene.		Erosion interval, planing of surfaces of preceding deposits	———
	Pamunkey	Glauconitic marls and sands	Eocene.
Cretaceous.		Erosion interval, planing of surface of Severn and Potomac formations	———
	Severn	Black, argillaceous sands, mainly	Cretaceous.
		Erosion interval, planing of surface of Magothy and Potomac formations	Cretaceous.
	Magothy	White sands and brown sandstones, also gravels	Cretaceous.
		Erosion interval, planing of surface of Potomac formation	Cretaceous.
	Potomac	Clays and sands, also gravels and sandstones	Early Cretaceous.
		Great erosional and stratigraphic break following Jura-Trias deposition.	

The Potomac formation lies directly on the crystalline rocks and outcrops over a wide belt eastward. Its western border extends westward on the ridges and the crystalline rocks extend eastward in the intervening depressions. It is succeeded eastward by the younger formations outcropping in succession in irregular northeast and southwest belts which are deflected westward of the ridges and eastward down the de-

pressions. The Lafayette and Chesapeake formations form a partial exception to this general statement for they overlap the other formations in some localities, and their western extension is now represented by small outliers occurring mainly in the higher lands to the northwest. The Columbia terraces extend across the other formations from the crystalline rocks in the depressions westward, to the Lafayette in the lowlands far to southeastward.

In southern Maryland the typical Coastal Plain topography of the south Atlantic region prevails, an elevated east-sloping plain capped by Lafayette formation, and holding sharply depressed drainage basins lined with low Columbia terraces which extend eastward into a wide low belt adjoining the ocean. This east-sloping Lafayette plain has also a gradual tilt northward and with increasing altitude it is more and more widely eroded. Near the latitude of Washington it finally terminates, except for a few small outliers, and through northeastern Maryland the region west of the bay, although still elevated, is rolling in contour in the higher lands and occupied by areas of Columbia terraces in the moderately elevated and low districts. The entire country east of Chesapeake Bay is a Columbia terrace relatively low throughout but gradually increasing in altitude to the north and northwest.



The Magothy Formation.

Distribution.—As is shown on the accompanying map the Magothy formation extends from the Delaware line to a point just southwest of Bowie, where it disappears in the overlap of the Severn onto the Potomac formation. I have not traced its eastward continuation through Delaware but the formation undoubtedly extends some distance at least, probably included in the sand marls described by Chester as the base of the glauconitic series.

East of Chesapeake Bay the Magothy formation extends in a nearly straight line from near Chesapeake City to below Worten's Point and outcrops below the Columbia deposits in the face of river and bay bluffs and in stream cuts. Its range of altitude is not great except in the outlying area of Maulden Mountain where it lies in greater part above one hundred feet above tide. Its dip is to the east-southeast at from 20 to 30 feet per mile.

West of the bay the formation begins a short ways below Bodkin Point at the mouth of the Patapsco, and crosses the rolling country and three or four intersecting valleys, south-westward to its termination. Its inclination of from 30 to 40 feet per mile carries it far westward up the long slopes of the ridges in irregular sheets and outliers but it descends below the Severn formation at tide level eastward along a line essentially continuous with its course on the eastern shore of the bay. The altitudes attained in the ridges westward are 130 feet on the neck between the Magothy and Patapsco Rivers, 240 feet in a far western outlier near Severn Station on the Magothy-Severn divide, 250 feet east of Odenton, 160 feet between the forks of the Patuxent and 190 feet on the ridge just east of Bowie.

General Features.—The Magothy formation consists mainly of white and buff sands with local beds of brown sandstone, and limonitic streakings both in plates and discolorations. Southwestward it becomes gravelly for some distance and some portions are locally lithified into loose conglomerates or harder, more or less pebbly, brown sandstones. The ferrugination which gives rise to the brown sandstones is by no means confined in this region to the Magothy formation for brown sandstone and limonitic masses and crusts are scattered locally in the Potomac, Pamunkey and Columbia formations and also but more rarely in the Severn, Chesapeake and Lafayette formations. The sands of the Magothy formation are moderately coarse and at some localities they are very coarse. They consist of quartz grains which vary in shape from rounded to subangular with a greater or less admixture of angular grains.

