AMERICAN TERTIARY MOLLUSKS OF THE GENUS CLEMENTIA

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INTRODUCTION

Aside from its value as an aid in determining the age of Tertiary beds, the chief interest of the genus *Clementia* lies in the anomalous features of its present and former distribution. An attempt is made in this paper to trace its geologic history, to point out its paleobiologic significance, and to describe all the known American Tertiary species.

The fossils from Colombia used in preparing this report were collected during explorations made under the direction of Dr. O. B. Hopkins, chief geologist of the Imperial Oil Co. (Ltd.), who kindly donated them to the United States National Museum. Dr. T. Wayland Vaughan, of the Scripps Institution of Oceanography, furnished information relating to specimens collected by him in Mexico. Dr. Bruce L. Clark, of the University of California; Dr. G. Dallas Hanna, of the California Academy of Sciences; Dr. H. A. Pilsbry, of the Philadelphia Academy of Natural Sciences; and Dr. W. D. Matthew, of the American Museum of Natural History, generously loaned type specimens and other material. Doctor Clark and Doctor Hanna also gave information concerning the Tertiary species from California. Mr. Ralph B. Stewart, of the University of California, read the manuscript, and I have taken advantage of his suggestions. I am also indebted to Mr. L. R. Cox, of the British Museum, for information relating to the fossil species from Persia, Zanzibar, and Burma, and to Dr. Axel A. Olsson, of the International Petroleum Co., for data concerning undescribed Tertiary species from Peru.

THE GENUS CLEMENTIA

CHARACTERISTIC FEATURES

Clementia is a clamlike bivalve mollusk of the family Veneridae, which embraces a large number of fossil and living mollusks, including the hard-shelled clam (*Venus mercenaria*) and others used for food. The most elaborately sculptured and most brilliantly colored shells of this family are found in the tropical seas. The hinge and pallial sinus of this genus are its most characteristic features, as in other genera of the Veneridae. Although these features are rarely seen on fossil specimens, *Clementia* has a characteristic sculpture consisting of *Inoceramus*-like waves—a feature that suggested the name of one of the American species. *Mactra* (*Harvella*), which may be confused with *Clementia* on the basis of sculpture, belongs to the family Mactridae and has an entirely different hinge. Even if the hinge can not be seen, *Harvella* can easily be recognized, as its shell is almost equilateral, whereas almost all species of *Clementia* are very inequilateral. *Harvella* also has a sharp-crested ridge extending from the umbo to the posterior ventral edge of the shell. This ridge may not be visible on internal molds, but the shallow furrow that lies in front of it can be seen. No species of *Clementia* has either ridge or furrow. The mactroid genera *Pteropsis* and *Labiosa* (*Raeta*), which have *Clementia*-like sculpture, can readily be distinguished by their shape and other features.

The shell of most species of *Clementia* is thin and fragile. Many fossil specimens are crushed and distorted, and generally they are preserved as internal molds to which parts of the shell may cling. The thin shell and closely interlocking hinge partly account for the scarcity of detached valves that show the hinge. Most of the fossils are internal molds of both valves in attached position.

PRESENT DISTRIBUTION

The living species of *Clementia* listed on page 26 have been described. There is no modern revision of the genus, and some of the names in the list, which is probably incomplete, may be duplicates.

The present range of the subgenera *Clementia* s. s. and *Egesta* is diagrammatically shown in Figure 1. The living species of *Clementia* s. s. are strung out in the western Pacific from Japanese waters southward to Tasmania. Species also are recorded from the Indian Ocean, the Red Sea, and South Africa. Most of these living Clementias are concentrated in the region from the Philippine Islands southward to Australia and in the Indian Ocean—that is, they are found in the tropical waters of the western Pacific and Indian Oceans and also in the cooler waters of southern Australia. Though the range of *Clementia* s. s. is probably continuous from Tasmania and Australia northward to Japan and westward along the border of the Indian Ocean, it is plotted in Figure 1 only at localities for which records could be found. There seem to be only two living species of *Egesta*, one in the waters off Japan and Chosen and the other in the Gulf of California.

Living species of Clementia

Species	Type locality
Clementia (Clementia) hyalina (Philippi) [a]	Philippine Islands (?).
Clementia (Clementia) similis Sowerby [b]	Philippine Islands.
Clementia (Clementia) granulifera Sowerby [c]	Do.
Clementia (Clementia) papyracea (Gray) [d]	Australia.
Clementia (Clementia) strangei Deshayes [e]	Do.
Clementia (Clementia) moretonensis Deshayes [f]	Do.
Clementia (Clementia) tasmanica Petterd [g]	Tasmania.
Clementia (Clementia) vitrea (Chemnitz) [h]	Indian Ocean.
Clementia (Clementia) crassiplica (Lamarck) [i]	Indian Ocean (?).
Clementia (Clementia) annandalei Preston [j]	Indian Ocean.
Clementia (Clementia) cumingii Deshayes [k]	Red Sea.
Clementia (Clementia) mcclellandi Tomlin [l]	South Africa.
Clementia (Egesta) vatheliti Mabille [m]	Japan.
Clementia (Egesta) solida Dall [n]	Gulf of California.

[a] Philippi, R. A., Abbildungen und Beschreibungen neuer oder wenig gekannten Conchylien, vol. 3, p. 83, *Venus*, pl. 10 (XXII, 5), fig. 6, 1851.
[b] Sowerby, G. B., Thesaurus Conchyliorum, pt. 13, pp. 700–701, pl. 151, fig. 156, 1852.
[c] Idem, p. 701, pl. 151, fig. 154.
[d] Gray, J. E., A list and description of some species of shells not taken notice of by Lamarck: Ann. Philosophy, new ser., vol, 9, p. 137, 1825. Wood, W., Supplement to the Index Testaceologicus, p. 5, pl. 2, fig. 8, 1828.
[e] Deshayes, G. P., Descriptions of two new species of *Clementia* in the collection of Hugh Cuming, Esq.: Zool. Soc. London Proc., pt. 21, p. 17, 1853.
[f] Idem, p. 18.
[g] Petterd, W. F., Description of new Tasmanian shells: Jour. Conchology, vol. 4, p. 145, 1884.
[h] Chemnitz, J. H., Neues systematisches Conchylien-Cabinet, vol. 11, p. 219, pl. 200, figs. 1959–1960, 1795.
[i] Lamarck, M. le Chevalier de, Histoire naturelle des animaux sans vertèbres, vol. 5, p. 471, 1818. Lamy, Édouard, Révision des Mactridae vivants du Muséum d'histoire naturelle de Paris: Jour. Conchyliologie, vol. 63, pp. 273, 363, pl. 7, fig. 8, 1917.
[j] Preston, H. B., Mollusca from the Chilka Lake on the east coast of India: Indian Mus. Rec., vol. 10, p. 306, figs. 14, 14 *a*, *b*, 1914.
[k] Deshayes, G. P., Descriptions of new shells from the collections of Hugh Cuming, Esq.: Zool. Soc. London Proc., pt. 22, p. 346, 1854.
[l] Tomlin, J. R. le B., Six new marine shells from South Africa: Jour. Conchology, vol. 16, p. 215, pl. 8, fig. 6, 1921.
[m] Mabille, Jules, Testarum novarum diagonoses: Soc. philomathique Paris Bull., 9th ser., vol. 3, pp. 57–58, 1901. Jukes-Browne, A. J., On a new species of *Clementia:* Annals and Mag. Nat. Hist., 8th ser., vol. 12, pp. 61–62, pl. 1, figs. 3–4, 1913.
[n] Dall, W. H., Synopsis of the family Veneridae and of the North American Recent species: U. S. Nat. Mus. Proc., vol. 26, pp. 401–402, pl. 14, fig. 4, 1902.

Jukes-Browne [1] described as *Clementia obliqua* a shell that was supposed to have been collected at Mayaguez, Porto Rico. Dall [2] showed that this shell not only is not a *Clementia* but must have been collected on the Pacific coast of North America, for it is the species described by Carpenter [3] in 1865 as *Clementia? subdiaphana*, now referred to the genus *Marcia*. Jukes-Browne [4] admitted the error as to locality, but still considered *Marcia subdiaphana* a species of *Clementia*.

GEOLOGIC HISTORY

The localities where Tertiary species of *Clementia* s. s. and *Egesta* have been found are shown diagrammatically in Figure 1. So far as known Tertiary species of *Egesta* are confined to the United States and Mexico. *Clementia* s. s. was more widely distributed particularly in America and the Orient. In America a suite of Eocene, Oligocene, and Miocene species has been collected at several localities extending from Brazil and Trinidad to Costa Rica along the Atlantic and Caribbean coasts, and from Peru to Costa Rica along the Pacific coast. The middle Miocene (Helvetian) marls of St. Florian (or Grosse Florian) in the Gratz Basin, province of Styria, Austria, carry the only European Tertiary species, *Clementia* (*Clementia*) *ungeri* (Rolle).[5] Furthermore, this is the only locality in Europe where this species has been found. According to Rolle's figures of the exterior and right hinge, *Clementia* (*Clementia*) *ungeri* closely resembles the small living oriental species. Fuchs [6] described as "*Venus* (*Clementia*) cf. *ungeri* Rolle" molds that were collected from middle Miocene beds cropping out in the Siwah oasis, in the Libyan Desert. In contrast to these isolated finds in Europe and north Africa, *Clementia* s. s. has been recorded at the localities in the Orient and east Africa listed on page 28. The names used in the list are those given by the writers cited, most of whom regard these Tertiary Clementias as representing living species.

[1] Jukes-Browne, A. J., On a new species of *Clementia:* Annals and Mag. Nat. Hist., 8th ser., vol. 12, pp. 58–62, pl. 1, figs. 1–2, 1913.

[2] Dall, W. H., Note on *Clementia obliqua* Jukes-Browne: Nautilus, vol. 27, pp. 103–104, 1914.

[3] Carpenter, P. P., Diagnoses specierum et varietatum novarum Moluscorum, prope Sinum Pugetianum a Kennerlio Doctore, nuper decesso, collectorum: Acad. Nat. Sci. Philadelphia Proc., vol. 17, p. 56, 1865.

[4] Jukes-Browne, A. J., Note on *Clementia subdiaphana* Carpenter: Annals and Mag. Nat. Hist., 8th ser., vol. 13, pp. 338–339, 1914.

[5] Rolle, Friedrich, Die tertiären und diluvialen Ablagerungen in der Gegend zwischen Gratz, Köflach, Schwanberg und Ehrenhausen in Steiermark: K.-k. geol. Reichsanstalt Jahrb., vol. 7, p. 572, 1856; Über einige neue oder wenig gekannte Mollusken-Arten aus Tertiär-Ablagerungen: K. Akad. Wiss. Wien Sitzungsber., Math.-Naturwiss. Classe, vol. 44, pt. 1, pp. 215–217, pl. 2, figs. 1, 1*a*, 2, 2*a*, 1862.

[6] Fuchs, Theodor, Beiträge zur Kenntnis der Miocaenfauna Aegyptens und der Libyschen Wüste, in Zittel, K. A., Beiträge zur Geologie und Palaeontologie der Libyschen Wüste und der angrenzenden Gebiete von Aegypten, pt. 2: Palaeontographica, vol. 30, pt. 1, p. 39 (p. 21), pl. 6, fig. 9, 1883.

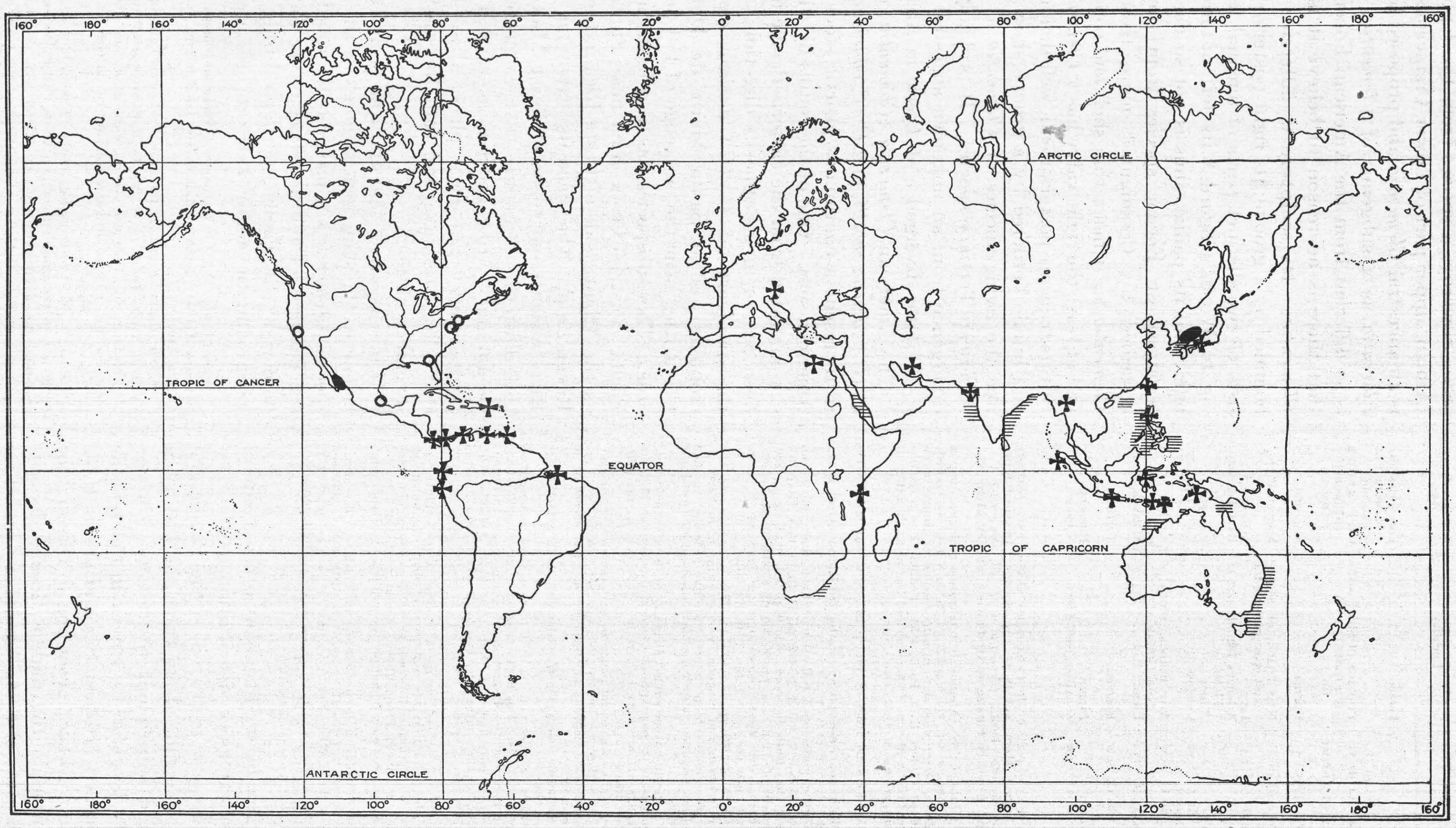


FIGURE 1.—Map showing present range and former distribution of *Clementia* s. s. and *Egesta*. Present range: *Clementia* [s. s., lined areas; *Egesta*, solid black areas. Tertiary localities: *Clementia* s. s., crosses; *Egesta*, circles

Oriental and east African Tertiary species of Clementia s. s.

