

Chesapecten, a New Genus of Pectinidae
(Mollusca: Bivalvia) From the Miocene
and Pliocene of Eastern North America

GEOLOGICAL SURVEY PROFESSIONAL PAPER 861



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By LAUCK W. WARD and BLAKE W. BLACKWELDER

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*A study of a stratigraphically important
group of Pectinidae with recognition of
the earliest described and figured
American fossil*



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**CHESAPECTEN, A NEW GENUS OF PECTINIDAE
(MOLLUSCA: BIVALVIA) FROM THE MIOCENE AND PLIOCENE
OF EASTERN NORTH AMERICA**

By LAUCK W. WARD and BLAKE W. BLACKWELDER

ABSTRACT

The genus *Chesapecten* (type species, *Chesapecten nefrens* Ward and Blackwelder n. sp.) is proposed for an important group of eastern North American Pectinidae. *Chesapecten* species are distinguished by their strong ribbing, their large size (adults often longer than 130 mm), the extreme reduction of cardinal crura, and the scabrous sculpture which covers the entire exterior of both valves. Included in *Chesapecten* are the species *Pecten* (*Chlamys*) *coccymelus* Dall 1898, *Chesapecten nefrens* Ward and Blackwelder n. sp., *Chlamys* (*Lyropecten*) *santamaria* Tucker 1934, *Pecten* (*Chlamys*) *santamaria middlesexensis* Mansfield 1936, *Pecten jeffersonius* Say 1824, *Pecten septenarius* Say 1824, and *Pecten madisonius* Say 1824. Type specimens of these species are illustrated, including Say's specimens from the British Museum. Say's 1824 publication entitled "An account of the fossil shells of Maryland" is shown to be based primarily upon specimens from the Yorktown Formation in Virginia. *Pecten madisonius* is regarded as a senior synonym of the North Carolina and Virginia upper Yorktown species, *Pecten edgecombensis* Conrad 1862. In 1687 one member of the *Chesapecten* group was described and figured by Martin Lister in his "Historiae Conchyliorum, Liber III" (pl. 167); this *Chesapecten* is the earliest illustrated and described American fossil.

INTRODUCTION

A distinctive morphological complex of pectinid species occurs in Miocene and Pliocene deposits of the Atlantic Coastal Plain; the name *Chesapecten* is proposed for these forms. The genus is distinguished from other taxa in that its right valve is flatter than the left, the cardinal crura are extremely reduced, and the entire exterior of the valves is covered with strong ribs and rows of scabrous lirae. *Chesapecten* lived with the flatter right valve resting on the sediment in water depths of a few meters to depths of more than 40 m (according to the biologic and lithologic characteristics of the deposits). The oldest species assigned to *Chesapecten* are found near the lower Miocene-middle Miocene boundary; in the upper part of the lower Pliocene (3 to 4 million years ago), *Chesapecten* apparently became extinct.

Miocene and Pliocene marine deposits are exposed discontinuously from New Jersey to Florida in the Atlantic Coastal Plain. Historically, formational names applied to these deposits more often than not have been chosen on the basis of the contained invertebrate fauna and not strictly upon lithostratigraphic evidence. That is, formational names have been extended from type areas faunally rather than lithically. This has been a common procedure at one time or another virtually throughout the Atlantic and Gulf Coastal provinces, but the practice has lingered in the Atlantic Coastal Plain (Waller, 1969, p. 90-91; Murray, 1961).

A comparison of the correlation charts of Olsson (1917), Clark and Miller (1912), and Mansfield (1928, 1936, and 1943) indicates the difficulties involved in using present formational terminology in the study area (chiefly Maryland, Virginia, and North Carolina). A particular problem is the St. Marys Formation of Virginia. Mansfield (1936) considered part of his St. Marys Formation in Virginia to be the same age as the St. Marys Formation (of Shattuck, 1904) in Maryland and part to be younger. A very few localities in Virginia do contain beds which correlate with the St. Marys Formation of Maryland, but Mansfield did not recognize these beds as distinct from the rest of his formation, which is younger and separated from these beds by an unconformity. Pending revision of formational terminology, we use "Virginia St. Marys Formation" as an informal name for beds entirely younger than the St. Marys Formation of Shattuck. Within this Virginia St. Marys Formation we recognize upper and lower units which are separated by a distinct unconformity (as seen at Cobham Wharf, Va., at 5 feet (1.5 m) above beach level (fig. 1, loc. 42). Caution is called for when using a formational name in Virginia because most workers have been inconsistent in their application of names. Consequently, in this paper strati-

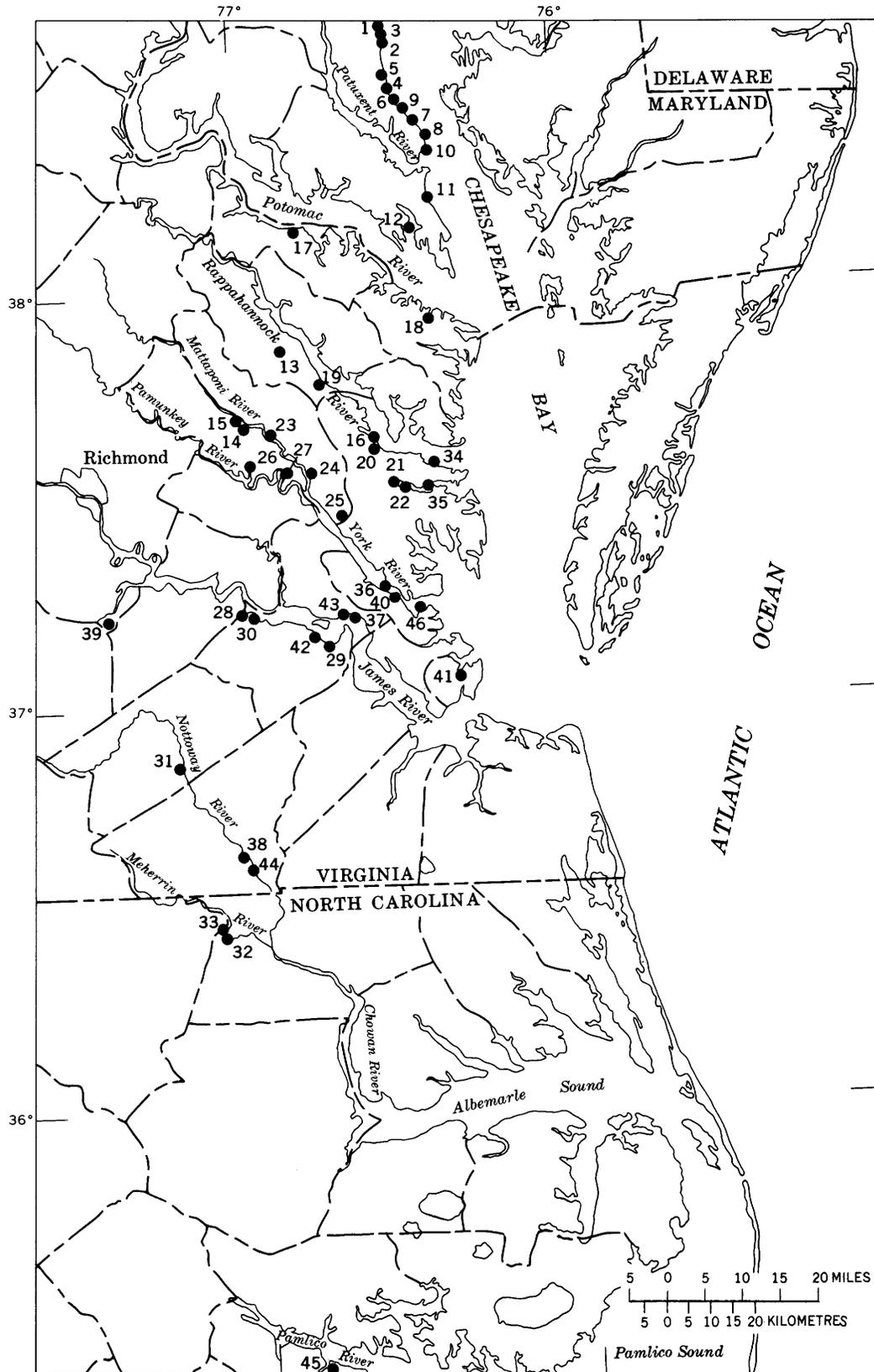


FIGURE 1.—Localities where specimens of *Chesapeake* were obtained in Virginia, Maryland, and North Carolina. Numbers keyed to the locality register.

graphic names are intended to be applied only to the beds at localities discussed under "Occurrence" in the systematic section. Figure 1 shows localities where specimens were obtained in our sampling area. Numbers in the figure are keyed to the locality register. In addition, the locality register also contains numbers for localities which have been recorded in the U.S. Geological Survey Cenozoic Locality Register. Figured specimens which have been collected by the writers have received U.S. National Museum numbers (USNM) and have been placed in collections of the National Museum. *Chesapecten* occurrences outside the principal study area are noted from other National Museum collections and are mentioned in the discussion on "Occurrence" in the systematic section.

Chesapecten is found abundantly within formations belonging to the Chesapeake Group. These formations include the Calvert and Choptank Formations (of Shattuck, 1904) as seen in Maryland, the St. Marys Formation (of Shattuck, 1904) in Maryland and northern Virginia, the lower and upper Virginia St. Marys Formation (of Mansfield (in part), 1936) in Virginia and North Carolina, and the lower and upper Yorktown Formation (of Mansfield, 1936) in Virginia and North Carolina. *Chesapecten* is not often found in age-equivalent deposits elsewhere in the coastal plain. However, localities from New Jersey to Florida where it does occur are noted in the systematic section under occurrences.

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SUMMARY OF PAST WORK

Most workers have placed the species here assigned to *Chesapecten* in the genus *Lyropecten* of Conrad (1863). *Lyropecten*, an eastern Pacific genus, is a similar but distinct early Miocene to Holocene genus possessing prominent cardinal crura; in *Chesapecten* the cardinal crura are ex-

tremely reduced. Such differences had been previously recognized by Mansfield (1936) and by Hertlein and Grant (1972).

Description of the different species of *Chesapecten* has had a long and complex history. In 1687 one member of the *Chesapecten* group was described and figured, but not named, by Martin Lister in his "Historiae Conchyliorum, Liber III" (pl. 167). With the figured specimen is the notation "A virg Ind Occ." The original label on the specimen probably read "a virg" and was wrongly construed by Lister to mean Virgin Islands (hence the "Ind Occ" meaning Indies Occidentale or West Indies). In 1824, Thomas Say, an American naturalist at the Philadelphia Academy of Science, recognized that Lister's plate 167 was intended to represent an American Atlantic Coast Tertiary bivalve species; Say (1824, p. 133-134, pl. 9, fig. 1) named this species *Pecten jeffersonius*. Thus, the source of Lister's specimen is thought to be the United States, specifically Virginia; there is no record of such a pectinid, fossil or living, from the Virgin Islands.

Also, another fossil figured by Lister (1688), no locality or description given, is apparently a specimen of the distinctive bivalve *Mercenaria tri-dacnoides* (Lamarck, 1818), which commonly occurs in the same general area as *Chesapecten jeffersonius* in southeastern Virginia.

Lister's description of *C. jeffersonius* preceded his illustration of another fossil said to be from Maryland. This taxon, the gastropod *Ecphora*, has generally been considered the first figured American fossil (Shattuck, 1904; Vokes, 1957). However, the figure of *Ecphora* was published in an appendix to "Historiae Conchyliorum" in 1692 and not the date 1685 cited by others. It seems clear, therefore, that the earliest illustrated and described American fossil is the species later named *Chesapecten jeffersonius* (Say, 1824) from the Yorktown Formation (lower Pliocene) of Virginia. A translation of Lister's original description is included in the systematic section along with notes written by Lister in a copy of his work. Lister's original figure is shown on our plate 1.

In addition to *Pecten jeffersonius*, Thomas Say (1824) also described two other species, here placed in *Chesapecten*. Most of the fossils described by Say at this time had been loaned to him by John Finch, a Scottish visitor to the United States. These fossils were mistakenly attributed by Say to Miocene deposits on the St. Marys River, Md. It is apparent from Say's descriptions, illustrations, and

material that he had no Maryland collections in his possession at the Philadelphia Academy at this time. Finch's description (1833) of his own travels in America indicates that he probably shipped all the Maryland material he collected directly to England from one of the ports in Virginia. The materials which Say examined at the Philadelphia Academy of Sciences were probably collected on Finch's visit to the James River near City Point and the York River at Yorktown (Finch, 1833, p. 266-275). The mollusks are all indicative of the Yorktown Formation of southeastern Virginia and northern North Carolina. The three *Chesapecten* species which Say described are all valid and all known to occur in southeastern Virginia (*Chesapecten jeffersonius*, *C. septenarius*, and *C. madisonius*). Maryland specimens of *Chesapecten* which have been referred to *C. madisonius* by many authors are not this species, but represent an unnamed species described in this paper as *Chesapecten nefrens*.

STRATIGRAPHIC SUCCESSION OF *CHESAPECTEN*

Table 1 lists the previously named species here assigned to *Chesapecten*. Their stratigraphic succession is given in table 2 and is shown in figure 2.

TABLE 1.—*Specific and subspecific names applied to Miocene and Pliocene species of Chesapecten*

Previous names	This study
<i>septenarius</i> Say, 1824	unchanged, locality not Maryland
<i>madisonius</i> Say, 1824 [not Conrad, 1840; Glenn, 1904; Mansfield, 1936; Tucker-Roland, 1938, Schoonover, 1941; Gardner, 1943]	unchanged, locality not Maryland
<i>jeffersonius</i> Say, 1824	unchanged, locality not Maryland
<i>madisonius</i> (of Conrad, 1840, p. 48, pl. 24, fig. 1; Glenn, 1904, p. 377, pl. C, fig. 1; Gardner, 1943, pl. 4, fig. 5)	<i>nefrens</i> , new species
<i>edgecombensis</i> Conrad, 1862, and others	<i>madisonius</i> Say, 1824
<i>sayanus</i> Dall, 1898	unchanged
<i>coccymelus</i> Dall, 1898	redefined
<i>santamaria</i> Tucker, 1934	unchanged
<i>santamaria middlesexensis</i> Mansfield, 1936	<i>middlesexensis</i> (Mansfield)
<i>jeffersonius palmyraensis</i> Mansfield, 1936	<i>septenarius</i> Say
<i>madisonius bassleri</i> Tucker-Roland, 1938	<i>coccymelus</i> Dall

TABLE 2.—*Stratigraphic succession of different species of Chesapecten in Maryland and Virginia*

	<i>C. coccymelus</i>	<i>C. sp.</i> ¹	<i>C. nefrens</i>	<i>C. nefrens-C. santamaria</i> (transitional form)	<i>C. santamaria</i>	<i>C. middlesexensis</i>	<i>C. jeffersonius</i>	<i>C. septenarius</i>	<i>C. madisonius</i>
Zone 2 ² Yorktown Formation	--	--	--	--	--	--	--	×	×
Zone 1 ² Yorktown Formation	--	--	--	--	--	--	×	--	--
"upper Virginia St. Marys Formation	--	--	--	--	--	×	--	--	--
"lower Virginia St. Marys Formation	--	--	--	--	--	×	--	--	--
St. Marys Formation, Windmill Point, Md	--	--	--	--	×	--	--	--	--
St. Marys Formation, Langley Bluff, Md	--	--	--	×	--	--	--	--	--
St. Marys Formation, Little Cove Point, Md	--	--	×	--	--	--	--	--	--
Choptank Formation Zone 20 ³	--	--	×	--	--	--	--	--	--
Choptank Formation Zone 19 ³	--	--	×	--	--	--	--	--	--
Choptank Formation Zone 18 ³	--	--	×	--	--	--	--	--	--
Choptank Formation Zone 17 ³	--	--	×	--	--	--	--	--	--
Choptank Formation Zone 16 ³	--	--	×	--	--	--	--	--	--
Calvert Formation Zone 14 ³	--	--	×	--	--	--	--	--	--
Calvert Formation Zone 10 ³	×	×	--	--	--	--	--	--	--

¹ Schoonover, 1941, pl. 5, fig. 1.

² Mansfield, 1943.

³ Shattuck, 1904.