They lie loosely—a characteristic feature, in beds usually quite thin and regular but locally cross-bedded, sometimes to an extreme degree. The thickness varies from 10 to 30 feet but about 15 feet is the usual amount. An admixture of carbonaceous materials is often present in the form of grains but several thin beds and interbeddings of lignite have been observed. A few thin streaks of pale gray clays occur interbedded in the formation in the Bohemia River region.

The unconformities between the Magothy and Potomac below and with the Severn above are planes of erosion everywhere distinct and participating in the general southeastward inclination of the Coastal plain deposits.

East of Chesapeake Bay.—The northeasternmost exposures of the Magothy formation, which I have observed, are in the vicinity of Chesapeake City near the eastern terminus of the Chesapeake and Delaware canal. The cuts of the canal begin about two miles east of Chesapeake City and are in the marls and black sands of the Severn formation of which they afford a superb exposure. At the western end of these cuts and in several small stream depressions in the vicinity there are showings of the Magothy sands overlain by the black Severn beds. The sands are white, gray, and buff, streaked irregularly with light brown. The entire thickness of the formation was not observed in this region but in one exposure twenty feet of its sands were seen, capped by weathered, gray-brown Severn beds along an undulating plane of unconformity.

Between Chesapeake City and Bohemia Creek small exposures of Magothy beds are frequent in the deeper stream cuts. They are overlain directly by the Columbia gravels and loams westward, and the feather-edge of the Severn sands eastward.

On the south shore of Bohemia Creek near its mouth there is a long, high bluff in which the Magothy and adjacent formations are finely exposed. The basal beds are typical Potomac variegated clays, pink and red predominating, but in part buff and dark lead color. These clays extend to an altitude of about 30 feet at the western end of the bluff but this upper surface dips gently eastward and finally sinks below the water in about a mile. This upper surface is an undulating plane presenting no marked irregularities of contour and it is clearly a product of aqueous erosion. It is overlain by the Magothy sands which have a thickness varying from fifteen to twenty-five feet. These sands are mainly white or light gray but in places they are stained with buff and pinkish streakings. The materials are moderately coarse quartz grains quite uniform in size, rounded or subangular in greater part and lying loosely compacted in thin beds with but little cross-bedding. Near their base they sometimes contain a

small amount of clay fleckings and intermixture, derived from the subjacent clay formation, and discontinues streaks of limonite. Towards the western end of the bluffs they include two elongated lenses of tough, laminated, gray clay. The lower mass is near the base of the formation and is about six feet thick; the upper one is near the top and has a maximum thickness of three feet. These clay streaks merge into the adjoining sands, but the transition is quite abrupt at most points. Overlying the Magothy formation eastward is a thin wedge of weathered Severn sands separated by an east dipping erosion plane similar to the one below. The Severn beds attain a thickness of 15 feet at the eastern end of the bluffs but are cut out westward by an overlap of the overlying Columbia formation onto the Magothy beds. The Severn beds are dark gray, argillaceous, carbonaceous, fine, laminated sands with some portions less argillaceous slightly glauconitic, more massive and lighter gray in color with buff mottlings. They are sharply contrasted from the Magothy beds and even without the separating unconformity could never be classed with them. The Columbia capping on these bluffs has a thickness of from four to seven feet. It consists of a basal bed of pebbles, bowlders and slabs with local beds of conglomerate and an upper bed of red-brown to buff, columnar loam with a few scattered pebbles.