Species	Locality	Age
Clementia sp.[a]	Persia	Fars series (late Miocene or Pliocene).
Clementia nonscripta (J. de C. Sowerby).[b]	Province of Sind, western India.	Gaj group (Miocene).
Clementia hyderabadensis (d'Archiac and Haime.)[c]	do	Do.
Clementia nonscripta (J. de C. Sowerby).[d]	Burma	Miocene.
Clementia nonscripta (J. de C. Sowerby).[e]	Nias Island, off southwest coast of Sumatra.	Miocene(?).
Clementia papyracea (Gray)[f]	Java	Miocene.
Clementia papyracea (Gray)[g]	Adenara Island, east of Flores.	Late Tertiary.
Clementia papyracea (Gray)[h]	Timor	Pliocene.
Clementia nonscripta (J. de C. Sowerby)[i] [C. papyracea (Gray)][j]	Celebes	Late Tertiary.
Clementia nonscripta (J. de C. Sowerby) var.?[k]	Aru Islands, south of New Guinea.	Do.
Clementia papyracea (Gray)[l] [C. hyalina (Philippi)][m]	Luzon, P. I.	Miocene.
Clementia nonscripta (J. de C. Sowerby).[n]	Formosa	Tertiary.
Clementia speciosa Yokoyama[o]	Japan	Pliocene.
Clementia nonscripta (J. de C. Sowerby).[p]	Zanzibar, east Africa	Miocene.

[a] Pilgrim, G. E., The geology of parts of the Persian provinces of Fars, Kirman, and Laristan: India Geol. Survey Mem., vol. 48, pt. 2, p. 89, 1924. In 1908 Pilgrim listed "*Clementia* n. sp. aff. *cumingii* Desh., *Clementia* n. sp. aff. *non scripta* d'A. & H., and *Clementia* n. sp." from the Fars series (India Geol. Survey Mem., vol. 34, pt. 4, p. 46, 1908).

[b] Sowerby, J. de C., in Grant, C. W., Memoir to illustrate a geological map of Cutch: Geol. Soc. London Trans., 2d ser., vol. 5, p. 327, pl. 25, fig. 8, 1840. D'Archiac, le Vicomte, and Haime, Jules, Description des animaux fossiles du groupe Nummulitique de l'Inde, p. 246, pl. 17, figs. 7, 7*a*, Paris, 1853. Fedden, J., On the distribution of the fossils described by Messrs. D'Archiac and Haime in the different Tertiary and Infra-Tertiary groups of Sind: Geol. Survey India Mem., vol. 17, p. 202, 1880.

[c] D'Archiac, le Vicomte, and Haime, Jules, op. cit., p. 247, pl. 17, figs. 8, 8a. Fedden, J., op. cit.

[d] Cox, L. R., Some late Kainozoic Pelecypoda from the Aru Islands: Geol. Mag., vol. 61, No. 716, p. 63, 1924.

[e] Woodward, Henry, Further notes on a collection of fossil shells, etc., from Sumatra, pt. 2: Geol. Mag., decade 2, vol. 6, p. 442, pl. 11, fig. 3, 1879. Reprint, Mijnwezen in Nederlandsch Oost-Indië Jaarboek, year 9, p. 224, pl. 3, fig. 3, 1880.

[f] Martin, K., Die Tertiärschichten auf Java, pp. 99–100, pl. 17, figs. 6, 6*a*, Leiden, 1879–80; Die altmiocäne Fauna des West-Progogebirges auf Java, pt. B: Geol. Reichs-Mus. Leiden Samml., new ser., vol. 2, No. 7, p. 273, 1917.

[g] Martin, K., op. cit. (1879–80), p. 100; op. cit. (1917), p. 273.

[h] Boettger, O., Liste die tertiären und jüngeren Versteinerungen, in Verbeek, R. D. M., Geologische verkenningstochten in het oostelijke gedeelte van den Nederlandsch Oost-Indischen Archipel: Mijnwezen in Nederlandsch Oost-Indië Jaarboek, year 37, p. 669, 1908.

[i] Dollfus, G. F., Paléontologie du voyage à l'île Célèbes de M. E. C. Abendanon, in Abendanon, E. C., Geologische en geographische Doorkruisingen van Midden-Celebes, vol. 3, p. 994, pl. 1, figs. 817, 818, 818*a*, Leiden, 1917. (French ed., pp. 1012–1013, pl. 1, figs. 817, 818, 818*a*, Leiden, 1918.)

[j] Martin, K., Bemerkungen über sogenannt oligocäne und andere Versteinerungen von Celebes: Geol. Reichs-Mus. Leiden Samml., new ser., vol. 2, No. 7, p. 301, 1917. Dollfus considered these deposits of Oligocene age, but according to Martin they are Miocene or later.

[k] Cox, L. R., Some late Kainozoic Pelecypoda from the Aru Islands: Geol. Mag., vol. 61, No. 716, p. 62, fig. 4, 1924.

[l] Martin, K., Über Tertiaere Fossilien von den Philippinen: Geol. Reichs-Mus. Leiden Samml., vol. 5, pp. 57, 59, 1896. English translation, Concerning Tertiary fossils in the Philippines, in Becker, G. F., Report on the geology of the Philippine Islands: U. S. Geol. Survey Twenty-first Ann. Rept., pt. 3, pp. 618, 619, 1901. Smith, W. D., Contributions to the stratigraphy and fossil invertebrate fauna of the Philippine Islands: Philippine Jour. Sci., vol. 8, sec. A, p. 272, pl. 7, fig. 5, pl. 8, fig. 3, 1913.

[m] Dickerson, R. E., A fauna of the Vigo group; its bearing on the evolution of marine molluscan faunas: Philippine Jour. Sci., vol. 18, p. 12, 1921. Reprint under title, Notes on a fauna of the Vigo group and its bearing on the evolution of marine molluscan faunas: California Acad. Sci. Proc., 4th ser., vol. 11, p. 15, 1921.

[n] Cox, L. R., Some late Kainozoic Pelecypoda from the Aru Islands: Geol. Mag., vol. 61, No. 716, p. 63, 1924.

[o] Yokoyama, M., Tertiary Mollusca from Deinichi in Totomi: Tokyo Imp. Univ. Coll. Sci. Jour., vol. 45, art. 2, p. 15, pl. 2, figs. 14–15, 1923 (I have not seen this report); Mollusca from the Tertiary basin of Chichibu: Tokyo Imp. Univ. Faculty Sci. Jour., sec. 2, vol. 1, pt. 3, p. 119, pl. 14, fig. 7, 1925; Molluscan fossils from the Tertiary of Mino: Idem, pt. 7, p. 222, 1926.

[p] Cox, L. R., op. cit. and written communication.

Clementia s. s. and *Egesta*, like many other groups of mollusks, had an extensive distribution in the Tertiary seas, but are now restricted to the Pacific and Indian Oceans. It is difficult to trace the history of this expansion and subsequent restriction. Characteristic species of *Clementia* s. s. appear in the deposits of the middle Eocene Caribbean Sea and also in those of the eastern Pacific, where, according to Olsson,[7] the genus is represented in the middle Eocene deposits of Peru. The ancestry of these American Clementias is unknown. Jukes-Browne[8] suggested that *Venus ovalis* Sowerby, a species from the Upper Greensand (Albian, upper part of Lower Cretaceous) of England, is an ancestral *Clementia* and proposed for it the name *Flaventia* as a subgenus of *Clementia*. This species is so different from the American Eocene Clementias that there is no reason to believe it is an ancestral *Clementia*. Its sculpture is different; its lunule is bounded by a groove; its right posterior cardinal consists of two distinct parts of unequal length; according to Woods's figures,[9] its left anterior cardinal is bifid; and its pallial sinus is not so deep. *Clementia deshayesi*, an Eocene species from the Paris Basin described by Cossmann[10] more closely resembles *Clementia*, as it has a thin shell and concentric waves, and at least the right valve has a *Clementia*-like hinge. But its truncate posterior end, well-defined escutcheon, and lunule bordered by a groove show that it is not like the living species of *Clementia* s. s. or like the American Tertiary species. It probably represents a divergence from an unknown ancestral stock, similar to the later divergence of *Egesta* in American waters.

The American *Clementia* (*Clementia*) *dariena vetula*, *C.* (*C.*) *dariena rabelli*, and *C.* (*C.*) *dariena dariena* seem to represent a continuous genetic stock developed in American seas. One of the routes by which *Clementia* s. s. migrated from the eastern Pacific into the Caribbean Sea, or in the opposite direction, is indicated by the discovery of *C.* (*C.*) *dariena dariena* in beds cropping out at Santa Maria de Dota, in central Costa Rica near the east edge of the province of San Jose. This subspecies has also been collected on the Pacific coast of Costa Rica near Punta Arenas and on the Atlantic side of Costa Rica in the valley of Rio Revantazon. The deposits extending across Costa Rica, which seem to be of lower Miocene age, were laid down in a channel that connected the Pacific Ocean and Caribbean Sea, as several writers have pointed out.[11] At most places these beds are concealed by later lava and tuff, but they crop out at several localities.

If it is assumed that the American Tertiary species belong to the same genetic stock as the living oriental species, *Clementia* s. s. probably migrated from the eastern Pacific to the oriental region by way of the north border of the Pacific, perhaps during Eocene time, when climatic zones were not so marked as now.

[7] Olsson, A. A., written communication.

[8] Jukes-Browne, A. J., On the genera of Veneridae represented in the Cretaceous and older Tertiary deposits: Malacol. Soc. London Proc., vol. 8, pp. 167–169, pl. 6, fig. 10, 1909.

[9] Woods, Henry, A monograph of the Cretaceous Lamellibranchia of England, vol. 2, pt. 5, pp. 191–192, pl. 29, figs. 19–26, Palaeontographical Soc., 1908.

[10] Cossmann, M., Catalogue des coquilles fossiles de l'Eocène des environs de Paris: Soc. roy. malacol. Belgique Annales, vol. 21 (4th ser., vol. 1), pp. 127–128, pl. 7, figs. 1–2, 1886.

[11] Gabb, W. M., On the geology of the Republic of Costa Rica (manuscript in library of U. S. Geological Survey), pp. 45–46. Alfaro, Anastasio, Comprobaciones geológicas: Bol. de Fomento, year 1, pp. 123–124, 1911. Romanes, James, Geology of a part of Costa Rica: Geol. Soc. London Quart. Jour., vol. 68, p. 137, 1912. Olsson, A. A., The Miocene of northern Costa Rica: Bull. Am. Paleontology, vol. 9, pp. 205–206, 1922.

This supposition is not confirmed by fossil occurrences, for no Tertiary species are known in the north Pacific, and in the Orient the earliest species that are definitely dated are of Miocene age. For some unknown reason after Miocene time this subgenus disappeared in the Caribbean Sea and in the eastern Pacific.

Clementia (*Clementia*) *ungeri*, which is recorded from Miocene beds in Egypt and Austria, probably represents a temporary Miocene invasion of oriental mollusks into the Mediterranean Sea. This invasion is attested by other genera, such as *Cancellaria* (*Scalptia*), *Cancellaria* (*Ventrilia*), *Mitra* (*Thala*), *Stossichia*, group of *Turritella terebralis*,[12] and *Placuna*. Dr. A. Morley Davies, of the Imperial College of Science and Technology, who has recently discussed some of the evidence for this invasion,[13] kindly called attention to these oriental genera that are found in Mediterranean Miocene deposits but not in earlier deposits in the Mediterranean region. There is a possibility that some of these genera represent a migration in the opposite direction, but it is more probable that they are autochthonous in oriental seas.

Egesta apparently represents a divergence from the American stock of Clementias. It first appeared in the Gulf of Mexico in Miocene time and in California apparently at almost the same time. Its route of migration across America is not known. It has not been found in the Caribbean region, and apparently the route lay farther north, perhaps in the Isthmus of Tehuantepec. During late Miocene time it migrated out of the Gulf of Mexico as far north as the Chesapeake embayment and New Jersey. For some unknown reason it then disappeared in Atlantic waters, but it remained in the eastern Pacific, where it is now found in the Gulf of California. Inasmuch as an *Egesta* that is similar to the fossils of the southeastern United States is now found in Japanese waters, it is assumed to represent a migration around the north border of the Pacific during late Tertiary time, though again no fossil records substantitate this supposition. This group of Egestas is unrepresented in the Tertiary deposits of California, and it is also not represented at the present time in the eastern Pacific. A second phylum of *Egesta*, typified by *Clementia* (*Egesta*) *pertenuis*, is found only as Miocene and Pliocene fossils in California. A third phylum seems to be represented by *C.* (*E.*) *conradiana*, a Miocene species from California, and *C.* (*E.*) *solida*, now living in the Gulf of California.

PALEOBIOLOGIC SIGNIFICANCE

There seem to be no records of the conditions under which *Egesta* lives. Dredging records of *Clementia* s. s. that could be gathered from published accounts are as follows:

Dredging records of Clementia s. s.

Species	Locality	Depth (fathoms)	Character of bottom
Clementia (Clementia) granulifera Sowerby. [a]	Manila Bay, Philippine Islands.	4-6	Sandy mud.
Clementia (Clementia) papyracea (Gray). [b]	Torres Strait, south of New Guinea.	3-11	
Clementia (Clementia) tasmanica Petterd. [c]	Off Long Bay and Brown's River, Tasmania.	7	
Clementia (Clementia) annandalei Preston. [d]	Lake Chilka and other localities, India.	1-2	Mud.

[a] Sowerby, G. B., Thesaurus conchyliorum, pt. 13, p. 701, 1852.
[b] Smith, E. A., Report on the Lamellibranchiata: *Challenger* Rept., Zoology, vol 13, pt. 35, p. 154, 1885.
[c] Petterd, W. F., Description of new Tasmanian shells: Jour. Conchology, vol. 4, p. 145, 1884.
[d] Preston, H. B., Mollusca from the Chilka Lake on the east coast of India: Indian Mus. Rec., vol. 10, p. 306, 1914. (Lake Chilka is a lagoon of salt water connected with the sea.)

Through the kindness of Dr. Paul Bartsch, curator of the division of mollusks of the United States National Museum, the following records are given of unstudied specimens of *Clementia* s. s. collected by the United States Bureau of Fisheries steamer *Albatross* in the seas adjoining the Philippine Islands.

Dredging records of Clementia s. s. collected by U. S. Bureau of Fisheries steamer Albatross in Philippine waters

Station	Locality	Number of specimens	Depth (fathoms)	Character of bottom
5164	Off Tawi Tawi Island, Sulu Archipelago.	1 right valve	18	Green mud.
5593	Sibuko Bay, Borneo	1 right valve	38	Fine sand.
5358	Off Sandakan Light, Borneo	3 right valves, 1 left valve.	39	Mud.
5235	Nagubat Island, east coast of Mindanao, Philippine Islands.	1 right, 1 left valve.	44	Soft mud.
5311	China Sea, off Pratas Island	1 left valve	88	Coarse sand and shells.

