Tertiary and Cretaceous Brachiopods from Cuba and the Caribbean

G. ARTHUR COOPER

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G. Arthur Cooper

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ABSTRACT

Cooper, G. Arthur. Tertiary and Cretaceous Brachiopods from Cuba and the Caribbean. *Smithsonian Contributions to Paleobiology,* number 37, 45 pages, 2 figures, 7 plates, 1 table, 1979.—Thirty-nine taxa of fossil brachiopods are described, figured, and discussed. Three come from Cretaceous rocks of Cuba and the remainder were found in Tertiary sediments of Cuba and other parts of the Caribbean region. These range in age from Eocene to Pliocene. Fourteen genera are identified of which two are new: one from the Cretaceous and the other from the Eocene, both from Cuba.

Thirty species are recognized among the fossil genera: *Cruralina,* 1 (new); *Terebratulina,* 1 (new); *Tichosina,* 2 new; *Tichosina?,* 3 (1 new); *Stenosarina,* 1 (new); *Gryphus,* 4 (2 new); *Gryphus?,* 1; *Dyscritothyris,* 1 (new genus and species); *Argyrotheca,* 12 (11 new); *Cistellarcula,* 1 (new); *Hercothyris,* 2 (new genus and 2 new species); *Lacazella,* 1. Representatives of the following genera are not identified specifically: *Cryptopora, Rugia, Terebratulina, Platidia, Argyrotheca, Thecidellina.*

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Tertiary and Cretaceous Brachiopods from Cuba and the Caribbean

G. Arthur Cooper

Introduction

Although brachiopods are fairly common in the waters around Cuba and in the Caribbean Region (Cooper 1977) very few fossil species have been described. Cooper (1955) and Macsotay (1969) have written the only papers dealing specifically with the subject. The present paper includes the descriptions of specimens in the collection of the National Museum of Natural History and some that were presented by geologists who had worked in Cuba. Dr. R. H. Palmer (1948) spent many years studying the geology and collecting the fossils of Cuba. In all of these years the collection of brachiopods made by him was small but has proved to be very important. From his collection Cooper (1955) described two new genera of Terebratulida and an unusual rhynchonellid with Mediterranean affinities (Cooper 1959). The largest number of specimens described herein were collected by Dr. Palmer.

Dr. Pedro J. Bermudez, a leader in studies of Cuban geology (Bermudez and Hoffstetter 1959), presented specimens from Matanzas Province. Another contributor to the collection was Primitivo J. Borro, Cuban micropaleontologist, who presented a number of interesting lots of small brachiopods. The specimens donated by these two Cuban geologists were mainly of genera that are normally small. Among the Bermudez and Borro collections are a great variety of species of *Argyrotheca,* a genus also abundant in the Palmer collections. Unfortunately, most of the species are represented by only one or a few specimens. Although *Argyrotheca* is usually a variable genus, some specimens are so distinctive and in such marked contrast to all other known species that they are described as new despite their small numbers.

All but one of the species described are extinct and so are the new genera proposed herein. Most of the genera described are living in the waters of the Caribbean today. These include *Argyrotheca, Lacazella, Thecidellina, Platidia, Cryptopora, Terebratulina, Stenosarina,* and *Tichosina.* The fossil list also includes two new but extinct genera and *Gryphus.* The latter is known as a living brachiopod in Mediterranean and adjacent Atlantic waters but is not now known from the Caribbean Sea.

This also seems a good opportunity to refigure and redescribe the species from Trinidad proposed by Guppy (1866). These specimens are filled with a hard, solid limestone making excavation of the loop almost impossible without destroying the specimens. In spite of this difficulty, the exterior characters are sufficiently good to make it probable that the genus (*Tichosina*) to which they are assigned herein is correct.

It is interesting to note that one of the more common Recent brachiopods in Caribbean waters, *Dallina floridana* (Pourtales), has not yet been found in the fossil state. The new genus *Her-*

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cothyris, proposed herein for an Eocene genus, is externally similar to *Dallina floridana* but its internal details are entirely different.

It is possible to prepare the loop of the short-looped *Terebratulina* preserved in marly limestone by sawing off the umbonal region of the pedicle valve with a fine copper wire on which carborundum dust is fed. This leaves a window in the ventral valve through which excavation of the loop may be accomplished. If the exterior needs to be restored and the ventral umbonal cap is carefully cut off, it may be cemented over the excavated part. The fine copper wire makes such a thin kerf that the thickness of the cementing medium will replace the space of the shell lost.The specimen figured on Plate 3 (figures 11–13) was so prepared.

The locality lists include the names of species from Cuba collected by Palmer and described by Cooper in 1955.

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ABBREVIATIONS.—The following abbreviations are used in this paper: PRI = Paleontological Research Institute, Cornell University; USGS = United States Geological Survey, Washington, D.C.; USNM = specimen numbers using abbreviation for the former United States National Museum, collections of which are in the National Museum of Natural History, Smithsonian Institution.

Register of Localities

PALMER (1948)

53. Eocene? Hard, brittle, light gray limestone. Loma Macagua, one km W of Esperanza, Santa Clara Province (now Las Villas Province).
    Terebratulina sp. 1
    Argyrotheca sp.
377. Miocene. SE end of Yumuri Gorge, in back of Standard Oil Station. Highest beds on N side. Matanzas Province.
    Terebratulina? palmeri n. sp.
    Argyrotheca serrata n. sp.
378. Miocene. NW end of Yumuri Gorge, on N side, Matanzas Province.
    Argyrotheca sublamellosa n. sp.
405a. Miocene. White marl at base of Cojimar Gorge at S end. Old Kiln. Habana Province.
    Tichosina guppyi n. sp.
440. Upper Cretaceous. Carretera Central, six km SE of Coliseo, Matanzas Province.
    Rugia? sp. undet.
727. Eocene. S slope of Cuartel Hill, just W of Nuevitas, Camaguey Province.
    Argyrotheca aequicostata n. sp.
757. Upper Cretaceous, cut under railroad bridge, two km W of Madruga at Central San Antonio, Habana Province.
    Terebratulina sp. undet.
785. Upper Cretaceous, railroad cut on W edge of Madruga, 30 m (100 feet) from intrusion, Habana Province.
    Terebratulina sp. undet.
812. Cretaceous. Directly under chalk, one km S of Central San Antonio in railroad cut, Habana Province.
    Cruralina cubensis n. sp.
840. Upper Cretaceous, from conglomeratic sand beds under Eocene-Oligocene chalk, 7.3 (?) km E-SE of Madruga; 2.4 km S of Grua Esperanza, Habana Province.
    Dyscritothyris cubensis n. sp.
859p. Upper Cretaceous, 150 m N of Grua Esperanza, six km E of Madruga, Habana Province.
    Dyscritothyris cubensis n. sp.
898p. Miocene, cut on Carretera Central just W of Nena Machado Hospital, Matanzas Province.
    Terebratulina? palmeri n. sp.
926. Miocene, cut on Carretera Central, approximately four km SW of Matanzas near km post 100 [97] from Habana, Matanzas Province.
    Terebratulina? palmeri n. sp.
932c. Miocene, Km 95–500 M Carretera Central, 7.5 km W of Matanzas, Matanzas Province (probably same locality as USNM 818c).
    Terebratulina? palmeri n. sp.
    Argyrotheca bermudezi n. sp.
    A. plana n. sp.
    Argyrotheca 2 sp.
    Lacazella caribbeanensis Cooper
    Thecidellina sp.
942. Upper Eocene, Tejar Consuelo (of Mato) la Cienaga, Reparto Cerro, Habana, 1.3 km E of Tropical Brewing Company, NE of Puentes Grandes, Habana Province.
    Stenosarina cuneata n. sp.
    Terebratulina sp. undet.
976. Lower Miocene (Cojimar Formation), tan and white marl directly over Cretaceous, 2.5 km W of Cojimar on the Carretera to Casa Blanca, Habana Province.
    Phragmothyris costellata Cooper
978. Miocene (middle-basal Yumuri Formation), marls in deep road cut, 1.6 km NW of Casa Blanca, Habana Province.
    Cryptopora sp.
997. Miocene, soft cavernous limestone, Cantera Toledo, 200 m W of locality 996, one km E of the Jockey Club, Marianao, Habana Province.
    Gryphus parvus n. sp.
1003. Eocene, N of Carretera Central, 3.4–3.5 km on road to San Diego de los Banos, Pinar del Rio Province.
    Terebratulina sp. 2
    Phragmothyris rotunda Cooper
1018. Miocene (basal Yumuri Formation), marl 2 km SW of Cojimar on Hershey Electric Railroad, Habana Province.

TABLE 1.—Fossil brachiopods of Cuba and the Caribbean (A = Antigua, B = St. Bartholomew, C = Camaguey Province, H = Habana Province, L = Las Villas Province, M = Matanzas Province, P = Pinar del Rio Province, T = Trinidad)

Taxa	Upper Cretaceous	Eocene	Upper Eocene	Eocene ?	Oligocene	Miocene	Probably Miocene	Pliocene
Argyrotheca aequicostata n. sp.		C						
A. anomala n. sp.					M			
A. bermudezi n. sp.						M		
A. clevei (Davidson)		B						
A. cyrtiniformis n. sp.		P						
A. inconstans n. sp.								M
A. intercalata n. sp.		M						
A. magnicostata n. sp.		C						
A. peculiaris n. sp.						M?		
A. plana n. sp.						M		
A. serrata n. sp.						M		
A. sublamellosa n. sp.						M		
A. sp. undet.		C,P	L			M		
Cistellarcula dubia n. sp.					A			
Cruralina cubensis n. sp.	H							
Cryptopora sp.					H	H,L	H,L	
Dyscritothyris cubensis n. sp.	H							
Erymnaria cubensis Cooper		M						
Gryphus cookei n. sp.				C				
G. carneoides (Guppy)		T						
G. parvus n. sp.						H		
G. ? stantoni (Maury)		T						
G. vaughani (Cooke)		B						
Hercothyris borroi n. sp.		C,P						
H. semiradiata n. sp.		C						
Lacazella caribbeanensis Cooper						M		
L. sp. undet.		M	P			M		
Orthothyris radiata Cooper	H							
Phragmothyris costellata Cooper		H,P						
P. cubensis Cooper		C						
P. palmeri Cooper		C						
P. rotunda Cooper		C,P						
P. subplana Cooper		C,P						
Platidia sp. undet.		M				M		M
Rugia sp. undet.	L,M							
Stenosarina cuneata n. sp.		H	H					
Terebratulina ? palmeri n. sp.						M,P		
T. sp. 1				L				
T. sp. 2		P						
T. sp. indet.	H	H	H		H	M		
Thecidellina sp. undet.		M				M		
Tichosina foresti n. sp.					A			
T. guppyi n. sp.						H		
T.? insolita n. sp.		C						
T.? lecta (Guppy)		T						
T.? trinitatensis (Guppy)		T						

Cryptopora sp.
Tichosina guppyi n. sp.

1030. Eocene (lowest), 200 m S of 1026 (which is just S of Riverside Club), on the W side of the Almendares River in Reparto Kohly, Habana Province.
Stenosarina cuneata n. sp.
Terebratulina sp. undet.

1035. Eocene, tan limestone with orbitoids, Finca Manchuria, one km S of Ferrocaril Cuba Station at Majagua, 25 km W of Ciego, Camaguey Province.
Hercothyris borroi n. sp.

1085. Eocene, E of Arroyo Blanco, 150 m, in road to Majagua, Camaguey Province.
Argyrotheca sp.
Hercothyris borroi n. sp.
Phragmothyris rotunda Cooper

1086. Eocene, Loma la Quinta (hill above 1085), Camaguey Province.
Hercothyris borroi n. sp.

1102. Eocene, marls 4.65 km W of Guanajay, Pinar del Rio Province.
Phragmothyris costellata Cooper
Hercothyris borroi n. sp.

1214. Upper Cretaceous, one km W of Central San Antonio, in cut on new cane railroad to Central Hershey, Habana Province.
Orthothyris radiata Cooper

1245. Probably Miocene, 0.5 km S of General Wood asphalt mine, 1.5 km SE of Santa Maria del Rosario, Habana Province (age of collection not given by Palmer).
Argyrotheca peculiaris n. sp.

1319. Miocene, Calzada Real de Marianao and Calle San Pablo, La Ceiba, Cojimar, Habana Province.
Tichosina guppyi n. sp.

1330. Miocene, Guanajay-San Pedro cane railroad, S end of cut 300 m S of Grua Norona, Pinar del Rio Province.
Terebratulina? palmeri n. sp.

1366. Upper Cretaceous, Finca San Real, on Ferrocarril Central, one km N, 30° W of Paradero San Francisco, Habana Province.
Terebratulina sp. undet.

1457. Eocene?, Finca Junquito, one km E of San Antonio on Maraguan Road, Camaguey Province.
Gryphus cookei n. sp.

1458. Eocene?, Finca Junquito, 200 m E of 1457, Camaguey Province.
Gryphus cookei n. sp.

1476. Eocene, riprap along Nuevitas beach about 73 km on the railroad to Pastelillo (taken from cut at km 74), Camaguey Province.
Hercothyris borroi n. sp.

1479. Eocene, between km 73.5 and 74 on railroad to Pastelillo, Camaguey Province.
Argyrotheca magnicostata n. sp.

1613. Middle Eocene, 0.7 km S 65° W of Saratoga, Matanzas Province.
Argyrotheca intercalata n. sp.

1640. Eocene, deep cut N of Grua 9, Ramal Juan Criollo, Camaguey Province.
Argyrotheca 2 sp.
Hercothyris semiradiata n. sp.
H. borroi n. sp.

1660. Oligocene, long cut S of Y switch on Ramal Valle. C. Jatibonico. Camaguey Province.
Phragmorthis cubensis Cooper
P. palmeri Cooper
P. subplana Cooper

4707. Eocene, 80 m NE of school, Chucho Machin, Matanzas Province, Cuba.
Erymnaria cubensis Cooper

4968. Pliocene, 30 m S of Gallego house, Rio Conimar, five km N of Guartol, Matanzas Province.
Argyrotheca inconstans n. sp.

United States Geological Survey

4369. Eocene, St. Bartholomew, Leeward Islands.
Gryphus vaughani (Cooke)

4399. Eocene, St. Bartholomew, Leeward Islands.
Gryphus vaughani (Cooke)

6897b. Eocene, St. Bartholomew, Leeward Islands.
Argyrotheca clevei (Davidson)

6924. Eocene, NW side of St. Jean Bay, Leeward Islands, St. Bartholomew. From top limestone of described section.
Gryphus vaughani (Cooke)

National Museum of Natural History

818.* Upper Cretaceous, 145.5 km from Carretera Central between Matanzas and Jovellanos, 5.6 km SE of Coliseo, Las Villas Province, Cuba. P. J. Borro collector. = Palmer 440.
Rugia? sp.

818a. Upper Oligocene, point N of Mariegalente Bay, Antigua. W. R. Forest collector.
Cistellarcula dubia n. sp.

818b. Eocene (Taguasco Formation), 3.8 km W of Marroqui, 13.8 km E and 1.2 km N of Arroyo Blanco, Camaguey Province, Cuba (Cuba Calfornia Oil Company M-64-194).
Tichosina? insolita n. sp.

818c. Miocene, on the highway to Havana, 8.5 km W of Matanzas, Cuba. Matanzas Province. P. J. Bermudez collector (probably same locality as Palmer 932c).
Terebratulina palmeri n. sp.
Argyrotheca bermudezi n. sp.
A. plana n. sp.

818d. Middle Eocene, Loma Candela, Pinar del Rio Province, Cuba. P. J. Borro collector.
Argyrotheca cyrtiniformis n. sp.

818e. Eocene, Batey of Ingenio, "Saratoga", Matanzas Province, Cuba. P. J. Bermudez collector.

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* USNM precedes all locality numbers in collection.

Platidia sp. indet.
Thecidellina sp.
Lacazella sp.

818f. Upper Oligocene, Finca Margarita near Obelisco de Bauta, Habana Province, Cuba. P. J. Borro collector.
Cryptopora sp.

818g. Pliocene, 800 m S of the mouth of Rio Canimar, Matanzas Province, Cuba. P. J. Borro collector.
Platidia sp. indet.
Argyrotheca inconstans n. sp.

818h. Upper Oligocene, Facey Creek, Antigua. W. R. Forest collector.
Tichosina foresti n. sp.

818i. Miocene (Cojimar Formation), 4.5 km W of Sagua la Grande, Las Villas Province, Cuba. P. J. Borro collector.
Cryptopora sp.

818j. Miocene, under Hospital Infantile, Matanzas City, Matanzas Province, Cuba. P. J. Borro collector.
Terebratulina? palmeri n. sp.
Platidia sp. indet.
Lacazella sp.

818k. Miocene, Tejar Zayas, Matanzas City, Cuba. P. J. Bermudez collector.
Terebratulina sp. undet.
Platidia sp. indet.

818–1. Middle Miocene Km 94, Los Molinos, Matanzas Province, Cuba. P. J. Borro collector.
Lacazella sp.

818m. Upper Eocene, 4.5 km from Carretera de Guanajay al Muriel, new cut in Loma de Canas, Pinar del Rio, Cuba.
Argyrotheca sp.
Lacazella sp.