The next notable Magothy exposures southward are in the long high bluffs extending north from Grove Point. Towards the point the bluffs are of Severn beds overlain by Columbia deposits both superbly exposed.* About 1000 yards north of the point the Magothy formation comes up on a low southern dip and soon attains prominence in the bluffs in which it continues to the end. The formation consists of coarse, loosely compacted, cross-bedded gray sands with irregular masses and streaks of brown sandstone and sandy limonite. The erosion plane separating the Severn formation is well exposed and is seen to be less regular in contour than usual. The ferrugination of the Magothy beds is here very irregular and predominates near the summit. Below are many scattered masses consisting of reticulated plates and tubes of sandy limonite, some of which are several feet in length and as much as a yard in thickness.

On the peninsula between Elk River and the head of Chesapeake Bay there is a high ridge on which there remains an outlier of Magothy with overlying Severn formation constitut-

* Detailed descriptions of the Columbia formation in these and many other bluffs in this region are given by McGee in a memoir on "The Geology of the head of Chesapeake Bay. U. S. Geol. Survey, Seventh annual report of the Director, pp. 537–646, pls. 1888.

ing two local eminences known as Maulden Mountain and Bull Mountain. The western sides of these so-called mountains are cut by the bay giving rise to very prominent bare bluffs 120 to 130 feet in height, in which the Potomac and Magothy formations are well exposed. The Potomac beds in this region are the typical variegated clays in which pink and buff colors predominate but some reds and purples also occur. In the upper part of the Potomac here there is a local bed of white sand with more or less pink clay admixture which extends for some distance along the bluff. The Magothy beds lie on the usual erosion plane and are distinct from the Potomac sands and clays below. They consist mainly of coarse, loose, pure sands, regularly bedded except at a few points where cross-bedding was observed. Several thin, local streaks of clay are included and many large masses of brown sandstone. Loose masses of this sandstone, in part pebbly, are prominent in sandy areas between the higher portions of the ridge. The Severn outliers are of weathered beds, consisting of dark gray, fine, argillaceous sands below and more arenaceous, gray buff members above, attaining in all a thickness of about forty feet. Their entire separateness from the Magothy beds is exhibited in several exposures. The higher summits about Maulden Mountain are from 150 to 180 feet above tide level, and are capped by outliers of Columbia of the high level series.

The high bluffs along the south shore of the Sassafras River near its mouth, expose the Severn beds in great force. Approaching Howell's Point the gentle southeast dip brings up the Magothy beds which soon displace the Severn formation, and extend westward nearly to the Point. They are the usual moderately coarse sands but vary in color from pink to flesh colored in greater part, with light brown streakings locally. Their thickness is about twenty-five feet. They are loosely bedded, with some cross-bedding. The underlying Potomac beds come up in turn about 600 yards west of the first appearance of the Magothy beds and the two formations continue to the end of the bluffs, a short distance westward. The Potomac beds are typical variegated clays comprising white, buff, pink, red, and dark lead colors. Their surface is quite uneven and the clays are separated from the Magothy sands by a thin, interrupted, layer of impure limonite and coarse sand with a few scattered quartz pebbles. The bluff is capped with Columbia members which constitute about two-thirds of its height.

Howell's Point is a tide marsh area, but a short distance south the bluffs again extend to the bay shore and thence continue to Still Pond. The Columbia formation extends down to tide level for considerable distances in these bluffs but the upper part of the Magothy beds is well exposed in the

intervals. The formation consists of the usual coarse, loosely bedded sands generally white but in places stained buff or pinkish. Several short thin streaks of light colored clays occur and a few thin, discontinuous layers of ironstone. In the base of the overlying Columbia are several masses of coarse brown sandstones and conglomerate but they are sharply separated from the Magothy beds. Near the entrance to Still Pond a change of trend in the bluffs to southeast, carries them into the Severn belt, bringing in Severn beds between the Columbia and Magothy formations. In the next half mile the dip carries the Magothy formation below tide level and soon after, the Columbia deposits come down to the base of the bluff. The Severn beds in the exposure are weathered at their base to gray and lead colored clays with sandy layers; an unusual character. Higher up they are the typical black argillaceous, carbonaceous sands, covered superficially with green and gray sulphurous incrustations from decomposing pyrite, a common feature at this region. Their relations to the Magothy beds are particularly well exposed here and the gently undulating erosion plane extends along the bluff in plain view for a considerable distance. At their southeasternmost exposure in the bluff the Magothy sands are steeply crossbedded, some of the bedding planes having an inclination of 25°.