None of these records show whether living or dead shells were collected. Probably all the shells were dead, but it is not likely that these paper-thin shells were carried far by waves or currents. According to these records *Clementia* s. s. lives in protected shallow water at depths of 1 to 11 fathoms, or in quiet deeper water in exposed localities at depths of 18 to 88 fathoms. In both the shallow and the deeper water it is generally found on a bottom of mud or fine sand. This habitat is in harmony with the thin texture of the shell. No observations have been made on living shells, but the deep pallial sinus and the statement by Deshayes[14] to the effect that *Clementia* s. s. has long united siphons show that it burrows in the mud or fine sand.

Clementia s. s. lives in sea water of normal salinity and also in water of low salinity. According to Stoliczka,[15] two unnamed species were collected in brackish water

[12] Guillaume, L., Essai sur la classification des Turritelles, ainsi que sur leur évolution et leurs migrations, depuis la début des temps tertiaires: Soc. géol. France Bull., 4th ser., vol. 24, pp. 300-302, 1924.

[13] Wayland, E. J., and Davies, A. M., The Miocene of Ceylon: Geol. Soc. London Quart. Jour., vol. 79, pp. 588-589, 591, 1923.

[14] Deshayes, G. P., Catalogue of the Conchifera or bivalve shells in the collection of the British Museum, pt. 1, p. 197, 1853. This statement seems to be the basis for the accounts in the manuals.

[15] Stoliczka, F., Cretaceous fauna of southern India, vol. 3, Pelecypoda. Geol. Survey India Mem., Palaeontographica Indica, 6th ser., pts. 1-4, p. 158, 1871.

near Calcutta, and Preston[16] recorded *C.* (*C.*) *annandalei* from Port Canning, in the Gangetic delta.

No field studies have been made with the object of gathering data on the manner in which the American fossil species of *Clementia* s. s. lived and died, but their occurrence confirms the assumption that they lived under essentially the same conditions as the present living species, with the exception that there is no evidence to show that the fossil species tolerated water of low salinity. In the whole Caribbean region *Clementia* is found in beds of mud, which may be calcareous, and in fine sand, but not in coarse sand or gravel nor in reef limestones. This bottom control explains its absence in many parts of the Carribbean region. The Eocene beds in Colombia carrying *Clementia* are mud deposits, but no specimens have been collected from widespread Eocene reef limestones of the Caribbean region. In Porto Rico *Clementia* is found in the mud beds at the base of the Tertiary deposits, which are of middle Oligocene age, and not in the overlying limestones. Elsewhere in the Caribbean region deposits of middle Oligocene age are reef limestones, in which *Clementia* has never been found. The mud beds in the Gatun formation of the Panama Canal Zone carry more specimens than any other Tertiary deposit in the Caribbean region. Along the Caribbean coast of Costa Rica *Clementia* is not found in the coralliferous limestones of the Gatun formation nor in the strand sandstones or conglomerates, nor in the coastal-swamp muds, but only in the mud or fine sand that was deposited between the reefs and the strand. Bottom control excludes *Clementia* from the middle Miocene Bowden formation of Jamaica, which carries a fauna of species that lived on a gravelly or sandy bottom at depths ranging from the intertidal zone to about 200 fathoms. In Venezuela and Brazil specimens are found in limestones or in less calcareous mud beds. It is strange that no Clementias have been discovered in the Miocene mud deposits of the Dominican Republic and the Republic of Haiti, although hundreds of species of mollusks and thousands of shells have been collected from these beds. They carry many large, heavy shells, and the water in which they were deposited may have been too much agitated. This explanation is not entirely satisfactory, for it is unreasonable to believe that the water was nowhere in this area quiet enough to permit these mollusks to live.

These burrowing shells apparently lived and died and were buried at or close to the place where they now are found—that is, their occurrence is autochton, to use the nomenclature introduced by Ehrenberg.[17] They are almost invariably found with both valves in attached position, indicating that they remained buried in the mud or fine sand in which they burrowed while they were alive. If they had lain unburied for some time on the sea bottom the valves would now gape or would be separated, depending on whether they were buried before or after the ligament decayed. If these thin shells had been washed about they would soon have been broken up. Unfortunately there are no confirmatory data with regard to the orientation of the shells in the deposits from which they have been collected.

The heavier shells of *Egesta* are in harmony with their occurrence in sands and sandstones, though they are also found in marls. Some of the sandstones in California that carry *Egesta* are coarse, but generally specimens are not found in pebbly sandstones or conglomerates. These mollusks burrowed in sand or mud. Their shells may at times have been carried by waves and currents some distance from the place where they lived and died, for detached valves are found at some localities.

The distribution of these two subgenera—*Clementia* and *Egesta*—also affords evidence of temperature control. Figure 1 shows that the American Tertiary species of *Clementia* s. s. were confined to tropical seas. On the Atlantic side the genus never got farther north than the Caribbean Sea. On the Pacific side fossil species have been found in northern Peru, Ecuador, Panama, and Costa Rica. The occurrence of *Clementia* s. s. in the Tertiary seas of the Orient is in harmony with its distribution in American Tertiary seas, and the Miocene Mediterranean Sea, in which the deposits of the Gratz Basin and Libyan Desert were laid down, was warmer than the present Mediterranean Sea. At the present time this subgenus is found in both tropical and warm temperate seas. In the waters of the Miocene Gulf of Mexico and on the Atlantic and Pacific coasts of the United States *Clementia* s. s. was replaced by *Egesta*. According to present interpretations, *Egesta* tolerated a considerable temperature range, for it is found in a variety of faunas ranging from the subtropical fauna of the Chipola formation of Florida to the warm-temperate faunas of the Calvert and Choptank formations of Maryland but not in cool temperate or boreal faunas. At the present time *Egesta* is found in the Gulf of California but not in the cooler waters of the California coast. Temperature control may account for its absence in the Pliocene deposits of California except in the warm-water facies of the Purisima formation.

AMERICAN TERTIARY SPECIES

The American Tertiary species of *Clementia* s. s. and *Egesta*, their age, and the localities where they have been found are as follows:

[16] Preston, H. B., Mollusca from the Chilka Lake, on the east coast of India: Indian Mus. Rec., vol. 10, p. 306, 1914.

[17] Ehrenberg, Kurt, Über das Vorkommen von Fossilresten: Naturwissenschaften, year 12, No. 29, pp. 593-596, 1924.

Clementia (*Clementia*) *dariena vetula* Woodring, n. subsp., middle Eocene, Colombia.

Clementia (*Clementia*) *dariena rabelli* Maury, middle Oligocene, Porto Rico.

Clementia (*Clementia*) *dariena dariena* (Conrad), lower and middle Miocene, Panama (Atlantic and Pacific sides), Costa Rica (Atlantic and Pacific sides and interior), Colombia, Venezuela, Trinidad, Brazil, Ecuador, and Peru.

Clementia (*Egesta*) *grayi* Dall, lower and middle Miocene, Florida, and lower Miocene, Mexico.

Clementia (*Egesta*) *inoceriformis* (Wagner), middle Miocene, Maryland, and upper Miocene, New Jersey.

Clementia (*Egesta*) *conradiana* (F. M. Anderson), lower and middle Miocene, California.

Clementia (*Egesta*) *martini* (Clark), upper Miocene, California.

Clementia (*Egesta*) *pertenuis* (Gabb), lower Miocene to lower Pliocene, California.

The following table shows at a glance the comparative age of these species:

Age and distribution of American Tertiary species of Clementia

	Time divisions	Atlantic coast of United States	Borders of Gulf of Mexico	Caribbean region	Pacific coast of Central America and northern South America	Pacific coast of United States
Pliocene	Upper					
	Middle					
	Lower					*Clementia* (*Egesta*) *pertenuis*, Purisima formation, California.
Miocene	Upper	*Clementia* (*Egesta*) *inoceriformis*, Kirkwood formation (Shiloh marl member), New Jersey.				*Clementia* (*Egesta*) *martini*, San Pablo formation (upper part) and Santa Margarita formation, California. *Clementia* (*Egesta*) *pertenuis*, *C.* (*E.*) *conradiana*, Santa Margarita formation, California.
	Middle	*Clementia* (*Egesta*) *inoceriformis*, Calvert, Choptank, and St. Marys formations, Maryland.	*Clementia* (*Egesta*) *grayi*, Shoal River formation, Florida.	*Clementia* (*Clementia*) *dariena dariena*, Gatun formation, Panama; Costa Rica; Colombia.	*Clementia* (*Clementia*) *dariena dariena*, Zorritos formation, Peru; Panama.	*Clementia* (*Egesta*) *pertenuis*, Topanga formation and *Turritella ocoyana* zone, California. *Clementia* (*Egesta*) *conradiana*, *Turritella ocoyana* zone, California.
	Lower		*Clementia* (*Egesta*) *grayi*, Chipola and Oak Grove formations, Florida; Tuxpan formation, Mexico.	*Clementia* (*Clementia*) *dariena dariena*, Culebra formation (upper part), Panama; Costa Rica; Colombia; Venezuela; Trinidad; Brazil.	*Clementia* (*Clementia*) *dariena dariena*, Ecuador; Panama; Costa Rica.	*Clementia* (*Egesta*) *pertenuis*, *C.* (*E.*) *conradiana*, Vaqueros formation (*Turritella inezana* zone), California.
Oligocene	Upper				*Clementia* (*Clementia*) sp. b, Peru.	
	Middle			*Clementia* (*Clementia*) *dariena rabelli*, San Sebastian shale and Juana Diaz shale, Porto Rico.		
	Lower					
Eocene	Upper				*Clementia* (*Clementia*) sp. b, Peru.	
	Middle			*Clementia* (*Clementia*) *dariena vetula*, Colombia.	*Clementia* (*Clementia*) sp. b, Peru. *Clementia* (*Clementia*) sp. a, Peru.	
	Lower					

22958°—27——3

Clementia? taeniosa Guppy,[18] an upper Miocene species from Trinidad, is a *Mactra* (*Harvella*). The type of this species is in the collections of the United States National Museum (catalog No. 107106). It may possibly be the species recently named *Mactra* (*Harvella*) *sancti-blasi* by Maury,[19] though it is larger than Maury's type and has fuller umbos. *Dosinia mercenaroides* Aldrich, a species from the middle Eocene Gosport sand of Alabama, described by Harris[20] as a *Clementia*, has none of the features of *Clementia* s. s. or *Egesta*. The discovery of characteristic Eocene Clementias in Colombia and Peru disposes of the idea, advocated by Harris, that this species is a transitional form leading up to *Clementia*.

Key to the American Tertiary species of Clementia

Shell thin, upper posterior slope not concave, posterior end not truncate, pallial sinus relatively wide. Subgenus *Clementia* s. s.
- Anterior end extended, length of adult shell not exceeding 45 millimeters ... *C.* (*C.*) *dariena vetula.*
- Anterior end not extended:
  - Length of adult shell not exceeding 50 millimeters *C.* (*C.*) *dariena rabelli.*
  - Length of adult shell not exceeding 80 millimeters *C.* (*C.*) *dariena dariena.*

Shell thin or relatively thick, upper posterior slope generally concave, posterior end generally truncate, pallial sinus very narrow ... Subgenus *Egesta.*
- Upper posterior slope concave, posterior end truncate:
  - Shell very inequilateral ... *C.* (*E.*) *grayi.*
  - Shell moderately inequilateral .. *C.* (*E.*) *inoceriformis.*
- Upper posterior slope not concave, posterior end not truncate:
  - Lunular area deeply depressed ... *C.* (*E.*) *conradiana.*
  - Lunular area not deeply depressed:
    - Shell moderately inequilateral ... *C.* (*E.*) *martini.*
    - Shell slightly inequilateral ... *C.* (*E.*) *pertenuis.*

DESCRIPTION OF SPECIES

Family VENERIDAE

Subfamily DOSINIINAE

Genus CLEMENTIA Gray

Subgenus CLEMENTIA s. s.

Gray, Synopsis of the contents of the British Museum, ed. 44, p. 75, 1842 (genus without species); Zool. Soc. London Proc., pt. 15, p. 184, 1847.

Type (by original designation, 1847): *Venus papyracea* Gray, Ann. Philosophy, new ser., vol. 9, p. 137, 1825. Wood, Supplement to the Index Testaceologicus, p. 5, pl. 2, fig. 8, 1828. Recent, Australia.

Shell generally small, thin and fragile, ovate, inequilateral. Lunule recognizable only by absence or suppression of sculpture. Sculpture consisting of coarse concentric waves and fine concentric threads, both of which are strongest in the umbonal region and may be replaced on the ventral part of the shell by growth lines. Under the umbo and extending a short distance parallel to the posterior cardinal lies a narrow shallow resilium groove. Hinge of right valve consisting of an anterior cardinal, a slightly heavier middle cardinal, and a long slender bifid posterior cardinal; hinge of left valve consisting of an anterior cardinal, a long, heavy middle cardinal, and a long, very slender posterior cardinal. On both valves a deep niche, formed by the hinge plate and the margin of the shell, lies in front of the anterior cardinal. Pallial sinus deep, ascending, wide, tapering to an asymmetrically U-shaped apex.

The name *Clementia* was first used by Gray in 1840 in the forty-second edition of a booklet entitled "Synopsis of the contents of the British Museum." As no copies of any editions of this booklet are available, the following account is based on Iredale's quotations.[20a] This name as used in 1840 is absolutely nude [20b] and therefore has no standing. But in the forty-fourth edition, issued in 1842, the following is added to the name *Clementia:* "The *Tapes* and *Venerupes* have oblong shells with very compressed teeth, and the *Clementia* are like the latter but are very thin and have a cavity in the margin before and behind the teeth." [20c] On account of this brief sentence the name *Clementia* as used in 1842 must be accepted as recognizable, or it must be considered a doubtful name (nomen dubium). The statement that the shell is thin and that it has a "cavity" lying in front of and behind the hinge justifies the contention, here advocated, that the genus is recognizable on the basis of the 1842 publication, though no species are mentioned. It is assumed that the "cavity behind the teeth" refers to the space between the hinge plate and the nymph, though this "cavity" is not so pronounced as the "cavity" in front of the hinge, which is a striking feature. *Venus papyracea* still remains the genotype by original designation, for a species was first assigned to the genus in the article in the Proceedings of the Zoological Society of London, 1847, and in this article Gray definitely states that he is designating types. If the name *Clementia* as used in 1842 is considered a doubtful name, its use in 1847 is automatically invalidated. On the assumption that *Venus papyracea* and *Venus inoceriformis*, the type of *Egesta*, are congeneric, all *Clementia*-like mollusks would then take the generic name *Egesta*—a name that was published in 1845 and that everyone has overlooked—and the species similar to *Venus papyracea* would take some other name, which apparently would have to be a new name, as a subgenus of *Egesta*. The burden of proof rests on anyone who would advocate such a change in currrent nomenclature.