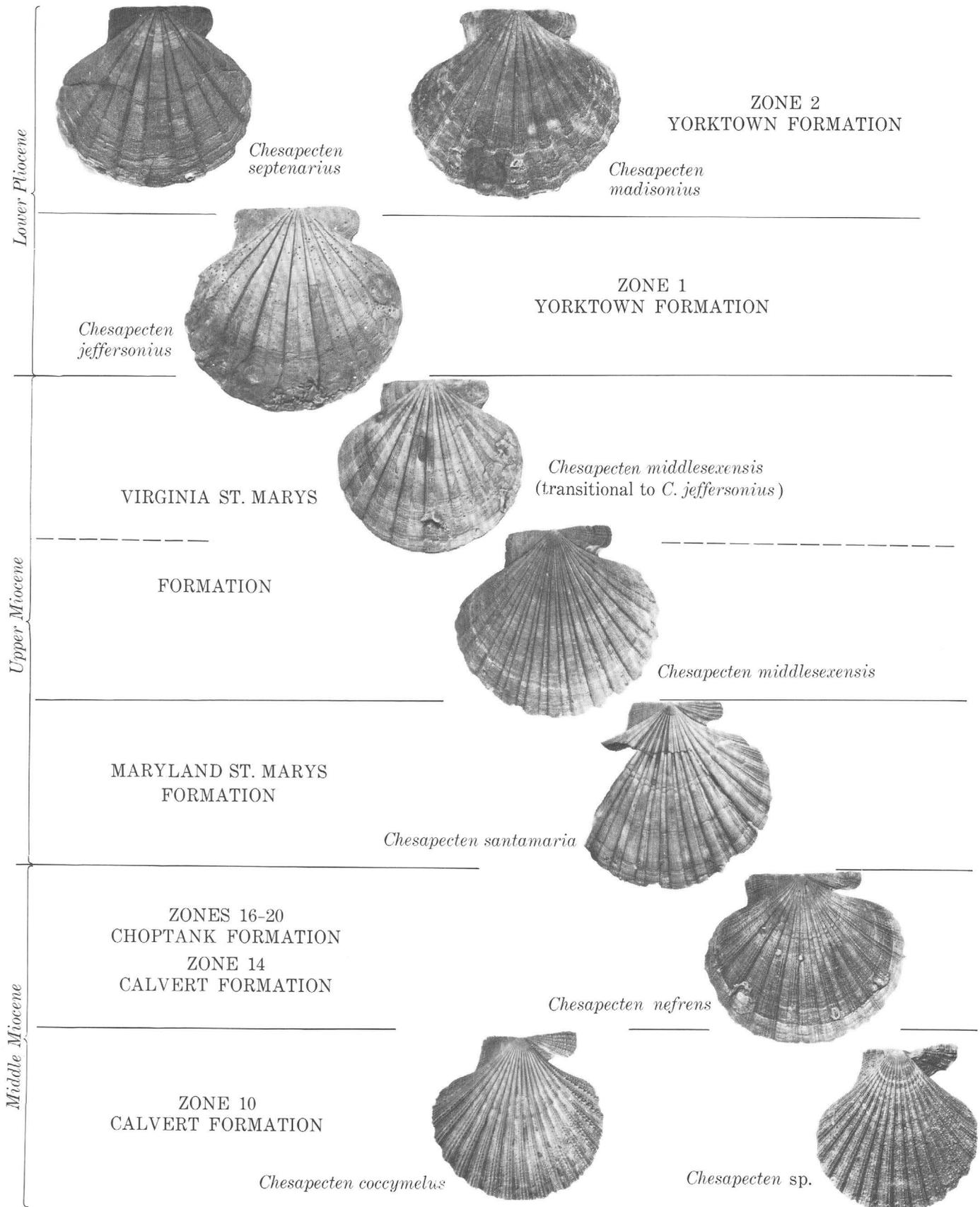


FIGURE 2.—Stratigraphic succession of *Chesapeake*.

As indicated on table 2, species ranges seldom extend across important stratigraphic breaks. Near these stratigraphic breaks some transitional forms do appear within populations containing specimens morphologically more typical of the species as a whole. However, no distinct morphological discontinuities appear to exist until stratigraphic breaks. For these reasons *Chesapecten* is an important stratigraphic guide in the Chesapeake Group and possibly elsewhere. Reference localities of particular species occurrences are listed in the systematic section.

Eocene, Oligocene, and earliest Miocene pectinids are small in size and differ from *Chesapecten* in the nature of the exterior sculpture and auricles. Apparently the first species of *Chesapecten* occur in the lower part of the middle Miocene Calvert Formation (Zone 10 of Shattuck, 1904). This interval (Zone 10) has been placed near the lower and middle Miocene boundary (Zones 8 and 9 of Berggren, 1972) on the basis of planktonic foraminifers (Gibson, 1971). This early species is *Chesapecten coccymelus* (Dall, 1898), a relatively small pecten with quite scaly sculpture. Occurring with *C. coccymelus* is a similar but as yet poorly understood species which lacks the pronounced scaliness. These two early species are succeeded by *Chesapecten nefrens* n. sp., which is herein designated the type species of the genus. *Chesapecten nefrens* is found in the Calvert Formation and in the middle Miocene Choptank Formation (Zones 14 to 20 of Shattuck, 1904) of Maryland. A younger form, possibly a subspecies of *Chesapecten nefrens* also, occurs in the probable upper Miocene St. Marys Formation at Little Cove Point (fig. 1, loc. 10).

Chesapecten santamaria (Tucker, 1934) is apparently derived from *C. nefrens*; it is similar in valve outline, convexity, nature of byssal notch, valve gape, coarseness of ctenolium, depressed broad byssal fasciole, number of ribs, shell thickness, and size, but differs in its finer, more uniform scabrous sculpture, its broader, flatter ribs, and its smaller hinge area. The earliest *C. santamaria* is represented by a morphologically intermediate form found at the well-known Langleys Bluff collecting site (fig. 1, loc. 11) in the St. Marys Formation, Maryland. *Chesapecten santamaria* occurs in the Miocene St. Marys Formation in Maryland at Windmill Point (loc. 12), St. Marys River, and at a number of localities in Virginia. As previously mentioned, beds in Virginia which have been termed part of the St. Marys Formation are altogether younger (probably of latest Miocene age)

than that part of the St. Marys Formation in which *C. santamaria* is found. This age relationship is clear, according to our present investigations, from both the nature of the physical stratigraphy and the nature of the molluscan assemblages. In this paper these younger parts of the St. Marys are informally referred to as the "lower Virginia St. Marys Formation" and "upper Virginia St. Marys Formation."

Chesapecten middlesexensis (Mansfield, 1936) occurs in both the lower and the upper Virginia St. Marys Formation. It is also reported from the Red Bay Formation of Florida (Druid Wilson, U.S. Geological Survey, oral commun., 1973). It is a distinct species from *C. santamaria* and can be recognized by its greater inflation, wider auricles, shallower byssal notch, and heavier valves.

In the upper beds of the Virginia St. Marys Formation are forms gradational between *C. middlesexensis* and its evolutionary successor, *C. jeffersonius* (Say, 1824), which has more inflated valves, a very shallow byssal notch, and a very heavy shell. *Chesapecten jeffersonius* is confined to Zone 1 of Mansfield (1943) in the Yorktown Formation. This species has been found as far north as New Jersey (in shallow dredging) and occurs in parts of the Tamiami Formation in Florida.

Chesapecten madisonius (Say, 1824) and *Chesapecten septenarius* (Say, 1824) succeed *C. jeffersonius* and are found in Zone 2 (Mansfield, 1943) of the Yorktown Formation and in deposits as far south as southern Florida. *Chesapecten madisonius* differs from *C. jeffersonius* in being much less convex, and it has a much more profound sinus in the ear of the superior valve. The strength of the ribs is much reduced, and the ribs are obscured on the interior of the shell by thick layers of calcite. The whole surface is covered by scaly striae.

Chesapecten septenarius differs from *C. jeffersonius* in having fewer primary ribs; also, its ribs are broader and usually stronger. *Chesapecten septenarius* and *C. madisonius* represent the end or near end of the *Chesapecten* lineage; the group becomes extinct during late Yorktown time (upper part of the *Orionina vauhani* Zone of Hazel, 1971), or apparently about 3 to 4 million years ago (Akers, 1972; Berggren, 1972; Joseph Hazel, U.S. Geol. Survey, oral commun., 1974)

REMARKS

Chesapecten is an important genus in the Atlantic Coastal Plain, in both a stratigraphic and a historic sense. The fact that a proper generic status had not

been accorded this group and that only informal stratigraphic terminology is available for many of the units involved demonstrates the extreme need for competent biostratigraphic work in these Tertiary units.

The species recognized in this paper are the dominant *Chesapecten* in the Atlantic Coast Cenozoic. The species as presently defined are excellent stratigraphic guides to the major geologic events in the Chesapeake Group and can be easily recognized in the field. It is possible to determine finer taxonomic divisions within some species of the *Chesapecten* group, but from our observations it is thought that these forms should probably have sub-specific or informal rank. We have not named subspecies in this paper, feeling instead that such subdivision should be done as a separate study which would relate very small population variation to sediment parameters and to other physical and biological parameters; such a study is beyond the scope of the present paper. In certain species there appear to be transitional forms from one species to the next (as in *nefrens-santamaria*, *middlesexensis-jeffersonius*, and *jeffersonius-madisonius*). That is, in the later part of some species ranges, certain individuals possess morphological features which are more characteristic of the succeeding species. However, major morphologic discontinuities usually do not occur until stratigraphic unconformities. For these reasons, we feel that the presently available specific names provide a convenient and useful division of a partly gradational *Chesapecten* sequence and we prefer to recognize the intermediaries (found in the extremes of different species ranges) as transitional forms.

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA
Class BIVALVIA
Order PTERIOIDA
Superfamily PECTINACEA
Family PECTINIDAE Rafinesque, 1815
Subfamily CHLAMYDINAE Korobkov, 1960

Genus CHESAPECTEN Ward and Blackwelder, new genus

Type species.—*Chesapecten nefrens* Ward and Blackwelder, n. sp.

Diagnosis.—This genus is characterized by its generally large size, the extreme reduction of cardinal crura, the scabrous sculpture over the entire exterior of the valves, and the greater convexity of the left valve.

Description.—Valves of adults usually longer than high, large (often 120 mm or more in height), biconvex, with the left valve more inflated than the right.

Auricles well developed and approximately equal in length, byssal notch deep to shallow; auricular denticles present, posterior auricular denticles usually weak, trace of outer ligament broad, ctenolium present in juveniles but absent in adults of heavy-shelled species; byssal fasciole broad.

Plicae of right valve usually 10 to 16 in number, but as few as 4 and as many as 23 in different species; plicae and exterior sculpture usually equally strong on both valves; rows of scabrous lirae over entire exterior of the valves; width of plicae about equal to that of interspaces.

Resilial insertions deep, higher than long, bounded by raised protuberances in the right valve; in the left valve the resilial insertion extends into the interior on a platform for about a distance of one-third the height of the resilial insertion; in the right valve the extension is much reduced; cardinal crura obsolete; adductor insertions large with a distinct nonstriate part usually about half the size of the striate part.

Remarks and comparisons.—*Chesapecten* differs from *Chlamys* in having relatively few ribs; also, its ribs are usually heavy and not dichotomous. Adult *Chesapecten* are also usually longer than high. In *Chesapecten*, unlike *Macrochlamys* and *Lyropecten*, the cardinal crura are extremely reduced or absent. *Chesapecten* occurs in middle Miocene to lower Pliocene Atlantic Coastal Plain strata from New Jersey to Florida.

Many of the features which are used to characterize different groups within the Chlamydiae are not constant within *Chesapecten*. The byssal notch changes within the evolutionary history of the group, as do valve convexity and the nature of the free margins of the posterior auricles. Many of the changes are probably adaptations to an unattached sedentary life habit, like that of *Chesapecten jeffersonius*. Earlier members of this genus, such as *Chesapecten nefrens* (pl. 2), were lighter shelled, free swimming or byssally attached species.

Ontogenetic variation in *Chesapecten* may be described as follows:

1. The length to height ratio changes, with the juveniles tending to be higher than long or equidimensioned whereas adults are longer than high.
2. Auricular denticles diminish or disappear.
3. In *C. middlesexensis* and all succeeding species the byssal notch becomes reduced with age, while *C. nefrens* and *C. santamaria* tend to retain the byssal notch as adults.
4. Internal deposits of calcite increase with shell

size, especially in *C. middlesexensis* and all succeeding species.

5. Scaling may become divergent in adult forms, especially in *C. madisonius* and in *C. middlesexensis*.
6. In *C. jeffersonius* the smaller individuals have very square-shaped ribs, and these ribs become rounded as the shell becomes larger. This trend is carried on to some extent in all species.

The name *Chesapecten* is used for this group because the development of this genus is best seen in exposures in the Chesapeake Bay and in adjoining rivers.

***Chesapecten coccymelus* (Dall)**

Plate 3, figures 1, 2; plate 7, figures 14, 15

1898. *Pecten* (*Chlamys*) *coccymelus* Dall, p. 741-742, pl. 34, fig. 1.
1904. *Pecten* (*Chlamys*) *coccymelus* Dall. Glenn, p. 374-375, pl. 99, fig. 3.
1936. *Chlamys* (*Chlamys*) *coccymelus* (Dall). Rowland, p. 1007-1008, pl. 8, fig. 3, 4.
1938. *Chlamys* (*Lyropecten*) *madisonius bassleri* Tucker-Rowland, p. 13-14, pl. 5, fig. 1.

Original description.—Shell small, ovate, inflated, strongly sculptured, with unequal ears; disk with eighteen narrow, high, compressed ribs, with wider interspaces, which near the basal margin carry one or two very small radial threads; the backs of the ribs support numerous high, evenly spaced, distally guttered, small spines; in the interspaces only transverse sculpture of wavy incremental lines; submargins small, narrow, with fine, beaded radial threads, which in the left valve also extend over the ears; hinge-line short, the cardinal crura developed, sharply cross-striated; auricular crura present; interior of the disk fluted in harmony with the external ribs. Alt. 30, lat. 25, semidiam. 5 mm.

Diagnosis.—*Chesapecten coccymelus* is a small *Chesapecten*, usually less than 60 mm in height, having very high distally concave spines and unequal auricles, the anterior auricle being longer than the posterior.

Description.—Valves small, usually less than 60 mm in height, thin, suborbicular, biconvex, left valve inflated, right valve less inflated, small gapes present along ventral commissure owing to inexact match of opposing valves; small gapes between opposing disk flanks.

Auricles well developed, anterior auricle larger than posterior, auricular denticles weakly expressed and in contact when valves together; free margins

of posterior auricles flat in plane of commissure; byssal notch deep, ctenolium coarse, byssal fasciole broad and depressed.

Plicae of right valve number 15 to 19, each plica strongly sculptured with one to three rows of very high distally concave spines and with one to three rows of less elevated spines in the interspaces.

Trace of outer ligament relatively narrow, resilial insertion not deep, higher than long, extending into the interior for about one-third of its height in the left and right valves, auricular denticles reduced, cardinal crura reduced (especially in larger specimens), ribbing expressed over most of interior of shell; dorsal margin encroaching on ligament.

Illustrated specimens and measurements.—Holotype, USNM 87754 left valve from Plum Point, Md. (Calvert Formation) (USGS loc. 25294). Length 24.3 mm, height 30.2 mm, total length of auricles along line of ligament 14.2 mm, length of auricle anterior to center of resilial insertion 9.0 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 92°. Convexity of left valve 5.4 mm (pl. 3, fig. 1; pl. 7, fig. 15).

USNM 193440 left valve from 0.5 mile (0.8 km) below Camp Roosevelt, Md. (Zone 10, Calvert Formation) (USGS loc. 25295). Length 38.0 mm, height 39.2 mm, total length of auricles along line of ligament 25.0 mm, length of auricle anterior to center of resilial insertion 14.4 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 103°. Convexity of left valve 8.1 mm (pl. 3, fig. 2).