South of Still Pond there are no notable exposures of Magothy beds, the prominent bluff on Worton Point lying west of their outcrop belt and exposing only Potomac and Columbia deposits.

Magothy River region.—The Magothy formation appears first on the western shore of Chesapeake Bay on the bay shore 1½ miles south of Bodkin Point. The exposure is in a low bluff and consists of an irregular mass of brown sandstone in buff sands in all about fifteen feet thick of which the greater part is sandstone. It is underlain by typical yellow and pink Potomac clays along an irregular plane and dips below weathered, but unmistakeable Severn beds exposed a short distance south but not in contact.

On the north side of the Magothy River the formation and its relations are well exposed in a small side inlet, Broad Creek, about three miles above the mouth of the river. To the east on Gibson, and Dobbin islands and in the adjoining higher lands notably Eagle Hill the Severn beds are extensively exposed with all their usual characteristics. To the west up the river the underlying Potomac clays and sands comes out. In the inlet above referred to the contact with the Potomac formation is exhibited in a long low bank and the line of unconformity is seen to be unusually irregularly and strikingly distinct. The Magothy beds are the usual coarse gray, loosely

bedded sands containing more or less brown sandstone. The Potomac formation here is a densely packed, moderately fine, "sharp" sand with more or less disseminated clay particles, a member which is first seen in this vicinity and extends for about twenty miles southwestward. This Potomac member merits some special description here on account of its unusual characters, relations to the Magothy formation and some misapprehensions which exist regarding it. Its sands grade into and give place to white and pink sandy clays at some localities but they are usually characterized by their purity and extreme compactness. At some points they are lithified in greater or less part into white or gray sandstones or quartzites, and less frequently brown sandstone. This sandstone constitutes the "White Rocks" out in the Patapsco River near its mouth and there are a number of other occurrences of it. This arenaceous Potomac member is, I suppose, the upper part of the "Albirupean formation" of Uhler, but as it grades into typical Potomac clays and sands and is unquestionably not separated by any stratigraphic break I see no grounds for its separation as a distinct formation.*

On the neck between the Magothy and Patapsco Rivers the sands and brown sandstones of the Magothy formation extend inland for several miles covering the higher areas and capping several small outlying knobs.

Severn River region.—In the bluffs along the north shore of the Severn River at Round Bay and for some distance above, the Magothy formation and its relations are finely exposed. Just south of the Round Bay hotel there is a bluff which with the steep slopes above expose 140 feet of beds from the top of the Magothy some distance up into the Pamunkey formation. The Pamunkey beds here are weathered to brown, buff and red sands with ferruginated masses, containing Eocene fossils. Lying unconformably below the Pamunkey formation are 90 to 100 feet of the black micaceous, argillaceous and carbonaceous sands of the Severn formation. Near the base of the bluff the base of the Severn beds is exposed for several yards lying unconformably on very coarse, white Magothy sands along an east-dipping plane extending to a few feet above water level.

In the next five hundred yards west these sands rise rapidly and some low bluffs exhibit a thickness of twelve feet with a

* The term Albirupean was proposed by P. R. Uhler in 1888 to the American Philosophical Society (see Proceedings, vol. xxv, page 42). The fossils exhibited and reputed to have been obtained from the "Albirupean" were shown by Heilprin and Lewis to be of Upper Silurian age and were probably fragments from the Columbia formation. Its taxonomy was never clearly defined and its author now includes under the name the greater part of the upper Potomac formation of Maryland, all the sand lenses in the Potomac from top to bottom, apparently, and I take it, the great Potomac series in Virginia.

thin capping of weathered Severn beds. The coarseness of the upper part of the Magothy is not so pronounced in this exposure and the sands for some distance below are of the usual moderately coarse, loosely bedded type. Near their base, thin, interbedded carbonaceous layers gradually come in and finally form an irregular lignitic layer with white sand streaks. Below this are irregular layers of brown sandstone two or three feet thick exposed along the beach.