The very thin fragile shell, slender hinge, and wide pallial sinus are characteristic of *Clementia* s. s. The

[18] Guppy, R. J. L., U. S. Nat. Mus. Proc., vol. 19, p. 327, pl. 30, fig. 8, 1896. Dall, W. H., Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1235, 1903. Maury, C. J. Bull. Am. Paleontology, vol. 10, p. 295, 1925.

[19] Maury, C. J., Bull. Am. Paleontology, vol. 10, pp. 266–267, pl. 32, fig. 2, 1925.

[20] Harris, G. D., Bull. Am. Paleontology, vol. 6, p. 151, pl. 47, figs. 8–11, 1919.

[20a] Iredale, Tom, A collation of the molluscan parts of the synopses of the contents of the British Museum, 1838–1845: Malacol. Soc. London Proc., vol. 10, pp. 294–309, 1913.

[20b] Idem, p. 298.

[20c] Idem, p. 304.

hinge plate is narrow and the hinge is spread out, so that the left middle cardinal is almost parallel to the edge of the nymph.

There are slight differences between the American species here described and the living species from the western Pacific, including the genotype, *C. papyracea;* and refined work may eventually eliminate the American species from *Clementia* s. s. The American fossils are larger than *C. papyracea* and other living species from the western Pacific, and they have a slightly heavier shell. Size alone may have no significance. *C. mcclellandi* Tomlin, a living species from South Africa, is fully as large as the American fossil *C. dariena.* All the American fossils have a recognizable escutcheon limited by a low ridge extending from the umbo almost or quite to the edge of the shell, whereas on *C. papyracea* the ridge disappears almost under the umbo. The resilium groove of the American species is wider, probably on account of the heavier shell. Though the hinge of none of the American fossils is fully known, enough of it is known to show that it is heavier than in *C. papyracea,* probably too heavy to be compensated alone by their heavier shell. Moreover, the hinge of the American fossils is compressed into a shorter space. Their pallial sinus is not quite so wide as in *C. papyracea.* On the basis of a comparison with *C. papyracea* the separation of the American fossils as a section of *Clementia* s. s. is justifiable, but such action must await a study of all the living and fossil species, for which material is not now available.

EOCENE SPECIES

Clementia (Clementia) dariena vetula Woodring, n. subsp.

Plate 14, Figures 1–4

Shell relatively small, moderately inequilateral, anterior end extended. Lunular area shallow, sculptured only with growth lines. Escutcheon narrow, limited by a ridge extending from the umbo almost or quite to the margin of the shell. Sculpture consisting of coarse concentric waves and fine low concentric threads of irregular width. Interior inaccessible except a broken right hinge, which shows a heavy middle cardinal and a long slender deeply bifid posterior cardinal.

Holotype, young shell: Length 24 millimeters, height 22 millimeters, diameter (both valves) 12 millimeters. Paratype: Length 33 millimeters, estimated height 28 millimeters, diameter (both valves) 19.8 millimeters. Another paratype: Estimated length 42 millimeters, height 32.5 millimeters, diameter (right valve) 10 millimeters.

The holotype has a definitely limited lunule, which seems to be due to a calcareous crust that at one place extends across the boundary of the lunular area. Neither paratype has a definite lunule. The ridge bounding the escutcheon is prominent. The paratype that shows the broken hinge also shows the deep, narrow groove at the upper edge of the ligament area and the long resilium groove lying back of the tip of the umbo parallel to the posterior cardinal.

This Eocene subspecies is represented by three specimens. Only one young shell, which is taken as the holotype, is perfect. It is remarkably similar to small specimens of the Miocene *C. dariena dariena.* The holotype and one of the paratypes show that the shell is more equilateral than in most specimens of *dariena dariena* (compare figs. 4 and 7, pl. 14), but some specimens of *dariena dariena* are almost as equilateral as *vetula.* The concentric waves extend to the base of the largest specimen of *vetula,* whereas on adult shells of *dariena dariena* they disappear on the lower third or less of the shell. This distinction may have no significance, as the largest shell of *vetula,* which is only half as large as the largest specimen of *dariena dariena,* may not be full grown. The difference in shape and apparent difference in size are the most significant distinctions, but they seem to be of only subspecific value.

The beds carrying *vetula* are undoubtedly of Eocene age and probably middle Eocene, although they may be as young as upper Eocene. The same collection contains a *Volutospina* very similar to *V. petrosa tuomeyi* (Conrad), from the Wilcox group of Alabama, and also similar to heavily callused specimens of *V. peruviana* Woods,[21] from the middle Eocene Parinas sandstone of Peru; a *Clavilithes* resembling *C. pacificus* Woods,[22] an Eocene species from Peru; an *Operculina* resembling *O. willcoxi* (Heilprin), an upper Eocene species from Florida; and species of *Oliva, Neverita, Lunatia, Glycymeris, "Scapharca," Callocardia,* and *Pitar* similar to species from the Claiborne group of the Gulf States. In addition to these fossils the collection contains remarkably large cashew nuts described by Berry [23] as *Anacardium eocenicum.* The possibility of mixing an Oligocene or Miocene *Clementia* with these Eocene fossils is eliminated, for the specimens of *Clementia* have precisely the same appearance as the Eocene shells and contain the same matrix, and no Oligocene or Miocene beds crop out in the region where they were collected.

Type locality: Middle Eocene, station 160 on traverse from Arroyo Macamajon to Ovejás, southeast of Pijaguay, Department of Bolivar, Colombia, R. L. Beckelhymer, collector; station 1/968; three specimens (holotype and two paratypes), all of which are figured.

Type material: Holotype (young shell, both valves in attached position), U. S. Nat. Mus. catalog No. 354036; two paratypes, U. S. Nat. Mus. catalog No. 354037.

[21] Woods, Henry, in Bosworth, T. O., and others, Geology of the Tertiary and Quaternary periods in the northwest part of Peru, pp. 101–104, pl. 15, figs. 3–5, London, 1922.

[22] Idem, pp. 99–100, pl. 13, fig. 10; pl. 14, figs. 1–2.

[23] Berry, E. W., New Tertic species of *Anacardium* and *Vantanea* from Colombia: Pan-Am. Geologist, vol. 42, pp. 259–262, pl. 18, 1924.

OLIGOCENE SPECIES

Clementia (Clementia) dariena rabelli Maury

Plate 14, Figure 5

Clementia rabelli Maury, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, pp. 37–38, pl. 6, figs. 2–3, 1920.

Maury, Bull. Am. Paleontology, vol. 10, p. 294, pl. 37, fig. 2, 1925.

Clementia dariena [not Conrad] Hubbard, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 118–120, pl. 19, figs. 10–11, 1921.

Shell medium sized, very inequilateral. Escutcheon narrow, limited by a low ridge extending from the umbo almost to the margin of the shell. Sculpture consisting of coarse concentric waves and fine concentric threads, which may not be visible on internal molds. Near the base of adult shells the concentric waves disappear and are replaced by growth lines. Hinge and pallial sinus not known.

Holotype: Length 43 millimeters, height 38 millimeters, diameter (left valve) 6 millimeters. Paratype, distorted specimen: Length 43 millimeters, height 36 millimeters, diameter (both valves) 24.5 millimeters.

Clementia dariena rabelli is even more similar to *C. dariena dariena* than *C. dariena vetula*, but it is smaller than *dariena dariena*, though a little larger than *vetula*. According to Hubbard, who tabulated the dimensions of a number of specimens of *rabelli* and *dariena dariena*, average full-grown shells of *rabelli* are about two-thirds as large as full-grown specimens of *dariena dariena*. The holotype of *rabelli* is less elongate and less inflated than specimens of *dariena dariena* of the same size, but the shape of both species is variable. According to Maury (1925), *rabelli* is more inequilateral than *dariena dariena*, but most specimens of *dariena dariena* are very inequilateral.

Clementia dariena rabelli is the only *Clementia* so far discovered in the West Indies proper and also is the only known American Oligocene *Clementia*. It is found in the middle Oligocene San Sebastian shale (also called Rio Collazo shale), at the base of the Tertiary system in northwestern Porto Rico, and in beds of the same age, known as the Juana Diaz shale, on the south side of the island.

All the American Tertiary species of *Clementia* s. s. and most of the living species have essentially the same sculpture. This feature should be borne in mind in considering the remarkable similarity of *C. dariena vetula* (middle Eocene), *C. dariena rabelli* (middle Oligocene), and *C. dariena dariena* (lower and middle Miocene). So far as shape and sculpture are concerned, these three subspecies represent a genetic stock or gens, as clearly as phylogeny can be demonstrated by the morphology of fossils. The increase in size of progressively younger specimens is the most striking feature of this series. If specimens were available from deposits of intermediate age it would be very difficult, if not impossible, to represent the different stages of this series by the usual methods of Linnean nomenclature. Inasmuch as the principal difference between *rabelli* and *dariena* is one of size, it seems desirable to consider *rabelli* a subspecies of *dariena*.

Type locality: Middle Oligocene (San Sebastian shale), Rio Collazo near San Sebastian, Porto Rico.

Other localities: Middle Oligocene (San Sebastian shale), other localities on Rio Collazo near San Sebastian, Porto Rico (Maury, Hubbard). Middle Oligocene (Juana Diaz shale), Juana Diaz, Porto Rico (Hubbard).

Type material: Holotype (left valve), Am. Mus. Nat. Hist., Div. Geology and Invertebrate Paleontology, catalog No. 22509. Paratype (distorted specimen, both valves in attached position), Am. Mus. Nat. Hist., Div. Geology and Invertebrate Paleontology, catalog No. 22508.

MIOCENE SPECIES

Clementia (Clementia) dariena dariena (Conrad)

Plate 14, Figures 6–11

Meretrix dariena Conrad, U. S. Pacific R. R. Expl., vol. 5 (33 Cong. 2d sess., H. Ex. Doc. 91), pt. 2, appendix, p. 328, pl. 6, fig. 55, 1855. (Reprint, Dall, U. S. Geol. Survey Prof. Paper 59, p. 170, 1909.)

Clementia dariena (Conrad). Gabb, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 8, p. 344, pl. 44, figs. 16, 16*a*, 1881.

Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1235, 1903.

Toula, K.-k. geol. Reichsanstalt Jahrb., vol. 58, pp. 725–726, 757, pl. 27, figs. 9–10, 1909.

Brown and Pilsbry, Acad. Nat. Sci. Philadelphia Proc., vol. 63, p. 371, pl. 28, fig. 1, 1911.

Olsson, Bull. Am. Paleontology, vol. 9, pp. 404–405, pl. 34, fig. 4, 1922.

Spieker, Johns Hopkins Univ. Studies in Geology, No. 3, pp. 141–143, pl. 8, fig. 5, 1922.

Maury, Bull. Am. Paleontology, vol. 10, pp. 293–294, pl. 37, figs. 1, 3, 5–7, 1925.

Harris, in Waring, Johns Hopkins Univ., Studies in Geology, No. 7, p. 110, pl. 20, fig. 8, 1926.

Not *Cytherea? (Meretrix) dariena?* Conrad, U. S. Pacific R. R. Expl., vol. 6 (33d Cong., 2d sess., S. Ex. Doc. 78), pt. 2, p. 72, pl. 5, fig. 21, 1856 [probably = *Macrocallista maculata* (Linné)]. (Reprint, Dall, U. S. Geol. Survey Prof. Paper 59, p. 178, 1909.)

Harvella? sp. undet., Nelson, Connecticut Acad. Arts Sci. Trans., vol. 2, p. 201, 1870.

Clementia dariena [part] (Conrad) Hubbard, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 118–120, pl. 19, fig. 12 (not pl. 19, figs. 10–11 = *Clementia dariena rabelli* Maury), 1921.

Clementia sp. cf. *C. dariena* (Conrad). Woods, in Bosworth and others, Geology of the Tertiary and Quaternary periods in the northwest part of Peru, p. 113, pl. 20, figs. 4*a*, 4*b*, London, 1922..

?*Clementia brasiliana* Maury, Brasil Servicio geol. mineral. Mon., vol. 4, pp. 422–423, pl. 24, fig. 3, 1925.

Shell moderately large, very inequilateral. Lunular area moderately depressed. Escutcheon narrow, limited by a low ridge extending from the umbo almost to the margin of the shell. Sculpture consisting of coarse concentric waves and fine concentric threads. On the ventral third or less of adult shells the concentric waves disappear and the threads merge into growth lines. Pallial sinus deep, moderately wide, ascending.

Neotype: Length 61 millimeters, height 48.6 millimeters, diameter (both valves) 30.2 millimeters. Topotype: Length 78 millimeters, height 65 millimeters, diameter (both valves) 27 millimeters.

Most specimens of this subspecies are elongate and very inequilateral, for the umbo lies close to the anterior end. Some shells have a more extended anterior end. These less inequilateral shells, which are most abundant in lower Miocene deposits, resemble *vetula*. Two small inequilateral shells are figured for comparison with *vetula*. Most of the specimens of *C. dariena dariena* in the collections of the United States National Museum are wholly or in part internal molds, and none show the hinge. Toula figured a right hinge, which consists of a slender anterior cardinal, a heavier middle cardinal (apparently broken), and a long, deeply bifid posterior cardinal. The pallial sinus is visible on several internal molds.

C. dariena dariena was widely distributed along the south and west edge of the Carribean Sea during lower and middle Miocene time and also in the eastern Pacific from Peru to Costa Rica. It has already been recorded from Brazil, Trinidad, Panama, Costa Rica, and Peru, and records are here given for Venezuela, Colombia, and Ecuador. Middle Miocene deposits carry the largest shells. Virtually all the specimens from lower Miocene beds are relatively small and grade almost imperceptibly into *C. dariena rabelli*.

The type of *C. dariena dariena* is apparently lost, as it is not in the United States National Museum among the types of the fossils described by Conrad in the reports of the Pacific Railroad explorations. The type specimen was collected by W. P. Blake, geologist of the surveying party under the command of Lieut. R. S. Williamson. Blake proceeded to San Francisco by way of the Isthmus of Panama and collected the type specimen and other fossils in a cut along the railroad "at Gatun, or Monkey Hill?"[25] Although the precise locality is a little uncertain it is of no great importance, as the Gatun formation, of middle Miocene age, is the only formation cropping out in this region. The specimen shown in Figure 10, Plate 14, is to be regarded as the neotype, at least until the original type is found. By this time topotypes are in many museums, for in the Canal Zone *C. dariena dariena* is very abundant in the lower part of the Gatun formation.

The only specimens from the Culebra formation of the Panama Canal Zone were collected from beds lying in the upper part 59 and 66 feet below the base of the Emperador limestone, according to MacDonald's section (stations 6019*d* and 6019*b*).[26] These specimens are very small and may not represent *C. dariena dariena*. The upper part of the Culebra formation seems to be Miocene (Aquitanian).

According to Maury's figure, *Clementia brasiliana* (pl. 14, fig. 11), based on specimens collected from lower Miocene beds in Brazil, seems to represent small specimens of *C. dariena dariena*. The specimens from Brazil are like small, slightly elongate shells of *C. dariena dariena* from Venezuela and other localities. Suites of specimens from the type locality of *dariena dariena* show that the shape of this species is too variable to introduce another name for small, slightly elongate Clementias from the lower Miocene beds of tropical America. At the anterior end of the shell the concentric waves of *C. brasiliana* are represented as erect frills, as in *Chione* (*Lirophora*), but this feature may have been exaggerated by the artist.