818n. Middle Oligocene, Finca Hatway, 5 km NE of San José de los Ramos, Matanzas Province, Cuba. P. J. Borro collector.
Argyrotheca anomala n. sp.

818o. Eocene, San Fernando, Trinidad.
Tichosina? lecta (Guppy)
T.? trinitatensis (Guppy)
Gryphus carneoides (Guppy)

Order RHYNCHONELLIDA Kuhn, 1949

This great group of brachiopods, prolific in the Paleozoic and dominant in the Mesozoic, declined drastically in the Tertiary. Only two genera are at present known from Cuba: *Erymnaria* and *Cryptopora*. The former is rare and unusual and is best known from Italy where it occurs in the Eocene. The Cuban occurrence (Cooper 1959:65) is also of Eocene age and helps to emphasize the Mediterranean affinities of the early Tertiary of Cuba. *Cryptopora* is known from a few small specimens having alate deltidial plates.

Superfamily RHYNCHONELLACEA Gray, 1848

Family CRYPTOPORIDAE Muir-Wood, 1955

Genus *Cryptopora* Jeffreys 1869

Cryptopora species

PLATE 5: FIGURE 6

Cryptopora Jeffreys, 1869:136.
Atretia Jeffreys 1870:421.—Davidson, 1887:173.—Thomson, 1927:146.—Cooper, 1959:17.—Ager, 1965:H620.

This genus occurs in the Miocene and Upper Oligocene. Only seven specimens were obtained that seem to represent the same species. They are smaller and rounder than *C. gnomon* Jeffreys, which is commonest in North Atlantic waters. The presence of winged deltidial plates on four of them suggests relationship to *C. rectimarginata* Cooper (1959). The Cuban forms are much more compressed and have a smaller and shorter beak than the Florida species. *Cryptopora* species figured by Toulmin (1940) from the Eocene (Saltmountain Formation) is a narrower species.

Cryptopora is another of the modern genera that was inherited from the Tertiary. It is now widely distributed, occurring in the Pacific and Indian Oceans as well as the North and South Atlantic. It can be expected in any of the Tertiary sediments of Cuba and elsewhere in the Caribbean. One specimen (USNM 550420) is from the Miocene (basal Yumuri Formation), from Palmer locality 1018; a second (USNM 550419) is from the Upper Oligocene, USNM locality 818f; a third specimen is from the Miocene at Palmer locality 978; a fourth lot (USNM 549424) of four specimens from Miocene sediments is from USNM locality 818i.

The specimen from the Miocene of Venezuela referred by Macsotay (1969) to *Glaciarcula* has all of the characters of *Cryptopora*: small size, open foramen, trace of winged deltidial plates, narrow lenticular profile, elongated beak and broadly uniplicate anterior commissure. It is possible that the Cuban specimens referred to above belong to Macsotay's species. *Glaciarcula* is an Arctic circumpolar genus not now known in equatorial waters or as a fossil. It is a cold water species.

Order TEREBRATULIDA Waagen, 1883

Superfamily CANCELLOTHYRIDACEA Cooper, 1973

Family CANCELLOTHYRIDIDAE Thomson, 1926

Subfamily CANCELLOTHYRIDINAE Thomson, 1926

Genus *Cruralina* Smirnova, 1966

Cruralina cubensis, new species

PLATE 1: FIGURES 24–29

Small, roundly oval in outline, posterolateral margins forming angle of about 108° at beak; sides and anterior margin strongly rounded; widest at middle; surface costellate; costellae numbering about three in one millimeter at front margin.

Ventral valve deeper than dorsal one, evenly and gently convex in lateral profile; anterior profile with long lateral slopes but only moderately convex medially; umbonal and median regions moderately swollen; beak nearly straight; foramen moderately large; deltidial plates vestigial.

Dorsal valve evenly and gently convex in lateral profile, anterior profile broadly and flatly convex, less than that of ventral valve; anterior half marked by broad, gentle sulcus barely indenting opposite valve; umbonal and median regions gently inflated. Interior with small rounded cardinal process, long and slender socket ridges; crural bases short, stout, directed sharply medially; descending branches slender; transverse ribbon and crural processes forming a ring with the descending branches.

MEASUREMENTS(mm).—Holotype: length 11.0, dorsal valve length 10.0, midwidth 10.4, thickness 5.7.

HORIZON AND LOCALITY.—Cretaceous: Palmer 812.

DIAGNOSIS.—Fine-lined, biconvex *Cruralina*.

TYPE.—Holotype: USNM 549408.

DISCUSSION AND COMPARISON.—The external form of this species suggests the modern genus *Chlidonophora*, which inhabits some of the deep waters in the Gulf of Mexico, the Atlantic near the Equator, the Caribbean Sea and the waters in the vicinity of Cuba. The fossil specimen, however, has a completely different loop from that of *Chlidonophora*, which does not have the closed ring of the Cancellothyrididae as the Cuban specimen does. No described Cretaceous species is like *C. cubensis*. *Cricosia filosa* (Conrad) is suggestive but this species is narrow-hinged and has a concave dorsal valve. *Cruralina? guadalupe* (Roemer) is similar to *C. filosa*. Undescribed, biconvex, round cancellothyrids occur in the Cretaceous of Texas.

Chlidonophora is an abyssal species found at depths of more than 2000 meters in the modern Caribbean, Indian Ocean, and Gulf of Mexico. It is thus unlikely to be found as a fossil.

Genus *Terebratulina* d'Orbigny, 1847

Terebratulina? palmeri, new species

PLATE 1: FIGURES 6–23; PLATE 7: FIGURES 9–20

Small for genus, ovate to subtriangular in outline, length and width nearly equal. Valves subequally deep, dorsal valve having a slightly greater depth. Lateral margins narrowly rounded; anterior margins slightly nasute. Posterolateral margins forming angle of 75°–98°. Anterior commissure narrowly uniplicate. Foramen large; deltidial plates vestigial. Surface multicostellate, about nine primary costellae at ventral beak forming main fascicles; costellae increasing by intercalation and bifurcation in three generations to form poorly defined fascicles anteriorly. Primary costellae fairly strongly beaded.

Ventral valve gently and evenly convex in lateral profile but broadly and flatly convex in anterior profile, medial region narrowly depressed. Sulcus extending from beak to anterior margin, very narrow and moderately deep. Flanks gently convex.

Dorsal valve gently and evenly convex in lateral profile, narrowly domed and medianly keeled in anterior profile; fold narrow, originating at umbo, and rising anteriorly but remaining narrow throughout. Flanks gently convex and steeply sloping.

Ventral valve with large thick teeth and short thin pedicle collar. Other details obscure. Dorsal valve with strongly elevated but rather thin socket ridges that protrude posterior to the hinge line; descending branches oblique, narrow and rounded in section supporting a moderately long loop; crural

processes moderately long and pointed, directed dorsally and slightly medially, not uniting. Anterior part of loop flattened, narrowly rounded to bluntly pointed and directed anteroventrally and strongly suggesting the loop of *Eucalathis*.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical angle (°)*
550329a	11.0	9.5	10.2	5.1	83
550329b	9.7	9.1	10.5	4.6	98
550329c	9.1	8.9	8.3	4.0	84
550329d	8.4	7.2	7.3	3.7	77
550329e	7.3	6.7	6.1	3.2	75
550330a	12.8	11.7	12.0	6.0	90
550330c	10.3	8.7	11.1	5.8	92
550330d	11.7	10.4	10.8	6.0	96
550330e	10.8	9.4	9.5	4.8	83

HORIZON AND LOCALITY.—Miocene: Palmer 377, 898p. 926, 932c, 1330; USNM 818j.

DIAGNOSIS.—Small *Terebratulina*? with carinate dorsal valve, narrowly sulcate ventral valve, and loop with crural processes separate.

TYPES.—Holotype: USNM 550329a. Figured paratypes: USNM 550330b, e, f, h-k. Unfigured paratypes: USNM 550329b-f, 550330a, c, d, g.

COMPARISON.—Although *Terebratulina* is one of the commonest brachiopods in the Tertiary formations of the Caribbean and southeastern United States, few species have been described to which *T.? palmeri* may be compared. *Terebratulina lachryma* (Morton) of the Eocene (Jacksonian) of southeastern United States and *T. kugleri* (Rutsch) of the Eocene of Soldado Rock in the Caribbean are not comparable to *T.? palmeri* because the second is a much larger species and both are differently ornamented as well as not being folded like the Cuban species.

Terebratulina cailleti Crosse, which occurs in modern Caribbean waters, is suggestive of *T.? palmeri* because the two are nearly the same size but the former is more strongly ornamented, more slender and more triangular. It does not have the deep, narrow sulcus and corresponding narrow fold that is so characteristic of *T.? palmeri*.

Terebratulina latifrons Dall, now living in the Caribbean, is like *T.? palmeri* in having a carinate dorsal valve and prominent ventral sulcus but its loop bears a ring. It is smaller and more triangular than *T.? palmeri*. It is sufficiently similar, however, to be a modern descendant of the Cuban species.

Terebratulina delheidi Vincent is similar to *T. palmeri* but its dorsal valve is much shallower than the ventral valve and it is a much rounder shell than the Cuban one, even though there is a carinate fold and sulcus like that of *T.? palmeri*.

DISCUSSION.—Few terebratulinas have the subcarinate fold and sulcus of *T.? palmeri*. Both the exterior and interior of this species are unusual. The majority of terebratulinas have the crural processes directed dorsomedially so that they soon fuse as they grow to form the anterior ring so characteristic of the *Terebratulina* loop. Six specimens were excavated to determine the loop of *T.? palmeri* only three of which gave complete loops. In not one of the six was a trace of a ring seen and the crural processes are so directed that they would never have formed a ring. The loop thus suggests that of *Eucalathis* or *Chlidonophora*. It is more like the latter because the loop of *Eucalathis* is very narrowly folded anteriorly and extends anterodorsally. The loop of *Chilidonophora* has a very narrow ribbon and extends ventrally like that of *T.?* palmeri.

Specimen USNM 550329i (Plate 7: figures 17, 18) of *T.? palmeri* was undoubtedly an old and obese shell because its loop is very thick, with thickened descending branches and a very broad ribbon. The crural processes, although broken at the points, are directed only slightly medially and point nearly directly ventrally.

The lateral profile of *T.? palmeri* with its dorsal valve more convex than the ventral valve suggests the Belgian Tertiary (Oligocene) genus *Rhynchonellopsis* (Vincent, 1893:50). The interior of the latter genus is not well known. The descending branches have been figured but on them is appended a tentatively drawn ring. This is evidently a guess. Its relationship to the Cuban species is thus uncertain, as is the possible generic relationship of *T.? palmeri* to *Rhynchonellopsis*.

Unidentified Species of *Terebratulina*

This genus is one of the commonest brachiopods in Tertiary rocks in Cuba as it is in Tertiary rocks of the southeastern United States and in the North

Atlantic today. Unfortunately, most of the specimens in the Palmer collection are too poor to be useful. If adult, most of them are too poorly preserved for description and most of the good to excellent specimens are immature and are thus unsatisfactory material on which to base species. Three lots were taken from the Upper Cretaceous from localities 757, 785, and 1366. The last two lots consist of immature specimens and the first consists of two adults and one immature specimen, all poorly preserved. These specimens indicate a strongly triangular species with costellae well separated by spaces equal in width to the width of the costellae. The largest specimen is 13 mm long by 11.5 mm wide.

Several lots from the Eocene are in the collection. Two of them from Palmer localities 942 and 1030 consist of immature specimens of fairly good preservation. A third lot from the Eocene obtained from P. J. Bermudez from USNM locality 818k also consists of immature specimens. Two additional lots are better preserved and noted below.

Terebratulina species 1

PLATE 2: FIGURES 17–19

Small for the genus, longitudinally elliptical in outline, valves of nearly equal depth. Anterior margin narrowly rounded; posterior forming an angle of 90°. Anterior commissure rectimarginate and slightly emarginate. Valves of nearly equal convexity in lateral profile but the ventral valve slightly the deeper; both valves moderately domed in anterior profile. Surface multicostellate; costellae slender, interspaces about equal to width of costellae; beading of the costellae on posterolateral margins. The best preserved specimen measures in mm: length 9.1; brachial valve length 7.8; width 7.0; thickness 4.5; apical angle 90°. The specimen is from the Eocene at Palmer locality 53.

FIGURED SPECIMEN.—USNM 550373.

Terebratulina species 2

PLATE 1: FIGURES 30, 31

Of about medium size for the genus, longer than wide and oval to subpentagonal in outline; apical angle about 85°. Sides rounded and anterior broadly rounded. Anterior commissure rectimarginate. Foramen small; deltidial plates vestigial. Valves subequal in depth, the ventral valve slightly deeper. Surface multicostellate, the costellae of the ventral valve slightly thicker than those of the opposite valve; interspaces nearly equal in width to the width of the costae. Intercalations and bifurcations in three or four generations and starting close to the beaks. Both valves evenly and gently convex in lateral profile and broadly but moderately domed in anterior profile.

MEASUREMENTS(mm).—USNM 550331a: length 14.1, dorsal valve length 13.2, maximum width 11.8, thickness 5.0, apical angle 84°.

DIAGNOSIS.—Medium sized *Terebratulina* with narrow, distant costellae.

HORIZON AND LOCALITY.—Eocene: Palmer 1003.

FIGURED SPECIMEN.—USNM 550331a.

COMPARISON.—Only two specimens are present in the collection and both are slightly crushed. They do not therefore make suitable material for naming. *Terebratulina* species 2 is not so elongate as *T. brundigensis* Aldrich, nor is it as elongated as *T. lachryma* (Morton). *Terebratulina louisianae* Stenzel is a larger species with less prominent and rounded shoulders than those of the Cuban specimens. *Terebratulina manasquani* Stenzel is strongly uniplicate, which is an unusual character for the genus. The shape of the Cuban species is much like that of *T. retusa* (Linnaeus) but their ornament is completely unlike.

Terebratulina species 2 is really closest to *T. kugleri* Rutsch (1939) from the island of Soldado Rock between Trinidad and the mouth of the Pedernales River in Venezuela. The two species have in common shape and L/W proportions but differ in ornament. Although the costellae of *Terebratulina* species 2 are rather distant they are not separated by interspaces as distant as those of *T. kugleri*. Furthermore, the Cuban shell does not have the median depression in both valves as described for the Soldado Rock species. It is possible that a large suite of *Terebratulina* species 2 would yield more ornament characters and establish a positive identification. At present it simply seems best to remark that *Terebratulina* species 2 is very similar to *T. kugleri*.

Family CHLIDONOPHORIDAE Muir-Wood, 1959

Subfamily CHLIDONOPHORINAE Muir-Wood, 1959

Genus *Rugia* Steinich, 1963

Rugia? species

PLATE 7: FIGURES 21–25

Minute, elongate oval in outline; greatest width anterior to midvalve; hinge straight, narrower than the greatest shell width. Profile plano- to unevenly biconvex, the ventral valve having the greater convexity Foramen large, margined by obliquely elevated deltidial plates. Surface costellate, costellae strongly beaded.

Ventral valve moderately and evenly convex in lateral profile, somewhat more strongly convex in anterior profile; median region swollen; anterior half marked by a shallow sulcus that originates at about midvalve. Ventral interior with a median thickening or ridge extending from near the beak to the anterior margin.

Dorsal valve lateral profile unequally convex, the posterior or umbonal part flattened and without ornament and the anterior half to two-thirds costellate and forming a poorly defined fold. Dorsal valve interior with broad and flattened socket ridges; crura originating anterior to the socket ridges; loop unknown.

MEASUREMENTS(mm).—USNM 550575: length 2.0, dorsal valve length 1.6, hinge width 1.3, maximum width 1.8, thickness 0.45.

HORIZON AND LOCALITIES.—Upper Cretaceous: Palmer 440, USNM 818.

TYPES.—Figured specimens: USNM 550574a, b, 550575.

DISCUSSION.—That these small shells are related to *Terebratulina* is without question but their correct generic assignment is difficult. They suggest small *Terebratulina* superficially but their costellation is not exactly like that of juvenile *Terebratulina* and the beak characters are not those of a juvenile. Assignment to *Rugia* is based chiefly on exterior characters: the beaded costellae and general form. The final test for these shells is to determine the character of the loop. *Rugia* has a loop similar to that of *Chlidonophora* rather than *Terebratulina*. It was not possible to determine the loop of these small shells.

Superfamily TEREBRATULACEA Gray, 1840

Family TEREBRATULIDAE Gray, 1840

Subfamily TEREBRATULINAE Gray, 1840

Genus *Tichosina* Cooper, 1977

As in the Caribbean today a variety of smooth Terebratulidae lived in those waters in Tertiary time. They were inherited from the Cretaceous when the short-looped Terebratulidae were abundant. Generic separation of these brachiopods has never been very satisfactory. The genera must be based on a combination of characters of which the loop is certainly the most important. A detailed analysis of the terebratulid loop in the Tertiary and Recent forms has not yet been made. Consequently, generic assignment of some of the Cuban Tertiary species is unsatisfactory. Their loops are not like those of *Gryphus,* which is well represented in the Cuban Eocene, although it is not now known from modern Caribbean waters. The loops of the species described herein are like those of *Tichosina* Cooper 1977, the type of which is *Terebratula floridensis* Cooper, which occurs in the Gulf of Mexico and the Caribbean Sea.