USNM 207692, right valve, (USGS loc. 25295), length of auricles along line of ligament 14.2 mm (pl. 7, fig. 14.).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten coccymelus* from map locality 3 (USGS loc. 25295) (see table 3 for explanation of the abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	57.4	58.1	34.5	19.6	110	9.4	16
2 -----	48.8	49.8	30.3	18.8	101	9.9	17
3 -----	45.8	46.7	27.0	16.1	102	8.1	15
4 -----	44.8	46.5	26.4	14.9	101	8.4	17
5 -----	43.5	44.8	25.3	15.7	102	7.2	17
6 -----	42.6	44.1	23.4	14.2	99	8.0	18
7 -----	41.6	41.6	25.2	14.3	106	7.3	17
8 -----	34.6	36.2	21.0	12.5	95	5.7	16
9 -----	30.3	31.9	19.5	12.1	96	5.1	17
10 -----	26.4	29.1	17.7	11.0	94	5.1	17
11 -----	22.0	24.7	15.1	8.8	90	3.2	15
12 -----	17.1	19.8	12.7	7.2	85	2.9	17

TABLE 3.—Morphological feature abbreviations used in measurement of specimens

LN	Length
HT	Height
LA	Total length of auricles along line of ligament
LAA	Length of auricle anterior to center of resilial insertion
ANG	Angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting edge of disk
CON	Convexity of valve
RIB	Number of ribs

Occurrence.—The type locality is the Calvert Formation, Plum Point, Md. Additional localities are Zone 10 (Shattuck, 1904) of the Calvert Formation from Randall Cliff (fig. 1, loc. 1; USGS loc. 25293) south to Plum Point (fig. 1, loc. 2, USGS loc. 25294).

Comparison and remarks.—*Chesapecten coccy-melus* differs from *C. nefrens* in its smaller size (average adults being only 40 to 50 mm long as opposed to 150 mm for *C. nefrens*), its rows of very high distally concave spines, and its unequal auricle size, the anterior auricle being longer than the posterior.

Dall's original specimen is an end member of a somewhat variable species. We have provided a new description which includes the more morphologically typical specimens of this species. A comparison of the holotype (pl. 3, fig. 1) and our specimen (pl. 3, fig. 2) shows that the number of rows of spines is a variable character. Contrary to Dall's original description, we consider the cardinal crura in this species to be reduced, especially in adult specimens. This species is common in Zone 10 of the Calvert Formation.

Mongin (1959) suggests that a new name, *calvertensis*, be applied to several species, including *C. bassleri* (Tucker-Rowland). The name *calvertensis* does not have priority and cannot be used. The species intended to be grouped under this name do not appear to be closely related.

Chesapecten nefrens Ward and Blackwelder, n. sp.

Plate 2, figures 4–6; plate 3, figures 4–7; plate 4, figures 1, 2; plate 7, figures 6, 13

1840. *Pecten Madisonius* Say. Conrad, p. 48, pl. 24, fig. 1.
 1863. *Pecten Madisonius* Say. Conrad, p. 581.
 1894. *Pecten Madisonius* Say. Whitfield, p. 30, pl. 4, fig. 5.
 1904. *Pecten (Chlamys) madisonius* Say. Glenn, p. 377, pl. C, fig. 1.
 1909. *Pecten (Chlamys) madisonius* Say. Grabau and Shimer, p. 502, fig. 673C.
 1936. *Pecten (Chlamys) madisonius* Say. Mansfield, p. 174, 176, 177, 184.
 1938. *Chlamys (Lyropecten) madisonia* (Say). Tucker-Rowland, p. 9–11, pl. 1, fig. 1, 2.
 1941. *Chlamys (Lyropecten) madisonius* (Say). Schoonover, p. 28–37, pl. 3, figs. 1–3; pl. 4, fig. 4; pl. 5, fig. 3.

1943. *Chlamys (Lyropecten) madisonia* (Say) Glenn. Gardner, p. 32, pl. 4, fig. 5; pl. 9, fig. 7.

1959. *Chlamys madisonia* (Say). Mongin, p. 309–314, pl. 26, figs. 1a–b.

Diagnosis.—*Chesapecten nefrens* is a large *Chesapecten* with large gapes between disk flanks and along the ventral commissure, nonuniform scabrous lirae, a pronounced byssal notch, unflattened ribs, and an only slightly convex right valve.

Description.—Valves large, adults often greater than 120 mm in height, suborbicular, biconvex, left valve strongly inflated, right valve very slightly inflated, most adults longer than high; gapes present along the ventral commissure owing to inexact match of opposing valves; very large gapes between opposing disk flanks.

Auricles well developed, subequal; auricular denticles present but not in contact when valves together. Free margins of posterior auricles flat and gaping in plane of commissure. Byssal notch deep, ctenolium coarse, but obscured in some adults; byssal fasciole broad, and very depressed.

Plicae of right valve usually number 13 to 16, each plicae bears three scabrous lirae; other lirae, less elevated than those upon the summits of the plicae, crowd the sides and interspaces.

Trace of outer ligament broad in adults, resilial insertion fairly deep, almost twice as high as long; resilial insertion extends into the interior for about one-third of its height in the left valve and slightly less in the right valve, posterior auricular denticles reduced, anterior auricular denticles moderately expressed, cardinal crura obsolete, pallial line weakly expressed; ribbing expressed over most of interior of shell. Adductor insertions large with distinct nonstriate portion less than half the size of the striate portion; dorsal margin often encroaches on ligament, gill suspensor insertion not impressed.

Illustrated specimens and measurements.—Holotype, USNM 199442 paired valves from Calvert County, Md., Chesapeake Bay Cliffs zone 19 (of Shattuck) at Camp Conoy 8 ft (2.5 m) above beach (USGS loc. 25299). Length 177.4 mm, height 158.8 mm, total length auricles along line of ligament 101.5 mm, length of auricle anterior to center of resilial insertion 46.8 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 128°. Convexity of left valve 40.7 mm. Convexity of right valve 27.6 mm (pl. 3, fig. 4–7).

Paratype, USNM 193443 paired valves from Calvert County, Md., Chesapeake Bay Cliffs Zone 19

at Camp Conoy at 8 ft (2.5 m) above beach (USGS loc. 25299). Length 134.3 mm, height 113.9 mm, total length auricles along line of ligament 73.2 mm, length of auricle anterior to center of resilial insertion 38.6 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk 131°. Convexity of left valve 30.8 mm. Convexity of right valve 12.4 mm (pl. 2, figs. 4-6; pl. 4, figs. 1, 2; pl. 7, figs. 6, 13).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten nefrens* from map locality 7 (USGS loc. 25299) (see table 3 for explanation of the abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	107.6	100.5	60.5	30.5	116	10.3	13
2 -----	106.8	96.2	62.4	31.4	122	9.7	14
3 -----	104.4	98.3	55.5	28.2	118	9.5	13
4 -----	67.0	62.7	39.2	23.8	113	7.2	14
5 -----	57.4	58.3	37.1	21.6	106	5.1	13
6 -----	55.7	52.3	36.3	18.9	109	8.0	13
7 -----	36.5	40.3	23.0	13.9	92	5.1	15
8 -----	32.4	31.6	20.5	12.0	105	4.1	12
9 -----	24.2	26.1	17.2	9.5	98	3.0	14

Occurrence.—The type locality is the Choptank Formation, Zone 19 (of Shattuck, 1904) at Camp Conoy, Calvert County, Md. (fig. 1, loc. 7; USGS loc. 25299). *Chesapecten nefrens* also occurs in the following Maryland middle Miocene zones of Shattuck:

Calvert Formation

Zone 14 from Camp Roosevelt (fig. 1, loc. 3) to Governor Run (fig. 1, loc. 4; USGS loc. 25296)

Choptank Formation

Zone 16 from Scientists' Cliffs (fig. 1, loc. 5; USGS loc. 25297) to Calvert Beach (fig. 1, loc. 6; USGS loc. 25298)

Zone 17 from Scientists' Cliffs to Camp Conoy (fig. 1, loc. 7)

Zone 18 from Scientists' Cliffs to Camp Conoy

Zone 19 from Scientists' Cliffs to Cove Point (fig. 1, loc. 8; USGS loc. 25306) (including loc. 9, USGS 25301).

A variety of this species also occurs in the St. Marys Formation at Cove Point, Md. (fig. 1, loc. 8; USGS loc. 25300).

Comparison and remarks.—*Chesapecten nefrens* differs from *C. santamaria* in having narrower, unflattened ribs, larger gapes between disk flanks, larger gapes along the ventral commissure, nonuniform scabrous lirae, and a larger byssal notch.

Most workers studying the Maryland Miocene

have referred to this species as *Pecten madisonius* of Thomas Say (1824). However, as previously mentioned, the specimens which Thomas Say examined did not come from Maryland but from the Yorktown Formation in southeastern Virginia. John Finch, who loaned Say most of the fossils that Say described in 1824, requested that three species of his collection that might prove to be new, should be dedicated to three particular men. Say does name three species: *Pecten jeffersonius*, *Pecten madisonius*, and *Pecten clintonius*. In his description of *P. madisonius*, however, Say mentions that his description was taken from specimens presented to the academy by a Mr. Watson. Whether there were other specimens in Finch's collection which were identical to those presented by Mr. Watson is not known. Specimens which must have come from the Virginia Yorktown Formation are found in Finch's collection and do fit the description given by Say. Watson evidently purchased his specimens at the sale of collections of one Professor Barton. In Barton's collection is a Virginia specimen of *Crassatella undulata* Say known only from the Yorktown Formation which indicates that Barton's collection came from the Yorktown. Additional evidence that Say's *P. madisonius* specimens came from the Virginia Yorktown Formation is given by the statement in Schoonover (1941, p. 29):

The only specimen with Say's label is not *C. madisonius*, but probably *C. jeffersonius edgecombensis*. The label indicates that the specimen came from St. Mary's River, Maryland, but this is probably a mistake, and it more likely came from Virginia.

The specimen was obtained by the writers from the Academy of Natural Sciences of Philadelphia. The measurements and description agree almost exactly with that given by Say. This specimen is treated in this paper as the only known existing original type specimen of *Pecten madisonius*.

It is apparent that Say's original specimens of *Pecten madisonius* were what Conrad and later workers have called *Pecten edgecombensis* (Conrad, 1862). (See table 1.)

Despite the common usage of the name "*madisonius*" for most of the Maryland *Chesapecten*, this species name can no longer be considered applicable to these specimens. *Chesapecten madisonius* is a validly described species from the Yorktown Formation of Virginia. Because many of Say's specific names have been applied to distinctly different species from Maryland, following the nomenclatural rules of priority and restricting names to the type material will best serve to promote clarity within the taxonomy of these Miocene and Pliocene species.

Chesapecten santamaria (Tucker)

Plate 4, figures 3-6; plate 7, figures 5, 12

1904. *Pecten* (*Chlamys*) *jeffersonius* Say. Glenn, p. 378-379, pl. C, fig. 2.
1934. *Chlamys* (*Lyropecten*) *santamaria* Tucker, p. 615, pl. 26, fig. 2.
1938. *Chlamys* (*Lyropecten*) *santamaria* Tucker. Tucker-Rowland, p. 16-17, pl. 1, figs. 5, 6; pl. 2, fig. 10.
1957. *Chlamys* (*Lyropecten*) *santamaria* Tucker. Vokes, p. 11, pl. 7, fig. 7.
1959. *Chlamys santamaria* Tucker. Mongin, p. 308-309.

Original description.—Shell equilateral, suborbicular, inequivalved. Radial sculpture of 12 to 16, most commonly 12 to 14, broad, well elevated ribs which are approximately 4 mm narrower, at the ventral margin, than the interspaces. Right valves commonly have about 12 ribs which are about 2 mm narrower than the interspaces. The right valves are flat, or nearly so, and resemble *C. madisonius* Say very closely in outline; left valve convex in the umbonal region; auricles subequal, radial sculpture of fine, scaly threads, the anterior the more coarsely threaded; fasciole broad. Auricles of the left valve subequal, uniformly sculptured with fine scaly threads. Summits and sides of the ribs threaded with numerous fine, scaly threads. Interspaces similarly ornamented; one or two of the threads are usually more strongly developed, especially on the right valve. Submargins have a fine uniform sculpture of closely spaced, scaly threads. Interior ribbed to the umbones. Provinculum present. Ctenolium retained throughout the life of the individual. Dimensions: right valve, height, 130, width 126 mm (figured shell); left, height 120, width 115 mm; convexity 33.5 mm.

Diagnosis.—*Chesapecten santamaria* has flattened ribs, a deep byssal notch, a short hinge area, exterior sculpture of uniform scabrous lirae, and an only slightly convex right valve.

Description.—Valves large, often greater than 120 mm in height, suborbicular, biconvex, left valve strongly inflated, right valve very slightly inflated, most adults longer than high, valves relatively thin, small gapes present along ventral commissure owing to imperfect match of opposing valves, moderate gapes between opposing disk flanks.

Auricles well developed, subequal, byssal notch deep, apex of byssal notch gently curved, outer ligament rather narrow in adults, ctenolium coarse, byssal fasciole broad and depressed in a gentle U-shape.

Plicae of right valve usually number 12 to 14; plicae elevated, broad, somewhat flattened, with flat interspaces. Entire exterior of both valves covered with uniform scabrous lirae.

Auricular denticles present and in contact with opposing denticles, resilial insertion deep, almost twice as high as long, with slightly raised protuberances on either side of the insertion in the right valve. In the left valve the resilial insertion extends into the interior on a platform for about one-third of its length. In the right valve the platform is almost absent. Cardinal crura obsolete, pallial line and most muscle insertions only vaguely impressed. Ribbing expressed over most of shell interior. Adductor insertions moderately large.

Illustrated specimens and measurements.—Lectotype, USNM 193448 (paratype of Tucker, 1934) right valve from St. Marys River, Md. (St. Marys Formation) (USGS loc. 2342). Length (broken), height 124.7 mm, total length auricles along line of ligament 59.0 mm, length of auricle anterior to center of resilial insertion 33.0 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk (broken). Convexity of right valve 14.6 mm (pl 4, fig. 3).

Paratype USNM 2498 (cotype of Tucker, 1934) left valve from St. Marys River, Md. (St. Marys Formation). Length 123.6 mm, height 122.5 mm, total length auricles along line of ligament 55.0 mm, length of auricle anterior to center of resilial insertion 28.5 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 123°. Convexity of left valve 27.1 mm (pl. 4, fig. 4).

USNM 193444 paired valves from Essex Mill, 3.5 miles (5.5 km) south of Tappahannock, Va. (USGS loc. 25058). Length 129.0 mm, height 121.8 mm, total length of auricles along line of ligament 54.5 mm, length of auricle anterior to center of resilial insertion 30.5 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 121°. Convexity of right valve 15.0 mm (pl. 4, figs. 5, 6; pl. 7, figs. 5, 12).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten santamaria* from fig. 1, locality 12 (USGS 25304) (see table 3 for explanation of abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	144.9	132.3	61.9	32.7	126	21.4	12
2 -----	138.5	129.7	60.3	31.8	120	17.1	11
3 -----	125.7	111.3	56.4	30.5	124	15.4	12
4 -----	124.9	110.0	52.1	29.4	129	12.8	14
5 -----	121.9	115.8	53.4	30.7	115	14.1	14
6 -----	58.5	59.2	(¹)	(¹)	111	6.9	14
7 -----	35.4	34.9	23.6	13.8	105	4.1	15
8 -----	30.5	31.1	17.6	10.2	102	4.3	14

¹ Broken

Occurrence.—Original type locality was given as the St. Marys River, Md. As a reference locality in the type area we designate the tan shell bed (3 ft (1 m) above high tide) in the St. Marys Formation at Windmill Point, St. Marys River, St. Marys County, Md. (fig. 1, loc. 12; USGS loc. 25304). This locality is probably the source of the type material.

Additional reference localities (in the St. Marys Formation of Shattuck 1904) are Essex Mill, Va. (fig. 1, loc. 13; USGS loc. 25058), White Oak Landing, Va. (fig. 1, loc. 14; USGS loc. 25059), and Mantua Landing, Va. (fig. 1, loc. 15; USGS loc. 25061).

Comparison and remarks.—*Chesapecten santamaria* differs from *C. middlesexensis* in having a less inflated right valve, a deeper byssal notch, flatter ribs which are squared off, less coarse subradials on the ribs, longer retention of the ctenolium, and a shorter hinge area.

Contrary to Tucker's description, the plicae in *C. santamaria* are not usually narrower than the interspaces but subequal and slightly variable in proportion from specimen to specimen. Also specimens from Langleys Bluff do not appear to be the same species but rather are intermediate between *C. santamaria* and *C. nefrens*. Tucker's (1934) measurements in the description of this species are incorrect.

In naming *C. santamaria*, Tucker (1934) designates two specimens as cotypes and one specimen as a paratype. The cotype specimen, which was figured, was stated to be in the collection of the Paleontological Research Institution, Ithaca, N.Y. However, it is apparently not there (Brann and Kent, 1960). The other cotype (a left valve) and the paratype (a right valve) are figured in this paper. This right valve was in Tucker's possession at the time the original species was described (Tucker, 1934, p. 615), the locality description for this specimen is more exact than that given for the other specimens, and, as the right valve is most distinctive of this species, this valve is designated the lectotype. Cotypes are highly artificial categories. According to present practice, the three specimens would have syntypic status. The selection of an unfigured "syntype" as lectotype was necessitated by the uncertainty of the depository of the originally figured specimen. This right valve which is designated the lectotype agrees quite well with the details from the figure of Tucker's original specimen.