Type locality: Middle Miocene (Gatun formation), near Gatun, Panama Canal Zone.

Other localities: Lower Miocene (upper part of Culebra formation), west side of Gaillard Cut near Las Cascadas, bed 12*c* of section, Panama Canal Zone; D. F. MacDonald and T. W. Vaughan, collectors; station 6019*d*; one small specimen; identification doubtful. Lower Miocene (upper part of Culebra formation), same locality as 6019*d*, bed 11 of section; D. F. MacDonald and T. W. Vaughan, collectors; station 6019*b*; one small specimen; identification doubtful. Lower Miocene, Vamos-a-Vamos (now under water), Panama Canal Zone; R. T. Hill, collector; station 2682; one specimen. Lower Miocene, Sapote (or Zapote), Rio Revantazon, Costa Rica (Gabb). Lower Miocene, near San Andres, Department of Bolivar, Colombia; H. S. Gale and E. S. Bleeker, collectors; station 1/151; one small specimen. Lower Miocene, "Dam site" series, northwest of Agua Clara, Falcon, Venezuela; Ralph Arnold, collector; station 8071; one small specimen. Lower Miocene, Rio Coro, near coal mine at Isiro, 6 miles south of Coro, Falcon, Venezuela; Ralph Arnold, collector; station 6308; one small specimen. Lower Miocene, Guaico-Tamana road, Trinidad; two small specimens (Maury). Lower Miocene, Manzanilla, Trinidad; two small specimens (Maury). Lower Miocene (Estação formation), agricultural station on railroad from Braganca to Belem, 155 kilometers west of Braganca, Para, Brazil (Maury). Lower (?) Miocene, pit at well location of Standard Oil Co. of California near Bajada and Amen, Santa Elena Peninsula, Ecuador; H. S. Gale, collector; station 1/453; one small crushed specimen; identification doubtful. Lower Miocene, Santiago de Veraguas, Panama; O. H. Hershey, collector; one specimen.

[25] Blake, W. P., U. S. Pacific R. R. Expl., vol. 5 (33d Cong., 2d sess., H. Ex. Doc. 91), pt. 2, p. 1, 1855.

[26] MacDonald, D. F., The sedimentary formations of the Panama Canal Zone, with special reference to the stratigraphic relations of the fossiliferous beds: U. S. Nat. Mus. Bull. 103, pp. 537-538, 1919.

Lower Miocene, crest of divide along road to Aguadulce, about 5 miles northeast of Santiago de Veraguas, Panama; W. P. Woodring, collector; station 8465; one specimen. Lower Miocene, half a mile above Sulphur Spring, northwest of San Felix, Chiriqui Province, Panama; D. F. MacDonald, collector; station 6534; one broken specimen; identification doubtful. Lower Miocene, near San Felix, Chiriqui Province, Panama; Henri Pittier, collector; station 6262; one small specimen. Lower Miocene, Rio Papayal, first main fossil bed above *Pecten* shale, Chiriqui Province, Panama; J. T. Duce, collector; station 1/690; one small crushed specimen; identification doubtful. Lower Miocene, Rio Gualaca, 500 meters north of mouth, Chiriqui Province, Panama; J. T. Duce, collector; station 1/691; three small broken specimens; identification doubtful. Lower Miocene, *Conus* bed, road to Gualaca, Chiriqui Province, Panama; J. T. Duce, collector; station 1/715; one small crushed specimen; identification doubtful. Lower Miocene, Carballo Cliff, east of Punta Arenas, Costa Rica; J. D. Sears, collector; station 8330; one broken specimen; identification doubtful.[27] Lower Miocene, Caldera, near Corballo tunnel, Costa Rica; A. Alfaro, collector; station 5468; one specimen. Lower Miocene, Santa Maria de Dota, Quebrada Rivas, Costa Rica; J. F. Tristan, collector; station 7274; one specimen. Middle Miocene (Gatun formation), cut on relocated line of Panama Railroad, 1½ to 2 miles west of Camp Cotton toward Monte Lirio, Panama Canal Zone; D. F. MacDonald and T. W. Vaughan, collectors; station 6030; 17 specimens (topotypes), one of which (neotype) is figured. Middle Miocene (Gatun formation), lowest bed in cut on relocated line of Panama Railroad, one-quarter to one-half mile from Camp Cotton toward Monte Lirio, Panama Canal Zone; D. F. MacDonald and T. W. Vaughan, collectors; station 6029*a*; three specimens (topotypes). Middle Miocene (Gatun formation), basal part of section, half a mile from Camp Cotton toward Gatun, Panama Canal Zone; D. F. MacDonald and T. W. Vaughan, collectors; station 6031; two broken specimens (topotypes). Middle Miocene (Gatun formation) lower part of lowest bed in cut on relocated line of Panama Railroad about 3,500 feet south of Gatun railroad station, Panama Canal Zone; D. F. MacDonald and T. W. Vaughan, collectors; station 6033*a*; two specimens (topotypes). Middle Miocene (Gatun formation), same locality as preceding collection but from upper part of lowest bed; station 6033*b*; two specimens (topotypes). Middle Miocene (Gatun formation), same locality as preceding collection; D. F. MacDonald, collector; station 6004; one broken specimen (topotype). Middle Miocene (Gatun formation), cuts on railroad southeast of Gatun; A. A. Olsson, collector; station 8381; four specimens (topotypes). Middle Miocene (Gatun formation), first high cut on left side of railroad going from Gatun toward Panama, Panama Canal Zone; W. P. Woodring, collector; station 1/997; two specimens (topotypes). Middle Miocene (Gatun formation), Quebrancha Hills overlooking Gatun Lake, 1½ miles northeast of Gatun, Panama Canal Zone; D. F. MacDonald, collector; station 5845; three specimens. Middle Miocene (Gatun formation), near spillway of Gatun Dam, Panama Canal Zone; D. F. MacDonald, collector; station 5846; eight specimens, two of which are figured. Middle Miocene (Gatun formation), cuts west of Gatun Dam, Panama Canal Zone; A. A. Olsson, collector; station 8365; one unusually well preserved, small specimen. Middle Miocene (Gatun formation), west of Gatun Lake, Panama Canal Zone; A. A. Olsson, collector; station 8360; one broken specimen. Middle Miocene (Gatun formation), Nancys Cay, Bocas del Toro Province, Panama (Olsson). Middle Miocene (Gatun formation), upper Hone Creek and its tributary Sousi Creek, Costa Rica (Olsson). Middle Miocene (Gatun formation), Banana River, Costa Rica; D. F. MacDonald, collector; station 5882*l*; one specimen. Middle Miocene, edge of town of Balsanco, Cerro de San Antonio area, Department of Magdalena, Colombia; H. S. Gale, collector; station 1/927; one broken specimen; identification doubtful. Middle Miocene, near Tubara, Department of Atlantico, Colombia; F. A. Sutton and P. Squibb, collectors; station 1/987; two specimens, one of which is figured. Middle Miocene, Tubara, Department of Atlantico, Colombia; A. Iddings, collector; station 1/988; one specimen, figured. Middle Miocene, Villa Nueva, Department of Bolivar, Colombia; O. B. Hopkins, collector; station 1/101; four specimens. Middle Miocene (Zorritos formation), near Zorritos, Peru (Nelson, Woods, and Spieker). Middle (?) Miocene, Quebrada Las Ajontas, a mile above confluence with Rio Cristobal, Chiriqui Province, Panama; E. R. Smith, collector; station 7961; one specimen.

Type material: Neotype (both valves in attached position), U. S. Nat. Mus. No. 354038.

Subgenus EGESTA Conrad

Conrad, Fossils of the Tertiary formations of the United States, p. 70, 1845. (Reprint, Dall, under title "Conrad's fossils of the medial Tertiary of the United States," p. 70, 1893.)

Type (by monotypy): *Venus inoceriformis* Wagner, Acad. Nat. Sci. Philadelphia Jour., vol. 8, pp. 51–52, pl. 1, fig. 1, 1839. Middle Miocene, Maryland.

Shell relatively large, thin or heavy, inequilateral, upper posterior slope generally flattened or slightly concave, producing a truncate posterior end. Lunular area moderately or deeply depressed, otherwise poorly defined. Escutcheon poorly defined. Sculpture *Clementia*-like, consisting of coarse concentric waves and fine concentric threads, both of which may

[27] Romanes collected *C. dariena* at the Carballo Cliff (Romanes, J., Geology of a part of Costa Rica: Geol. Soc. London Quart. Jour., vol. 68, p. 125, 1912).

be replaced on the ventral part of the shell by growth lines. Resilium groove long, wide, and deep. Hinge of right valve consisting of a slender anterior cardinal, a heavier middle cardinal, and a slender, deeply bifid posterior cardinal; hinge of left valve consisting of a slender anterior cardinal, a heavy middle cardinal, and a very thin posterior cardinal. Pallial sinus narrow, deep, ascending, slightly tapering to an asymmetrically U-shaped apex.

Conrad casually gave the name *Egesta*, as a subgenus of *Venus*, to *Venus inoceriformis* and promptly forgot it. Apparently the name has been overlooked It is here proposed to use *Egesta* as a subgeneric name embracing several American fossils and two living species—*Clementia solida* Dall, from the Gulf of California, and *Clementia vatheliti* Mabille, from waters off Japan and Chosen.

The larger and heavier shell, flattened or concave upper posterior slope, accompanying truncation of the posterior end, longer and deeper resilium groove, heavier hinge, and narrower pallial sinus separate *Egesta* from *Clementia* s. s. A comparison of *Clementia papyracea* with *Clementia solida* (pl. 16, figs. 7, 8), which seems to be the culminating species of the subgenus *Egesta*, shows pronounced differences, but when other species are considered the separation of the subgenera is not so satisfactory. *Egesta* has a heavier hinge, a natural result of the heavier shell, and it is compressed into a relatively shorter space, so that the right posterior cardinal is not so far from the right middle cardinal and is less recumbent, and the left middle and posterior cardinals are less recumbent. According to the meager evidence available the American fossil species referred to *Clementia* s. s. have precisely the same kind of heavy compressed hinge. The pallial sinus of the American species of *Egesta*, both living and fossil, is very narrow, much narrower than in *Clementia* s. s., but *Clementia vatheliti*, which is here referred to *Egesta*, has a pallial sinus of intermediate width. The resilium groove of this species is not so wide as in the American species of *Egesta*. The niche in front of the anterior cardinal of living species of *Clementia* s. s. is almost eliminated in *Egesta* and in the American fossil *Clementia* s. s. on account of the greater thickness of the shell and hinge plate and the greater depression of the lunular area. The lunular area of *Clementia* (*Egesta*) *solida* is deeply depressed, its margin being thus brought almost parallel to the anterior cardinal, but this feature is not so pronounced in other species except the fossil *C.* (*E.*) *conradiana*.

The characteristic features of *Egesta* are less pronounced in the Miocene species *C.* (*E.*) *grayi* and *C.* (*E.*) *inoceriformis*. Their shells are not so heavy, the upper posterior slope is not so concave, the posterior truncation is not so pronounced, the lunular area is not so deeply depressed, and the pallial sinus is not quite so narrow. The living Japanese species *C.* (*E.*) *vatheliti* is more similar in these features to these two American Tertiary species than to *C.* (*E.*) *solida*. Dall[29] pointed out the similarity of *C.* (*E.*) *grayi* and *C.* (*E.*) *vatheliti*. On the basis of its narrow pallial sinus *Venus pertenuis*, a fossil species from California, is an *Egesta*, but its upper posterior slope is not flattened. *Venus conradiana* and *Venus martini* are considered Egestas, but their pallial sinus is not known.

MIOCENE SPECIES

Clementia (Egesta) grayi Dall

Plate 15, Figure 4

Clementia grayi Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1193, pl. 37, fig. 12, 1900; pt. 6, p. 1236, 1903. Gardner, U. S. Geol. Survey Prof. Paper 142, p. 154, pl. 24, fig. 6, 1926.

Clementia cf. *dariena* Conrad. Dickerson and Kew, California Acad. Sci. Proc., 4th ser., vol. 7, table opposite p. 128, 1917.

Shell moderately large, thin or moderately heavy, very inequilateral. Upper posterior slope flattened or slightly concave, posterior end truncate. Lunular area moderately depressed. Sculpture consisting of coarse concentric waves and fine concentric threads, both of which are confined to about the umbonal third of adult shells and are replaced by irregular growth lines on the remainder of the shell. Hinge of right valve consisting of a slender anterior cardinal, a heavier middle cardinal, and a long, slender bifid posterior cardinal; hinge of left valve consisting of a slender anterior cardinal, a heavy middle cardinal, and a long, thin posterior cardinal; pallial sinus deep, narrow, ascending, slightly tapering to an acute apex.

Holotype: Length 63 millimeters, height 54 millimeters, diameter (left valve) 19 millimeters.

The holotype is an almost perfect left valve, though the hinge is defective. It is the only fully adult specimen discovered except two broken internal molds. The shell of the holotype is relatively thick, so thick that the concentric waves are not visible on the interior. It is the only shell that is so thick. The concentric waves are visible on the interior of a piece of shell collected at the same locality, but this thinner shell is smaller than the holotype. All the young shells are thin. The hinge of the right valve is known only from a small shell fragment collected at station 3856.

C. (*E.*) *grayi* is a characteristic *Egesta* and is similar to the living species *C.* (*E*). *vatheliti*. It is found in western Florida in the Chipola (lower Miocene), Oak Grove (lower Miocene), and Shoal River (middle Miocene) formations, and also in Mexico in the Tuxpan formation (lower Miocene). All the specimens from the Chipola formation are internal molds, except one

[29] Dall, W. H., Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1236, 1903.

specimen collected at station 7151. The flattened upper posterior slope is very obscure on most of these molds and generally can not be seen at all on young specimens. The type locality of *grayi* is the only locality where it has been found in the Oak Grove sand. At one locality in the Shoal River formation (station 3856) it is very abundant, but none of the shells are full grown. The largest specimens from the Tuxpan formation of the Tampico embayment of Mexico are very similar to specimens from Florida, but it is more difficult to identify small specimens.

Type locality: Lower Miocene (Oak Grove sand), Yellow River, half a mile east of Oak Grove, Okaloosa County, Fla.; F. Burns, collector; station 2646; one specimen (holotype) and fragments of another specimen.