Tichosina? *bartletti* (Dall)

PLATE 2: FIGURES 20–24

Terebratula bartletti, Dall, 1920:314.—Cooper, 1977:64, pl. 4: figs. 27, 28; pl. 10: figs. 11–17.

Illustrations of this large and strongly uniplicate living species are introduced for comparison with the Caribbean Tertiary species *Terebratula*? *lecta* and *T.*? *trinitatensis* Guppy. Folding of the anterior margin of shells referred to *Tichosina* is variable, and folding as strong as that of Guppy's species and *T.*? *bartletti* is unusual. Beside the aberrant nature of the folding of *T.*? *bartletti,* the loop has longer outer hinge plates; consequently its assignment to *Tichosina* is queried.

LOCALITY.—Recent: Barbados.

TYPE.—Holotype: USNM 110852.

Tichosina foresti, new species

PLATE 3: FIGURES 6–13

Average size for the genus; elongate oval in outline, maximum width anterior to midvalve. Sides rounded; anterior margin broadly rounded. Ventral valve slightly deeper that the dorsal valve; lateral commissure straight; anterior commissure slightly uniplicate. Beak strongly labiate; foramen large, permesothyridid; symphytium covered. Surface smooth.

Ventral valve moderately convex in lateral profile, moderately domed in anterior profile. Posterior third somewhat narrowly swollen, the swelling continuing to midvalve, but the anterior third broadly flattened. Lateral slopes convex and steep.

Dorsal valve fairly evenly and moderately convex in lateral profile; anterior profile moderately domed, about equal in convexity to that of the opposite valve. Umbonal region moderately swollen, the swelling extending to midvalve, after which the valve is somewhat flattened. Lateral slopes slightly convex and steep.

Ventral valve with strong pedicle collar. Dorsal valve interior with loop occupying slightly more than one-third of the valve length. Socket ridges strong; outer hinge plates moderately concave and moderately long, not quite extending to half the loop length; descending lamellae broad and bladelike; transverse ribbon strongly arched medially and broad.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical angle (°)*
550333a	27.6	24.0	22.3	16.3	78
550333b	29.3	25.9	21.3	?	78

HORIZON AND LOCALITY.—Upper Oligocene: USNM 818h.

DIAGNOSIS.—Faintly uniplicate *Tichosina* narrowly ovate in outline.

TYPES.—Holotype: USNM 550333a. Figured paratype: USNM 550334b.

COMPARISON AND DISCUSSION.—The holotype is not perfect because the valves are slightly offset but not seriously enough to affect the description and measurements. The species is unlike *T.? bartletti* (Dall) and *T.? trinitatensis* (Guppy) in having only slight uniplication of the anterior margin. *Tichosina? lecta* (Guppy) has a much different shape with its nasute anterior and it is also more strongly folded anteriorly than *T. foresti*. Named for W. R. Forest, who collected the specimens.

Tichosina guppyi, new species

PLATE 2: FIGURES 11–16

Elongate oval in outline, widest at midvalve, sides broadly rounded; anterior margin gently curved; anterolateral extremities a small obtuse angle. Beak erect, obliquely truncated; foramen moderately large, permesothyridid, labiate. Symphytium partially visible. Anterior commissure faintly and broadly uniplicate. Lateral commissure nearly straight. Surface smooth.

Ventral valve strongly and evenly convex in lateral profile but moderately domed with flattened sides in anterior profile. Umbonal and median regions swollen, the swelling extending to beyond midvalve; anterior somewhat abruptly flattened.

Dorsal valve unevenly convex in lateral profile with the maximum convexity in the posterior half; anterior profile moderately convex and with somewhat flattened sides and strongly resembling the anterior profile of the opposite valve. Posteromedian region strongly swollen; anterior moderately flattened with a moderately long and steep anterior slope.

MEASUREMENTS(mm).—Holotype: length 21.8, dorsal valve length 19.6, maximum width 15.0, thickness 13.6, apical angle 71°.

HORIZON AND LOCALITIES.—Miocene (Yumuri Limestone): Palmer 405a (type), 1018, 1319.

DIAGNOSIS.—Elongate oval *Tichosina*, anteriorly broad but faintly uniplicate.

TYPES.—Holotype: USNM 550337. Unfigured paratype: USNM 550338.

COMPARISON.—None of the Recent Caribbean or West Indian species of *Tichosina* has the fairly narrow, elongated form of this species. Of Cuban species it is somewhat suggestive of *Tichosina foresti*, new species, but that species is somewhat triangular as it widens anteriorly.

Tichosina? insolita, new species

PLATE 3: FIGURES 1–5

Large, roundly pentagonal in outline with maximum width near midvalve; ventral valve much

deeper that the dorsal valve; length slightly greater than the width; sides broadly rounded; anterior margin somewhat narrowly rounded. Lateral commissure nearly straight; anterior commissure gently but distinctly uniplicate. Beak narrow labiate and not extended notably in a posterior direction; foramen small, permesothyridid; symphytium visible. Surface smooth.

Ventral valve strongly and evenly convex in lateral profile; anterior profile strongly and narrowly domed. Median region from umbo to beyond midvalve narrowly swollen; anterior slope somewhat flattened; lateral slopes flattened but steep.

Dorsal valve very gently and evenly convex in lateral profile but broadly and gently convex in anterior profile; median region from umbo to anterior margin slightly convex and producing a slightly nasute anterior margin; flanks flattened and sloping gently to the lateral margin.

Interior unknown.

MEASUREMENTS(mm).—Holotype: length 35.0, dorsal valve length 31.5, maximum width 31.8, thickness 19.5, apical angle 97°.

HORIZON AND LOCALITY.—Eocene (Taguasco Formation): USNM 818b.

DIAGNOSIS.—Large strong inequivalve laterally rounded *Tichosina*? with gentle uniplication.

TYPE.—Holotype: USNM 550334.

COMPARISON AND DISCUSSION.—This species is not characteristic of the genus to which it is referred. No other large species of *Tichosina* fossil or Recent has the almost circular outline and short narrow beak of this Cuban specimen. Assignment to *Tichosina* is based on the definite uniplication of the anterior margin. Although the beak of *T.? insolita* is small the foramen is proportionately large and is also somewhat labiate. These are features of *Tichosina*. The dorsal valve is also shallower than usual in the genus.

Tichosina? lecta (Guppy)

PLATE 2: FIGURES 1–5

Terebratula lecta Guppy, 1866:296, pl. 19: fig. 3.

This species is based on three specimens, all of them poor but collectively giving a fair idea of the species. No details of the interior are available but the exterior form, profile and folding suggest a species of *Tichosina* possibly related to *T.? trinitatensis* (Guppy). Characteristic exterior features of *Tichosina* appear in the permesothyridid strongly labiate foramen and the uniplicate folding of the anterior commissure. This folding is unlike that of *T.? trinitatensis* in being narrow and without the strong anterolateral angulations of that species. Furthermore, the anteromedian parts of both valves are not conspicuously flattened as in the larger species.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical angle (°)*
115646a (Tertiary catalog)	29.7	28.3	24.8	16.6	73
115646b	24.0	23.0?	21.7	14.7?	81

TYPES.—Lectotype: USNM 115646a (Tertiary catalog).

HORIZON AND LOCALITY.—Eocene: USNM 818o.

DIAGNOSIS.—Anteriorly tapering *Tichosina*? with a narrow anterior fold.

COMPARISON AND DISCUSSION.—The striking differences between this species and *T. trinitatensis* (Guppy) are referred to above. It is unlikely from the nature of the folding that *T.? lecta* could be the young of *T.? trinitatensis* although the two seem to be generically related. *Tichosina? lecta* is more like *T.? bartletti* (Dall) externally as the latter tapers somewhat, but not so strongly as the Trinidad species. The valves of *T.? bartletti* are more swollen about the umbo and the beak is narrower than that of *T.? lecta*.

Tichosina? trinitatensis (Guppy)

PLATE 2: FIGURES 31–35

Terebratula trinitatensis Guppy, 1866:296.

This is a large and robust species quite adequately described by Guppy. The front "edge" is said to be nearly straight but the statement masks the true condition of the anterior commissure that is strongly uniplicate. The plication produces the "obscure carination radiating to each angle of the front edge." The fold is broad and its posterolateral manifestations make a flattened S. The broad fold produces a corresponding very broad and conspicuous flattening of the anterior half of the ventral valve. The beak is strongly labiate and the foramen

large and permesothyridid. No details of the interior can be seen.

MEASUREMENTS(mm).—Holotype: length 40.8, dorsal valve length 47.5, maximum width 31.0, thickness 26.0, apical angle 73°.

DIAGNOSIS.—Large, strongly uniplicate *Tichosina* with conspicuous flattening of the anterior of both valves.

TYPE.—Holotype: USNM 115647 (Tertiary catalog).

HORIZON AND LOCALITY.—Eocene: USNM 818o.

COMPARISON AND DISCUSSION.—*Tichosina? trinitatensis* is very suggestive of the Recent *T.? bartletti* (Dall) living in eastern Caribbean waters. The two are approximately of the same size in examples of the modern species but their outline and details of both valves are quite different. Although *T.? bartletti* is strongly uniplicate the fold is much narrower than that of the Trinidad species and the anterior of both valves is convex or slightly swollen rather than strongly flattened as in the San Fernando species. The interior of *T.? trinitatensis* is unknown but its exterior is so similar to that of *Tichosina? bartletti* that the tentative assignment to the modern genus seems reasonable. Other American terebratuloids from the Eocene are unlike *Tichosina* internally and externally. The loop and folding of *"Terebratula" wilmingtonensis* Lyell and Sowerby are different from those of *Tichosina* and this is true also of *Oleneothyris,* common in the Paleocene of New Jersey, which has a loop with elevated, angular transverse ribbon.

Genus *Stenosarina* Cooper, 1977

Cooper (1977) proposed *Stenosarina* for Terebratulidae having deep ventral valves, shallow dorsal valves, small obliquely truncated and depressed ventral beak and narrow loop. The exterior lateral profile is distinctive. The genus occurs today in the Gulf of Mexico and Caribbean Sea.

Stenosarina cuneata, new species

PLATE 2: FIGURES 6–10

Shell of about medium size, elongate triangular in outline; sides gently rounded; anterior margin broadly rounded; maximum width in anterior third; valves strongly inequivalve, the pedicle valve deeper than the brachial valve. Anterior commissure rectimarginate; lateral commissure strongly curved toward the brachial valve. Foramen small, round, permesothyridid. Surface smooth.

Ventral valve gently convex in lateral profile, maximum convexity at about midvalve; anterior profile strongly domed, the top of the dome flattened, the sides flattened and very steep. Beak short; umbo narrow. Median region swollen. Anterior slope long and steep.

Dorsal valve shallow but strongly convex in lateral profile, with the maximum convexity at midvalve; anterior profile broadly and flatly convex; umbonal and median regions swollen; lateral slopes gentle; anterior slope long and somewhat rounded; hinge plates and loop as in *Tichosina.*

MEASUREMENTS(mm).—Holotype: length 19.8, dorsal valve length 19.4, maximum width 14.7, thickness 12.0, apical angle 70°.

TYPES.—Holotype: USNM 549436a. Unfigured paratype: 549436b.

HORIZON AND LOCALITY.—Eocene: Palmer 942, 1030 (type).

DIAGNOSIS.—Elongate, triangular *Stenosarina* with shallow dorsal valve.

DISCUSSION.—This species is characterized by the great difference in the thickness of the valves, small foramen and short, strongly truncated beak. It is suggestive of *Dallithyris sphenoidea* (Philippi) from the Pliocene and Recent of the Mediterranean region. The European form is, however, a larger shell with more incurved beak, larger foramen and with much less dorsal curve to the lateral commissure. The dorsal valve of the Cuban species is more arched and the species generally is a more delicate one.

Genus *Gryphus* Megerle von Mühlfeldt, 1811

Gryphus vitreus (Born)

PLATE 1: FIGURES 32–36

Views of *Gryphus vitreus* (Born) are introduced to show the loop and hinge region for comparison with these features of *Tichosina.* The loop of *Gryphus* has solid rounded descending lamellae or crura posterior to the processes. This is in strong contrast to the flat blade-like crura of *Tichosina.* Furthermore the outer hinge plates of *Gryphus* are

fairly flat compared to the deeply concave plates of *Tichosina*. In *Gryphus* the outer hinge plates are not bounded by elevated cural bases as they are in *Tichosina*. Note too that the anterior commissure of *Gryphus* is rectimarginate.

LOCALITIES.—Recent: Gulf of Naples; off Sardinia.

TYPES.—Hypotypes: USNM 109734a, 109770.

Gryphus carneoides (Guppy)

PLATE 3: FIGURES 22–29

Terebratula carneoides Guppy, 1866:296, pl. 19: fig. 2 [not Davidson 1874:8, pl. 8: figs. 11a, b; = *Liothyrina vaughani* Cooke].

This species makes a marked contrast to the other two described by Guppy, herein placed in *Tichosina*? *Gryphus carneoides* has many characters relating it to *Gryphus vitreus* (Born), a fact mentioned by Davidson in a discussion of Guppy's species (Davidson 1874:8). The valves are strongly swollen, that of the dorsal side having a rather strong carination that produces, with the narrow ventral valve, a somewhat nasute anterior. The anterior commissure is rectimarginate and the foramen is small. This species will not be confused with *G. vaughani*, which is smaller in size, has subcarinate valves, and elongate elliptical outline.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical angle (°)*
115645a (Tertiary)	36.5	32.4	30.0?	21.0?	95?
115645b	38.0	34.8	30.6	24.3	107

DIAGNOSIS.—Large, elongate elliptical *Gryphus* with subcarinate valves and nasute anterior.

HORIZON AND LOCALITY.—Eocene: USNM 818o.

TYPES.—Lectotype: USNM 115645b, (Tertiary catalog). Paratype: USNM 115645a.

Gryphus cookei, new species

PLATE 1: FIGURES 37–46

Large, thick-shelled; slightly elongated to nearly circular in outline; sides and anterior margin gently rounded; posterolateral extremities moderately rounded; anterior commissure rectimarginate. Lateral commissure nearly straight. Maximum width at midvalve. Surface smooth except for poorly defined growth lines.

Ventral valve slightly deeper than dorsal valve, evenly and moderately convex in lateral profile; anterior profile slightly greater in convexity than that of lateral profile; beak small, erect, foramen minute, permesothyridid; symphytium generally concealed. Umbonal region narrowly swollen, not extended in posterior direction; umbonal swelling continuing anteriorly for about ¾ valve length; anterior quarter somewhat flattened and forming a steep anterior slope; principle (median) pallial trunks deeply impressed.

Dorsal valve with lateral profile slightly less convex than the anterior profile; umbonal region somewhat narrowly swollen, the swelling continuing almost to anterior margin; anterior slope steep in front quarter of valve. Lateral slopes flattened but steep. Cardinalia with minute cardinal process and small socket ridges. Outer hinge plates flattened and supporting stout crura and short narrow loop. Transverse ribbon not preserved; descending lamellae rounded in cross-section.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical angle (°)*
549411a	38.3	35.9	33.3	21.5	110
549411b	34.8	33.4	30.6	21.5	106
549411c	28.7	26.5	26.5	16.6	105
549411h	34.5	31.7	33.9	20.3	116

DIAGNOSIS.—Moderately large *Gryphus* with strongly convex valves, minute foramen and smooth posterolateral slopes.

HORIZON AND LOCALITIES.—Eocene(?): Palmer 1457, 1458.

TYPES.—Holotype: USNM 549411b. Figured paratypes: USNM 549411a, d, f, g. Unfigured paratypes: USNM 549411c, e, h–l.

COMPARISON AND DISCUSSION.—This is a large swollen *Gryphus* having resemblance to *G. carneoides* (Guppy), *G. vaughani* (Cooke) and *G. vitreus* (Born). The first, from the Eocene of San Fernando, Trinidad, is of about the same size, with a minute foramen but instead of having a rounded outline it is markedly elongate elliptical with a distinct anterior taper.

Gryphus vaughani (Cooke) is a much larger shell

than *G. cookei* but is very similar nevertheless. It is somewhat more elongated proportionally than *G. cookei* and has a slight but distinct uniplication of the anterior margin. An expression of the difference of shape is shown also in the slightly smaller apical angle of *G. vaughani.*

Preparation of a complete loop of *G. cookei* proved impossible. Although the attempt was made on three specimens, each proved to have had the transverse ribbon broken off. Nevertheless the hinge plate is characteristic of *Gryphus* as it has flattened outer hinge plates and stout descending lamellae, round in cross-section, and with anteriorly placed crural processes.

Gryphus cookei is about the same size as *G. vitreus* of the Mediterranean but the modern form has less convex valves, a larger foramen and possesses distinct folds that extend to the anterolateral extremities.

Gryphus parvus, new species

PLATE 3: FIGURES 14–21

Small for genus, elongate ovate in outline; valves subequally convex, ventral valve deeper than dorsal valve; greatest width anterior to middle; sides and anterior margin well rounded; surface smooth.