In the next bluff up the river, Potomac, Magothy and Severn beds are exposed in a section thirty feet in height. The Severn caps the bluff to a thickness of from six to nine feet and consists of fine, argillaceous sands weathered to a gray-buff color. They lie on a very even but clearly defined erosion plane exposed for nearly a hundred feet along the bluff. The Magothy beds average twenty feet in thickness but are several feet thicker at several points. They consist of regularly bedded, loosely compacted, gray sands with light buff streaks and blotchings containing thin streaks of brown sandstone above, and large masses of brown sandstone below. They lie on a very uneven surface of the densely packed sands and clays which as before stated characterizes the upper part of the Potomac formation in this region. One of the most notable irregularities of this surface is an old channel four or five feet in depth in which the Magothy beds come down nearly to water level. The Potomac deposits lying next below the Magothy formation are very densely packed, gray sands, in part lithified. They also contain a short streak of carbonaceous materials. Below, they give place abruptly to a series of lenses of very tough pearl-gray sulphurous clay with sulphur crusts on its surface. Underlying this clay are several masses of sandstone which outcrop at the base of the bluff. A person unfamiliar with the complicated stratigraphic relations in the coastal plain formation would be puzzled by this exposure with its several exceptional features in the Potomac formation, and their apparent unconformities, and by the two horizons of brown sandstones.

Ascending the river the dip brings up in succession lower and lower beds which exhibit very plainly the true general relations. There are several bluffs on the north shore exposing the very compact sands and clays of the Potomac, unconformably overlain by the loosely bedded coarse, white Magothy sands here constituting the surface formation. In a bluff about a mile and a half above Round Bay the Potomac beds attain an elevation of twenty-two feet and are overlain by from eight to ten feet of Magothy sands. This exposure is the key to the horizon of the compact sands and gray sulphurous clays for they are finely exhibited, *grading* laterally and downward into looser white

sands with streaks of red and pink clay of the usual Potomac type. A short way west these sands are exceptionally pure and they are quarried for use in the arts but in the western part of the quarries and beyond they are seen to grade into variegated sandy clays and then pure clays of typical Potomac character. There can be no doubt of the Potomac age of these compact sands and clays lying immediately below the Magothy formation in the district.

North of the Severn River in this region the Magothy gray and buff sands with brown sandstone fragments cap the higher summits over a considerable area and at many points are seen lying on Potomac clays westward and the compact sand and clay member eastward. The northwesternmost Magothy exposure is a brown sandstone cap on a very small, shaly elevated knob a mile east by south from Severn station.

On the south side of the Severn River the banks are lower and present no notable Magothy exposures. In the slopes south ascending westward nearly to Odenton there are frequent outcrops in which are seen gray and buff sands with brown sandstone masses. They lie on a gentle undulating plane of unconformity with local irregularities, and dip southeastward at the usual rate of about thirty feet per mile.

Odenton Region.—In the hills east of Odenton the Magothy beds attain an elevation of 220 feet and cap the higher lands over an irregular area of considerable extent. They are overlain by several small outlying areas of weathered Severn beds westward and the northwestern edge of this formation extends along the eastern slopes of the Magothy hills.

In the southwestern extension of the Magothy formation the light colored sands give place to darker colored and coarser sediments in which brown sandstones, gravels and conglomerates prevail. The gravels are most conspicuous a mile and a half east of Odenton in the cuts of the Annapolis railroad, and on the adjoining hills. The relation to the Severn sands is plainly exposed in these cuts and at several points in stream and road cuts in their vicinity and southwestward. The gravels are more or less cemented into a loose conglomerate and intermixed with sand and brown sandstone. The aggregate thickness is variable but it amounts to 23 feet in the railroad cuts. Two and a half miles southeast of here towards Millersville in the cuts for the Drum Point railroad a somewhat greater thickness is seen of buff sand, and brown sandstone, in part sparingly pebbly. Typical Potomac clays and sands are exposed underlying the Magothy formation at many points in the Odenton region and the usual unconformity is always very distinct.