The left-valve cotype of Tucker (USNM 2498) was collected by E. Ruffin in 1863 from St. Marys River, Md. The right-valve paratype of Tucker (USNM 193448) was collected by Harris in 1891

from the St. Marys River, Md., along the eastern bank for perhaps 0.5 mile (0.8 km) above the mouth of St. Inigos Creek. Many of the larger specimens collected were float on the beach (USGS loc. 2342).

Chesapecten middlesexensis (Mansfield)

Plate 5, figures 1, 2; plate 7, figures 4, 11

1928. *Pecten madisonius* Say var. Mansfield, p. 10, pl. 2, fig. 1; pl. 3, fig. 1.

1936. *Pecten (Chlamys) santamaria middlesexensis* Mansfield, p. 187, pl. 22, figs. 5, 6.

1938. *Chlamys (Lyropecten) madisonius richardsi* Tucker-Rowland, p. 14-15, pl. 3, figs. 4, 5.

Original description.—*Pecten santamaria middlesexensis* is like *santamaria* Tucker, ss., in its major features, but differs in the following minor features. Right valve slightly more inflated, the ears relatively wider, the byssal notch shallower, the ribs less rounded distally; left valve with less rounded ribs distally and coarser subradials on the ribs. The new subspecies is a descendant of *P. santamaria*.

Diagnosis.—*Chesapecten middlesexensis* is a very large *Chesapecten* with a moderately deep byssal notch, valves of moderate thickness, small gapes between valves, and a highly variable number of ribs.

Description.—Valves large, often greater than 120 mm in height, suborbicular, biconvex, left valve strongly inflated, right valve moderately inflated, most adults longer than high, small gapes present along the ventral commissure owing to the inexact match of opposing valves, small gapes present opposing disk flanks, valves of moderate thickness.

Auricles well developed, subequal, ctenolium obscured very early; anterior and posterior auricular denticles very reduced and in contact when valve closed, byssal notch shallow, byssal fasciole only slightly impressed.

Plicae of right valve usually number 10 to 19, plicae elevated, broad, rounded, with flattened interspaces. Entire exterior with rows of fairly scabrous sculpture.

Auricular denticles slightly expressed and in contact when valves together, resilial insertion deep, about two-thirds as long as high, with raised broad protuberances on either side of the insertion in the right valve. In the left valve the resilial insertion extends into the interior on a platform for about one-third of its length; in the right valve the platform is very reduced. Cardinal crura obsolete, pallial line and most muscle insertions only vaguely impressed, ribbing expressed over most of shell interior, adductor insertions moderately large.

Illustrated specimens and measurements.—Lectotype, USNM 373074 right valve from Urbanna, Va. (USGS loc. 3915). Length 140.7 mm, height 129.5

mm, total length auricles along line of ligament 68.3 mm, length of auricle anterior to center of resilial insertion 36.8 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 118°. Convexity of right valve 19.5 mm (pl. 5, fig. 1; pl. 7, figs. 4, 11).

Paratype, USNM 207693 left valve from Urbanna, Va., riverfront between mouth of creek and Wharf of Weems line of Steamers (USGS loc. 3915). Length 154.1 mm, height 142.8 mm, total length auricles along line of ligament 7.6 mm, length of auricle anterior to center of resilial insertion 37.9 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 122°. Convexity of left valve 32.0 mm (pl. 5, fig. 2).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten middlesexensis* from map locality 42 at 13 ft (3.9 m) above beach level (see table 3 for explanation of the abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	162.7	155.2	84.1	42.5	117	30.4	12
2 -----	127.8	126.5	68.9	36.6	110	22.2	12
3 -----	121.4	113.6	58.4	28.9	111	19.1	13
4 -----	110.3	104.9	54.1	32.6	117	17.2	19
5 -----	103.9	100.1	46.8	29.2	111	14.8	16
6 -----	103.5	98.2	46.4	28.8	114	14.7	18
7 -----	101.6	101.8	46.9	27.2	110	16.1	18
8 -----	94.4	88.2	47.8	24.9	110	15.7	10
9 -----	79.2	77.2	40.8	24.4	107	12.0	22
10 -----	71.7	73.8	38.0	21.5	114	10.3	13
11 -----	42.5	45.0	23.1	15.4	96	8.4	18
12 -----	39.7	42.3	24.6	15.8	95	4.9	16
13 -----	24.9	27.6	16.4	10.7	91	3.5	19

Occurrence.—The type locality is Urbanna, Middlesex County, Va. in the lower Virginia St. Marys Formation (of Mansfield, 1936) (fig. 1, loc. 16; USGS loc. 3915).

Reference localities in the Virginia St. Marys Formation include the Nomini Cliffs (fig. 1, loc. 17; USGS loc. 25306), Hull Creek (fig. 1, loc. 18; USGS 25307), Bowlers Wharf (fig. 1, loc. 19; USGS loc. 25308); Urbanna Creek (fig. 1, loc. 20; USGS loc. 25309), Freeport (fig. 1, loc. 21; USGS loc. 25310), Blands Wharf (fig. 1, loc. 22; USGS loc. 25311), White Oak Landing (fig. 1, loc. 14), Court House Landing (fig. 1, loc. 23; USGS loc. 25312), Corbin Pond (fig. 1, loc. 24; USGS loc. 25313), Gressitt Pond (fig. 1, loc. 25; USGS loc. 25314), White Landing (fig. 1, loc. 26; USGS loc. 25315), Romancoke (fig. 1, loc. 27; USGS loc. 25316), the lower green-gray sandy clay bed from Chippokes Creek (fig. 1, loc. 28) to Cobham Bay (fig. 1, loc. 29; USGS loc. 25318), the tan sandy shell bed (upper Virginia St.

Marys Formation) from Sunken Marsh Creek (fig. 1, loc. 30; USGS loc. 25319) to Cobham Bay, the Nottoway River at 631 bridge (fig. 1, loc. 31; USGS loc. 25320), Murfreesboro (lower foot of section) (fig. 1, loc. 32; USGS loc. 25321), and 2 miles (3.2 km) above rte. 258 bridge at Murfreesboro (lower 2 ft (0.5 m) of section) (fig. 1, loc. 33; USGS loc. 25322).

Comparison and remarks.—*Chesapecten middlesexensis* differs from *C. jeffersonius* in having more ribs, thinner valves, less inflated valves (especially the right valve), less tight closure along the ventral commissure, a deeper byssal notch, a byssal fasciole which is differentiated from the auricle with respect to sculpture and elevation, and the exterior of the valves covered with moderately coarse scabrous lirae.

Conrad (1862, p. 291) describes a pecten from the Miocene of Virginia and names it *Pecten fraternus*. The diagnosis of this specimen sounds very much like that of *Chesapecten middlesexensis*, but there is no figure, no locality other than Virginia, the type specimen appears to be lost, and the description is not complete enough to make a satisfactory judgment as to the intended species. *Pecten tricarinatus* Conrad (1867) may have been described from the same specimen Conrad used to describe *P. fraternus* Conrad (Heilprin, 1881).

The type specimens of *Chesapecten middlesexensis* were collected by Frank Burns in 1903 from the river front at Urbanna, Middlesex County, Va., "between the mouth of Creek and Wharf of Weems line of Steamers on the Rappahannock River, Va." The right valve (USNM 373074) is here designated the lectotype of *C. middlesexensis*.

The type specimens of *Chlamys madisonius richardsi* Tucker-Rowland (1938) are the specimens Mansfield (1928) illustrated as *Pecten madisonius* var. Although Mansfield (1936) thought these specimens represented a form occurring in the highest beds of the St. Marys Formation of Virginia, the specimens actually came from units which belong to the lower Virginia St. Marys Formation.

Chesapecten jeffersonius (Say)

Plate 1; plate 2, figures 1-3; plate 5, figures 3-7; plate 7, figures 3, 10

1824. *Pecten Jeffersonius* Say, p. 133, pl. 9, fig. 1.
 1840. *Pecten Jeffersonius* Say. Conrad, p. 46, pl. 22, fig. 1.
 1858. *Pecten Jeffersonius* Say. Emmons, p. 281, 282, fig. 199.
 1904. Not *Pecten (Chlamys) jeffersonius* Say. Glenn, p. 378, pl. C, fig. 2 (= *C. santamaria* (Tucker)).
 1909. *Pecten (Chlamys) jeffersonius* Say. Grabau and Shimer, p. 502, fig. 673f.
 1932. *Chlamys (Lyropecten) jeffersonius* Say. Mansfield, p. 59, pl. 11, fig. 1.

1936. *Pecten* (*Chlamys*) *jeffersonius* Say. Mansfield, p. 174, 178, 179, 181, 184, 185.
1938. *Chlamys* (*Lyropecten*) *jeffersonius* (Say). Tucker-Rowland, p. 19–20, pl. 1, figs. 3, 4; pl. 5, figs. 19, 20.
1943. *Chlamys* (*Lyropecten*) *jeffersonia* (Say) Glenn. Gardner, p. 32–34, pl. 4, fig. 2.
1959. *Chlamys jeffersonia* (Say). Mongin, p. 307–308, pl. 27, fig. 3.

Original description and original comments.—Shell rounded, convex, not quite equivalved, one of the valves being a little more convex than the other; the whole surface covered with approximate, scaly striae: ribs elevated, rounded, with six or seven striae on the back of each; intervening grooves profound: ears equal; sinus of the ear of the superior valve, not profound, being barely one eighth part of the length of the ear: within with broad rounded flattened ribs.

Length five inches and three-tenths, breadth five inches and seven-tenths.

Specimens of this truly fine shell are not uncommon. The Academy has been long in possession of several single valves, in an excellent state of preservation, obtained by my friend Mr. J. Gilliams, and others which were presented by Mr. Watson, who purchased them at the sale of the collection of the late Professor Barton. Mr. Finch has succeeded in obtaining entire specimens of the two valves of the same individual. I am of the opinion that Lister's plate 167, is intended to represent this shell, and that the singular appearance of the marginal striae in that figure is a deviation from the ordinary formation of the species, and is owing to the dislocation of the lines of increment, and obliteration of the longitudinal striae. Lister describes his specimens to be of a "blue-clay colour," in this respect perfectly corresponding with two specimens before me. On one of the specimens is an imperfect *Astrae*.

Diagnosis.—*Chesapecten jeffersonius* has a very small byssal notch in adult forms, a moderately heavy shell, a byssal fasciole hardly differentiated from the auricle with respect to sculpture and elevation, and a right valve which becomes quite convex, especially during later growth, whereas convexity in the left valve is seen during earlier growth.

Description.—Valves large, often greater than 120 mm in height, suborbicular, biconvex, left valve strongly inflated and right valve slightly less so, most adults longer than high, closure along ventral commissure tight with no gape, small gapes are present between opposing disk flanks, valves thick.

Auricles well developed, subequal, ctenolium ob-

scured very early, byssal notch extremely shallow, byssal fasciole broad but hardly differentiated from auricle with respect to sculpture and elevation.

Plicae of right valve usually number between 9 and 12, plicae elevated, broad, slightly rounded with interspaces. Entire exterior covered with reduced scabrous lirae which give an almost beaded appearance to the shell exterior.

Anterior and posterior auricular denticles very reduced and in contact when valves closed, resilial insertions very deep, almost twice as high as long, and usually directed very slightly posteroventrally; resilial insertion extends into interior on a platform for about one-third of its length in the left valve; in the right valve the platform is hardly extended; cardinal crura obsolete, pallial line very impressed, impressed narrow insertions of circular pallial muscles, interior ribbing expressed chiefly in extrapallial margin area of shell and in adductor muscle region, adductor insertions large with a distinct nonstriate portion slightly over half the size of the striate portion, dorsal margin does not encroach on ligament, gill suspensor insertions impressed, trace of outer ligament broad.

Illustrated specimens and measurements.—Lectotype, British Museum (No. L13212), paired valves probably from Virginia. Length 99.2 mm, height 93.1 mm, total length auricles along line of ligament 50.1 mm, length of auricle anterior to center of resilial insertion 24.2 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 109°. Convexity of paired specimen 42.3 mm (pl. 5, figs. 5–7).

USNM 193445, paired valves from Cobham Wharf, right bank of James River, Va., 18 to 22 ft (6 m) above beach, Zone 1 of Mansfield, Yorktown Formation (USGS loc. 25331). Length 135.0 mm, height 144.1 mm, total length auricles along line of ligament 80.6 mm, length of auricle anterior to center of resilial insertion 36.6 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 117°. Convexity of left valve 36.6 mm. Convexity of right valve 31.2 mm (pl. 2, figs. 1–3; pl. 5, figs. 3, 4; pl. 7, figs. 3, 10).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten jeffersonius* from map locality 42 at 20 ft (6 m) above beach level (see table 3 for explanation of the abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	137.7	124.6	64.6	31.6	123	26.5	10
2 -----	133.4	120.9	74.3	37.4	122	29.9	9
3 -----	120.8	110.6	65.8	33.6	116	24.0	8
4 -----	120.2	107.6	61.5	30.9	121	25.1	9
5 -----	107.6	96.7	53.1	28.5	117	18.2	9
6 -----	65.6	59.9	31.0	16.9	113	11.4	10
7 -----	40.9	40.5	25.0	13.3	103	6.9	10
8 -----	36.9	38.7	19.2	9.1	99	7.3	10
9 -----	31.2	31.4	19.8	10.1	102	5.7	10
10 -----	30.1	30.0	20.0	10.1	99	4.8	9

Occurrence.—The type locality is Virginia, probably from the James River near City Point or the York River at Yorktown. Additional Virginia localities (Yorktown Formation Zone 1 of Mansfield) include 2 miles (3.2 km) below Grays Point Bridge on the Rappahannock River (fig. 1, loc. 34; USGS loc. 25323), Glebe Neck (beach to +3 ft (1 m)) (fig. 1, loc. 35; USGS loc. 25324), Mouth of Felgate's Creek (at beach level) (fig. 1, loc. 36; USGS loc. 25325), Zone 1 Yorktown Formation (of Mansfield) from

Chippokes Creek to Grove Wharf (beach to +5 ft (1.5 m)) (fig. 1, loc. 37; USGS loc. 25326), and Delaware at rte. 671 bridge over Nottoway (lower 1.5 ft (0.5 m)) (fig. 1, loc. 38; USGS loc. 25327).

Comparison and remarks.—*Chesapecten jeffersonius* differs from *C. septenarius* in having more plicae (usually 9 to 12 as opposed to approximately 6 or 7), which are less broadened, less flattened on the summits, and less square sided, with the exterior covered with less coarse scabrous sculpture. *Chesapecten jeffersonius* differs from *C. madisonius* in having more convex valves, in having fewer and more elevated plicae; also, in the exterior sculpture being less "beaded" in appearance, and in the interior ribbing being expressed in the adductor muscle region.

The following information (the title and the abstracted text) was given by Huddesford (1770) in a new edition of Lister's publications.

The following NOTES and OBSERVATIONS were written by Dr. Lister in a Copy of this Work (consisting chiefly of Proof Plates) now in the Possession of Mr. Ingham Forster, Merchant in London, by whom it was most obligingly communicated to the Editor. A. D. 1769.

Tab. N^o.

167. 4. This is the biggest Scallop I have seen; it is also thick and heavy; it was of a blue Colour, but it was apparently old and weather beaten, so that the natural Beauty of the living Fish was perished. It is but shallow. It has but ten Ridges; but the Furrows betwixt them are very deep, and cut down almost at right Angles; at the very Head of the Shell, betwixt the Eares, the Furrows are very deep, though small, and end all in a Point very elegant; whereas in the two former Shells the Heads are smooth, and the Ridges and Furrows in that Part are almost obliterated. The Ridges and Furrows here are all of them curiously streaked. A good Inch from the Bottom of the Shell the Ridges and Furrows become suddenly of another Fashion and Grain, and are, as it were, transversely waved and smooth.

I never saw but two of these, and they were both bigger or upper Shells of the Scallop.

N.B. That is a Fault in the Engraver to have made the Ridges towards the Head a little crooked, whereas they lie all very straight and run to a Point.

A translation of Lister's original Latin description (Lister, 1687, p. 69) is as follows: By far the largest of all scallops presented with 8 or 10 ridges at the highest point and similarly deep grooves.