Ventral valve strongly convex in lateral profile, with maximum curvature in umbonal region; anterior profile moderately convex, having about same convexity as dorsal valve; umbo and median regions inflated. Sides steep. Beak slightly incurved; foramen large, mesothyridid; beak ridges strong.

Dorsal valve moderately convex in lateral profile, most convex at midvalve; anterior profile moderately convex; median region swollen, slopes to all margins moderately steep. Interior with loop about equal in length to ⅓ the valve length; sides parallel; socket ridges short, small; hinge-plates flattened; crural bases stout; crural process stout; descending lamellae short; transverse ribbon broad and only slightly elevated medially.

MEASUREMENTS(mm).—Holotype: length 11.8, dorsal valve length 9.6, maximum width 10.6, thickness 9.1, apical angle 83°.

TYPES.—Holotype: USNM 549412a. Unfigured paratype: USNM 549412b, c.

HORIZON AND LOCALITY.—Miocene: Palmer 997.

DIAGNOSIS.—Small, rounded, and rotund *Gryphus.*

DISCUSSION.—This species is characterized by its small size and strongly convex valves. It is suggestive of *G. affinis* (Calcara) but the Mediterranean species is more elongate and the valves are less swollen than those of the Cuban form.

Gryphus? *stantoni* (Maury)

PLATE 2: FIGURES 25–30

Terebratula stantoni Maury, 1912:104, pl. 13: figs. 17, 18.

Small, subcircular in outline, subequally biconvex, lateral commissure straight, anterior commissure rectimarginate. Sides rounded, anterior broadly rounded. Widest at midvalve. Beak low, suberect, foramen small, symphytium mostly covered; foramen submesothyrid. Surface smooth.

MEASUREMENTS(mm).—Lectotype (PRI 28564a): length 18.9, midwidth 17.3, thickness 10.6, apical angle 114°.

HORIZON AND LOCALITY.—Eocene: bed 8, Soldado Rock, near the Serpents Mouth, Gulf of Paria, Trinidad.

TYPES.—Lectotype: PRI 28564a (Maury 1912, pl. 13: fig. 18). Paratype: PRI 28564b.

DISCUSSION.—Little is known about the interior of this species except that the paratype exhibits an outer hinge plate which is flat like that of *Gryphus.* This and the small size of the foramen determine the assignment here to *Gryphus*?.

Gryphus vaughani (Cooke)

PLATE 3: FIGURES 30–32; PLATE 7: FIGURES 1, 2

Terebratula carneoides Davidson, 1874:8, pl. 8: figs. 11a, b. *Liothyrina vaughani* Cooke, 1919:152, pl. 16: figs. 1a-c.

This is one of the largest known species of *Gryphus* but like many other species the name is based on unsatisfactory material. Cooke's types (USNM 167202a–g) consist of seven specimens, six with both valves, one with ventral valve only. The specimens are very thick-shelled and are unusual in this genus for having a faintly uniplicate anterior commissure. This may be a gerontic feature but the faint plication may be seen in the growth lines of the lectotype for some distance toward the posterior. Assignment to *Gryphus* is based on the narrowly pinched umbonal region, incurved beak, minute foramen, and interior details.

A silicified specimen (Plate 7: figures 1, 2) made possible a view of the interior of both valves showing the flat outer hinge plates characteristic of *Gryphus*. The ventral valve interior has small teeth; its posterior is greatly thickened and muscles deeply inset. The dorsal valve interior is greatly thickened. The adductor scars are separate and elongate and the cardinal process elevated. The myophore is narrowly rounded and recessed. The hinge plates are thickened and difficult to differentiate from the socket ridges. The loop was not preserved.

The species suggests some of the larger forms of *G. vitreus* (Born) from the Mediterranean but it differs in having a smaller foramen, only slight anterior taper, but strongly swollen valves. Comparison with *G. cookei* is made under the description of that species.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical Angle (°)*
167202a (lectotype)	42.7	40.3	35.7	28.2	102
167202b	39.6	37.4	34.9	27.5	102
167202f	47.6	?	41.6	28.0?	114

DIAGNOSIS.—Very large *Gryphus* with thick, swollen valves and minute foramen.

HORIZON AND LOCALITY.—Eocene: USGS 4369, 4399, 6924.

TYPES.—Lectotype:USNM 167202a (Tertiary catalog). Paratypes: USNM 167202b–g. Figured hypotype: USNM 550618.

Dyscritothyris, new genus

Small, subcircular with unequally deep valves, ventral valve having greater depth. Beak short, foramen rounded, moderately large, submesothyridid to mesothyridid; deltidial plates small, disjunct to conjunct. Anterior commissure somewhat narrowly uniplicate. Surface marked only by concentric growth lines. Punctae closely crowded.

Ventral valve interior with stout teeth and no dental plates. Dorsal valve interior with long socket ridges posteriorly, narrowly curved toward exterior and produced anteriorly as long trough; outer hinge plates nearly flat, attached to side of socket ridges; hinge plate tapering rapidly anteriorly crural process and transverse ribbon not preserved, the former therefore well anterior in position. Loop equal to about ⅓ dorsal valve length.

TYPE SPECIES.—*Dyscritothyris cubensis*, new species.

DIAGNOSIS.—Small terebratulidae with elongated, curved socket ridges and flat outer hinge plates.

COMPARISON AND DISCUSSION.—This genus is based on a few specimens but all characters except the anterior of the loop are well preserved. An attempt to excavate the loop was made on four specimens but the loop in every case was damaged. Two specimens were sectioned and each proved to have the anterior end of the loop broken off. In spite of these difficulties this brachiopod seems to be unique in the structure of its socket ridges and hinge plates. Comparison of the pattern produced in serial sections with those of Muir-Wood's standard patterns (1965:H818) reveals identity to none of them and similarity to only one, i.e., the "horizontal tapering" type. This type has the outer hinge plates attached to the socket ridge and extending horizontally into the interior and the ventrally facing surface of the hinge plate flat. This is evidently a very rare type of pattern because it appears only in *Platythyris* Middlemiss (1959) of all the generic diagrams given by Muir-Wood (1965:H773–H818). The Cuban shell, however, differs markedly from *Playtythyris* both internally and externally. *Platythyris*, from the Aptian of England and France, is an elongate terebratulacean with large foramen and obliquely truncated beak. The interior differs from that of *D. cubensis* in not having the strongly concave or curved socket ridge and in having the hinge plate attached to the socket ridge more posteriorly than in *Dyscritothyris*. Furthermore, the loop develops differently in the two genera, that of *Dyscritothyris* having the crural processes anterior and the hinge plates long and tapering.

Of all the cardinalia diagrams in the Treatise (Muir-Wood, 1965) none other is like that of *Dyscritothyris*. In the vast majority of these the hinge plates are concave, clubbed, keeled, or otherwise modified. The Treatise gives no cross-section diagram of the cardinalia and loop of *Gryphus*. In spite of the incompleteness of the specimens of *Dyscritothyris* the ensemble of structures suggest those seen in *Gryphus*.

The cardinalia of *Gryphus vitreus* (Born) (see plate 1: figures 35, 36) are characterized by being flat and nearly horizontal (if the dorsal shell were lying on a table, the surface of the hinge plates would be parallel to the horizontal surface of the

table). They are margined on the inner edge by a slight thickening that would give them a "clubbed" appearance in a serial section. The hinge plate of *Gryphus* narrows rapidly and tapers into a solid rodlike stem to which the crural processes and transverse ribbon are attached. It is visualized that the loop of *Dyscritothyris* is similar but that the anterior end of the loop carrying the crural processes and transverse ribbon is broken off. This portion of the loop was its weakest part.

I have not seen any genera or species like this one described in any of the contemporary articles on brachiopods in Recent European or Russian literature.

ETYMOLOGY.—The name is from the Greek *dyskritos* ("hard to determine").

Dyscritothyris cubensis, new species

FIGURE 1

Small, subcircular to rounded subpentagonal in outline with maximum width at about midvalve; sides well rounded; anterior margin broadly to somewhat narrowly rounded depending on age, subnasute in old age. Valves nearly equal in depth. Anterior commissure uniplicate in adult specimens; beak small and low, foramen moderately large, submesothyridid. Deltidial plates conjunct. Surface

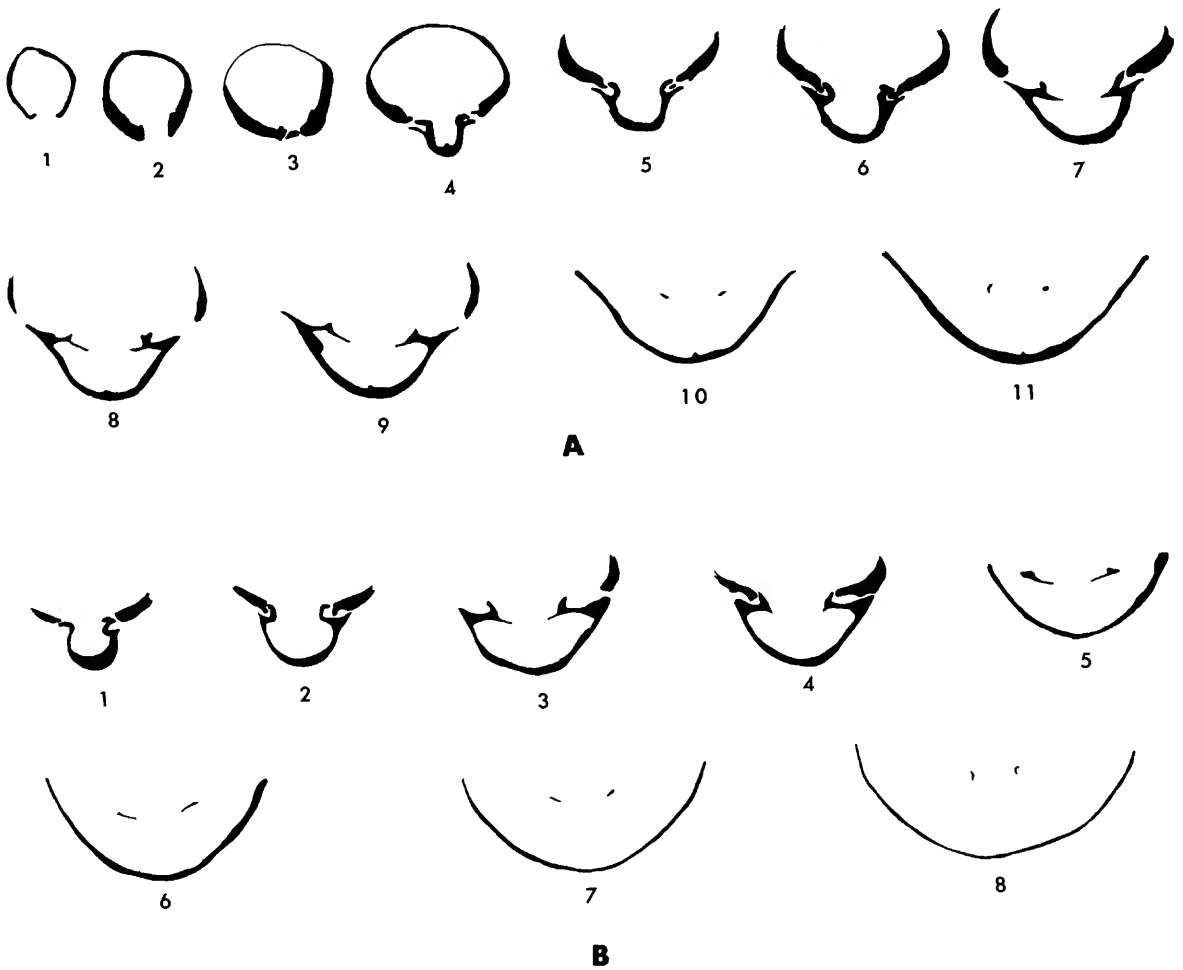

FIGURE 1.—Serial sections showing interior of *Dyscritothyris cubensis,* new species (distance between sections in mm: SPECIMEN A: 0–1 = 0.50, 1–2 = 0.30, 2–3 = 0.50, 3–4 = 0.40, 4–5 = 0.30, 5–6 = 0.10, 6–7 = 0.30, 7–8 = 0.20, 8–9 = 0.20, 9–10 = 0.60, 10–11 = 0.40; SPECIMEN B: 0–1 = 1.30, 1–2 = 0.20, 2–3 = 0.30, 3–4 = 0.20, 4–5 = 0.30, 5–6 = 0.20, 6–7 = 0.40, 7–8 = 0.60).

smooth except for fine concentric lines of growth.

Ventral valve gently and evenly convex in lateral profile; maximum convexity near midvalve; anterior profile broadly domed; median region somewhat narrowed, sides sloping moderately. Umbonal region broadly convex, rising to midvalve that is swollen; anterior somewhat flattened to form shallow sulcus and short rounded tongue.

Dorsal valve moderately convex in lateral profile, convexity slightly less than that of opposite valve; anterior profile broadly and moderately rounded, not medially narrowed. Umbonal and posteromedian regions fairly strongly swollen; anterior half somewhat flattened and narrowed anteriorly to form low, poorly defined fold.

Ventral valve interior without dental plates, with moderately strong teeth; other details obscure. Dorsal valve with strong socket ridges, flattened outer hinge plates and loop about 1/3 the length of the dorsal valve. Median ridge low and obscure. Transverse ribbon of loop not seen.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*	*Apical Angle (°)*
550460a (Holotype)	10.9	9.9	9.7	7.0	106
550459a	11.0	10.0	10.3	6.7	112
550459b	10.8	10.0	10.3	6.2	112

HORIZON AND LOCALITIES—Upper Cretaceous: Palmer 840, 895p.

DIAGNOSIS.—Small, nearly circular *Discritothyris* with nearly equally deep valves.

TYPES.—Holotype: USNM 550460a. Figured paratype: USNM 550459a. Unfigured paratypes: USNM 550459b–h, 550460b–d.

COMPARISON AND DISCUSSION.—The only species of this genus so far known and no comparable species yet described.

Superfamily TEREBRATELLACEA King, 1850

Family PLATIDIIDAE Thomson, 1927

Genus *Platidia* Costa, 1852

Platidia species

PLATE 5: FIGURES 45, 46

Platidia Costa, 1852:47.—Thomson 1927:217.—Hatai and Elliott, 1965:H833.

Morrisia Davidson, 1852:371.

Platydia Davidson, 1887:152.

Specimens of *Platidia* have been taken from Cuban Tertiary sediments ranging in age from Eocene to Pliocene. The specimens range in size from small to minute and none is as large as the living species. Specimens of a living species have been taken at 300 fathoms off Matanzas Bay. These too are small but would probably be referred to *P. anomioides* (Scacchi and Philippi), which has been identified from many parts of the world. It is a very widely distributed species and is known from the Mediterranean, off the Portugese and northwest African coasts, and in the Gulf of Mexico. It is reported also from the Pacific and Indian Oceans but these identifications may not be correct.

Platidia has been identified from the Eocene of Maryland and will probably be found in other Tertiary sediments of the United States east coast. The Cuban shells are so small as to suggest that they are immature. Only a few specimens are represented in the collection, making any attempt at naming them futile. The largest specimen (illustrated) is approximately 1.3 mm in diameter.

Platidia cretacea Weller from the Lower Eocene (Vincentown Formation), New Jersey is about the same size and shape as the Cuban specimens figured herein. The probability is that these too are immature. Because of the small number of Cuban specimens and their different geological age, I hesitate to identify any of them with Weller's species.

HORIZON AND LOCALITIES.—Eocene: USNM 818e (USNM 550426). Pliocene: USNM 818g (USNM 550427), USNM 818j (USNM 550428). Miocene: USNM 818k (USNM 550407).

TYPES.—Illustrated specimens: USNM 550407a, b.

Family MEGATHYRIDIDAE Dall, 1870

Genus *Argyrotheca* Dall, 1900

Argyrotheca is one of the commonest brachiopods in the Caribbean today and was also abundant in the past as exhibited by the numerous species in Tertiary sediments of Cuba. The genus is prolific in species. One of the peculiar characters of the genus is its opposite folding, a costa of one valve opposing a costa on the opposite valve. A median sulcus may occur in either or both valves. This opposite character of the ornament leads to specimens that are bilobed with prominent anterior

median reentrant of the margin and often have a serrate anterior margin.

Argyrotheca is also identified in the Cretaceous. It is one the few genera that cross the boundary from Cretaceous to Tertiary. In Cuba *Phragmothyris,* a fairly large brachiopod, is like *Argyrotheca* in the opposite character of its folding but representatives of the genus retain some primitive characters such as a symphytium, a structure lost to *Argyrotheca* in its early history. *Phragmothyris* has not been found outside of Cuba. The occurrence of *Phragmothyris* is recorded in the register of Palmer localities.