Patuxent River region.—South of Odenton the Magothy formation gradually thins but it extends to some distance beyond the Patuxent River before terminating.

In the ridge just east of Bowie and again on the ridge between the two forks of the Patuxent there are outliers of Magothy brown sandstones in turn capped by small areas of weathered Severn beds. The Potomac formation in the adjacent slopes are typical variegated clays in greater part, but there are also lenses of compact gray sands locally silicified to white quartzites.

The southwestern termination of the Magothy formation is not clearly exposed and the outcrops along the Patuxent are obscure. In the hills southwest of Bowie the Severn beds lie directly on Potomac clays and are themselves cut out at intervals westward by Pamunkey beds as far south as Washington.

The thinning may be due to an actual decrease in thickness of the original deposit or an overlap of its shore lines by a later formation, but it appears to have resulted from an increase southward of the erosion to which its surface was subjected in the interval preceding Severn deposition.

Original extent and thickness.—How far south the Magothy formation may have extended is not known, and as its surface has been eroded the original thickness is not determinable. The location of the northwestern shore line of the formation is not defined but it was probably very near the gravelly deposits extending from Bowie to beyond Odenton.

Definition.—The Magothy formation is a thin series of arenaceous deposits lying between the Potomac and Severn formations and separated from both by erosional unconformity and great dissimilarity of character. There are local unconformities at various horizons in the Potomac formation at the base of some of its sand lenses but these unconformities are due solely to current action and exist only within a restricted area. I have studied many of these Potomac sand lenses and found the sands grading laterally into clays or clays and sands and these merging downward across the horizon of unconformity into clays below. The unconformity at the base of the Magothy formation is clearly not of this character nor is the break at its summit, but both are in every way similar to the erosion planes which bound all the other members of the Coastal plain series.

The age and equivalence of Magothy formation is not known with any degree of precision but its stratigraphic position places it in the early Cretaceous. It contains plant remains at several localities notably in the lignitic members on

the Severn River at Round Bay, but they have not been studied.

The formation is not divisible into individual members, for the variations in character which it presents are local features not characterizing definite horizons.

Synonomy.—The Magothy formation has never before been discriminated or at least with any degree of definiteness. Mr. P. R. Uhler in his several papers* has referred more or less definitely to some of its features at several localities but he does not set forth its true relations. He has separated a member, which he terms "alternate sand series" beginning somewhere at this horizon and extending up into the Severn formation, but its definition is so vague and moreover so variable in each succeeding publication of his that the name cannot be adopted without confusion.

Economic geology.—The Magothy formation has not as yet yielded any great amount of economic products. Its sandstone members have been employed locally to some extent as building stone and its gravels are used for railroad ballast. Some portions of its sands are, I believe, sufficiently pure for use in the arts notably on the Magothy River and at several points on the bay shore south of Howell's Point.

History.—The Magothy formation is a product of littoral deposition following the uplift and erosion of the Potomac deposits. It represents a time when currents and beach action were sufficiently active to sort out moderately coarse sands and spread them in beds, regular where the currents were gentle, and crossed where currents were more powerful. A few thin lenses of clay indicate that slack waters existed locally and the gravels westward indicate proximity to a shore line. The materials were probably all derived from the Potomac formation and the shore line was located within the Potomac area throughout. The far eastward extension of the Magothy beds now deeply buried below the Severn deposits, undoubtedly consists of the finer sands and clays which were carried farther off shore before being deposited.

Magothy deposition was succeeded by a general uplift and erosion interval during which the surface of the Magothy deposit was planed off in greater or less measure and degradation of the Potomac surface westward was continued. This epoch was followed by Severn deposition.

* Maryland Acad. Sci. Trans., vol. i, 1888–1892.