It should be noted that there was no separate text for each figure, but that the entire description was included with each figure (as reproduced in pl. 1).

A probable syntype of *C. jeffersonius* was obtained from the British Museum, the repository of of the fossil material which J. Finch loaned Say to describe. This specimen agrees with Say's figure in size, although the details of sculpture are apparently artistically generalized possibly from several specimens (synthetograph). This articulated specimen from the British Museum is here designated as the lectotype.

Chesapecten septenarius (Say)

Plate 6, figures 5-7; plate 7, figures 2, 9

- 1824. *Pecten septenarius* Say, p. 136, pl. 9, fig. 3.
- 1840. *Pecten septenarius* Say. Conrad, p. 47, pl. 22, fig. 2.
- 1856. *Pecten septenarius* Say. Tuomey and Holmes, p. 31, pl. 13, figs. 1-4.
- 1898. *Pecten Jeffersonius* var. *septenarius* Say. Dall, p. 722.
- 1904. *Pecten (Chlamys) jeffersonius* var. *septenarius* Say. Glenn, p. 379, pl. C, fig. 4.
- 1936. *Pecten (Chlamys) jeffersonius septenarius* Say. Mansfield, p. 174, 179, 184, 185.
- 1936. *Pecten (Chlamys) jeffersonius palmyrensis* Mansfield, p. 187-188, pl. 23, fig. 3.
- 1938. *Chlamys (Lyropecten) jeffersonius septenarius* (Say). Tucker-Rowland, p. 20-21, pl. 3, fig. 15.
- 1938. *Chlamys (Lyropecten) jeffersonius palmyrensis* (Mansfield). Tucker-Rowland, p. 20, pl. 2, fig. 11.
- 1964. *Pecten jeffersonius septenarius* Say. Darby and Hoyt, pl. 18, fig. 16.

Original description.—Shell convex, suborbicular: auricles subequal: surface with numerous slightly scaly striae, and about seven remote ribs, of which the three intermediate ones are much elevated, rounded, or slightly flattened on the top. Length nearly two inches and seven-tenths.

Diagnosis.—*Chesapecten septenarius* has very heavy deposits of calcite on the interior of the valves, usually 6 to 7 plicae, a shallow byssal notch, an only slightly differentiated byssal fasciole, and broad ribs with flattened summits and square sides.

Description.—Valves moderate in size (adults about 110 mm in height), suborbicular, biconvex, left valve quite inflated and right valve slightly less inflated, most adults slightly longer than high, valves close tightly along ventral margin, small gapes between opposing disk flanks, shell thick and heavy.

Auricles well developed and subequal, byssal notch very small, ctenolium obscured very early in growth, auricular denticles very reduced and in contact with opposing denticles, byssal fasciole inconspicuous and little differentiated with respect to auricle and sculpture on auricle.

Plicae usually number about 6 to 7, plicae broad, flattened, square sided, with very slightly curved interspaces, entire exterior covered by moderately coarse scabrous sculpture.

Trace of outer ligament broad, dorsal margin not encroaching on ligament, resilial insertion deep and about half as long as high, in left valve resilial insertion extends to the interior for about one-third of its height and in the right valve there is no extension. In the right valve, moderate prominences apparent on either side of the resilial insertion. Cardinal crura obsolete.

Pallial line and muscle insertions moderately expressed. Adductor insertions very large. Ribbing in interior expressed largely along extrapallial margin but also in pallial area despite heavy deposits of calcite.

Illustrated specimens and measurements.—Holotype (monotype), British Museum (No. L13197). Left valve from Virginia (probable locality). Length 64.9 mm, height 67.3 mm, total length auricles along line of ligament 40.1 mm, length of auricle anterior to center of resilial insertion 22.3 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 109°. Convexity of left valve 16.9 mm (pl. 6, figs. 5, 6).

USNM 193446 paired valves from Lee Creek mine on right bank of Pamlico River, N.C. (USGS loc.

25334). Length 116.5 mm, height 109.2 mm, total length auricles along line of ligament 60.6 mm, length of auricle anterior to center of resilial insertion 31.0 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 108°. Convexity of left valve 30.0 mm. Convexity of right valve 24.1 mm (pl. 6, fig. 7; pl. 7, figs. 2, 9).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten septenarius* from map locality 45 (USGS loc. 25334) (see table 3 for explanation of the abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	129.2	122.7	(¹)	(¹)	110	21.4	6
2 -----	92.9	87.4	50.2	26.5	114	17.7	9
3 -----	88.3	85.3	53.9	27.4	103	18.8	6
4 -----	77.8	73.2	48.8	24.6	102	14.3	5
5 -----	70.9	68.2	42.0	21.4	107	14.4	6
6 -----	42.1	42.9	24.7	12.8	105	7.6	7

¹ Broken.

Occurrence.—The type locality is Virginia, probably from the James River near City Point or the York River at Yorktown.

Additional Virginia localities (Yorktown Formation Zone 2 of Mansfield) include Petersburg (first 6 ft (1.8 m) above Virginia St. Marys Formation contact with Zone 2 Yorktown) (map loc. 39; USGS loc. 25328), 2 miles (3.2 km) above Yorktown (fig. 1, loc. 40; USGS loc. 25329), Rices Borrow Pit (fig. 1, loc. 41; USGS loc. 25330), Cobham Wharf (top shell bed) (fig. 1, loc. 42; USGS loc. 25336), Kings Mill Wharf (fig. 1, loc. 43; USGS loc. 25332), Lee Creek mine pit (fig. 1, loc. 45; USGS loc. 25334).

Comments.—The specimen figured here (pl. 6, figs. 5, 6) was obtained from the British Museum. It agrees almost exactly with Say's figured specimen, including the large breaks in the shell margin. The specimen is labeled "N. Amer." Say apparently had only one specimen.

***Chesapecten madisonius* (Say)**

Plate 6, figures 1-4; plate 7, figures 1, 7, 8

1824. *Pecten Madisonius* Say, p. 134.

1862. *Pecten Edgecombensis* Conrad, p. 291.

1863. *Pecten edgecombensis* Conrad. Conrad, p. 581.

1863. Not *Pecten Madisonius* Say. Conrad, p. 581, (= *C. nefrens*).

1894. Not *Pecten Madisonius* Say. p. 30, pl. 4, figs. 1-5.

1904. *Pecten jeffersonius* var. *edgecombensis* (Conrad). Glenn, p. 379, pl. C, fig. 3 [locality not St. Marys River].

1904. Not *Pecten (Chlamys) madisonius* Say. Glenn, p. 377, pl. C, fig. 1, (= *C. nefrens*).

1909. Not *Pecten (Chlamys) madisonius* Say. Grabau and Shimer, p. 502, fig. 673c, (= *C. nefrens*).

1936. Not *Pecten* (*Chlamys*) *madisonius* Say. Mansfield, p. 174, 176, 177, 184, (= *C. nefrens*).
1938. Not *Chlamys* (*Lyropecten*) *madisonius* (Say). Tucker-Rowland, p. 9-11, pl. 1, fig. 1, 2 (= *C. nefrens*).
1938. *Chlamys* (*Lyropecten*) *jeffersonius edgecombensis* (Conrad). Tucker-Rowland, p. 15-16, pl. 2, fig. 5; pl. 4, fig. 6.
1941. Not *Chlamys* (*Lyropecten*) *madisonius* (Say). Schoonover, p. 28-37, pl. 2, figs. 3, 5-6; pl. 3, figs. 1-3, 6; pl. 4, figs. 1-4; pl. 5, figs. 1-3.
1943. Not *Chlamys* (*Lyropecten*) *madisonia* (Say) Glenn. Gardner, p. 32, pl. 4, fig. 5; pl. 9, fig. 7, (= *C. nefrens*).
1959. Not *Chlamys madisonia* (Say). Mongin, p. 309-314, pl. 26, figs. 1a, b (= *C. nefrens*).

Complete original description.—Much compressed, with about sixteen striated ribs.

Shell rounded, much compressed; the whole surface covered with scaly striae: ribs elevated, rounded, with about three striae on the back of each; intervening grooves rather profound: ears equal, sinus of the ear of the superior valve profound, extending at least one third of the length of the ear.

Length rather more than four inches and a half; breadth four inches and four-fifths.

In magnitude this shell is justly entitled to compare with the preceding; but it differs in being much less convex, and in having a much more profound sinus in the ear of the superior valve. Three specimens, from which the above description was taken, belong to the Academy and were presented by Mr. Watson.

Description.—Valves moderately large (often greater than 100 mm in height), suborbicular, bi-convex, left valve strongly inflated and right valve only slightly less so, most adults longer than high, closure along ventral commissure tight with no gape, small gapes are present between opposing disk flanks, valves thick.

Auricles very well developed, subequal, ctenolium obscured very early, byssal notch extremely shallow, byssal fasciole broad but hardly differentiated from auricle with respect to sculpture and elevation.

Plicae of right valve usually number 14 to 16, plicae not greatly elevated, but broad, rounded, with rounded interspaces. Entire exterior covered with rows of closely spaced reduced scabrous lirae.

Trace of outer ligament broad, resilial insertion moderately deep and two-thirds as long as high, in left valve resilial insertion extends into shell on platform for about one-third of its height and in right valve for about one-fourth of its height. Posterior auricular denticles weak and in contact when valves closed; anterior auricular denticles moderately expressed. Cardinal crura obsolete, pallial line

impressed, narrow insertions of pallial muscles fairly impressed, interior ribbing expressed almost exclusively in extrapallial margin of shell. Adductor insertions large with a distinct nonstriate portion slightly over half the size of the striate portion, dorsal margin does not encroach upon ligament, gill suspensor insertions impressed.

Illustrated specimens and measurements.—Lectotype, Academy Natural Sciences of Philadelphia (ANSP 31787) left valve from Virginia (probable locality). Length 123.9 mm, height 116.1 mm, total length auricles along line of ligament 62.5 mm, length of auricle anterior to center of resilial insertion 31.7 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 118°. Convexity of left valve 29.9 mm (pl. 6, figs. 3, 4).

USNM 193447 right valve from Cobham Wharf, right bank of James River, Surry County, Va. +24.5 to +28 ft (8 m) Zone 2 Yorktown Formation (of Mansfield) (USGS loc. 25336). Length 112.8 mm, height 103.7 mm, total length auricles along line of ligament 59.7 mm, length of auricle anterior to center of resilial insertion 29.0 mm, angle formed by lines through origin of shell growth (at beak) and (both anteriorly and posteriorly) tangent to, but nowhere intersecting, edge of disk, 115°. Convexity of right valve 19.0 mm (pl. 6, figs. 1, 2; pl. 7, figs. 1, 8).

The following measurements (in millimeters) have been taken from the right valves of additional specimens of *Chesapecten madisonius* from map locality 41 (USGS loc. 25330) (see table 3 for explanation of the abbreviations):

Specimen	LN	HT	LA	LAA	ANG (°)	CON	RIB
1 -----	148.2	142.7	90.6	46.7	114	29.9	16
2 -----	142.0	131.3	81.8	42.0	117	25.1	14
3 -----	124.1	113.4	74.5	40.8	111	20.3	15
4 -----	116.9	109.5	67.7	35.9	111	16.5	14
5 -----	109.8	105.6	63.4	34.5	112	19.7	16
6 -----	96.5	91.2	60.2	31.3	111	17.0	13
7 -----	91.1	88.7	57.7	30.6	107	12.1	16
8 -----	80.3	79.4	46.8	25.1	103	10.2	16
9 -----	77.7	73.6	43.6	22.8	112	10.3	15
10 -----	74.7	72.6	46.8	24.6	106	11.8	14
11 -----	63.6	63.1	37.7	19.6	105	9.8	16
12 -----	55.8	56.8	32.8	18.1	103	6.2	14
13 -----	46.3	46.3	26.8	14.4	102	7.5	14
14 -----	43.6	44.7	27.1	14.9	100	7.2	16

Occurrence.—The type locality is unknown but probably Virginia or North Carolina.

Additional Virginia localities (Yorktown Formation Zone 2 of Mansfield) include the York River from Yorktown (fig. 1, loc. 40; USGS loc. 25329) to 2 miles (3.2 km) below Yorktown (fig. 1, loc. 46; USGS loc. 25335), Cobham Wharf (fig. 1, loc. 42;

USGS loc. 25336), Rices Pit (fig. 1, loc. 41; USGS loc. 25330), and Sycamore Bend (fig. 1, loc. 44; USGS loc. 25333).

North Carolina localities (Yorktown Formation Zone 2 of Mansfield) include the rte. 258 bridge at Murfreesboro (6–9 ft (2+ m) above the Virginia St. Marys contact and Zone 2 Yorktown) (fig. 1, loc. 33; USGS loc. 25322), and Lee Creek Pit (fig. 1, loc. 45; USGS loc. 25334).

Comments.—The reasons for restricting the name *Chesapecten madisonius* to specimens found in Zone 2 of the Yorktown Formation are discussed in the section on *C. nefrens*. In Say's description of *C. madisonius*, he was probably considering as the superior valve the right valve, which in this genus, unlike many other Pectinidae, is the lower valve. The right valve does have a distinct sinus which is especially pronounced in younger individuals. Certainly, as Say was comparing the holotype of *C. jeffersonius*, the specimens of *Pecten clintonius*, and the holotype (monotype) of *C. septenarius* with the right valves of *C. madisonius*, he would have seen a pronounced sinus, which is about one-third the length of the ear in smaller individuals (pl. 7, fig. 7). Although the three "striae" are usually more prominent in specimens of *C. nefrens*, the number of striae in the specimens we consider to be *C. madisonius* from the Yorktown Formation is usually three, particularly in specimens from certain beds. Say indicates in his description that the number of striae was not constant in the specimens before him. Such inconstancy would be normal for *C. madisonius* but unusual for a collection of specimens of *C. nefrens*. Also the term "striae" is hardly applicable to the scaly sculpture common in *C. nefrens*, whereas it is quite applicable to *C. madisonius* and particularly to the specimen here illustrated as the lectotype of *C. madisonius* (pl. 6, fig. 3, 4). In number of ribs both *C. nefrens* and *C. madisonius* are similar.

Prior to this paper and before recognition of Say's specimen at the Philadelphia Academy, a worker at the British Museum had selected from Finch's collection a specimen which he considered making a lectotype of *C. madisonius*. The specimen he selected is a Yorktown Formation *C. madisonius*. This selection would indicate that the material in Finch's collection which most resembles the description of *C. madisonius* is a Virginia Yorktown specimen. Say states that *C. madisonius* has about 16 ribs. Our lectotype has 15 ribs, while the British Museum specimen (a right valve) has 16 ribs.

Conrad applied Say's name *madisonius* to the Maryland species and consequently gave another species name, *edgecombensis*, to what was actually

the *P. madisonius* of Say. All known references to *C. madisonius* in the Calvert and Choptank Formations are to the species here called *nefrens* and all known references to *C. madisonius* in the Yorktown Formation are misidentifications of the species formerly known as *Pecten edgecombensis*, here shown to be the *madisonius* of Say (1824).

Dall (1898) incorrectly recorded the species (*Pecten edgecombensis*=*C. madisonius*) from Langley's Bluff, Md. Glenn (1904) incorrectly recorded this Yorktown species (*P. edgecombensis*) from the St. Marys River, Md., and also from Langley's Bluff, Md. Tucker-Rowland (1938) incorrectly recorded this species (*P. edgecombensis*) from Little Cove Point, Md. and her other "Maryland" locality (Grove Wharf) is in Virginia. There are no known occurrences of *Chesapecten edgecombensis* (= *C. madisonius*) in Maryland. Glenn's (1904) figured specimen (pl. C, fig. 3) of this species (*P. edgecombensis*) is wrongly labeled "St. Marys River" in the plate explanation. The specimen actually came from Edgecombe County, N.C., and was collected by J. L. Bridges and entered in the National Museum catalogue in 1863 (type locality and collection from which original specimens of *edgecombensis* came).

Plate 6, figures 3 and 4 show the specimen which appears to be the only one remaining from the three original type specimens of Say's *Pecten madisonius*. It agrees with Say's original description in having three striae on the back of elevated ribs, in having equal ears, in the length and height measurements, and in being much more compressed than *C. jeffersonius*. This specimen was obtained from the Philadelphia Academy of Natural Sciences.

Collections in the British Museum apparently lack the type specimens. Because the specimens of *C. madisonius* were not collected by Finch, they probably were not sent to England. Some small specimens of *C. madisonius* are found in the Finch collection.