Argyrotheca aequicostata, new species

PLATE 6: FIGURES 36–40

About medium size for genus, quadrate in outline, width slightly greater than length; sides gently rounded; anterior margin broadly rounded; posterolateral extremities forming a broadly obtuse angle. Valves strongly inequivalve, ventral valve deeper than dorsal one. Anterior commissure rectimarginate. Interareas narrow, apsacline. Foramen large, occupying most of posterior. Surface marked by narrowly rounded, closely crowded costae, separated by spaces narrower than costae. Costae intercalated in two generations, one 1.5 mm anterior to the dorsal beak, second generation at 4 mm anterior to dorsal beak. Costae opposite, forming regularly scalloped margins. Costae numbering 22 around margin.

Ventral valve subpyramidal, gently convex in lateral profile; anterior profile moderately convex, somewhat narrowed medially, slopes long, steep. Median region posteriorly inflated but anteriorly flattened. Median three costae slightly depressed to form poorly defined sulcus. Posterolateral slopes steep.

Dorsal valve gently convex in lateral profile, broadly and flatly domed in anterior profile with the median region slightly depressed. Median three costae depressed to form poorly defined sulcus as in opposite valve, the two sulci producing a slight median indentation of the anterior margin. Posterolateral extremities slightly depressed.

Interior unknown.

MEASUREMENTS(mm).—Holotype: length 6.9, dorsal valve length 5.9, maximum width 7.3, hinge width 5.8, thickness 3.8

HORIZON AND LOCALITY.—Eocene: Palmer 727.

DIAGNOSIS.—Quadrate *Argyrotheca* with narrowly rounded, closely crowded costae having obscure median sulci on both valves and scalloped margins.

TYPE.—Holotype: USNM 550452.

COMPARISON AND DISCUSSION.—This species has the form and size of *A. intercalata,* new species, but differs radically in the nature of the ornament, that of the latter species consisting of fine costae or costellae that are separated by spaces wider than the costellae. Of Recent Cuban species all have flatter and more widely spaced costae than *A. aequicostata.*

Argyrotheca anomala, new species

PLATE 7: FIGURES 31–36

Medium size for genus; elongate rectangular in outline; ventral valve deeper than dorsal valve; sides rounded; anterior margin broadly rounded, medially indented. Interarea apsacline, fairly broad; anterior commissure slightly sulcate. Surface costate, costae mostly confined to the posterior, becoming obsolescent anteriorly.

Ventral valve gently convex in lateral profile, strongly domed in anterior profile; sides precipitous. Sulcus originating at beak, bounded by two strong costae at beak, the costae disappearing anteriorly, although the sulcus maintains its identity to the anterior margin. Flanks steep, marked only by concentric varices of growth.

Dorsal valve gently convex in lateral profile and broadly convex in anterior profile, the middle indented by sulcus. Sulcus narrow, expanding gradually to front margin, bounded by flanks marked only by concentric varices of growth.

Ventral valve interior with short apical plate and long median septum extending to midvalve where it becomes low and divides to send two slightly diverging ridges nearly to the anterior margin. Space between the ridges occupied by five deep pits.

Dorsal valve with a well defined, elongate cardinal process jutting from apex into anterior nearly at right angles to shell; septum extending from cardinal process to anterior margin; posterior half of septum expanded to form trough; septum bounded on each side by vertical plate that extends to about midvalve and is fused with the valve floor; posterior part of loop welded to posterior margin; anterior

part of loop thin, attached to valve floor and rising onto anterior part of septum as usual in genus.

MEASUREMENTS(mm).—

USMN	Length	Midwidth	Hinge width	Thickness
55045a (ventral valve)	3.4	3.0	2.4	1.3
55045b (dorsal valve)	1.9	2.5	2.8	?

HORIZON AND LOCALITY.—Middle Oligocene: USNM 818n.

DIAGNOSIS—*Argyrotheca* having obsolescent costae on the exterior and with adventitious lateral partitions inside the dorsal valve.

TYPES.—Holotype: USNM 550454c. Figured paratypes: USNM 550454a, b.

COMPARISON AND DISCUSSION.—Not only are the exterior characters of this species unique but the interior as well is unlike any described *Argyrotheca*. The obsolescence of the costae is unique among known American *Argyrotheca* but is somewhat suggestive of *A. eugenii* (de Morgan) from the Miocene of France. The Cuban species has the costae strongest in the posterior region and obsolete anteriorly whereas the French species is obscurely costate throughout. Furthermore, the interior of the ventral valve of the French species has a marginal row of nodes lacking in any Cuban species. The interior of the dorsal valve of *A. eugenii* was not figured.

Argyrotheca hewatti Cooper (1977) from the Gulf of Mexico has adventitious growths inside the dorsal valve, but these do not take the form of lateral partitions. They are expansions from the septum and affect the position of the loop, the anterior part of which is near midvalve.

Argyrotheca bermudezi, new species

PLATE 4: FIGURES 1–23

Large for genus, wider than long, variable; subrectangular to nearly square in outline; sides rounded; anterior margin broadly rounded to slightly bilobed. Hinge straight, narrower than maximum shell-width that is at midvalve; anterior commissure rectimarginate to slightly bowed ventrally. Beak usually partially resorbed, interarea fairly broad, inclined from slightly apsacline to procline. Deltidial plates, vestigial, inclined. Surface multicostate; costae narrowly rounded, about 14 primary costae, others intercalated in two additional generations, totaling 25 to 28 along the anterior margin.

Ventral valve moderately convex in lateral profile, broadly and moderately domed in anterior profile; posteromedian region somewhat swollen, anteromedian region flattened; lateral slopes steep, gently swollen. Sulcus variable, usually poorly defined near beak but deepening slightly anteriorly, never prominent and usually producing only a slight anterior emargination.

Dorsal valve evenly and gently convex in lateral profile, broadly and slightly domed in anterior profile; sulcus narrow and shallow at beak, deepening and widening anteriorly but never conspicuous and forming reentrant of front margin with sulcus of ventral valve. Flanks slightly swollen; posterolateral extremities slightly flattened.

Ventral valve interior with wide thick teeth; median septum thin, strongly elevated posteriorly in muscle region but becoming a low ridge just posterior to midvalve; muscle area fairly strongly impressed. Anterior part of median ridge with three or four depressions corresponding to projections on dorsal median septum.

Dorsal valve interior with moderately thick socket ridges giving off loop that is narrowly curved anteriorly just distally of union with socket ridge; loop joining valve floor at about midvalve opposite muscle scar and running on anterior side of muscle scar to join median septum just anterior to its highest point. Median septum low at posterior but rising abruptly at about anterior end of adductor field, attaining a sharp point and then descending obliquely nearly to the anterior margin; anterior edge of anterior slope of median septum serrate, with five notches to produce four projections. Muscle region thickened.

MEASUREMENTS(mm).—

USMN	Length	Dorsal valve length	Hinge width	Width	Thickness
550324a	7.2	6.5	8.6	10.3	4.5
550324b	7.7	7.0	8.6	10.0	4.8
550324c	6.5	6.1	8.8	9.7	4.5
550324e	6.6	5.6	6.2	7.6	4.0
550323a	6.7	6.0	6.6	9.2	4.8
550323b	7.6	7.3	10.0	10.8	4.5
550323c	8.1	6.4	8.5	9.1	4.0

HORIZON AND LOCALITIES.—Miocene: Palmer 932c, USNM 818c.

DIAGNOSIS.—Large quadrate *Argyrotheca* with costae in three generations and strongly elevated dorsal median septum.

TYPES.—Holotype: USNM 550323a. Figured paratypes: 550324a, c, f, g, h. Unfigured paratypes: USNM 550323b, c, 550324b, d, e.

COMPARISONS.—*Argyrotheca bermudezi* is a fairly large species for the genus. The size eliminates any need to compare a large number of the very small species. It differs from *A. gardnerae* Cooke, an unusually large species, in its much smaller size, more transversely rectangular outline and less convex pedicle valve.

The Recent *Argyotheca lutea* Dall is suggestive of this Miocene species but differs in being somewhat smaller, in having stronger ornament and more nearly equal dimensions. *Argyrotheca johnsoni* Cooper, a Recent species, is slighty smaller, more transverse, less deep, and more strongly costate. *Argyrotheca barrettiana* (Davidson), also Recent, differs in having stronger and more even costae, a scalloped anterior margin, and different shape.

DISCUSSION.—A feature of interest in this species is the pitting of the anterior half of the median ridge of the ventral valve corresponding to the serration of the median septum of the opposite valve. The ridge and septum fit so closely that the nodes of the septum have accommodated themselves either by wear or prevention of growth at the points of contact. Like most species of *Argyrotheca* the beaks of both valves are considerably abraded or distorted, so closely attached were the shells to the substrate.

The Palmer and Bermudez collections are probably from the same place although there is a discrepancy in distances between them. The collections are identical in abundance of specimens and composition of the fauna.

Argyrotheca clevei (Davidson)

PLATE 4: FIGURES 24–28

Arigiope clevei Davidson, 1874:8 pl. VIII: fig. 12.
Argyrotheca dalli Cooke, 1919:152, pl. 16: figs. 5a-c [not *A. dalli* Aldrich, 1911:13].

The specimen figured by Davidson is roughly 10.3 by 11.3 mm in length and width and is said to have 22 costae, half of which are intercalated between the primary costae. The specimen has a fairly long apsacline interarea. This is a large species for *Argyrotheca* but the specimen figured by Cooke as *A. dalli* is still larger, measuring 13.7 mm in length and width. Its rib count is about 28 and the costae are intercalated in three generations. The interarea is long and strongly apsacline.

Cooke notes that Guppy (1874:443) recorded Davidson's species but could not find any other reference to it. This is not surprising because Davidson's description is in an appendix to a discussion of the Tertiary brachiopods of Belgium. Cooke's species is certainly a synonym of *A. clevei* (Davidson). The form and outline of the two specimens are very similar, additional growth of *A. clevei* would probably tend to equalize the dimensions. The third generation of costae would also tend to increase the count of costae. Cooke suggested that the two may be the same.

TYPES.—Holotype of *A. dalli* Cooke: USNM 167201a (Tertiary catalog).

HORIZON AND LOCALITY.— Eocene: USGS 6897b.

Argyrotheca cyrtiniformis, new species

PLATE 5: FIGURES 1–5

Small, semipyramidal in profile with the hinge forming the widest part; interarea strongly apsacline to procline, fairly broad and interrupted by a wide delthyrium; deltidial plates vestigial. Costae narrow, low, crowded, with few intercalations; one costa occupying ventral sulcus. Flanks marked by seven costae.

Ventral valve semipyramidal in profile, very deep and moderately convex; anterior profile roundly domed; sulcus narrow and shallow, extending from beak to anterior margin; flanks rounded and fairly steep. Interior with a broad, shallowly concave apical plate supported by a strong median septum that extends to about midvalve.

Dorsal valve shallow and gently convex in lateral profile; broadly and gently convex in anterior profile; median region marked by a broad, shallow sulcus, forming a short acute tongue at the anterior. Flanks gently convex and sloping slightly laterally. Interior with strong, high median septum with crest at about midvalve then descending

gently for short distance to become precipitate anteriorly; septum not extending to anterior margin. Septum flattened along proximal surface. Muscle region slightly thickened.

MEASUREMENTS(mm).—

USMN	Length	Dorsal valve length	Hinge width	Mid-width	Thickness
550336a	4.9	3.7	5.0	4.6	5.0
550336b	3.2	2.5	3.7	3.3	2.1

HORIZON AND LOCALITY.—Middle Eocene: USNM 818d.

DIAGNOSIS.—Small cyrtiniform *Argyrotheca* with large apical plate in ventral valve and elongate beak.

TYPES.—Holotype: USNM 550336a. Paratypes: USNM 550336b, c.

COMPARISON.—The elongated beak and long flattened interarea distinguish this species from all other described Cuban and modern argyrothecas, except *A. peculiaris,* new species. The latter has an elongated beak but the valves are coarsely costate and quite unlike *A. cyrtiniformis.*

Argyrotheca inconstans, new species

PLATE 6: FIGURES 1–15

Small, variable in outline and ornament; usually transversely quadrate with straight hinge slightly narrower or slightly wider than greatest width and, when wider, with slightly auriculate lateral extremities. Anterior commissure rectimarginate to faintly sulcate. Interareas fairly wide, apsacline to nearly procline; foramen fairly large, triangular, bounded by narrow, slightly raised deltidial plates. Surface varying from smooth in young to costate, costae varying from faint to strong; costae numbering from 9 to 11, somewhat broadly rounded and separated by spaces narrower than the costae. Varices of growth strong in some specimens.

Ventral valve semipyramidal with gentle convexity in lateral profile, the umbonal region the most convex part and the anterior flattened; anterior fairly strongly domed, somewhat narrowed medially and with long steep slopes in anterior profile. Median region marked by a narrow, indistinct sulcus occupied by a costa of varying distinctness.

Dorsal valve shallower than ventral valve, evenly and moderately convex in lateral profile but broadly and gently convex in anterior profile; umbonal region smooth and moderately swollen; sulcus originating anterior to the umbo, shallow, but deeper than that of the ventral valve and also occupied by a costa of varying strength in different specimens.

Ventral valve interior with fairly strong and long apical plate supported by thin, long median septum that forms a crest near its termination at midvalve; septum continued anterior to midvalve as a low divided ridge marked by several pits (usually four).

Dorsal valve with small socket ridges; septum originating anterior to notothyrial platform, rising to a sharp crest anterior to midvalve and with precipitous, serrated anterior edge. Muscle scars elongate, deeply impressed; posterior ribbon of loop narrow but lateral and anterior parts not preserved.

MEASUREMENTS(mm).—

USNM	Length	Dorsal valve length	Mid-width	Hinge width	Thickness
550455a	2.0	1.9	2.4	2.5	1.3
550455b	1.9	1.5	2.3	2.4	1.2
550455c	2.0	1.7	2.5	1.9	1.2

HORIZON AND LOCALITY.—Pliocene: USNM 818g.

DIAGNOSIS.—Small, variable *Argyrotheca* with 9–11 distant costae and an indistinct sulcus in each valve.

TYPES.—Holotype: USNM 550455a. Figured paratypes: USNM 550455b–e. Unfigured paratypes: USNM 550455f, g.

COMPARISON AND DISCUSSION.—This is a very small *Argyrotheca* with variable costae unlike those of any of the species described herein. The species differs from all of the Recent species of *Argyrotheca* found in the waters around Cuba in the character of its ornament and in its size. It is not so rectangular as *A. woodwardiana* (Davidson) from off Jamaica. *Argyrotheca cordata* (Risso) from the Mediterranean is variable in its ornment but it is differently shaped and has a longer beak than *A. inconstans.*

Argyrotheca intercalata, new species

PLATE 6: FIGURES 21–25

Medium size, quadrate in outline, with length and width nearly equal; sides nearly straight; an-

terior margin broadly rounded; posterolateral margins forming strongly obtuse angle; hinge straight, slightly narrower than maximum width, which is anterior to midvalve; anterior commissure rectimarginate. Interarea short, curved apsacline; foramen fairly large, partly bounded anteriorly by fairly large disjunct deltidial plates. Surface multicostellate, costellae narrowly rounded, Intercalated in two generations, one two mm anterior to dorsal beak, the other three mm. Costellae on margins tending to become obsolescent. Fourteen costellae on a side.

Ventral valve moderately but unevenly convex in lateral profile, most convex medially, anteriorly becoming concave marginally. Anterior profile strongly and somewhat narrowly domed with long sloping sides. Umbonal region narrowly swollen, with steep posterolateral slopes. No evidence of sulcus.

Dorsal valve gently convex in lateral profile and flattened toward anterior margin; anterior profile flatly convex; umbonal and median regions slightly inflated. No sulcus.

Apical plate of ventral valve short, thick, supported by the median septum. Other details of interior of either valve not known.

MEASUREMENTS(mm).—Holotype: length 7.0, dorsal valve length 6.3, maximum width 6.9, hinge width 5.0, thickness 3.7.

HORIZON AND LOCALITY.—Middle Eocene: Palmer 1613.

DIAGNOSIS.—Fairly large *Argyrotheca* with numerous costellae.

TYPE.—Holotype: USNM 550448.

COMPARISON AND DISCUSSION.—This species has about the same size, outline and profile as *A. aequicostata,* new species, but the ornament, consisting of thin, somewhat distant costae, is quite unlike that of the latter species. Furthermore, the anterior and lateral margins of *A. intercalata* are only slightly serrate rather than strongly so as in *A. aequicostata. Argyrotheca johnsoni* Cooper and *A. barrettiana* (Davidson) of the Recent Caribbean fauna are differently shaped and more strongly costate than *A. intercalata.*

Argyrotheca magnicosta, new species

PLATE 6: FIGURES 26–30

About medium in size for genus, wider than long with rounded, quadrate outline; sides well rounded and anterior margin broadly rounded; posterolateral extremities when produced forming obtuse angle; hinge straight, narrower than maximum width, which is at midvalve. Anterior commissure rectimarginate. Interarea short, apsacline; beak much eroded; foramen large, occupying most of posterior. Surface multicostate, costae broad, rounded, closely crowded and opposite, forming a broadly scalloped margin. Costae numbering 11, most of them separated by a narrow depression appearing anterior to midvalve that divides the costae into pairs.

Ventral valve gently and evenly convex in lateral profile, depth slightly greater than that of dorsal valve; anterior profile forming broad, moderately convex dome. Median region inflated; sides moderately steep. No fold or sulcus.