Other localities: Lower Miocene (Chipola formation), north bank of Tenmile Creek, at wagon bridge on road from Forestville to Marianna, Calhoun County, Fla.; C. W. Cooke and W. C. Mansfield, collectors; station 7151; one specimen. Lower Miocene (Chipola formation), Sopchoppy, Wakulla County, Fla.; G. C. Matson, collector; station 7468; seven specimens. Lower Miocene (Chipola formation), Bruce Creek just above Waldon Bridge, about 5 miles west of Redbay, Walton County, Fla.; W. C. Mansfield and W. M. Gomillion, collectors; station 1/979; two specimens. Lower Miocene (Chipola formation), near Rocky Landing, Choctawhatchee River, Washington County, Fla.; W. C. Mansfield and W. M. Gomillion, collectors; station 1/968; one specimen. Lower Miocene (Chipola formation), The Woodyard, three-fourths mile above Shell Landing, Holmes Creek, Washington County, Fla.; lower bed; J. A. Gardner, collector; station 1/609; one specimen. Lower Miocene (Chipola formation), Whites Creek, half a mile below bridge on road from Eucheeanna to Knox Hill, Walton County, Fla.; J. A. Gardner, collector; station 1/611; two specimens. Lower Miocene (Tuxpan formation), San Fernando, Tamaulipas, Mexico; W. F. Cummins, collector; station 4568; one broken internal mold. Lower Miocene (Tuxpan formation), 1 kilometer west of Temapache, Vera Cruz, Mexico; T. H. Kernan, collector; one specimen. Lower Miocene (Tuxpan formation), Huasteca Railroad, cut 10 kilometers from east terminus of railroad, District of Ozuluama, Vera Cruz, Mexico; T. W. Vaughan, collector; eight specimens. Middle Miocene (Shoal River formation), 5 to 6 miles west of Mossyhead, Walton County, Fla.; G. W. Nichols, collector; station 3856; 22 specimens. Middle Miocene (Shoal River formation), Folk's Creek, about 4 miles south of Argyle, Walton County, Fla.; T. W. Vaughan, collector; station 5192; one small specimen; identification doubtful. Middle Miocene (Shoal River formation), Shoal River, 1½ miles below Shell Bluff, Walton County, Fla.; T. W. Vaughan, collector; station 5193; one small specimen; identification doubtful. Same locality as preceding collection; station 5194; one specimen. Middle Miocene (Shoal River formation), Shoal River half a mile below Shell Bluff, Walton County, Fla.; T. W. Vaughan, collector; station 5079; one specimen.

Type material: Holotype (left valve), U. S. Nat. Mus. catalog No. 107381.

Clementia (Egesta) inoceriformis (Wagner)

Plate 15, Figures 5, 6

Venus inoceriformis Wagner, Acad. Nat. Sci. Philadelphia Jour., vol. 8, pp. 51–52, pl. 1, fig. 1, 1839.

Conrad, Fossils of the Tertiary formations of the United States, p. 70, pl. 40, fig. 1, 1845. (Reprint, Dall, under title "Conrad's fossils of the medial Tertiary of the United States," p. 70, pl. 40, fig. 1, 1893.)

Clementia inoceriformis (Wagner). Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 14, p. 575, 1863.

Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, pp. 1235–1236, 1903.

Glenn, Maryland Geol. Survey, Miocene, pp. 315–316, pl. 82, figs. 1–2, 1904.

Clementia inoceramiformis (Wagner). Meek, Smithsonian Misc. Coll., vol. 7, No. 183, p. 10, 1864 (error for *inoceriformis*).

Shell medium sized, relatively thin, moderately inequilateral, anterior end extended. Upper posterior slope flattened, posterior end truncate. Lunular area deeply depressed. Sculpture consisting of coarse concentric waves and fine concentric threads; the waves are most pronounced on the dorsal half of the shell and may be absent on the ventral half. Hinge of right valve consisting of a slender anterior cardinal, a heavier middle cardinal, and a very slender bifid posterior cardinal; hinge of left valve consisting of a slender anterior cardinal, a heavy middle cardinal, and a very thin, long posterior cardinal. Pallial sinus deep, narrow, ascending.

Holotype: Length 75 millimeters, height 64 millimeters, diameter (left valve) 17 millimeters.

This species is the only *Clementia*-like mollusk found on the Atlantic coast of the United States north of Florida. Though it is recorded from the middle Miocene Calvert, Choptank, and St. Marys formations of Maryland, only a few specimens have been collected. An internal mold collected from the Calvert formation 1½ miles above Plum Point, on Chesapeake Bay (station 2457), closely resembles *grayi*, but the mold may be distorted. Two small hinges glued to the interior of the holotype are labeled "Shiloh, N. J." They probably represent small specimens of *inoceriformis*. If this locality label is trustworthy, these specimens represent the northernmost locality at which *Egesta* has been collected on the Atlantic coast. The internal mold from Gay Head, Mass., mentioned by Dall[30] as possibly representing this species seems to be some other veneroid mollusk, probably *Macrocallista*.

[30] Dall, W. H., Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1236, 1903.

C. (*E.*) *inoceriformis* is similar to *grayi* but is larger and less inequilateral, and the flattening of its upper posterior slope is not so pronounced. The concentric waves of *inoceriformis* extend farther down on the shell.

Type locality: Middle Miocene (St. Marys formation), Portobello, St. Marys River, St. Marys County, Md.

Other localities: Middle Miocene (Calvert formation), clay bed below Plum Point marl member, 1½ miles above Plum Point, Calvert County, Md.; G. D. Harris, collector; station 2457; one specimen. Middle Miocene (Calvert formation), Hollin Cliff and Wye Mills, Calvert County, Md. (Glenn). Middle Miocene (Choptank formation), west shore of Choptank River, about one-fourth to one-half mile below Barker's Landing and about 5 miles southeast of Easton, Talbot County, Md.; F. Burns and G. D. Harris, collectors; station 2350*a;* one specimen, piece of left valve showing hinge. Middle Miocene (Choptank formation), Governor Run and Sand Hill, Calvert County, Md. (Glenn). Middle Miocene (St. Marys formation), Cove Point, Chesapeake Bay, Calvert County, Md.; Maryland Geol. Survey; three broken specimens. Upper Miocene (Shiloh marl member of Kirkwood formation), Shiloh, Cumberland County, N. J.; two specimens.

Type material: Holotype (left valve), Philadelphia Acad. Nat. Sci. catalog No. 4303.

Clementia (Egesta) conradiana (F. M. Anderson)

Plate 15, Figures 1, 2; Plate 17, Figures 4, 5

Venus (*Chione*) *conradiana* F. M. Anderson, California Acad. Sci. Proc., 3d ser., Geology, vol. 2, pp. 195–196, pl. 14 fig. 35, 1905.

Shell large, moderately elongate, very inequilateral, anterior end not extended, lunular area deeply depressed. Sculpture consisting of coarse concentric waves and fine concentric threads. Near the base of the shell the concentric waves and threads merge into growth lines. Pallial sinus not known.

Holotype (measurements based on Anderson's figure): Approximate length 90 millimeters, height 78 millimeters. Figured specimen from Santa Margarita formation: Length 74 millimeters, height 65 millimeters, diameter (both valves) 35 millimeters.

This species is not represented in the collections of the United States National Museum. The unfluted inner margin, described by Anderson, shows that it is neither a *Venus* nor a *Chione*. When this account was first written it was supposed that the holotype was destroyed in the San Francisco fire of 1906, but later information shows that it stood the ordeal. Doctor Hanna kindly sent the photographs reproduced as Figures 4 and 5 on Plate 17 and also a cast of the hinge. This material unexpectedly shows that, unlike the other fossil species from California, this species has a deeply depressed lunular area, though it has no definite lunule. It therefore seems to be similar to the living *C.* (*E.*) *solida*, but it is more inequilateral, and its upper slope is not concave. Plate 17 was added after this paper was in proof.

A specimen in the collections of the California Academy of Sciences (pl. 15, fig. 1) seems to represent *Venus conradiana*, as it is very inequilateral, but it was collected from the upper Miocene Santa Margarita formation.

According to Clark[31] and other writers, the Vaqueros formation of reports issued by the United States Geological Survey on the oil fields of central California embraces two faunal zones—a lower zone carrying *Turritella inezana*, which corresponds to Merriam's *Turritella hoffmanni* (= *T. inezana*) zone[32] and to Smith's Vaqueros fauna,[33] and an upper zone carrying *Turritella ocoyana*, which corresponds to Merriam's *Turritella ocoyana* zone and to Smith's "Temblor" fauna. Clark restricted the name Vaqueros (Vaqueros "group," as used by Clark) to the lower zone, and for the upper zone used the name "Temblor group," a name first proposed by F. M. Anderson[34] in the form "Temblor beds." In a recent publication on the geology of Ventura and Los Angeles Counties Kew[35] adopted the restriction of the name Vaqueros formation to the lower Miocene deposits carrying *Turritella inezana* and proposed the name Topanga formation for the middle Miocene beds carrying *Turritella ocoyana.* In the following list of localities and elsewhere in this report the beds in central California carrying *Turritella ocoyana*, which apparently are the equivalent of the Topanga formation, are referred to as the *Turritella ocoyana* zone.

Smith[36] recorded *C.* (*E.*) *conradiana* from both the lower Miocene Vaqueros fauna and the middle Miocene "Temblor" fauna.

Type locality: Middle Miocene (*Turritella ocoyana* zone), 3 miles east of La Panza Springs, San Luis Obispo County, Calif.[37]

Other localities: Lower Miocene (Vaqueros fauna), California (Smith). Upper Miocene (Santa Margarita formation), bed of small creek about 2 miles north of Santa Margarita, about 100 yards south of

[31] Clark, Bruce, The marine Tertiary of the west coast of the United States; its sequence, paleogeography, and the problems of correlation: Jour. Geology, vol. 29, pp. 595–600, 1921.

[32] Merriam, J. C., A note on the fauna of the lower Miocene of California: California Univ. Dept. Geology Bull., vol. 3, pp. 377–381, 1904.

[33] Smith, J. P., Geologic range of Miocene invertebrate fossils of California: California Acad. Sci. Proc., 4th ser., vol. 3, pp. 164–165, 1912.

[34] Anderson, F. M., A stratigraphic study in the Mount Diablo Range of California: California Acad. Sci. Proc., 3d ser., Geology, vol. 2, p. 170, 1905; A further stratigraphic study in the Mount Diablo Range of California: California Acad. Sci. Proc., 4th ser., vol. 3, pp. 18–20, 38–39, 1908.

[35] Kew, W. S. W., Geology and oil resources of a part of Los Angeles and Ventura Counties, Calif.: U. S. Geol. Survey Bull. 753, pp. 40–51, 1924.

[36] Smith, J. P., Geologic range of Miocene invertebrate fossils of California: California Acad. Sci. Proc., 4th ser., vol. 3, p. 178, 1912.

[37] Kew (U. S. Geol. Survey Bull. 753, p. 51, 1924) listed "*Venus* cf. *V. conradianus* Anderson" from the middle Miocene Topanga formation of southern California.

Mr. Meyer's house, San Luis Obispo County, Calif.; F. M. Anderson, collector; California Acad. Sci. station 74; one specimen, figured; identification doubtful.

Type material: Holotype (left valve), California Acad. Sci. catalog No. 2152.

Clementia (Egesta) martini (Clark)

Plate 15, Figure 3

Venus martini Clark, California Univ. Dept. Geology Bull., vol. 8, pp. 470–471, pl. 54, fig. 1, 1915.

Shell moderately large, elongate, moderately inequilateral. Sculpture consisting of coarse concentric waves and fine concentric threads. The waves extend to the base of the shell, but near the base they are more closely spaced. Hinge of left valve similar to left hinge of *pertenuis*. Pallial sinus not known.

Holotype: Length 63 millimeters, approximate height 50 millimeters, diameter (both valves) 32 millimeters.

This species also is not represented in the collections of the United States National Museum. The holotype is somewhat distorted, and no undistorted large specimens are available. A small undistorted topotype is suspiciously similar to *C.* (*E.*) *pertenuis*. Additional material may show that *martini* and *pertenuis* represent the same species. Two topotypes show broken left hinges that, so far as can be seen, are essentially similar to left hinges of *pertenuis*. As *C.* (*E.*) *martini* now stands, it is very similar to elongate specimens of *pertenuis* but apparently is more elongate and more inequilateral, though less inequilateral than *conradiana*.

According to Clark *C.* (*E.*) *martini* is found in the upper part of the San Pablo formation of Contra Costa County, Calif., and also in the Santa Margarita formation of the region north of Coalinga in beds carrying *C.* (*E.*) *pertenuis*.

Type locality: Upper Miocene (upper part of San Pablo formation), center of north edge of NW. ¼ sec. 28, T. 1 S., R. 1 E., Mount Diablo quadrangle, Contra Costa County, Calif.; Univ. California station 741.

Other localities: Upper Miocene (upper part of San Pablo formation), other localities in Contra Costa County, Calif. (Clark). Upper Miocene (Santa Margarita formation), north of Coalinga, Fresno County, Calif. (Clark).

Type material: Holotype (both valves in attached position), Univ. California Pal. Coll. catalog No. 11570.

MIOCENE AND PLIOCENE SPECIES

Clementia (Egesta) pertenuis (Gabb)

Plate 16, Figures 1–6

Venus kennerlyi Reeve? Gabb, California Geol. Survey, Paleontology, vol. 2, p. 22, pl. 5, fig. 37, 1866.[38]

Venus pertenuis Gabb, California Geol. Survey, Paleontology, vol. 2, pp. 22, 55–56, pl. 5, fig. 37, 1866.

Arnold, U. S. Geol. Survey Bull. 396, p. 17, pl. 8, fig. 3, 1909.

Arnold and R. Anderson, U. S. Geol. Survey Bull. 398, pp. 85, 86, pl. 30, fig. 3, 1910.

Venus (*Chione*) *pertenuis* Gabb. F. M. Anderson, California Acad. Sci. Proc., 3d ser., Geology, vol. 2, p. 195, 1905.

Shell relatively thin, reaching a large size; shape variable, slightly or decidedly elongate, slightly inequilateral, anterior end extended. Lunular area moderately depressed. Sculpture consisting of coarse concentric waves and fine concentric threads. Near the ventral margin the waves are lower and more closely spaced, or they may disappear. Hinge of right valve consisting of a slender anterior cardinal, a heavier middle cardinal, and a long, slender, deeply bifid posterior cardinal; hinge of left valve consisting of a heavy anterior cardinal, a slightly heavier middle cardinal, and a long, thin posterior cardinal. Pallial sinus deep, very narrow, ascending.

Holotype: Length 58 millimeters, height 52 millimeters, diameter (both valves) 24 millimeters. Topotype: Approximate length 62 millimeters, height 52 millimeters, diameter (both valves) 25.5 millimeters. Figured specimen from Santa Margarita formation: Length 79 millimeters, height 63 millimeters, diameter (both valves) 38 millimeters. Specimen figured by Arnold: Length 91 millimeters, height 75 millimeters, diameter (both valves) 44.6 millimeters.

The very narrow pallial sinus of this species indicates that it is an *Egesta*, although the upper posterior slope is not flattened, and therefore the posterior end is not truncate. Figure 2 on Plate 16 shows part of the pallial sinus impressed on the internal mold of a topotype and showing where the shell is broken. The hinge (pl. 16, figs. 5, 6) is visible on shells from Kern River, where, in contrast to other localities, the shells are beautifully preserved. The right posterior cardinal of the specimen shown in Figure 5 was broken after the description was written. So far as the hinge is concerned *C.* (*E.*) *pertenuis* closely resembles *grayi* and *inoceriformis*, but its left anterior cardinal is a little heavier, and its left middle cardinal is not quite so heavy.