It should be noted that the specimen Tucker-Rowland (1938) figures (pl. 4, fig. 8) and mentions as the possible holotype of *C. madisonius* (Say, 1824) is actually a specimen collected in 1887 by Frank Burns from New Jersey (according to the U.S. Geological Survey Cenozoic Collection Catalogue).

LOCALITY REGISTER

Locality No. in figure 1	USGS locality No.	Description
1	25293	Randall Cliff, west shore of Chesapeake Bay, 0.5 mile (0.8 km) south of Chesa-

Locality No. in figure 1	USGS locality No.	Description	Locality No. in figure 1	USGS locality No.	Description
		peake Beach, Calvert County, Md. (North Beach 7½-minute quad.), in Zone 10 at approximately 35 ft (10.6 m) above beach; Calvert Formation.			old wharf piling, very shelly dark clay, from beach to +1 ft (0.3 m) (King and Queen 7½-minute quad.); St. Marys Formation.
2	25294	Plum Point, west shore of Chesapeake Bay, Calvert County, Md. (Prince Frederick 7½-minute quad.), in Zone 10 at beach level; Calvert Formation.	15	25061	Mantua Landing, 2.5 miles (4.0 km) east of King William Court House, on right bank of Mattaponi River, very shelly dark green gray clay (1 ft (0.3 m) thick) resting on unconformity located 1 ft (0.3 m) above beach level (King and Queen 7½-minute quad.); St. Marys Formation.
3	25295	Camp Roosevelt, 0.5 mile below, on west shore of Chesapeake Bay, Calvert County, Md., (North Beach 7½-minute quad.) in Zone 10 at 15 ft (5 m) above beach; Calvert Formation.	16	3915	Urbanna, riverfront between mouth of creek and Wharf of Weems line of steamers, right bank of Rappahannock River, Middlesex County, Va. (Urbanna 7½-minute quad.); upper Virginia St. Marys Formation.
4	25296	Governor Run, west shore of Chesapeake Bay, Calvert County, Md., (Prince Frederick 7½-minute quad.), in Zone 14 at beach level; Calvert Formation.	17	25306	Nomini Cliffs, right bank of Potomac River, Westmoreland County, Va. (Stratford 7½-minute quad.), 35 ft (10 m) elevation; upper Virginia St. Marys Formation.
5	25297	Scientist's Cliffs, west shore of Chesapeake Bay, Calvert County, Md., (Prince Frederick 7½-minute quad.), in Zone 16 at 30 ft (9 m) above beach; Choptank Formation.	18	25307	Hull Creek, right bank of Potomac River, Northumberland County, Va. (Heathsville, 7½-minute quad.); upper Virginia St. Marys Formation.
6	25298	Calvert Beach, west shore of Chesapeake Bay, Calvert County, Md. (Cove Point 7½-minute quad.), in Zone 16 at beach level to 5 ft (1.5 m) Choptank Formation.	19	25308	Bowler's Wharf, 1-2 miles (2.4 km) south of Bowler's Wharf right bank of Rappahannock River, Essex County, Va. (Moratico 7½-minute quad.), <i>Spisula</i> bed from beach level to +12 ft (+3 m), upper Virginia St. Marys Formation.
7	25299	Camp Conoy, west shore of Chesapeake Bay, Calvert County, Md., (Cove Point 7½-minute quad.), in Zone 19 at 8 ft (2 m) above beach; Choptank Formation.	20	25309	Urbanna Creek, 0.5 mile south of Urbanna, Middlesex County, Va. (Urbanna 7½-minute quad.), from beach to 3 ft (1 m); upper Virginia St. Marys Formation.
8	25300	Cove Point, west shore of Chesapeake Bay, Calvert County, Md., (Cove Point 7½-minute quad.); St. Marys Formation (USGS 25300) and Zone 19 Choptank Formation (USGS 25306).	21	25310	Freeport, just above mouth of Harper Creek, right bank of Piankatank River, Gloucester County, Va. (Saluda 7½-minute quad.), at +6 ft (2 m) in shell bed; upper Virginia St. Marys Formation.
9	25301	Flag Pond, west shore of Chesapeake Bay, Calvert County, Md., (Cove Point 7½-minute quad.); Choptank Formation, Zone 19.	22	25311	Blands Wharf, just below mouth of Harper Creek, right bank of Piankatank River, Gloucester County, Va., (Wilton 7½-minute quad.), at +7 ft (2 m) in shell bed; upper Virginia St. Marys Formation.
10	25302	Little Cove Point, west shore of Chesapeake Bay, Calvert County, Md., (Solomons Island 7½-minute quad.), in upper shell bed at +11 ft (3+ m); St. Marys Formation.	23	25312	Courthouse Landing, left bank of Mattaponi River, King and Queen County, Va. (King and Queen 7½-minute quad.); from beach level to +4 ft (+1 m), upper Virginia St. Marys Formation.
11	25303	Langley's Bluff, west shore of Chesapeake Bay, 2 miles (3.2 km) southeast of Hermanville, St. Marys County, Md. (St. Marys City 7½-minute quad.), shell bed at beach level; St. Marys Formation.	24	25313	Corbin Pond, where rte. 14 crosses Corbin Creek, King and Queen County, Va. (West Point 7½-minute quad.); in streamcut below bridge; upper Virginia St. Marys Formation.
12	25304	Windmill Point, right bank of St. Marys River, opposite mouth of St. Inigoes Creek, St. Marys County, Md. (St. Marys City 7½-minute quad.), tan shell bed at 3 ft (1 m) elevation; St. Marys Formation.	25	25314	Gressitt Mill, in millrace, King and Queen County, Va., (Gressitt 7½-minute quad.); upper Virginia St. Marys Formation.
13	25058	Essex Mill, 3.5 miles (5.6 km) south of Tappahannock on Mill Creek, a tributary of Piscataway Creek, Essex County, Va., (Dunnsville 7½-minute quad.), in mill race; St. Marys Formation.	26	25315	0.5-1.5 miles (0.8-2.4 km) below White Landing, left bank of Pamunkey River,
14	25059	White Oak Landing, 2.5 miles (4.0 km) east of King William Court House, on right bank of Mattaponi River, just upriver of			

Locality No. in figure 1	USGS locality No.	Description	Locality No. in figure 1	USGS locality No.	Description
		King William County, Va. (New Kent 7½-minute quad.); series of small exposures as much as 4 ft (1 m) above water; lower Virginia St. Marys Formation.			(2 m) above Virginia St. Mary's Formation contact with Zone 2 Yorktown; Zone 2 of Yorktown Formation.
27	25316	1.1 miles (1.76 km) northwest of Romancoke, left bank of Pamunkey River, King William County, Va. (West Point 7½-minute quad.), at water level; upper Virginia St. Marys Formation.	40	25329	2.0 miles (3.2 km) above Yorktown, right bank of York River, York County, Va. (Clay Bank 7½-minute quad.), float on beach; Zone 2 of Yorktown Formation.
28	25317	Mouth of upper Chippokes Creek at Claremont, right bank of James River, Surry County, Va. (Claremont 7½-minute quad.), at water level to +8 ft (+2 m); lower Virginia St. Marys Formation.	41	25330	Rice's borrow pit at intersection of Fox Hill Road and Harris Creek Road, Hampton, Va. (Hampton 7½-minute quad.); Zone 2 of Yorktown Formation.
29	25318	Bluffs at Chippokes Plantation, right bank of James River at Cobham Bay, Surry County, Va. (Hog Island 7½-minute quad.), at beach level; lower Virginia St. Marys Formation.	42	25331 25336	Cobham Wharf, right bank of James River, Surry County, Va. (Surry 7½-minute quad.); Zone 1 Yorktown Formation 18 to 22 ft (about 6 m) above beach and Zone 2 Yorktown Formation 24.5 to 28 ft (about 8 m) above beach; Boundary between upper and lower Virginia St. Marys Formation is at 5 ft (1.5 m) above beach.
30	25319	Just below mouth of Sunken Marsh Creek, right bank of James River (Claremont 7½-minute quad.), at +30 to +32 ft (+9 m); upper Virginia St. Marys Formation.	43	25332	0.6 mile (0.96 km) below old Kings Mill Wharf Pilings, left bank of James River, James City County, Va. (Hog Island 7½-minute quad.); Zone 2 of Yorktown Formation.
31	25320	Just below Rte. 631 bridge over Nottoway River right bank, Sussex County, Va. (Sebrell 7½-minute quad.), lower 3 ft (1 m); upper Virginia St. Marys Formation.	44	25333	Sycamore Bend, 1.25 miles (2 km) southeast of Delaware, left bank of Nottoway River, Southampton County, (Franklin 7½-minute quad.); Zone 2 of Yorktown Formation.
32	25321	0.5 mile (0.8 km) above the rte. 258 bridge at Murfreesboro, Meherrin River, Hertford County, N.C. (unmapped quad.), at +1 ft (0.3 m); upper Virginia St. Marys Formation.	45	25334	Lee Creek mine (Texas Gulf Sulfur phosphate mine) north of Aurora, N.C., on the right bank of the Pamlico River (Aurora 7½-minute quad.); Zone 2 of Yorktown Formation.
33	25322	2 miles (3.2 km) above the rte. 258 bridge at Murfreesboro, right bank of Meherrin River, Hertford County, N.C. (unmapped quad.), from water level to +3 ft (+1 m); upper Virginia St. Marys Formation.	46	25335	2.0 miles (3.2 km) below Yorktown at the Moore House, right bank of York River, York County, Va., (Poquoson West 7½-minute quad.); Zone 2 of Yorktown Formation.
34	25323	2 miles (3.2 km) below Greys Point Bridge, right bank of Rappahannock River, Middlesex County, Va. (Deltaville 7½-minute quad.); Zone 1 of Yorktown Formation.			
35	25324	Glebe Neck, left bank of Piankatank River, Middlesex County, Va. (Wilton 7½-minute quad.), from beach level to +3 ft (+1 m); Zone 1 of Yorktown Formation.			
36	25325	Mouth of Felgates Creek, right bank of York River, York County, Va. (Clay Bank 7½-minute quad.), at beach level; Zone 1 of Yorktown Formation.			
37	25326	Grove Wharf, left bank of James River, James City County, Va. (Hog Island 7½-minute quad.), beach level to +5 ft (1.5 m); Zone 1 of Yorktown Formation.			
38	25327	0.2 mile (0.32 km) above rte. 671 bridge at Delaware, left bank of Nottoway River, Southampton County, Va., (Courtland 7½-minute quad.); water level to +1.5 ft (0.5 m); Zone 1 of Yorktown Formation.			
39	25328	Lieutenant Run, 0.2 mile (0.32 km) upstream of Baylor Lane, Petersburg, Va. (Petersburg 7½-minute quad.) first 6 ft			

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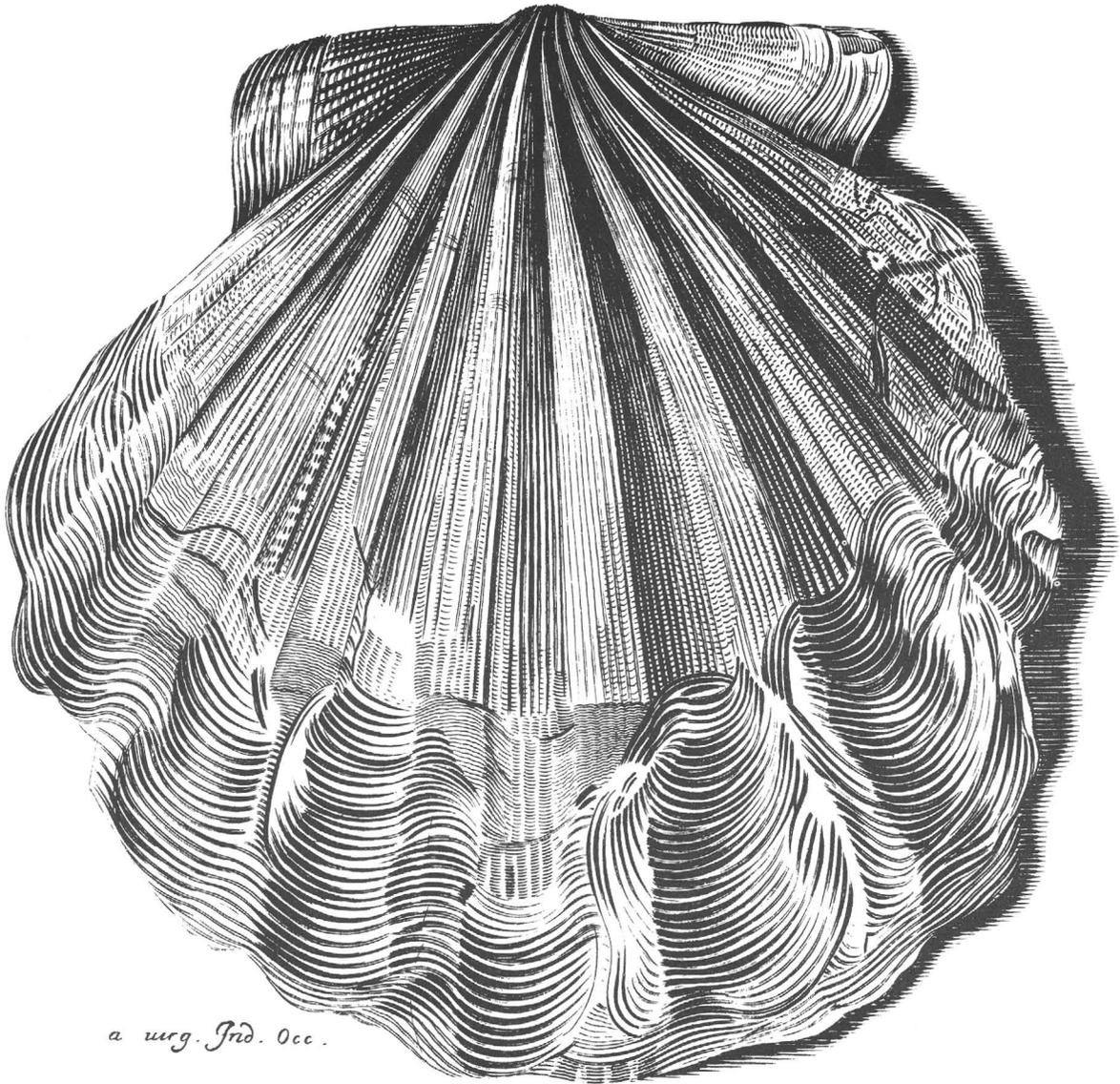
PLATES 1-7

Contact photographs of the plates in this report are available, at
cost, from U.S. Geological Survey Library, Federal Center,
Denver, Colorado 80225

PLATE 1

Reproduction of the illustration of the earliest figured and described fossil from America. Reproduction is original size and from Lister's (1687) "Historiae Conchyliorum Liber III." Lister's entire description is with each figure and not in a separate text. Say (1824) mentions this figure as being his species *Pecten jeffersonius*.

4. pecten omnium longè maximus, muris cavius, octo uel decem ad summum stryis donatus,
item huic canaliculi profundi.



a uerg. Frid. Occ.

PLATE 2

FIGURES 1-3. *Chesapecten jeffersonius* (Say) (p. 13).

Ventral, posterior, and anterior views of articulated specimen USNM 193445, from Cobham Wharf, Va. (USGS loc. 25331), length 135.0 mm, height 144.1 mm.

4-6. *Chesapecten nefrens* n. sp. (p. 9).

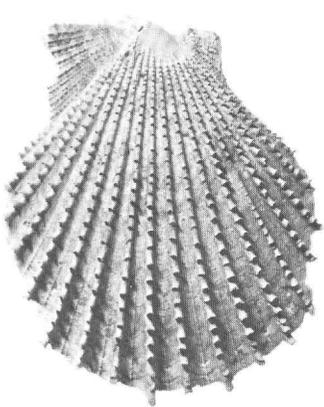
Ventral, posterior, and anterior views of articulated specimen USNM 193443, from Camp Conoy, Md. (USGS loc. 25299), length 134.3 mm, height 113.9 mm.



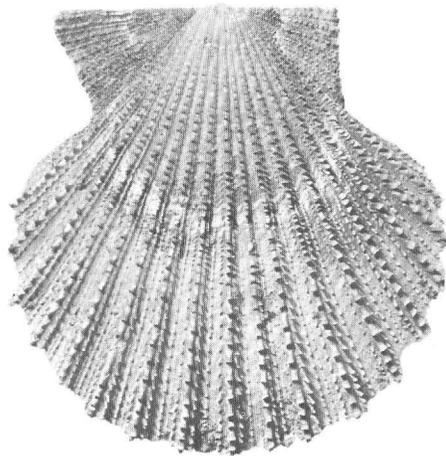
CHESAPECTEN JEFFERSONIUS (SAY) AND *C. NEFRENS* N. SP.