Dorsal valve moderately convex in lateral profile, broadly and moderately domed in anterior profile; umbonal and median regions slightly swollen. Median costa very slightly depressed to form indefinite sulcus.

Interior unknown.

MEASUREMENTS(mm).—Holotype (550451): length 6.1, dorsal valve length 5.5, maximum width 7.0, hinge width 5.3, thickness 3.5.

DIAGNOSIS.—*Argyrotheca* with wide, low, rounded, closely crowded costae.

HORIZON AND LOCALITY.—Eocene: Palmer 1479.

TYPE.—Holotype. USNM 550451.

COMPARISON.—The thick and crowded costae of this species separate it from all described *Argyrotheca.*

Argyrotheca peculiaris, new species

PLATE 7: FIGURES 26–30

Medium size, subtrigonal in ventral view, with rounded sides and broadly rounded anterior. Valves unequal in size and depth, ventral valve having the greater depth. Posterolateral margins forming acute angle; hinge straight, narrower than maximum width, which is anterior to midvalve; anterior commissure faintly sulcate. Interarea narrow, forming margin of a wide foramen that occupies nearly the entire posterior of the ventral valve; deltidial plates vestigial. Costae numbering six; broad, indistinct, and separated by wide interspaces.

Ventral valve subpyramidal, gently convex in lateral profile; narrowly domed and steep-sided in anterior profile; valve elongated posteriorly with beak narrowly truncated. Apical plate short.

Dorsal valve strongly convex in lateral profile and with greatest convexity in median region; anterior profile forming broad, even, moderately convex dome depressed slightly medially. Sulcus originating at beak, shallow, widening anteriorly to produce a slight tongue. Flanks moderately convex.

Interior unknown.

MEASUREMENTS(mm).—Holotype: length 7.0, dorsal valve length 5.4, maximum width 7.0, hinge width 4.8, thickness 4.7.

HORIZON AND LOCALITY.—Probably Miocene: Palmer 1245.

DIAGNOSIS.—*Argyrotheca* with a few strong distinct costae and an elongated ventral beak.

TYPE.—Holotype: USNM 550449.

COMPARISON AND DISCUSSION.—This species, with its wide and coarse costae and their consequent broad scalloping of the anterior and lateral margins is unique among described *Argyrothecas.*

Argyrotheca plana, new species

PLATE 4: FIGURES 29–49

Medium size, transversely semielliptical in outline; plano-convex or nearly so in profile; cardinal extremities slighty acute to slightly obtuse; anterior margin broadly rounded and gently scalloped. Anterior commissure broadly bowed ventrally. Beak region variable, often distorted varying from apsacline to procline. Deltidial plates vestigial or absent. Surface costate, costae broadly rounded, separated by fairly distant interspaces. Costae numbering 14; intercalations few, one in median interspace and an occasional one on sides.

Ventral valve moderately convex in lateral profile but fairly strongly domed; slopes steep in anterior profile. Median region swollen, without distinct sulcus. Dorsal valve nearly flat, usually slightly concave, occasionally slightly convex in lateral profile; anterior profile usually broadly and slightly concave. Lateral regions flattened; median region gently sulcate.

Interior of both valves as in *A. bermudezi* but the ventral median septum not so strongly elevated.

MEASUREMENTS(mm).—

USNM	*Length*	*Dorsal valve length*	*Mid-width*	*Hinge width*	*Thickness*
550328a	6.0	5.3	9.3	9.9	3.6
550328b	5.6	5.3	8.7	9.4	3.3
550328c	5.3	5.0	7.8	8.5	3.1
550327a	7.7	6.6	5.3	10.5	4.0
550327b	7.8	6.1	9.6	9.5	4.3
550327c	5.3	4.8	8.2	8.6	3.3

HORIZON AND LOCALITIES.—Miocene: Palmer 932c, USNM 818c.

DIAGNOSIS.—Transverse *Argyrotheca* with strong costae and flat to concave dorsal valve.

TYPES.—Holotype: USNM 550328a. Figured paratypes: USNM 550327a, e, f, 550328b. Unfigured paratypes: USNM 550327b–d, 550328c–e.

COMPARISONS.—This species differs from *A. bermudezi* with which it is found in the flat to concave dorsal valve and strong costae with few intercalations. *Argyrotheca johnsoni* Cooper is much like *A. plana.* The rib count is essentially the same but the costae of the former are stronger and produce a fairly strong scalloping of the margin. Except for the median costa, *A. johnsoni* has no intercalated costae and the median rib is more strongly developed than that of *A. plana.* The dorsal valve of *A. lutea* Dall is too convex to be confused with *A. plana. Argyrotheca barrettiana* (Davidson) has a more convex dorsal valve and more numerous costae than *A. plana* although they attain about the same size.

This species is suggestive of *A. serrata,* new species, which is transverse and of about the same size. *Argyrotheca plana* differs in having a flatter and less sulcate dorsal valve, apsacline interarea and broader, flatter costae that only scallop the margins to a slight degree.

Argyrotheca serrata, new species

PLATE 6: FIGURES 31–35

Medium size, wider than long, rectangular in outline; cardinal extremities nearly right angle; sides gently rounded; anterior margin broadly rounded and narrowly indented medially. Interarea wide, procline; foramen large; deltidial plates disjunct. Anterior commissure broadly sulcate. Surface marked by broadly rounded closely crowded

costae separated by very narrow interspaces; costae opposite, thus serrating the margins; costae numbering 25 around the margin, appearing in three generations: a primary set at beak, a second set appearing closely adjacent to beak and a third set squeezing in at 3 mm anterior to the beak.

Ventral valve semipyramidal, gently convex in lateral profile but somewhat carinate in anterior profile, the sides rising by a long steep slope to a narrowed crest. Beak region narrowly swollen and continuing anteriorly to form obscure fold that is medially depressed to form a shallow sulcus occupied by three compressed costae.

Dorsal valve evenly and moderately convex in lateral profile but flatly convex in anterior profile, median part gently depressed but sides short, moderately steep. Sulcus originating at beak, broader than that of ventral valve, and occupied by 7 costae, two of which meet the beak and the others intercalated. Posterolateral extremities slightly flattened; flanks bounding sulcus gently convex.

MEASUREMENTS(mm).—Holotype: length 5.8, dorsal valve length 5.8, midwidth 8.2, hinge width 8.0, thickness 3.0.

HORIZON AND LOCALITY.—Miocene: Palmer 377.

DIAGNOSIS.—Fairly large, wide *Argyrotheca* with numerous closely crowded costae.

TYPE.—Holotype: USNM 550456.

COMPARISON AND DISCUSSION.—The ornament of this species is similar to that of *A. aequicostata,* new species, but that species is rather square in outline whereas *A. serrata* is transverse and has a much stronger sulcus on the dorsal valve. *A. serrata* has the costae closer together than either *A. bermudezi* or *A. plana,* new species. This is true also when *A. serrata* is compared with *A. barrettiana* (Davidson) and *A. lutea* (Dall). Although *A. johnsoni* Cooper is marginally strongly serrate its costae are not so closely crowded nor so numerous as those of *A. serrata.*

Argyrotheca sublamellosa, new species

PLATE 6: FIGURES 16–20

Medium size for genus, wider than long, transversely pentagonal in outline; sides nearly straight; anterior margin broadly rounded and slightly indented medially; cardinal extremities approximately a right angle; posterolateral extremities forming a slightly obtuse angle; anterior commissure gently sulcate; interareas narrow, apsacline; foramen large; hinge straight, about equal to maximum width, which is at midvalve. Surface marked by 8–10 subangular, strong costae separated by spaces wider than the costae; one costa occupying median sulcus in each valve; costae opposite and gently serrating the margins. Costae crossed by closely crowded elevated concentric lines that give a lamellose effect.

Ventral valve moderately and evenly convex in lateral profile; evenly and strongly domed in anterior profile; median region swollen; sulcus originating at the beak, shallow and poorly defined; lateral slopes moderately steep.

Dorsal valve evenly and moderately convex in lateral profile, broadly and slightly convex in anterior profile with the median part slightly depressed. Sulcus originating at beak, shallow and widening anteriorly, bounded by the two strongest costae. Cardinal extremities flattened.

Ventral valve with short apical plate supported by a thick, strong, and elevated median septum. Dorsal median septum short and strongly elevated.

MEASUREMENTS(mm).—Holotype: length 5.4, dorsal valve length 3.7, maximum width 5.8, hinge width 5.7, thickness 3.2.

HORIZON AND LOCALITY.—Miocene: Palmer 378.

DIAGNOSIS.—*Argyrotheca* with strong concentric growth lines and widely spaced costae.

TYPE.—Holotype: USNM 550453.

COMPARISON AND DISCUSSION.—The fairly strong concentric elevated lines distinguish this species from all other described *Argyrotheca.* None of the Recent Caribbean species is marked like this one although its profile and outline are like those of many other species.

Argyrotheca species undetermined

A number of the Palmer localities yielded specimens of *Argyrotheca* of considerable variety not referrable to described species. These localities are listed and may be identified by consulting the Palmer (1948) index of Cuban localities: 53, 932c, 1027, 1065, 1082, 1102, 1163, 1214, 1640, 1660, 1720, 2030, 2908, 2166. These range in age from Late Cretaceous to Oligocene.

Genus *Cistellarcula* Elliott, 1954

Cistellarcula dubia, new species

PLATE 5: FIGURES 7–23

About medium size, length and width nearly

equal when interarea well developed but wider than long in other specimens; subrectangular to nearly square in outline; sides rounded; anterior margin broadly rounded; anterior commissure rectimarginate; surface costellate, costellae strongest near beaks but becoming low and broad to obsolete anteriorly in some specimens.

Ventral valve with a broad interarea, in some specimens with a broad symphytium, in others interarea and symphytium remnantal; foramen large and irregular; lateral profile strongly and evenly convex; anterior profile fairly strongly domed; umbonal and median regions swollen. Lateral slopes steep.

Dorsal valve less deep than ventral valve, gently convex in lateral profile; anterior profile strongly and moderately convex; median region in some specimens marked by faint sulcus. Posterior somewhat swollen; flanks moderately steep.

MEASUREMENTS(mm).—

USMN	*Length*	*Dorsal valve length*	*Maximum width*	*Thickness*
550335a	6.4	5.6	7.3	4.0
550335b	7.0	5.7	8.0	4.3
550355c	7.1	6.2	7.8	3.9

HORIZON AND LOCALITY.—Upper Oligocene: USNM 818a.

DIAGNOSIS.—Rotund and convex *Cistellarcula* with low costellae becoming broad and wide or obsolete anteriorly.

TYPES.—Holotype: USNM 550335b. Paratypes: USNM 550335a, c. Unfigured paratypes: 550335d-g.

COMPARISON AND DISCUSSION.—Of described North American species, this one suggests *Argyrotheca akymatophora* Stenzel and *A. powersi* Gardner from the Eocene, but the Antigua species is larger and has a definite ornamentation whereas the mentioned species are smooth or nearly so.

Superfamily DALLINACEA Beecher, 1893

Family HERCOTHYRIDIDAE, new family

Dallinacea having a median septum in both valves and dorsal valve without outer hinge plates, crural bases attached directly to the socket ridges.

The cardinalia of this family suggest those of *Terebratalia* in the attachment of the crural bases to the socket ridges. Other details, however, are quite unlike the Terebrataliidae, such as the presence of conjunct deltidial plates and the uniplicate anterior commissure. The presence of a strong median septum in the ventral valve is unusual in modern terebratulids.

Hercothyris, new genus

Medium size, pentagonal to elongate oval in outline; valves unequal in depth, the ventral valve deeper; anterior commissure uniplicate; surface smooth to faintly costellate in posterolateral regions; punctate fine and densely crowded.

Ventral valve with large mesothyridid to submesothyridid foramen, beak labiate to anteriorly excavated; deltidial plates conjunct. Pedicle valve interior with strong median septum extending to about midvalve. Dental plates absent.

Dorsal valve with simple cardinalia consisting of strong socket ridges welded to crural bases; cardinal process small and transverse. Loop long, other details not known. Median septum low at posterior extending nearly to beak, anteriorly rising to crest, then descending to front margin to divide interior into two chambers. Adductor scars elongate.

TYPE SPECIES.—*Hercothyris borroi,* new species.

DIAGNOSIS—Dallinacea with a septum in both valves; cardinalia without outer hinge plates.

DISCUSSION.—The foramen of the ventral valve is variable, in some specimens opening onto the dorsal umbo when the deltidial plates have been resorbed. In another example (Plate 5: figure 43) the foramen is submesothyridid and the beak labiate. Although specimens are few, this difference in the foramen and beak appears not to be a function of growth because the young forms have an abraded foraminal margin or one that is entirely worn away.

The septum of the ventral valve is variable in the two species, that of *H. semiradiata* is slender but that of *H. borroi* is thick and has an expanded base. Although the septum of *H. semiradiata* is slender, it is, nevertheless, thicker and stronger than the septum of the dorsal valve. The ventral septum of *H. semiradiata* is neither so long nor so elevated as the dorsal septum.

The septum of the dorsal valve is low and inconspicuous at the posterior for 6.6 mm in *H. borroi* but after this distance it abruptly extends longitudinally to divide the anterior three quarters into

two chambers. At the point of maximum elevation the septum nearly touches that of the opposite valve, then descends to the anterior margin.

The cardinalia are weak and simple, suggesting those of *Terebratalia*. They consist of moderately strong socket ridges to which are welded the narrow crural bases. The descending lamellae of the loop are moderately broad and somewhat crescent-shaped in section. They continue for about 5 mm in that form and then become abruptly U-shaped with the open end of the U facing the ventrolateral area. They maintain the U-shaped form for 2.7 mm but after that nothing is know of the loop. The three specimens cut, two of them serially, were filled with fairly coarse matrix of large foraminifera. This type of matrix is not conducive to preservation of a fragile loop. It is believed that the loop was long but unattached to the septum, thus in the dalliniform stage because no trace of an attachment was seen on the septum.

The cardinal process is small and transverse in both species. The muscle marks in the brachial valve of *H. borroi* are fairly deeply impressed, and elongated.

DISCUSSION.—This genus is unique among American Tertiary and Recent species in the extravagant development of septa in both valves. *Hercothyris* has a superficial resemblance to *Dallina floridana* (Pourtales) and it was thought that the two were probably congeneric until the ventral septum and the peculiar cardinalia were discovered. The latter make it impossible to assign the specimens here discussed to the genus *Dallina*.

ETYMOLOGY.—The name is from the Greek *hercos* ("partition") plus *thyris* ("opening").

Hercothyris borroi, new species

FIGURE 2; PLATE 4: FIGURES 50–55; PLATE 5: FIGURES 33–44

Shell of about medium size, thin, subpentagonal in outline, varying from wider than long, to length and width nearly equal, lateral margins narrowly rounded, oblique posterolateral margins, anterior margin subnasute, anterior commissure narrowly uniplicate; greatest width at or near the middle. Apical angle 90° or slightly more. Surface marked only by concentric lines of growth.

Ventral valve evenly but moderately convex in lateral profile, anterior profile moderately convex

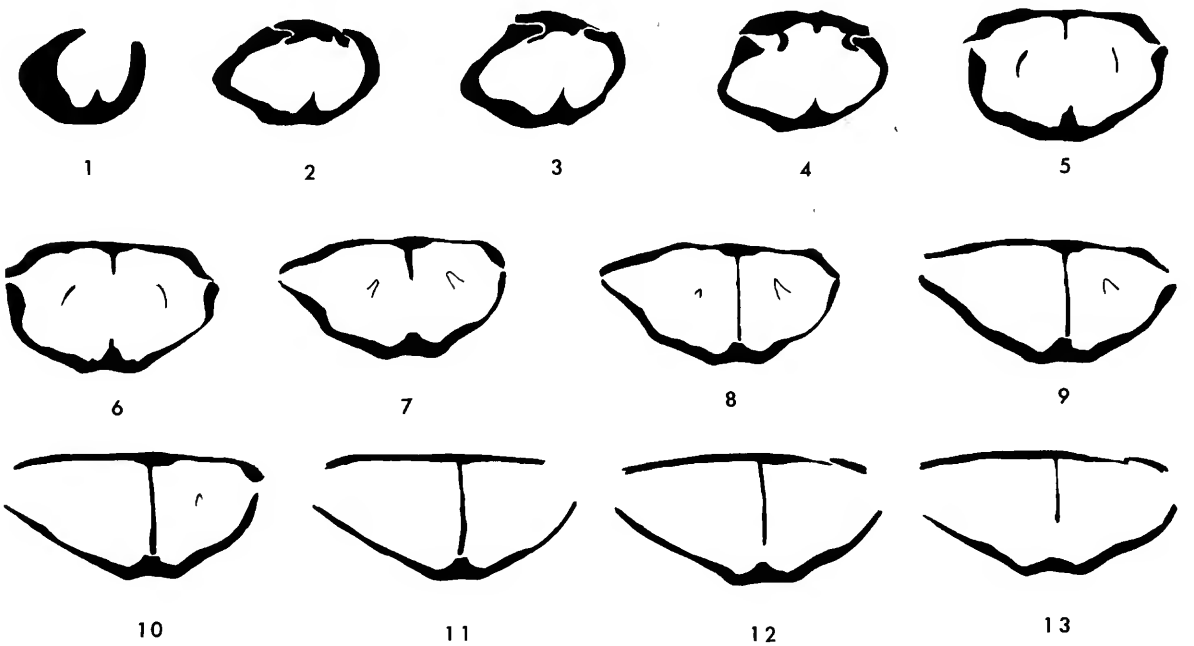

FIGURE 2.—Serial sections showing interior of *Hercothyris borroi*, new species (distance between sections in mm: 0–1 = 0.55, 1–2 = 2.10, 2–3 = 0.35, 3–4 = 0.85, 4–5 = 1.40, 5–6 = 0.30, 6–7 = 1.50, 7–8 = 0.30, 9–10 = 0.20, 10–11 = 1.10, 11–12 = 0.60, 12–13 = 1.20, 13 = 0.3).

and narowly depressed medially; umbo and median region swollen; sulcus originating just posterior to middle, deepening and widenieg rapidly to the anterior margin, sulcus extended as short subangular tongue; sulcus bounded by two indistinct costae; flanks gently inflated, slopes steep; anterior margin of flanks with a slight dorsal wave; lateral slopes narrowly rounded; beak suberect; foramen round and large, submesothyridid; interior with long median septum reaching to midvalve.