The specimens shown on Plate 16, figures 2, 3, may be regarded as topotypes, as they were collected from the *Turritella ocoyana* zone in the general region of the type locality. Figure 3 represents a slightly elongate shell that closely resembles the holotype (pl. 16, fig. 1). Figure 2, which represents a more elongate shell collected at the same locality, shows that the shape is variable. Most specimens from the Santa Margarita formation are elongate. (See pl. 16, fig. 4.) Arnold figured a large elongate specimen from the *Turritella ocoyana* zone of the Coalinga district. The shell is also variable in thickness, but in virtually all specimens it is so thin that the concentric waves are impressed on internal molds.

[38] The title-page of this publication gives the date 1869, but according to the footnote on page xiv of the preface, section 1, part 1 (pp. 1–38), was published in 1866. I am indebted to Mr. Ralph B. Stewart for pointing out this discrepancy in dates. A copy of section 1, part 1, in the library of the Geological Survey bears the date 1866.

According to Smith,[39] *Venus pertenuis* is found in the Vaqueros, "Temblor," Santa Margarita, and Purisima faunas of California—that is, its range is lower Miocene to lower Pliocene. Apparently all the specimens in the collections of the United States National Museum are from the middle Miocene *Turritella ocoyana* zone and the upper Miocene Santa Margarita formation.

In the Santa Cruz folio [40] the Purisima formation is considered upper Miocene and Pliocene, but it is now generally regarded as of lower Pliocene age.

Type locality: "From the Miocene, at Griswold's on road to New Idria, Monterey County" [San Benito County, Calif.].

Other localities: Lower Miocene (Vaqueros fauna), California (Smith).[41] Middle Miocene (*Turritella ocoyana* zone), Griswold's, by Vallecitos Valley, San Benito County, Calif.; H. W. Turner, collector; station 213; one specimen (topotype). Middle Miocene (*Turritella ocoyana* zone), Griswoldville, Fresno County (apparently error for San Benito County), Calif.; H. W. Turner, collector; station 422; one specimen (topotype). Middle Miocene (*Turritella ocoyana* zone), Vallecitos Valley, San Benito County, Calif.; H. W. Turner, collector; station 424; four specimens (topotypes), two of which are figured. Middle Miocene (*Turritella ocoyana* zone), south side of the Vallecitos, 3½ miles due west of Ashurst place and about 1¼ miles south of Dixon Spring, SW. ¼ sec. 9, T. 17 S., R. 11 E., San Benito County, Calif.; Robert Anderson, collector; station 5815; two specimens (topotypes). Middle Miocene (*Turritella ocoyana* zone), *Turritella*-bearing bed on east flank of high hill northeast of Oil City, SE. ¼ NE. ¼ sec. 16, T. 19 S., R. 15 E., Fresno County, Calif.; Ralph Arnold and J. H. Pierce, collectors; station 4631; four specimens, one of which was figured by Arnold. Middle Miocene (*Turritella ocoyana* zone), *Turritella*-bearing bed about 11 miles north-northeast of Coalinga just below Big Blue serpentinous member in ridge in sec. 10, T. 19 S., R. 15 E., Fresno County, Calif.; Ralph Arnold, collector; station 4633; one specimen. Middle Miocene (*Turritella ocoyana* zone), reef beds one-fourth mile south-southeast of Barton's cabin, in NW. ¼ sec. 23, T. 25 S., R. 18 E., Devils Den district, Kern County, Calif.; Ralph Arnold, collector; station 4861; one specimen; identification doubtful. Middle Miocene (*Turritella ocoyana* zone), reef bed 1½ to 3 miles west of Painted Rock ranch, Carrizo Plain district, San Luis Obispo County, Calif.; Ralph Arnold, collector; station 5161; one specimen; identification doubtful. Middle Miocene (*Turritella ocoyana* zone), bluff on south bank of Kern River, 500 feet east of Barker's old ranch house, one-half mile north of Ant Hill, Kern County, Calif.; Robert Anderson, collector; station 6088; one specimen, figured. Middle Miocene (*Turritella ocoyana* zone), south bank of Kern River, along abandoned irrigation ditch about 300 yards east of old buildings at Barker's ranch, Kern County, Calif.; R. W. Pack and J. D. Northrop, collectors; station 6613; one specimen. Middle Miocene (*Turritella ocoyana* zone), north bank of Kern River, bluffs above irrigation ditch about 1¼ miles northeast of Rio Bravo ranch, Kern County, Calif.; R. W. Pack and A. T. Schwennesen, collectors; station 6623; one specimen, figured. Middle Miocene (*Turritella ocoyana* zone), about a mile southeast of Rio Bravo ranch, gullies draining southwestward from crest of 1,100-foot ridge due south of junction of Kern River and Cottonwood Creek, Kern County, Calif.; A. T. Schwennesen, collector; station 6611; one specimen. Middle Miocene (*Turritella ocoyana* zone), small arroyo tributary to Adobe Canyon, W. ½ sec. 36, T. 27 S., R. 28 E., Kern County, Calif.; R. W. Pack and A. T. Schwennesen, collectors; station 6627; six specimens. Middle Miocene (*Turritella ocoyana* zone), southwest slope of Pyramid Mountain, hard sandstone reefs just north of old road running east and west between Kern River and Poso Creek, Kern County, Calif.; J. D. Northrop and R. W. Pack, collectors; station 6638; one specimen. Middle Miocene (Topanga formation), Aliso Canyon, creek bed one-half to three-quarters mile southwest of A. Joughlin's place, Los Angeles County, Calif.; W. S. W. Kew and C. M. Wagner, collectors; station 8127 (Kew).[42] Middle Miocene (Topanga formation), trail eading southeastward from road over Santa Monica lMountains up Sierra Canyon, Los Angeles County, Calif.; W. S. W. Kew and C. M. Wagner, collectors; station 8135 (Kew).[42] Upper Miocene (Santa Margarita formation), Big Blue Hills, north bank of Domengine Creek, NE. ¼ sec. 33, T. 18 S., R. 15 E., Fresno County, Calif.; Robert Anderson and R. W. Pack, collectors; station 5833; four specimens, one of which is figured. Upper Miocene (Santa Margarita formation), Big Blue Hills, 2¼ miles northwest of Domengine place, SW. ¼ sec. 18, T. 18 S., R. 15 E., Fresno County, Calif.; Robert Anderson and R. W. Pack, collectors; station 5827; three specimens; identification doubtful. Upper Miocene (Santa Margarita formation), Big Blue Hills, 2½ miles northwest of Domengine place, about 1,000 feet northwest of station 5827, Fresno County, Calif.; Robert Anderson and O. P. Jenkins, collectors; station 5828; one specimen. Upper Miocene (Santa Margarita formation), Coalinga district, just above big oyster bed one-fourth mile northwest of Perliss well, Fresno County, Calif.;

[39] Smith, J. P., Geologic range of Miocene invertebrate fossils of California: California Acad. Sci. Proc., 4th ser., vol. 3, p. 174, 1912.

[40] Branner, J. C., Newsom, J. F., and Arnold, Ralph, U. S. Geol. Survey Geol. Atlas, Santa Cruz folio (No. 163), pp. 5-6, 1909.

[41] Kew (U. S. Geol. Survey Bull. 753, p. 46, 1924) listed "*Venus* cf. *V. pertenuis* Gabb" from the Vaqueros formation of southern California (station 8137). This collection is not in the United States National Museum at the present time.

[42] These collections are not in the United States National Museum at the present time.

Ralph Arnold, collector; station 4848; two specimens. Upper Miocene (Santa Margarita formation), Tejon Hills, Kern County, Calif. (Nomland [43]). Lower Pliocene (lower part of Purisima formation), Santa Cruz quadrangle, Calif. (Branner, Newsom, and Arnold [44]).

Type material: Holotype (both valves in attached position), Univ. California Pal. Coll. catalog No. 12000.

Doubtful species

The following descriptions, which were added after this account was in proof, may represent *Clementia*, but the species can not now be certainly identified.

Astarte dubia D'Orbigny

Plate 17, Figures 1, 2

Astarte dubia D'Orbigny, Voyage dans l'Amérique méridionale, Paléontologie, vol. 3, pt. 4, p. 105, 1842; vol. 8, pl. 6, figs. 12, 13, 1847.

According to D'Orbigny's figures, which are here reproduced, this species may be a *Clementia*. The dimensions given are as follows: Length 38 millimeters; height, 33 millimeters; diameter, 20 millimeters. The following is a free translation of D'Orbigny's statement concerning this species:

> I will not consider the age or locality of this species. I found it in a collection at Chuquisaca, and I was told that it came from Peru. It belongs, I think, to the Cretaceous terrains of these regions.

Though Chiquisaca is probably in the interior of Peru, it should be noted that D'Orbigny states that he found this specimen in a collection at Chuquisaca, not from Chuquisaca. It may possibly have been collected from the Tertiary beds in the coastal region of northwestern Peru, though, according to the figures, it is not the same as either of two undescribed Eocene and Oligocene species from Peru, specimens of which Doctor Olsson kindly sent me.

Venus brioniana Trask

Plate 17, Figure 3

Venus brioniana Trask, California Univ. Dept. Geology Bull., vol. 13, p. 151, pl. 5, fig. 1, 1922.

Mr. Ralph B. Stewart called my attention to this species, which otherwise would have been overlooked. The holotype is an internal mold of a right valve, with part of the shell attached, impressed on coarse detrital rock. It has a length of about 87.7 millimeters and a height of about 88.5 millimeters. So far as can be seen, this specimen is virtually undistorted. It has a trigonal shape and is only slightly inequilateral. The sculpture consists of *Clementia*-like waves that become obscure on the lower half of the shell. It can not be seen whether the shell has a lunule, and all the internal features are inaccessible.

This specimen is less inequilateral and has a greater relative height than any large specimens of *Clementia* (*Egesta*) *pertenuis* examined, though it is quite similar on an enlarged scale to slightly elongate shells of this species, such as the topotype shown in Plate 16, Figure 3. Although this species is probably an *Egesta*, its disposition must await additional material. It has a much greater relative height than the holotype of *Clementia* (*Egesta*) *martini*, which, however, is crushed, so that comparisons based on that specimen are unreliable. According to Trask, both *Clementia* (*Egesta*) *martini* and *Venus brioniana* are found in the Briones sandstone. They may represent the same species, and both may be the same as *C.* (*E.*) *pertenuis*. There is no doubt that the outline of *pertenuis* is variable. As it is found in the Santa Margarita formation it would not be surprising to find it in beds lying between the Santa Margarita formation and the *Turritella ocoyana* zone. In Trask's photograph the shell is not correctly oriented and therefore appears too inequilateral.

Type locality: Upper Miocene (Briones sandstone), Concord quadrangle, Calif.; Univ. California station 177.

Type material: Holotype (right valve), Univ. California Pal. Coll. catalog No. 12377.

[43] Nomland, J. O., Fauna of the Santa Margarita beds in the North Coalinga region, Calif.: California Univ. Dept. Geology Bull., vol. 10, p. 302, 1917.

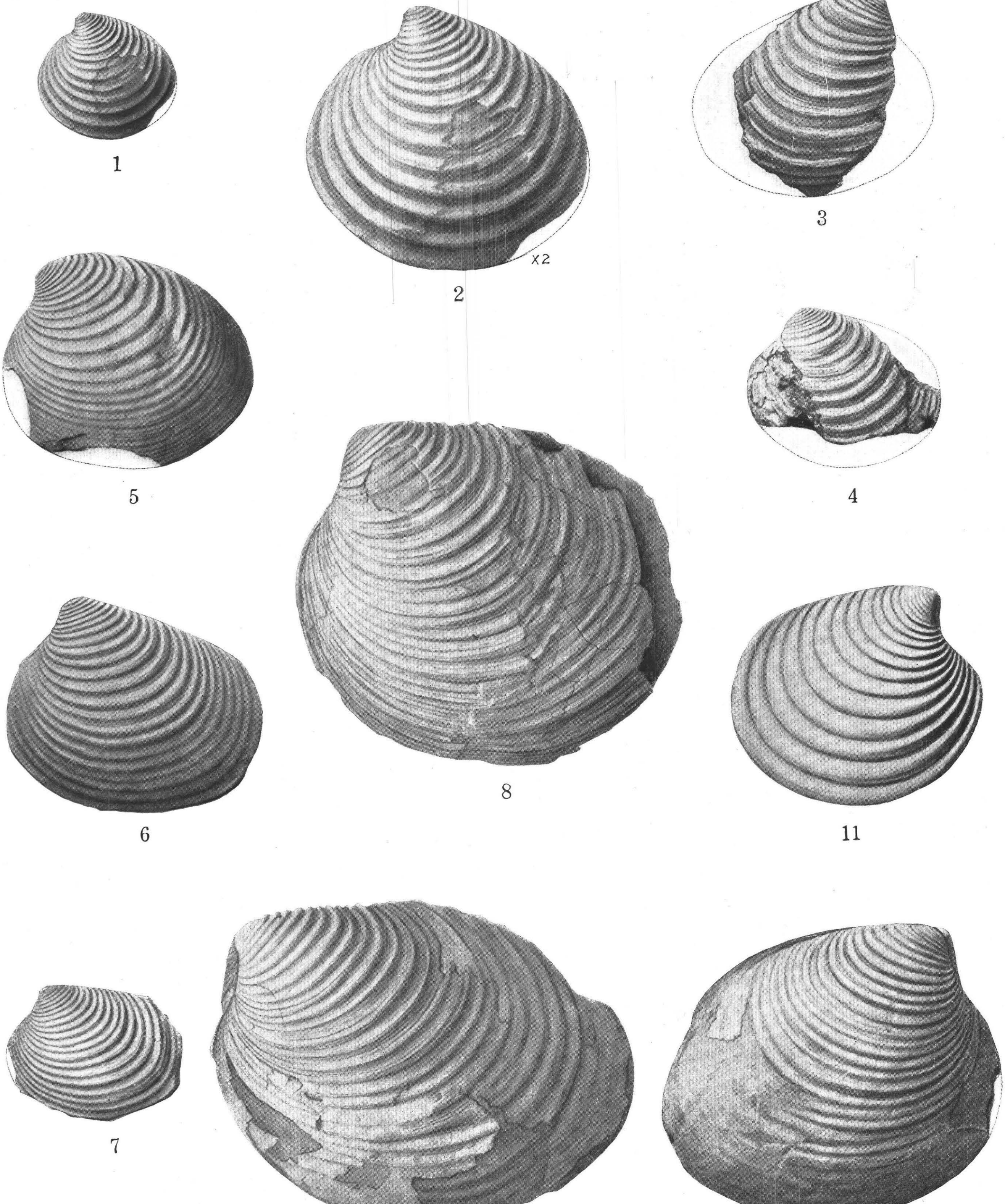
[44] Branner, J. C., Newsom, J. F., and Arnold, Ralph, U. S. Geol. Survey Geol. Atlas, Santa Cruz folio (No. 163) p. 6, 1909.