PLATE 3

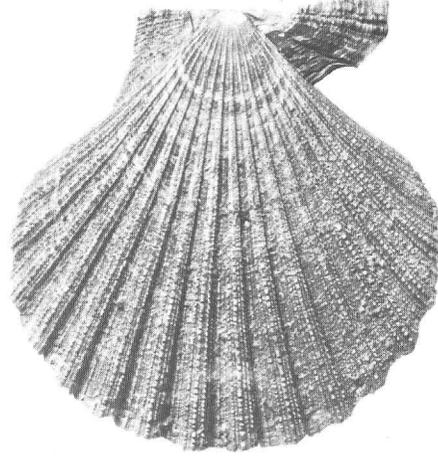
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1. Left valve, USNM 87754, holotype from Plum Point, Md. (USGS loc. 25294), length 24.3 mm.
 2. Left valve, USNM 193440, from Camp Roosevelt, Md. (USGS loc. 25295), length 38.0 mm.
 3. *Chesapecten* sp.
Right valve, USNM 193441, from Camp Rcosevelt, Md. (USGS loc. 25295), length 35.2 mm.
 - 4-7. *Chesapecten nefrens* n. sp. (p. 9).
Right and left valves of articulated specimen, holotype, USNM 193442, from Camp Conoy, Md. (USGS loc. 25299), length 177.4 mm.



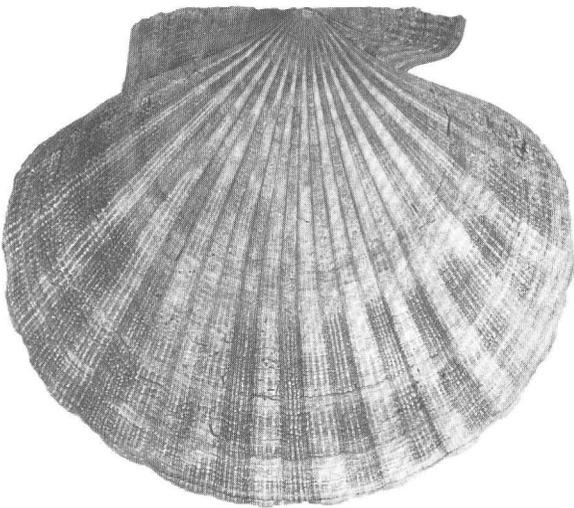
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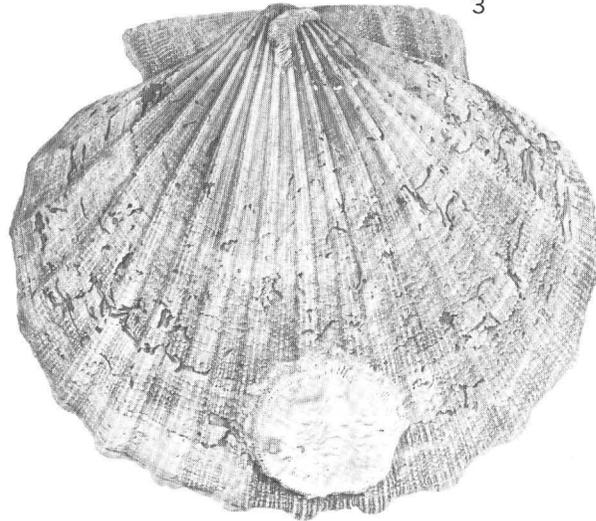
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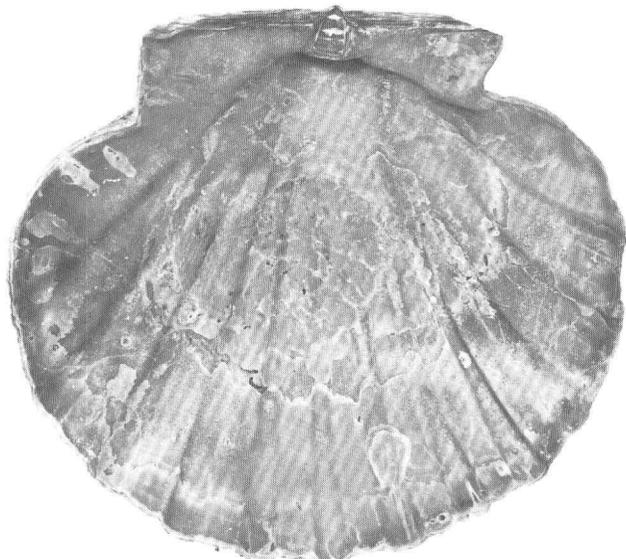
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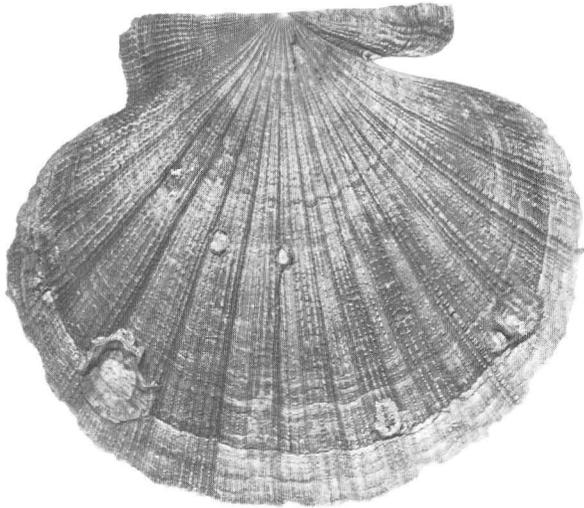


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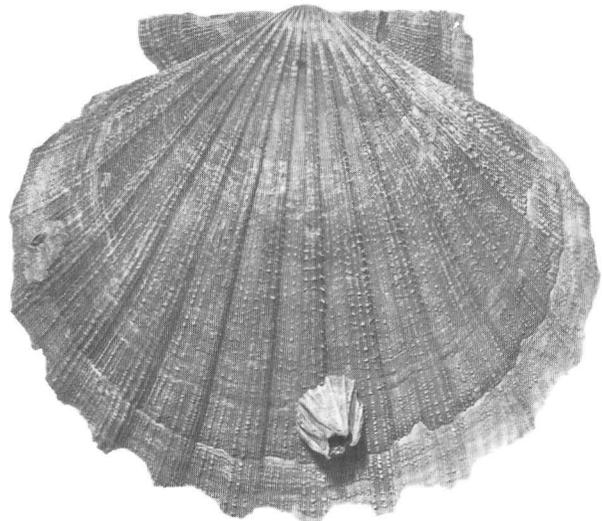
CHESAPECTEN COCCYMELUS (DALL), *C. SP.*, AND *C. NEFRENS* N. SP.

PLATE 4

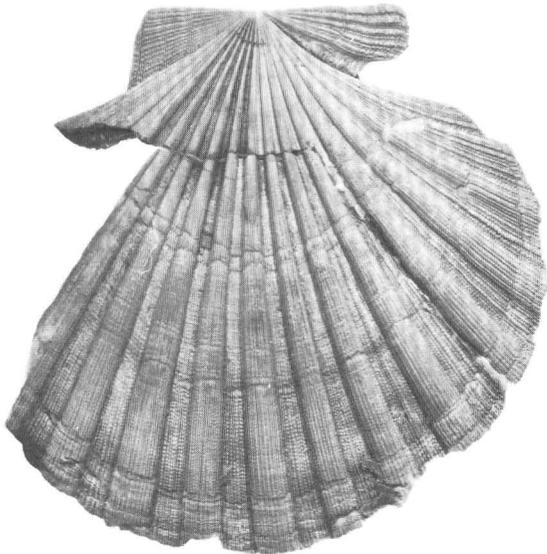
- FIGURES 1, 2. *Chesapecten nefrens* n. sp. (p. 9).
Right and left valves of articulated specimen (USNM 193443), paratype, from Camp
Conoy, Md. (USGS loc. 25299), length 134.3 mm.
- 3-6. *Chesapecten santamaria* (Tucker) (p. 11).
3. Right valve, lectotype, USNM 193448, from St. Marys River, Md. (USGS loc.
2342), height 124.7 mm.
4. Left valve, paratype, USNM 2498, from St. Marys River, Md., length 123.6 mm.
5, 6. Right valve, USNM 193444, from Essex Mill, Va., (USGS loc. 25058), length
129.0 mm.



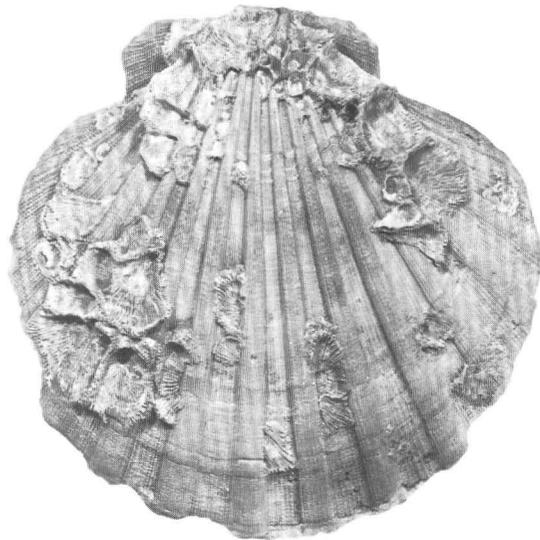
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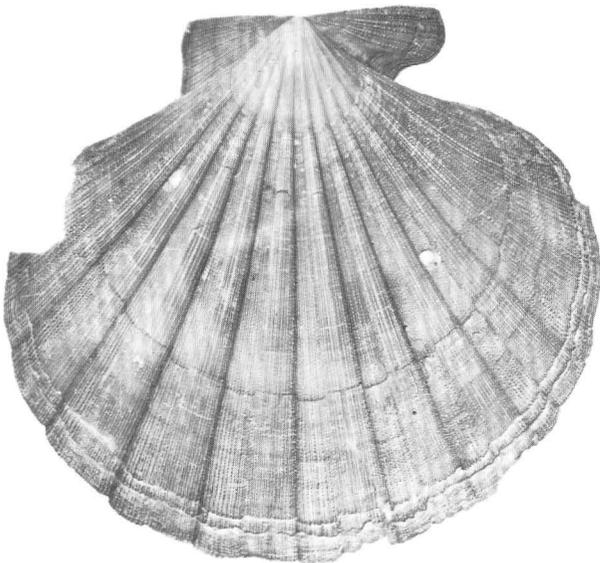
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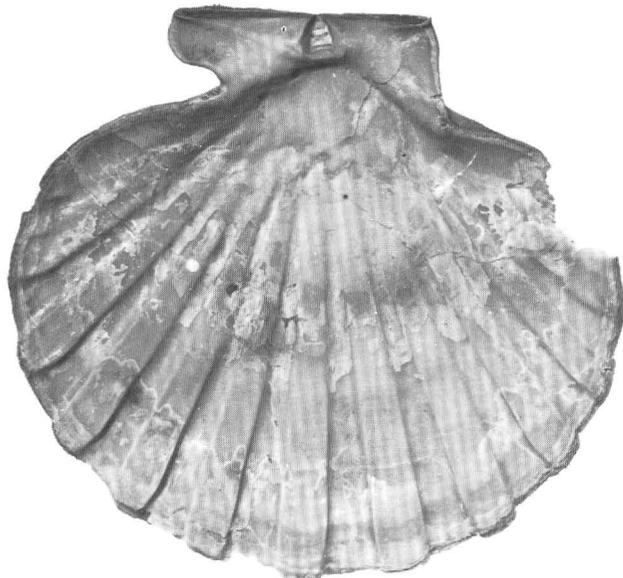
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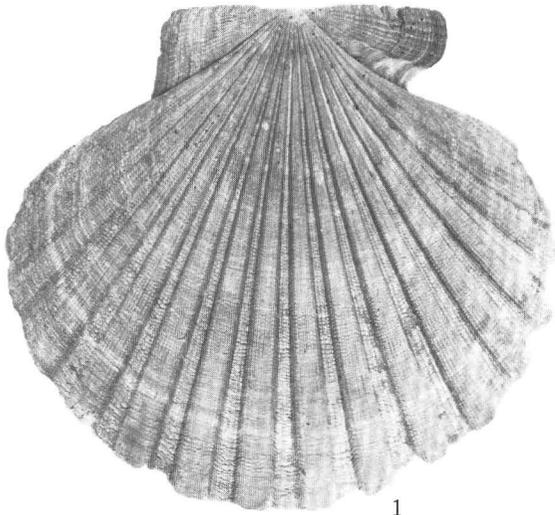


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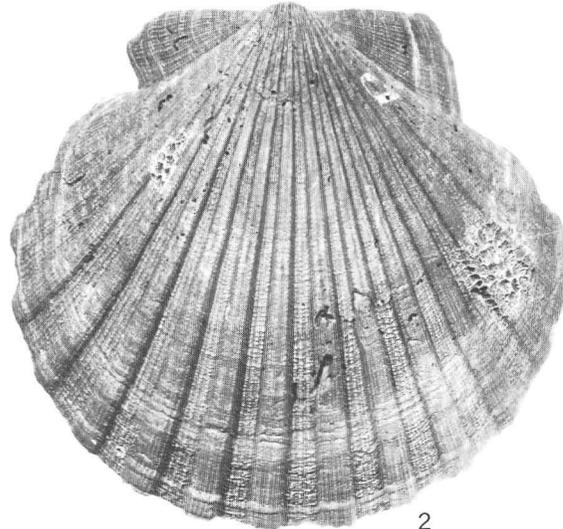
CHESAPECTEN NEFRENS N. SP. AND *C. SANTAMARIA* (TUCKER)

PLATE 5

- FIGURES 1, 2. *Chesapecten middlesexensis* (Mansfield) (p. 12).
1. Right valve, lectotype, USNM 373074, from Urbanna, Va. (USGS loc. 3915), length 140.7 mm.
 2. Left valve, paratype, USNM 207693, from Urbanna, Va. (USGS loc. 3915), length 154.1 mm.
- 3-7. *Chesapecten jeffersonius* (Say) (p. 13).
- 3, 4. Right and left valves, articulated specimen, USNM 193445, from Cobham Wharf, Va. (USGS loc. 25331), length 135.0 mm.
 - 5-7. Anterior, left, and right views of articulated specimen, lectotype, British Museum No. L13212, from Virginia, length 99.2 mm, height 93.1 mm.



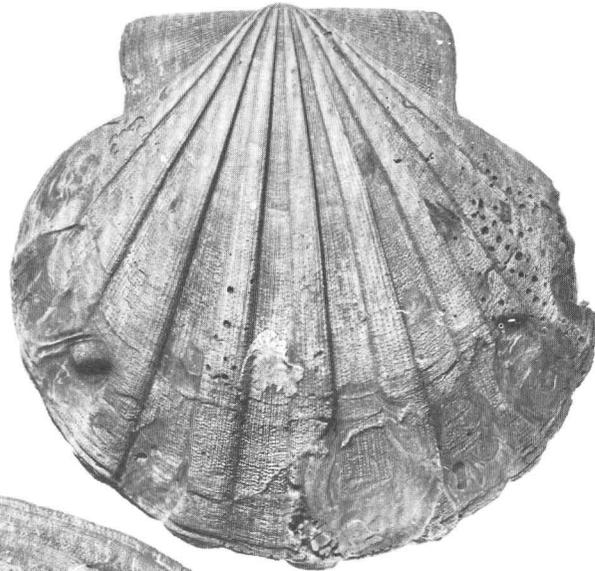
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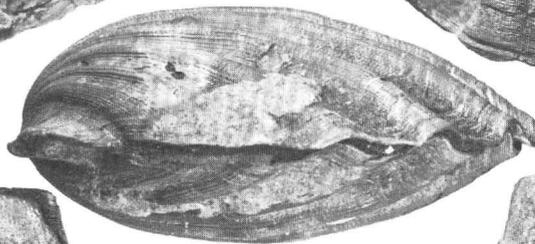
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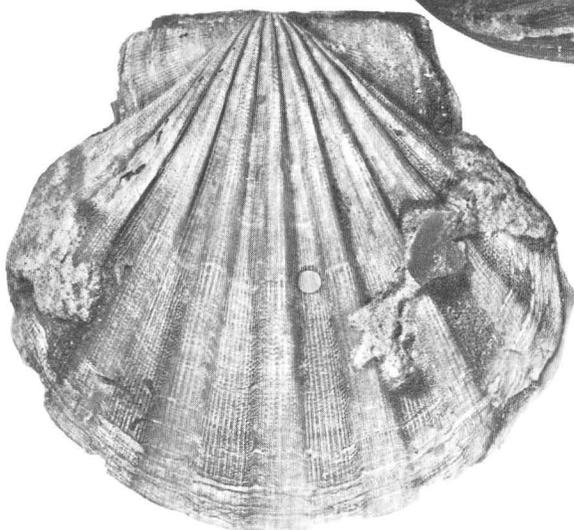
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7

CHESAPECTEN MIDDLESEXENSIS (MANSFIELD) AND *C. JEFFERSONIUS* (SAY)

PLATE 6

FIGURES 1-4. *Chesapecten madisonius* (Say) (p. 16).