Dorsal valve flat to gently convex in lateral profile; anterior broadly and gently convex; umbonal, median, and posterolateral regions flattened; fold originating just anterior to midvalve, narrowly rounded; flanks depressed below the fold, gently swollen to form a broad plica at the margin.

Interior as described for the genus.

MEASUREMENTS(mm).—

USMN	*Length*	*Dorsal valve length*	*Mid-width*	*Thick-ness*	*Fold width*	*Apical angle (°)*
549396a	17.8	16.5	21.4	9.9	8.7	92
549396b	21.3	18.4	21.0	12.0	8.8	90

TYPES.—Holotype: USNM 549396a. Figured paratypes: USNM 549395; 549397; 549400a. Unfigured paratypes: USNM 549394a, b; 549396b; 549399; 549400b, c.

DIAGNOSIS.—*Hercothyris* with length and width nearly equal and lacking radial ornament on the posterolateral areas.

HORIZON AND LOCALITY.—Eocene: Palmer 1035, 1085, 1086, 1102, 1476, 1640.

DISCUSSION.—This species and *H. semiradiata* new species differ so strongly that they are not likely to be confused. The latter species is longer than wide and is posterolaterally radiate whereas *H. borroi* new species is transverse and smooth. The interior of the two is likewise very different, the septa of *H. borroi* are stout but those of *H. semiradiata* are delicate and slender.

Hercothyris semiradiata, new species

PLATE 5: FIGURES 24–29

Shell thin, large elongate oval to elongate subpentagonal in outline with greatest width at middle; sides somewhat narrowly rounded; anterior margin subnasute; anterior commissure narrowly uniplicate; surface smooth, except for the posterolateral regions, which are faintly costellate. Apical angle 91°.

Ventral valve moderately convex in lateral profile; anterior profile strongly convex but median region depressed slightly by narrow, shallow sulcus; beak narrow, suberect; foramen large, mesothyridid, labiate; beak ridges not prominent, Umbo narrowly swollen; median region inflated; sulcus originating on umbo, narrow, shallow, rounded, and extending to front margin making short, angular tongue. Flanks narrowly convex bordering sulcus and with long, steep, gently convex slopes to margins.

Ventral interior with a long, slender median septum reaching about to midvalve; other details not known.

Dorsal valve with less than half depth of ventral valve, and with slightly convex lateral profile; anterior profile nearly flat but with slight subangular median elevation; umbonal and median regions flattened; fold originating just posterior to midvalve, narrow, subangular, only strongly developed in anterior half; flanks bounding fold in median region flattened but anteriorly depressed below level of fold in anterior half.

Dorsal interior with weak cardinalia; cardinal process small, delicate; socket ridges slender and short; crura divergent and expanded; median septum thin and delicate, low near break but rising rapidly to reach sharp crest about 3 mm anterior to beak, descending gradually anteriorly and reaching almost to front margin.

MEASUREMENTS(mm).—Holotype: length 24.6, dorsal valve length 22.6, midwidth 22.3, thickness 12.7, fold width 9.4, apical angle 91°.

TYPES.—Holotype: USNM 549398a. Unfigured paratype: USNM 549398b.

HORIZON AND LOCALITY.—Eocene: Palmer 1640.

DIAGNOSIS.—*Hercothyris* with length greater than the width and with fine radial lines on the posterolateral regions.

DISCUSSION.—For a comparison of this species with *H. borroi* Cooper, new species, see above.

Genus *Dallina* Beecher, 1893

Dallina floridana (Pourtalès)

PLATE 5: FIGURES 30–32

Views of this common Caribbean species are introduced for comparison with *Hercothyris*. Note

character of median septum in the dorsal valve and the nature of the cardinalia that are totally unlike those of *Hercothyris*.

HORIZON AND LOCALITY.—Recent: Florida Straits.

TYPES.—Hypotypes: USNM 110861a, b.

Order THECIDEIDA, Pajaud 1970

Suborder THECIDEIDINA Elliott, 1958

Superfamily THECIDEACEA Gray, 1840

Family THECIDEIDAE Gray, 1840

Genus *Lacazella* Munier-Chalmas, 1881

Lacazella caribbeanensis Cooper

PLATE 1: FIGURES 2–5

Lacazella caribbeanensis Cooper, 1977:132, pl. 4: figs. 12–19.

This species, which is smaller than *L. mediterranea* Risso, has a narrow margin having large nodes and the descending branches of the "loop" attached to the valve floor; the ascending branches are smooth, not spiny or serrated as in *L. mediterranea*. *Lacazella caribbeanensis* comes from off the Dominican Republic and Jamaica, indicating that the species has inhabited West Indian waters since the Miocene. *Lacazella* occurs in the Eocene of the Gulf Coast of the United States. It is common in the Mediterranean.

LOCALITY.—Palmer 932c.

TYPES.—Hypotypes: USNM 549420a, b.

DISCUSSION.—*Lacazella* also occurs at four other localities ranging in age from Eocene to Miocene: USNM 818e, USNM 818j, USNM 818–l, and USNM 818m. The specimens are few and very small, probably representing several species but the lots are too small for specific differentiation.

Lacazella mediterranea (Risso)

PLATE 1: FIGURE 1

A specimen of the dorsal valve interior is introduced for comparison with the Cuban Tertiary specimens. Note the numerous spines and excrescences on the ascending elements and their absence from the Cuban species.

HORIZON AND LOCALITY.—Recent: Vendres, France.

TYPES.—Figured specimen: USNM 173594d.

Genus *Thecidelina* Thomson, 1915

Thecidellina species

Several specimens of *Thecidellina* in two lots occur in the collections. Both are dorsal valves showing the long undivided median ascending apparatus characteristic of this genus. One is from the Eocene, USNM 818e, the other is from the Miocene, Palmer locality 932c.

That this genus occurs in the Eocene of the United States is shown by a collection made by F. S. MacNeil of the U. S. Geological Survey from the Eocene-Midway (Clayton Member), from NW ¼ sect 12, T 8 N, R 28 E, in which *Lacazella* and *Thecidellina* occur together. *Thecidellina* is common in modern Caribbean waters where it occupies cryptic habitats among corals and corallines. The genus is not known in the Mediterranean, but it is fairly common in the southwestern Pacific, where it also occurs in Eocene sediments (Cooper 1971:F6).

MENTIONED SPECIMENS.—USNM 550413, 550417.

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PLATES

PLATE 1

Lacazella, Terebratulina, Cruralina, and *Gryphus*

FIGURE 1.—*Lacazella mediterranea* (Risso): Interior of the dorsal valve, ×6, introduced for comparison with that of *L. caribbeanensis* Cooper (Figure 5), figured specimen, USNM 173594d. Recent, Port Vendres, France.

FIGURES 2–5.—*Lacazella caribbeanensis* Cooper: 2–4, Ventral, side, and dorsal views, ×8, of a hypotype, USNM 549402a, showing the broad attachment scar; 5, interior of the dorsal valve, ×10, hypotype, USNM 549402b. Miocene, Palmer 932c.

FIGURES 6–23.—*Terebratulina? palmeri,* new species: 6–10, Anterior, posterior, side, dorsal, and ventral views ×1, showing the strong, carinate fold, holotype, USNM 550392a. 11–14, ventral, side, anterior, and dorsal views of the holotype ×2 showing narrow, deep ventral sulcus and carinate dorsal valve. Miocene, USNM 818c.

15–19, Dorsal, posterior, ventral, anterior, and side views of a paratype, ×1, USNM 550330b; 20–23, anterior, side, ventral, and dorsal views, ×2, of the preceding paratype. Miocene, Palmer 932c.

FIGURES 24–29.—*Cruralina cubensis,* new species: 24–28, Dorsal, posterior, side, anterior, and ventral views, ×2, of the holotype, USNM 549408; 29, dorsal view of the holotype, ×1, Cretaceous, Palmer 812.

FIGURES 30, 31.—*Terebratulina,* species 2: Dorsal views, ×1, ×2, of a somewhat crushed specimen, figured specimen, USNM 550331a. Eocene, Palmer 1003.

FIGURES 32–36.—*Gryphus vitreus* (Born): 32–34, Dorsal, side, and anterior views of a complete specimen, ×1, showing the small foramen, incurved beak, and rectimarginate anterior and straight lateral commissures, hypotype, USNM 109770. Recent, Gulf of Naples.

35, 36, Partial side and ventral views, ×2, of the posterior part of the dorsal valve of another specimen showing the narrow, solid, descending branch of the loop, its broad transverse ribbon, and the flattened outer hinge plates, hypotype, USNM 109734a. Recent, off Sardinia, Mediterranean Sea.

FIGURES 37–46.—*Gryphus cookei,* new species: 37, Dorsal view of a large specimen, ×1, showing minute foramen and symphytium, paratype, USNM 549411a; 38–42, side, posterior, anterior, ventral, and dorsal views, ×1, of the holotype, USNM 549411b, showing small foramen, straight lateral and rectimarginate anterior commissures; 43, 44, dorsal and posterior views of an internal mold showing muscle scars and main pallial impressions, ×1, paratype, USNM 549411d; 45, 46, posterior of two dorsal valves, ×2, showing the flattened broad outer hinge plates and small cardinal process, paratypes, USNM 549411g, f. Eocene?, Palmer 1458.

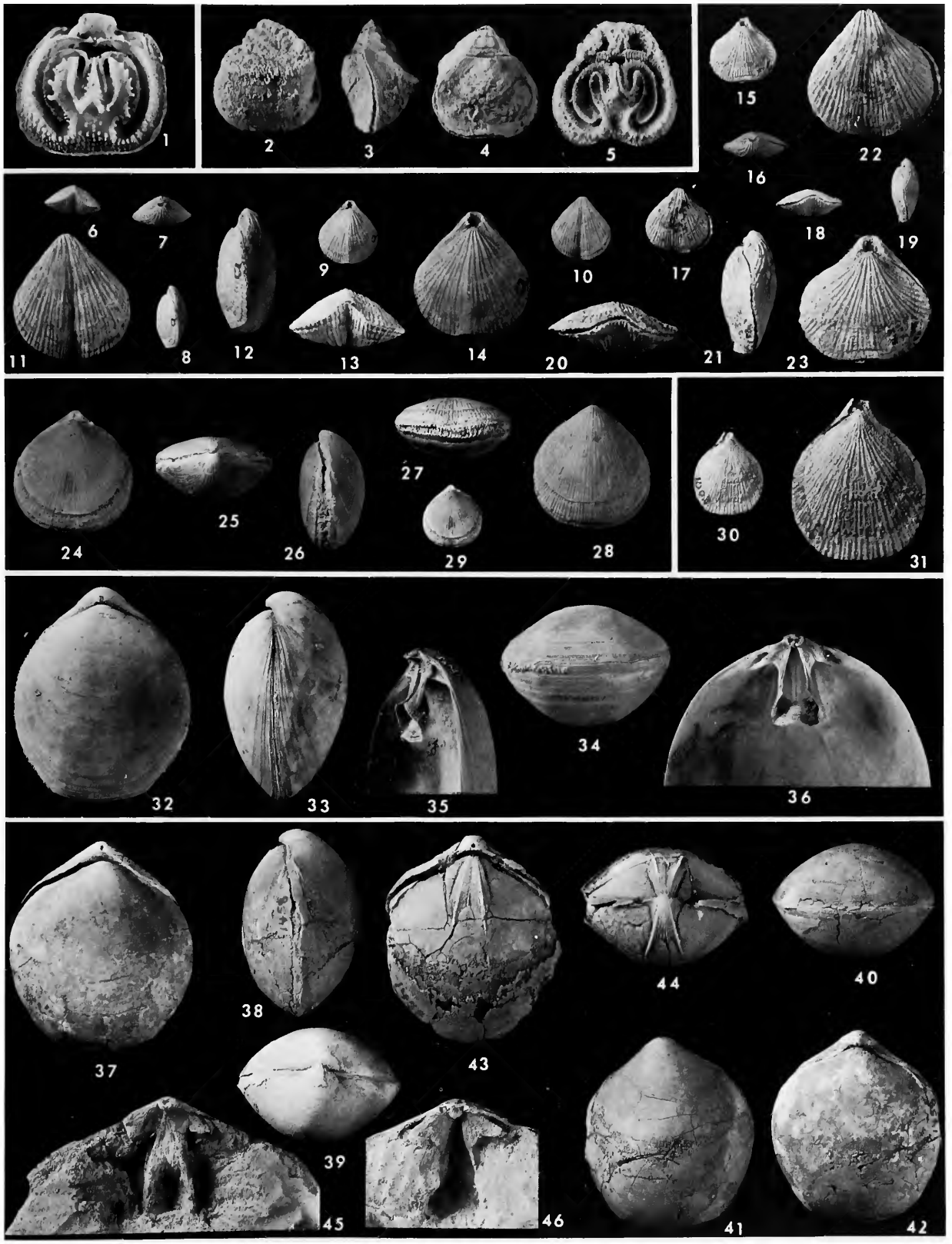
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PLATE 2

Stenosarina, Tichosina?, Tichosina, Gryphus, and *Terebratulina*

FIGURES 1–5.—*Tichosina? lecta* (Guppy): Dorsal, posterior, side, anterior, and ventral views of the holotype, ×1, showing uniplicate anterior commissure, USNM 115646. Eocene, USNM 818o.

FIGURES 6–10.—*Stenosarina cuneata,* new species: Posterior, anterior, side, ventral, and dorsal views of the holotype, ×1, USNM 549436a. Eocene, Palmer 1030.

FIGURES 11–16.—*Tichosina guppyi,* new species: 11–15, Posterior, anterior, side, dorsal, and ventral views of the holotype, ×1, USNM 550337; 16, posterior of the holotype, excavated to show the descending branches of the loop, ×2, the transverse band being broken away. Upper Oligocene, Palmer 405a.

FIGURES 17–19.—*Terebratulina,* sp. 1: 17, 18, Ventral and dorsal views of a complete specimen, ×1, figured specimen, USNM 550373; 19, the same specimen, ×3, showing the ornament. Eocene?, Palmer 53.

FIGURES 20–24.—*Tichosina? bartletti* (Dall): 20–22, Dorsal, anterior, and side views of the holotype, ×1, USNM 110852, showing the uniplicate anterior commissure and fairly large, labiate foramen; 23, 24, side and ventral views of the loop, ×2, of the holotype. Recent, Barbados, 73 fathoms (=134 meters).

FIGURES 25–30.—*Gryphus? stantoni* (Maury): 25–29, Ventral, anterior, posterior, dorsal, and side views, ×1, of the lectotype PRI 28564a; 30, posterior of the holotype, ×2, showing small foramen, a characteristic feature of *Gryphus.* Eocene, bed 8, Soldado Rock, near the Serpents Mouth, in the Gulf of Paria, Trinidad.

FIGURES 31–35.—*Tichosina? trinitatensis* (Guppy): Dorsal, anterior, side, posterior, and ventral views, ×1, of the holotype, USNM 115647, showing broad, uniplicate anterior commissure. Eocene, USNM 818o.