PLATES 14–17

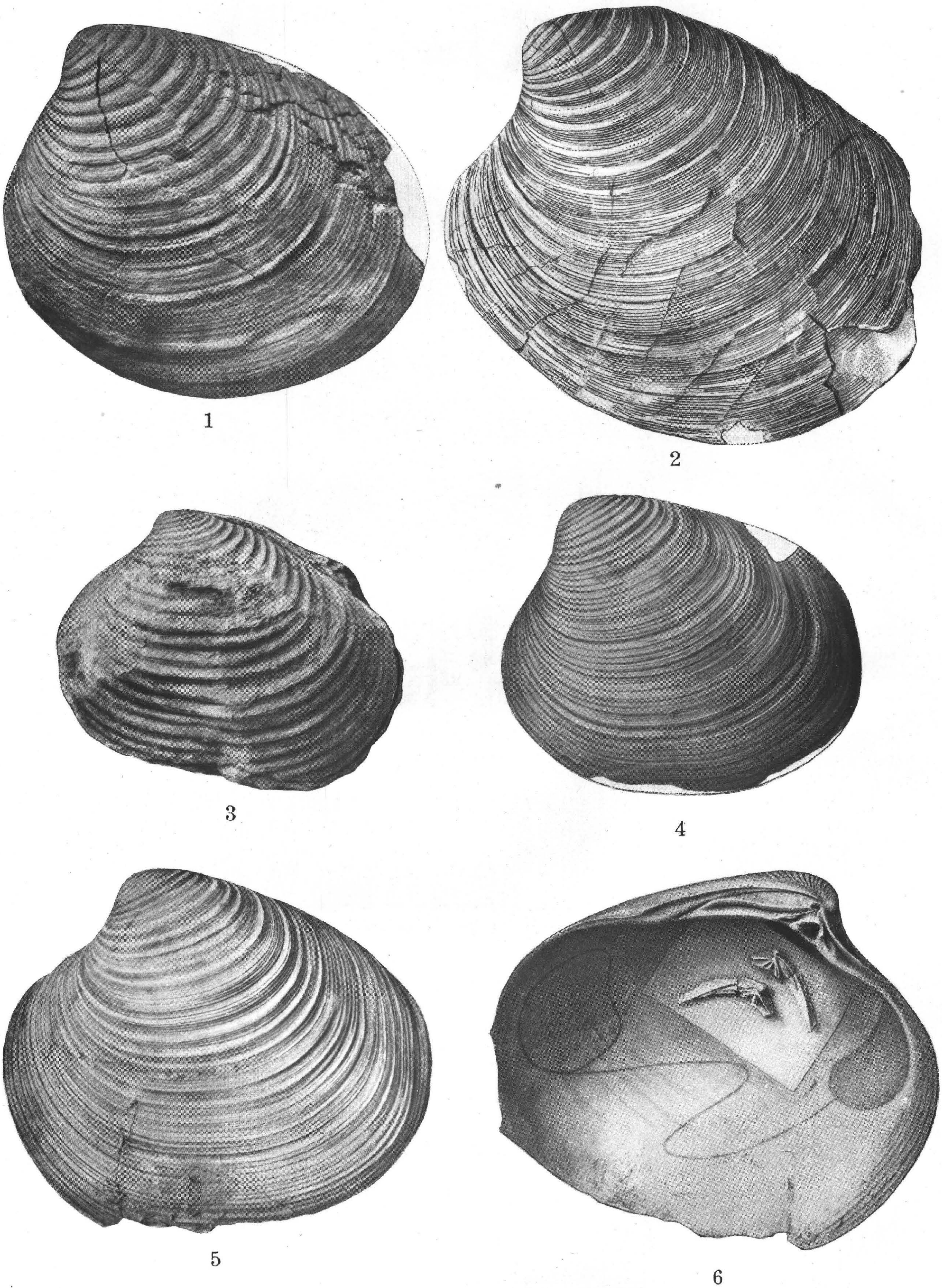
PLATE 14

[All figures natural size except as otherwise indicated]

		Page
FIGURES 1, 2.	*Clementia (Clementia) dariena vetula* Woodring, n. subsp. Holotype. Middle Eocene, southeast of Pijaguay, Colombia, station 1/986. U. S. Nat. Mus. catalog No. 354036	33
3, 4.	*Clementia (Clementia) dariena vetula* Woodring, n. subsp. Paratypes. Same locality. U. S. Nat. Mus. catalog No. 354037	33
5.	*Clementia (Clementia) dariena rabelli* Maury. Holotype. Middle Oligocene (San Sebastian shale), near San Sebastian, Porto Rico. Am. Mus. Nat. Hist. Div. Geol. and Invertebrate Pal. catalog No. 22509	34
6, 7.	*Clementia (Clementia) dariena dariena* (Conrad). Middle Miocene (Gatun formation), Spillway, Gatun Dam, Panama Canal Zone, station 5846. U. S. Nat. Mus. catalog No. 354039	34
8.	*Clementia (Clementia) dariena dariena* (Conrad). Middle Miocene, Tubara, Colombia, station 1/988. Slightly elongate specimen. U. S. Nat. Mus. catalog No. 354040	34
9.	*Clementia (Clementia) dariena dariena* (Conrad). Middle Miocene, near Tubara, Colombia, station 1/987. Elongate, slightly distorted specimen. U. S. Nat. Mus. catalog No. 354041	34
10.	*Clementia (Clementia) dariena dariena* (Conrad). Neotype. Middle Miocene (Gatun formation), east of Gatun, Panama Canal Zone, station 6030. U. S. Nat. Mus. catalog No. 354038	34
11.	*Clementia (Clementia) dariena dariena* (Conrad)? Holotype of *Clementia brasiliana* Maury. Lower Miocene (Estação formation), agricultural station near Braganca, Brazil. After Maury, Brasil Servicio geol. mineral. Mon., vol. 4, pl. 24, fig. 3, 1925	34



AMERICAN TERTIARY SPECIES OF CLEMENTIA S. S.



AMERICAN TERTIARY SPECIES OF EGESTA

PLATE 15

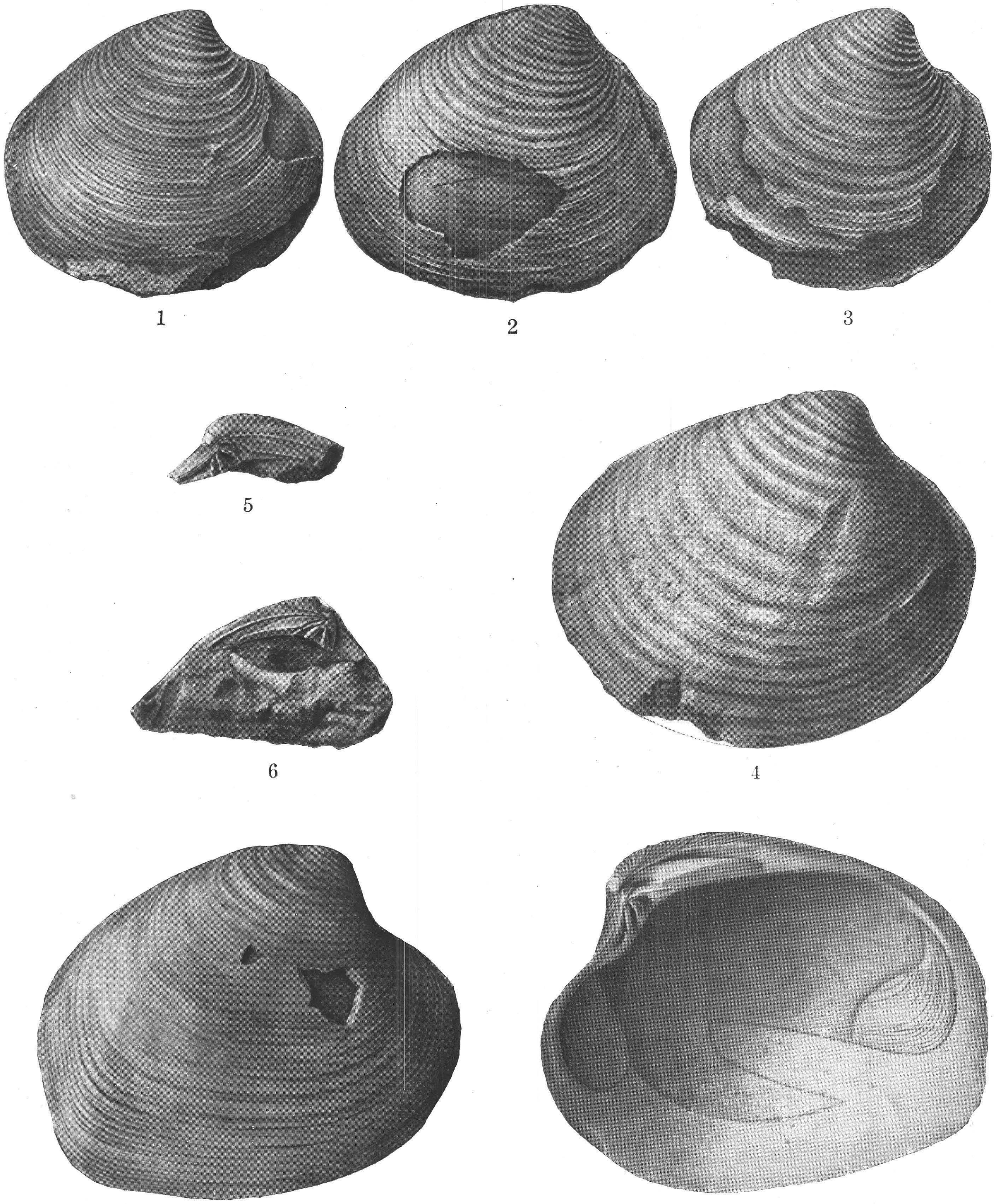
[All figures natural size]

		Page
FIGURE 1.	*Clementia* (*Egesta*) *conradiana* (F. M. Anderson)? Upper Miocene (Santa Margarita formation), near Santa Margarita, Calif., California Acad. Sci. station 74. California Acad. Sci. catalog No. 2212	39
2.	*Clementia* (*Egesta*) *conradiana* (F. M. Anderson). Holotype. Middle Miocene (*Turritella ocoyana* zone), La Panza Springs, Calif. After F. M. Anderson, California Acad. Sci. Proc., 3d ser., Geology, vol. 2, pl. 14, fig. 35, 1905	39
3.	*Clementia* (*Egesta*) *martini* (Clark). Holotype. Upper Miocene (San Pablo formation), Contra Costa County, Calif., Univ. California station 741. Univ. California Pal. Coll. catalog No. 11570	40
4.	*Clementia* (*Egesta*) *grayi* Dall. Holotype. Lower Miocene (Oak Grove sand), Oak Grove, Fla., station 2646. U. S. Nat. Mus. catalog No. 107381	37
5, 6.	*Clementia* (*Egesta*) *inoceriformis* (Wagner). Holotype. Middle Miocene (St. Marys formation), Portobello, Md. Philadelphia Acad. Nat. Sci. catalog No. 4303. The anterior and posterior cardinals are broken. The hinges glued on the interior are labeled "Shiloh, N. J."	38

PLATE 16

[All figures natural size]

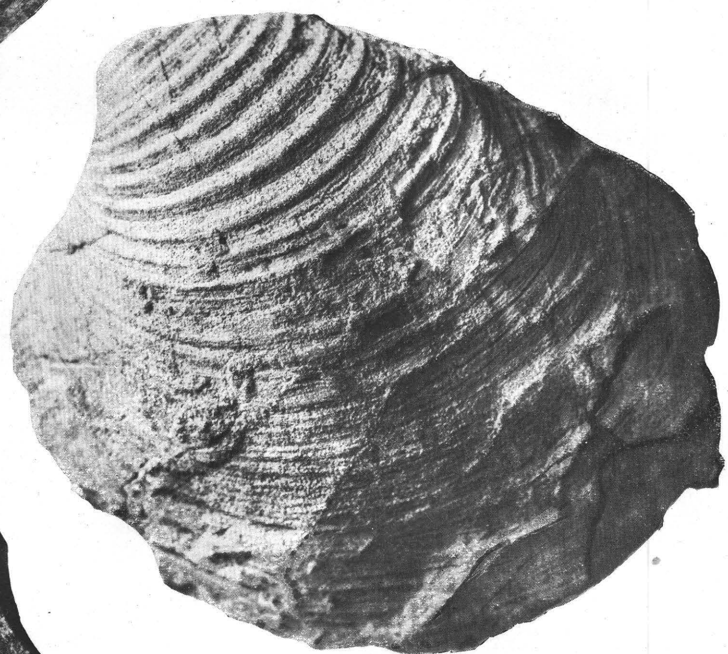
		Page
FIGURE 1.	*Clementia* (*Egesta*) *pertenuis* (Gabb). Holotype. Middle Miocene (*Turritella ocoyana* zone), Vallecitos, Calif. Univ. California Pal. Coll. catalog No. 12000	40
2, 3.	*Clementia* (*Egesta*) *pertenuis* (Gabb). Topotypes. Middle Miocene (*Turritella ocoyana* zone), Vallecitos, Calif., station 424. U. S. Nat. Mus. catalog No. 354042	40
4.	*Clementia* (*Egesta*) *pertenuis* (Gabb). Upper Miocene (Santa Margarita formation), north of Coalinga, Calif., station 5833. U. S. Nat. Mus. catalog No. 354045	40
5.	*Clementia* (*Egesta*) *pertenuis* (Gabb). Hinge of right valve. Middle Miocene (*Turritella ocoyana* zone), Kern River, Calif., station 6623. U. S. Nat. Mus. catalog No. 354044. The lower part of the posterior cardinal is broken	40
6.	*Clementia* (*Egesta*) *pertenuis* (Gabb). Hinge of left valve. Middle Miocene (*Turritella ocoyana* zone), Kern River, Calif., station 6068. U. S. Nat. Mus. catalog No. 354043	40
7, 8.	*Clementia* (*Egesta*) *solida* Dall. Holotype. Recent, Topolobampo, Gulf of California. U. S. Nat. Mus. catalog No. 126352. The posterior cardinal is broken.	



AMERICAN TERTIARY AND LIVING SPECIES OF EGESTA

3

1



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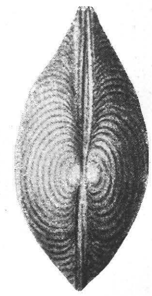

2

AMERICAN TERTIARY SPECIES OF EGESTA AND DOUBTFUL SPECIES

PLATE 17

[All figures natural size]

		Page
FIGURES 1, 2.	*Astarte dubia* D'Orbigny. Locality and age unknown. After D'Orbigny, A., Voyage dans l'Amérique méridionale, vol. 8, pl. 6, figs. 12, 13, 1847	42
3.	*Venus brioniana* Trask. Holotype. Upper Miocene (Briones sandstone), Concord quadrangle, Calif.; Univ. California station 177. Univ. California Pal. Coll. catalog No. 12377	42
4, 5.	*Clementia* (*Egesta*) *conradiana* (F. M. Anderson). Holotype. Middle Miocene (*Turritella ocoyana* zone), La Panza Springs, Calif. California Acad. Sci. catalog No. 2152	39

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