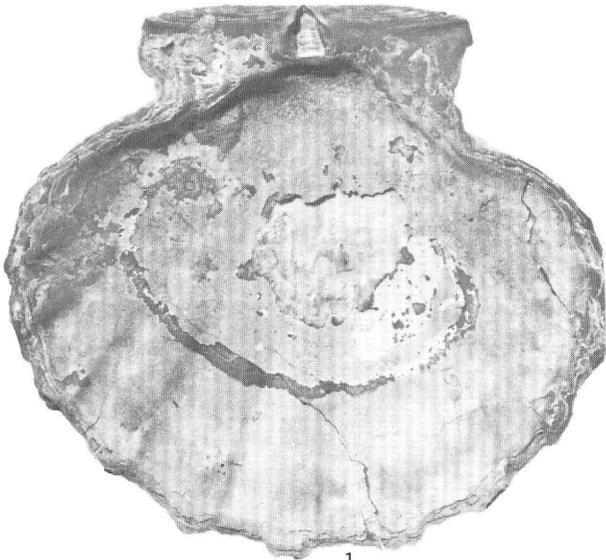
1, 2. Right valve, USNM 193447, from Cobham Wharf, Va. (USGS loc. 25336), length 112.8 mm.

3, 4. Left valve, lectotype (ANSP 31787), from Virginia, length 123.9 mm.

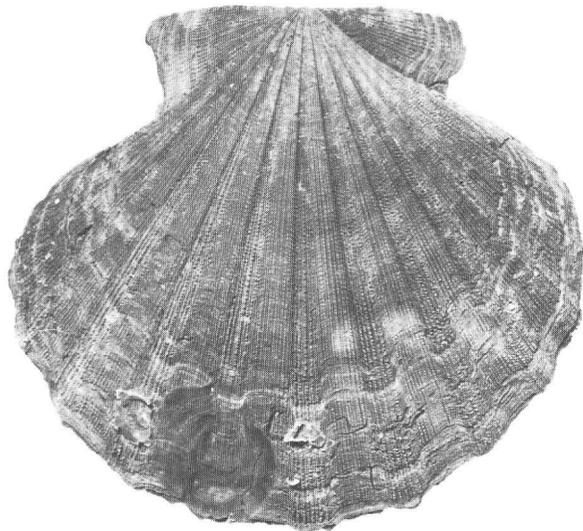
5-7. *Chesapecten septenarius* (Say) (p. 15).

5, 6. Left valve, holotype, British Museum No. L13197, from Virginia, length 64.9 mm.

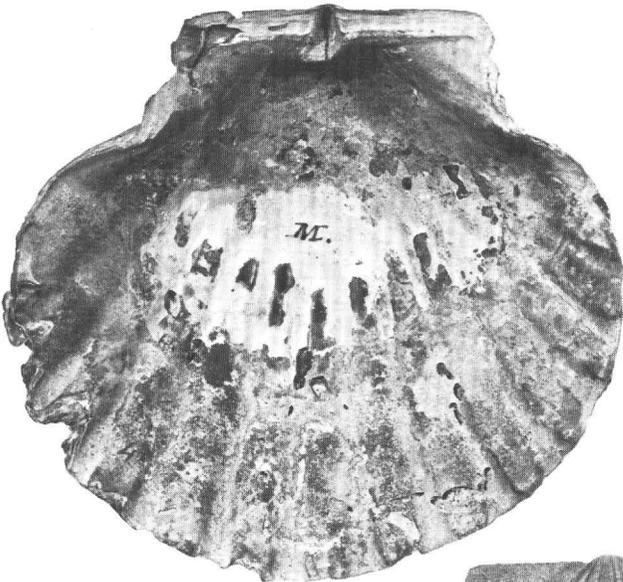
7. Right valve, USNM 193446, from Lee Creek mine, North Carolina (USGS loc. 25334), length 116.5 mm.



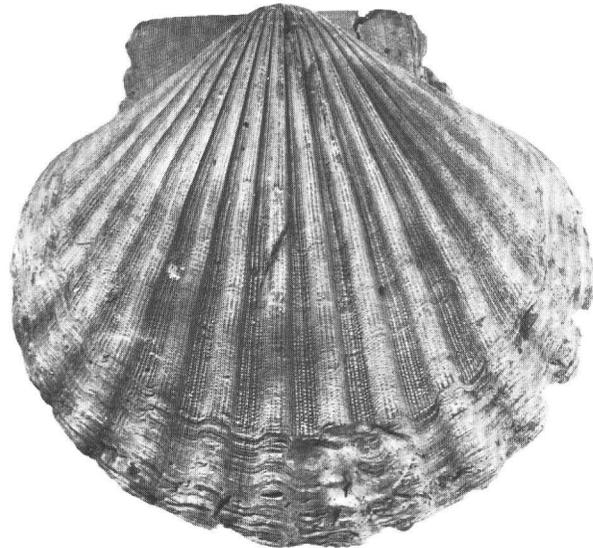
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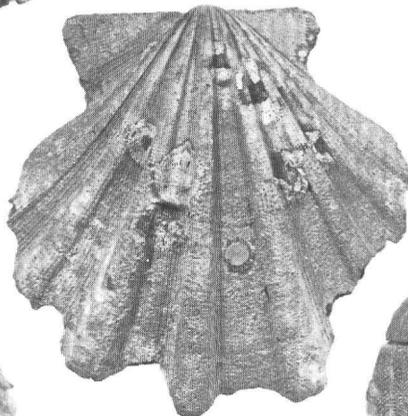
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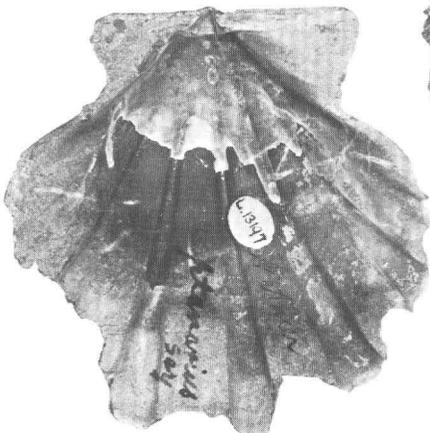
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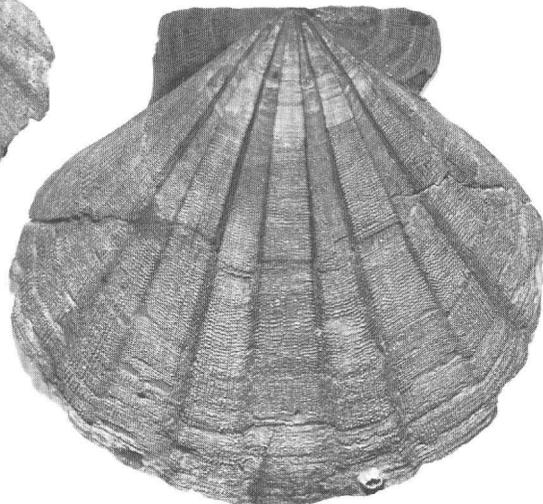
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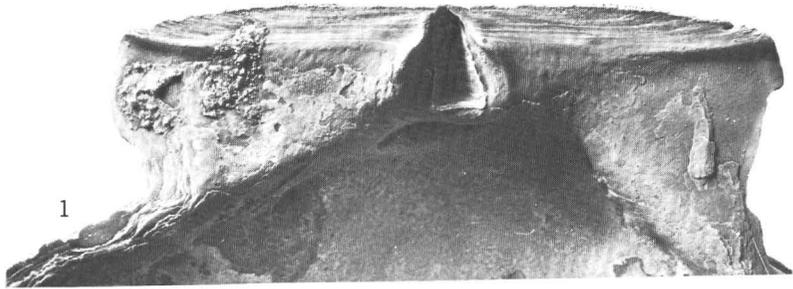


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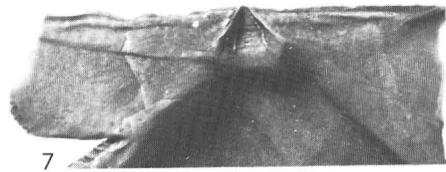
CHESAPECTEN MADISONIUS (SAY) AND *C. SEPTENARIUS* (SAY)

PLATE 7

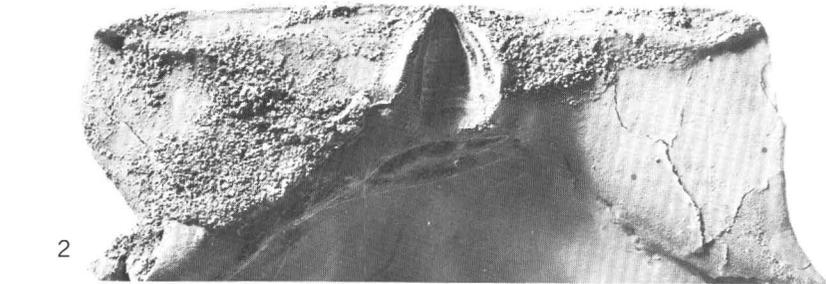
- FIGURES 1, 7, 8. *Chesapecten madisonius* (Say) (p. 16).
1, 8. Right valve, USNM 193447, from Cobham Wharf, Va. (USGS loc. 25336).
View of auricles (length of auricles along line of ligament 59.7 mm) and enlargement of 20 mm-long section of exterior sculpture near anterior margin.
7. Right valve, juvenile, British Museum No. LL27417, from the collection of John Finch, length of auricles along line of ligament 28 mm.
- 2, 9. *Chesapecten septenarius* (Say) (p. 15).
Right valve, USNM 193446, from Lee Creek mine, North Carolina (USGS loc. 25334). View of auricles (length of auricles along line of ligament 60.6 mm) and enlargement of 20 mm-long section of exterior sculpture near anterior margin.
- 3, 10. *Chesapecten jeffersonius* (Say) (p. 13).
Right valve, USNM 193445, from Cobham Wharf, Va. (USGS loc. 25331). View of auricles (length of auricles along line of ligament 80.6 mm) and enlargement of 20 mm-long section of exterior sculpture near anterior margin.
- 4, 11. *Chesapecten middlesexensis* (Mansfield) (p. 12).
Right valve, lectotype, USNM 373074, from Urbanna, Va. (USGS loc. 3915). View of auricles (length of auricles along line of ligament 68.3 mm) and enlargement of 20 mm-long section of exterior sculpture near anterior margin.
- 5, 12. *Chesapecten santamaria* (Tucker) (p. 11).
Right valve, USNM 193444, from Essex Mill, Va. (USGS loc. 25058). View of auricles (length of auricles along line of ligament 54.5 mm) and enlargement of 20 mm-long section of exterior sculpture near anterior margin.
- 6, 13. *Chesapecten nefrens* n. sp. (p. 9).
Right valve, paratype, USNM 193443, from Camp Conoy, Md. (USGS loc. 25299).
View of auricles (length of auricles along line of ligament 73.2 mm) and enlargement of 20 mm-long section of exterior sculpture near anterior margin.
- 14, 15. *Chesapecten coccymelus* (Dall) (p. 8).
14. Right valve, USNM 207692 from Camp Roosevelt, Md. (USGS loc. 25295). View of auricles (length of auricles along line of ligament 32.8 mm).
15. Left valve, holotype, USNM 87754, from Plum Point, Md. View of auricles (length of auricles along line of ligament 14.2 mm).



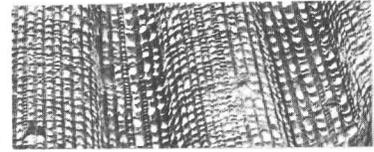
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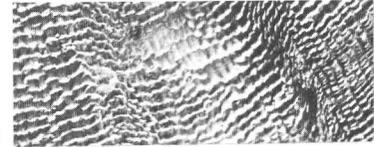
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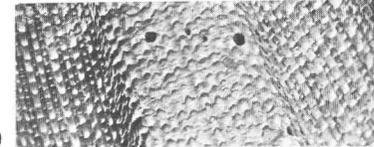
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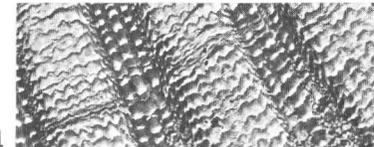
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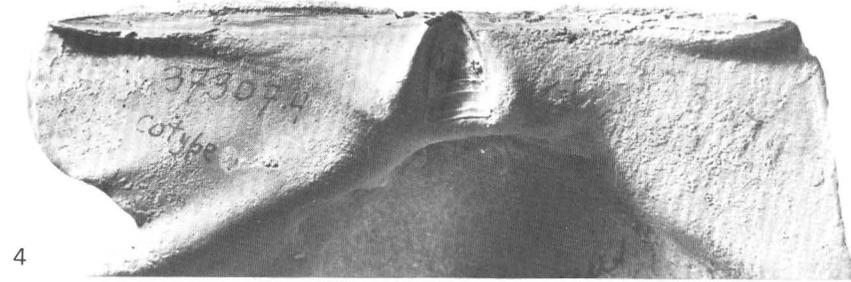
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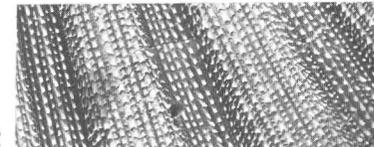
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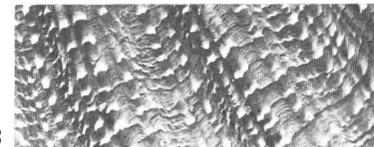
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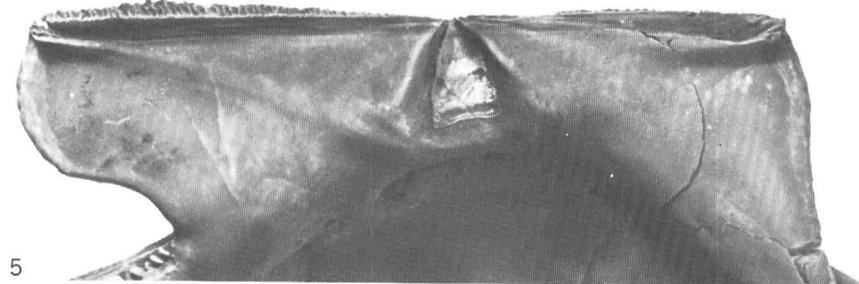
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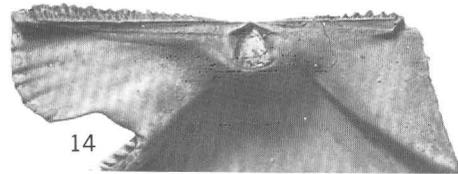
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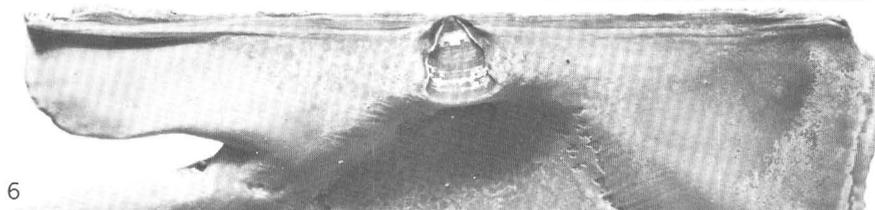
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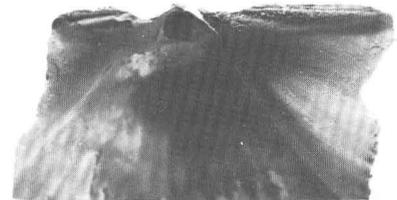
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15

CHESAPECTEN MADISONIUS, *C. SEPTENARIUS*, *C. JEFFERSONIUS*, *C. MIDDLESEXENSIS*,
C. SANTAMARIA, *C. NEFRENS*, AND *C. COCCYMELUS*