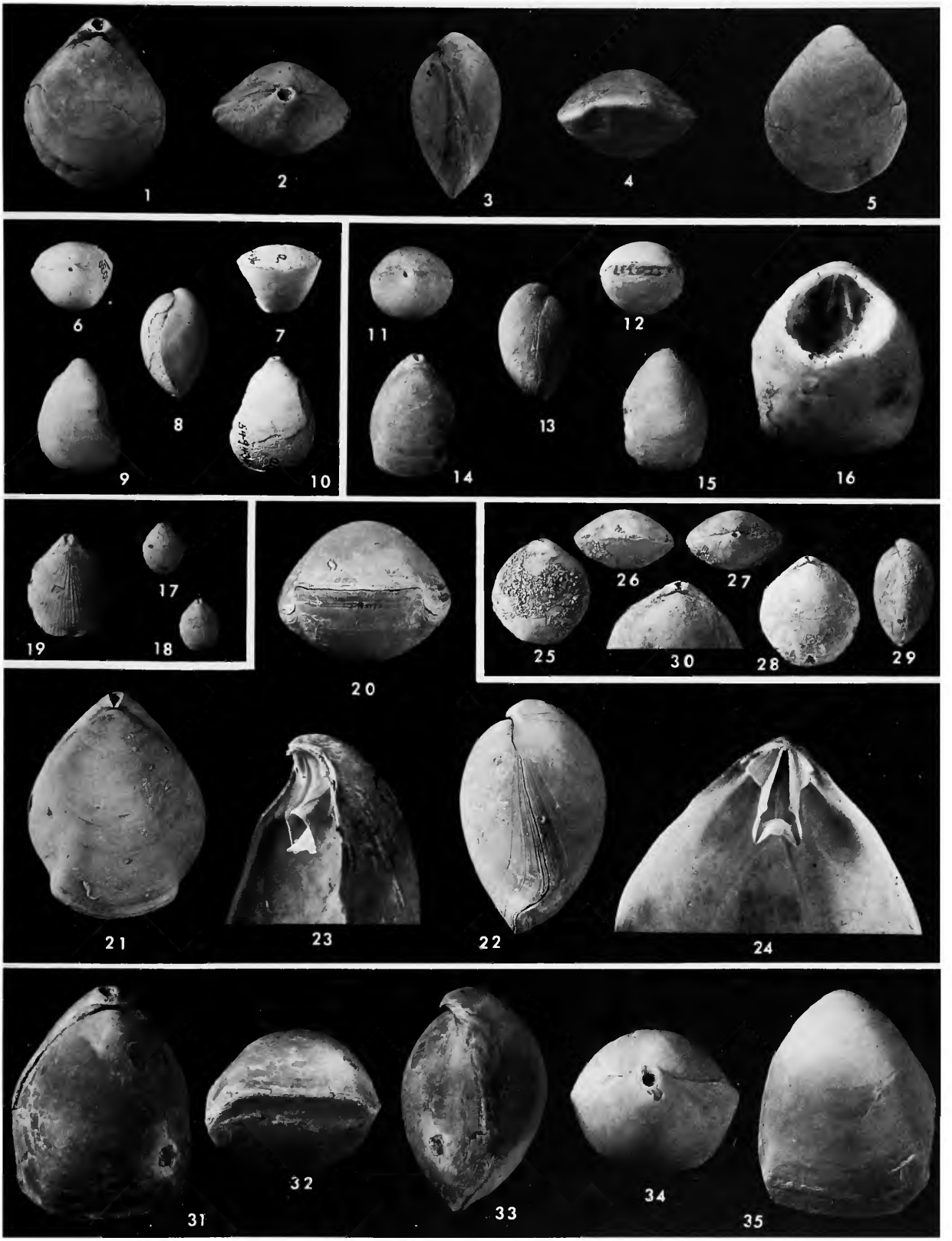
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PLATE 3

Tichosina?, Tichosina, and *Gryphus*

FIGURES 1–5.—*Tichosina? insolita,* new species: Ventral, posterior, side, anterior, and dorsal views of the holotype, ×1, USNM 550334, showing uniplicate anterior commissure. Eocene (Taguasco Formation), USNM 818b.

FIGURES 6–13.—*Tichosina foresti,* new species: 6–10, Ventral, side, posterior, anterior, and dorsal views of the holotype, ×1, USNM 550333a; 11–13, laterally tilted, ventral and dorsal views of a paratype, ×1, showing the loop, USNM 550333b. Upper Oligocene, USNM 818h.

FIGURES 14–21.—*Gryphus parvus,* new species: 14–18, Dorsal, anterior, side, posterior, and ventral views, ×1, of the holotype, USNM 549412a; 19, 20, side and dorsal views of the holotype, ×2; 21, interior of the posterior part of the holotype, ×4, showing the loop. Miocene, Palmer 997.

FIGURES 22–29.—*Gryphus carneoides* (Guppy): 22, 23, Dorsal and side views of a complete but damaged specimen, ×1, paratype, USNM 115645a; 24, posterior of the preceding specimen, ×2, showing the minute foramen; 25–29, anterior, ventral, side, posterior, and dorsal views of the lectotype, ×1, USNM 115645b. Eocene, USNM 818o.

FIGURES 30–32.—*Gryphus vaughani* (Cooke): Dorsal, side, and anterior views of the lectotype, ×1, USNM 167202a, showing a uniplicate anterior commissure. Eocene, USGS 6924.

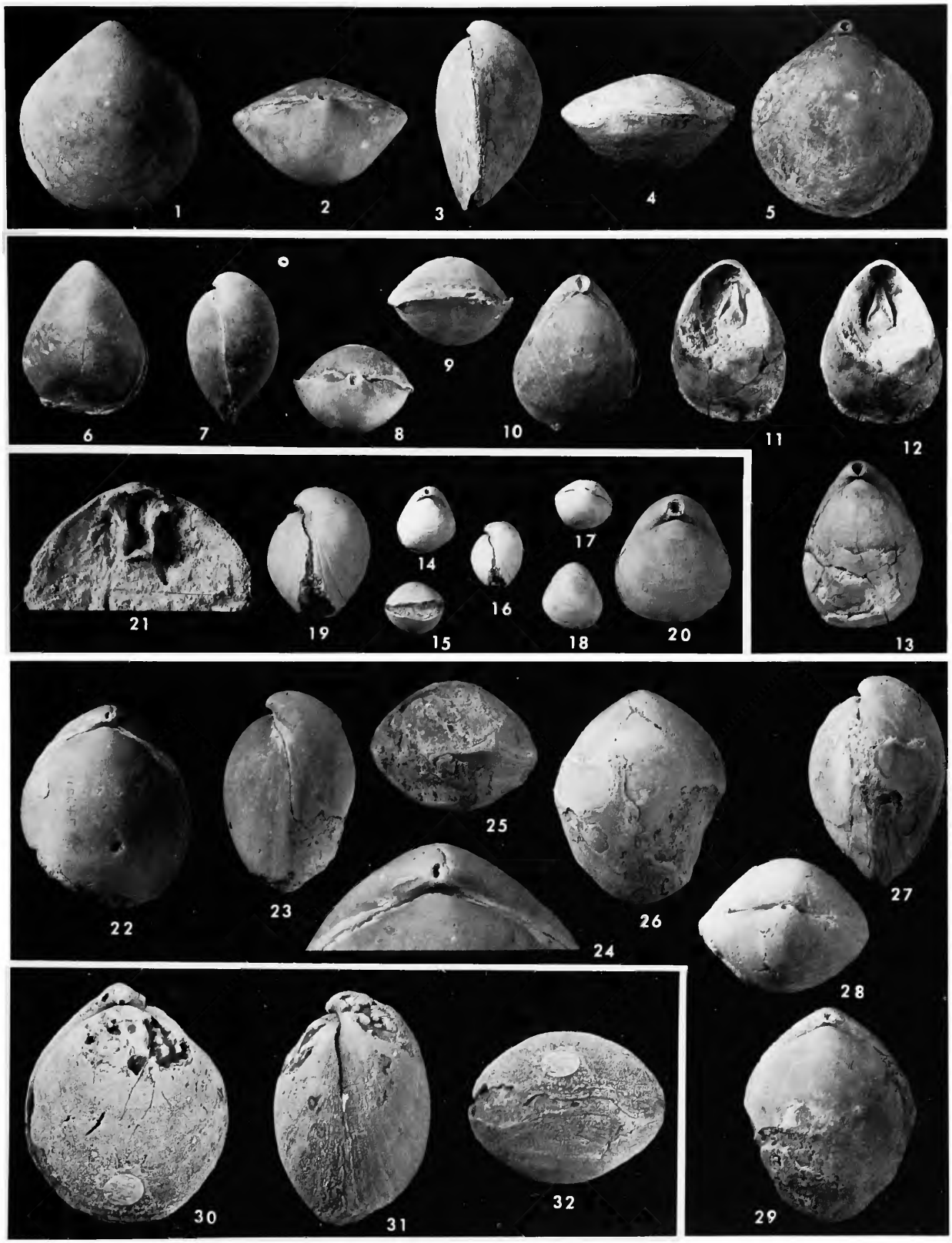
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PLATE 4

Argyrotheca and *Hercothyris*

FIGURES 1–23.—*Argyrotheca bermudezi,* new species: 1, Dorsal view of the paratype, ×1, USNM 550324a; 2–6, dorsal, posterior, anterior, ventral, and side views of the same paratype, ×2, 7, dorsal view of a paratype, ×1, USNM 550324c; 8–12, posterior, side, anterior, ventral, and dorsal views of the preceding paratype, ×2; 13, interior of the dorsal valve, ×3, paratype, USNM 550324g; 14, 15, side and ventral views of another dorsal valve interior, ×3, showing serrate median septum, paratype USNM 550324h; 17, interior of the ventral valve, ×3, showing pits in median ridge, paratype, USNM 550324f. Miocene, Palmer locality 932c.

16, Interior of another dorsal valve showing the muscle scars, ×3, holotype, USNM 550323a; 18, dorsal view of the complete holotype, ×1; 19–23, anterior, side, posterior, dorsal, and ventral views of the holotype, ×2. Miocene, USNM 818c.

FIGURES 24–28.—*Argyrotheca clevei* (Davidson): Posterior, anterior, side, dorsal, and ventral views, ×1, of the holotype, USNM 167201a. Eocene, USGS 6897b.

FIGURES 29–49.—*Argyrotheca plana,* new species: 29–33, Anterior, side, dorsal, ventral, and posterior views of the holotype, ×2, USNM 550328a; 34, dorsal view of the holotype, ×1; 35–39, side, posterior, dorsal, ventral, and anterior views, ×2, of a paratype, USNM 550328b; 40, dorsal view of the preceding paratype, ×1. Miocene, Palmer 932c.

41–45, Anterior, side, ventral, dorsal, and posterior views of another paratype, ×2, USNM 550327a; 46, dorsal view of the preceding specimen ×1; 47, 48, interior of the ventral and dorsal valves of another paratype, ×3, USNM 550327e; 49, interior of another dorsal valve showing muscle scars and remnants of the loop, ×3, paratype, USNM 550327f. Miocene, USNM 818c.

FIGURES 50–55.—*Hercothyris borroi,* new species: 50, Section 2 mm anterior to the beak showing beginning of septum of ventral valve; 51, section 3½ mm anterior to the beak, dorsal valve septum just starting; 52, section about 5 mm anterior to beak; 53, section about 8 mm anterior to beak. The ventral septum has disappeared, all from paratype, USNM 549397, all ×2. Eocene, Palmer 1086.

54, Section showing dorsal median septum nearly extending to the ventral valve, ×4; 55, section 10 mm anterior to the beak showing the dorsal septum tapering anteriorly, all ×2, paratype USNM 549400b. Eocene, Palmer 1102.

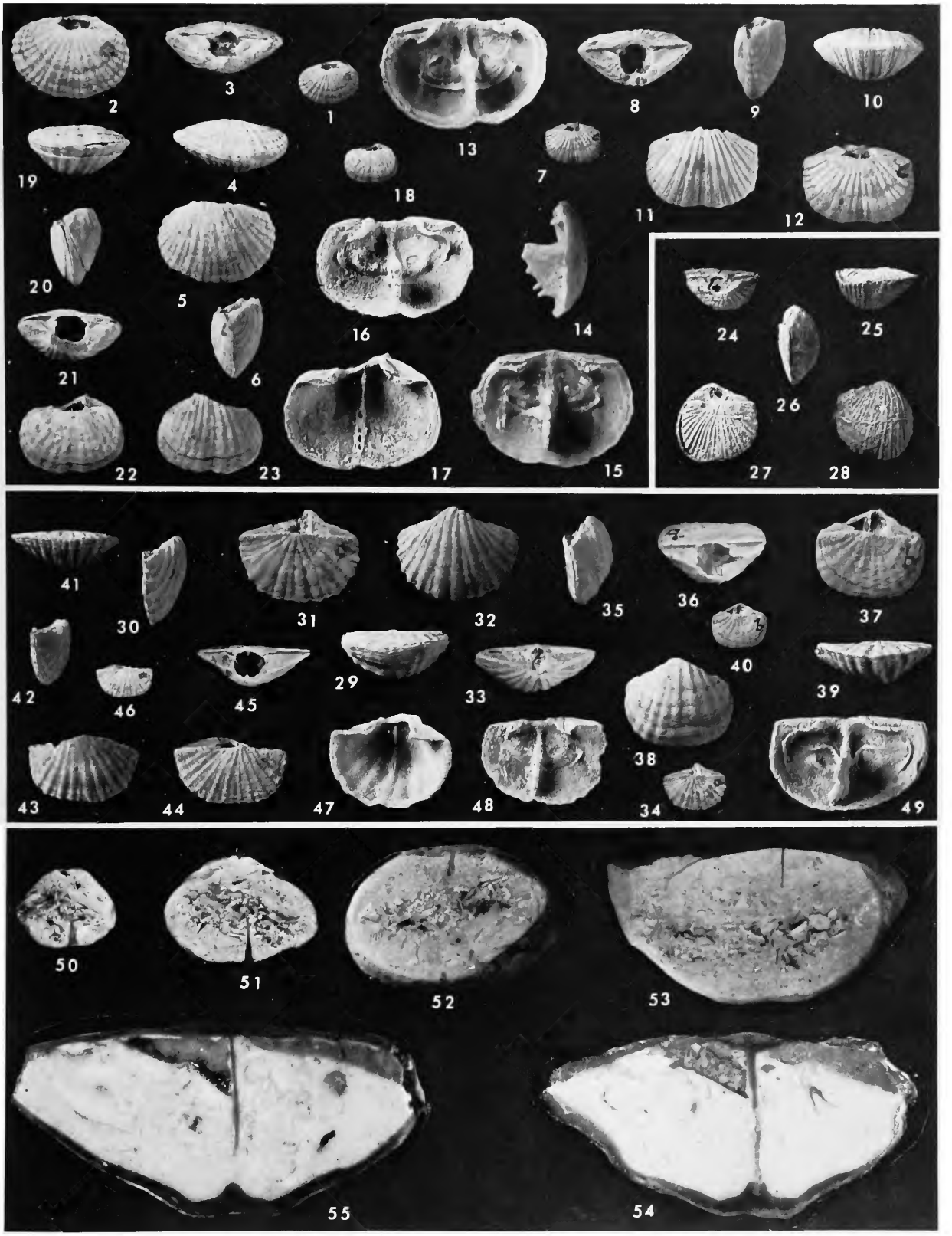
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PLATE 5

Argyrotheca, Cryptopora, Cistellarcula, Hercothyris, Dallina, and *Platidia*

FIGURES 1–5.—*Argyrotheca cyrtiniformis,* new species: 1–3, Posterior, dorsal, and side views of the complete specimen, ×4, holotype, USNM 550336a; 4, interior of the brachial valve of the holotype, ×4; 5, interior of the pedicle valve of the holotype, ×4. Middle Eocene, USNM 818d.

FIGURE 6.—*Cryptopora* sp.: Dorsal view of a complete specimen, ×10, showing small wings on the deltidial plates, figured specimen, USNM 550419. Upper Oligocene, USNM 818f.

FIGURES 7–23.—*Cistellarcula dubia,* new species: 7, Dorsal view, ×1, paratype, USNM 550335c; 8–12, anterior, posterior, side, dorsal, and ventral views, ×3, of the preceding paratype; 13, dorsal view, ×1, of another paratype, USNM 550335a; 14–17, dorsal, anterior, side, and ventral views, ×3, of the preceding paratype; 18, dorsal view of the holotype, USNM 550335b, ×1; 19–23, anterior, dorsal, side, posterior, and anterior views of the holotype, ×3. Upper Oligocene, USNM 818a.

FIGURES 24–29.—*Hercothyris semiradiata,* new species: 24–28, Anterior, ventral, side, posterior, and dorsal views of the holotype, ×1, USNM 549398a; 29, dorsal view of the holotype, ×1–1.5 showing the obscure costellae on the shoulders. Eocene, Palmer 1640.

FIGURES 30–32.—*Dallina floridana* (Pourtales): 30, 31, Dorsal and anterior views, ×1, showing the external form for comparison with that of *Hercothyris,* hypotype USNM 110861a; 32, interior of the dorsal valve, ×2, showing the cardinalia, hypotype USNM 110861b. Compare with Figure 44 below. Recent, Florida Straits.

FIGURES 33–44.—*Hercothyris borroi,* new species: 33–37, Anterior, posterior, side, dorsal, and ventral views of the holotype, ×1, USNM 549396a; 38, dorsal view of the holotype, ×2. Eocene, Palmer 1640.

39–42, Anterior, side, dorsal, and ventral views, ×1, of a paratype, USNM 549395; 43, dorsal view of the preceding paratype, ×2. Eocene, Palmer 1476.

44, Fragment of a dorsal valve showing the cardinalia, ×2, paratype, USNM 549400a. Compare with *Dallina* in Figure 32 above. Eocene, Palmer 1102.

FIGURES 45, 46.—*Platidia* sp.: Dorsal view of two complete individuals, ×10, showing the amphithyrid foramen, figured specimens USNM 550407a, b. Miocene, USNM 818k.

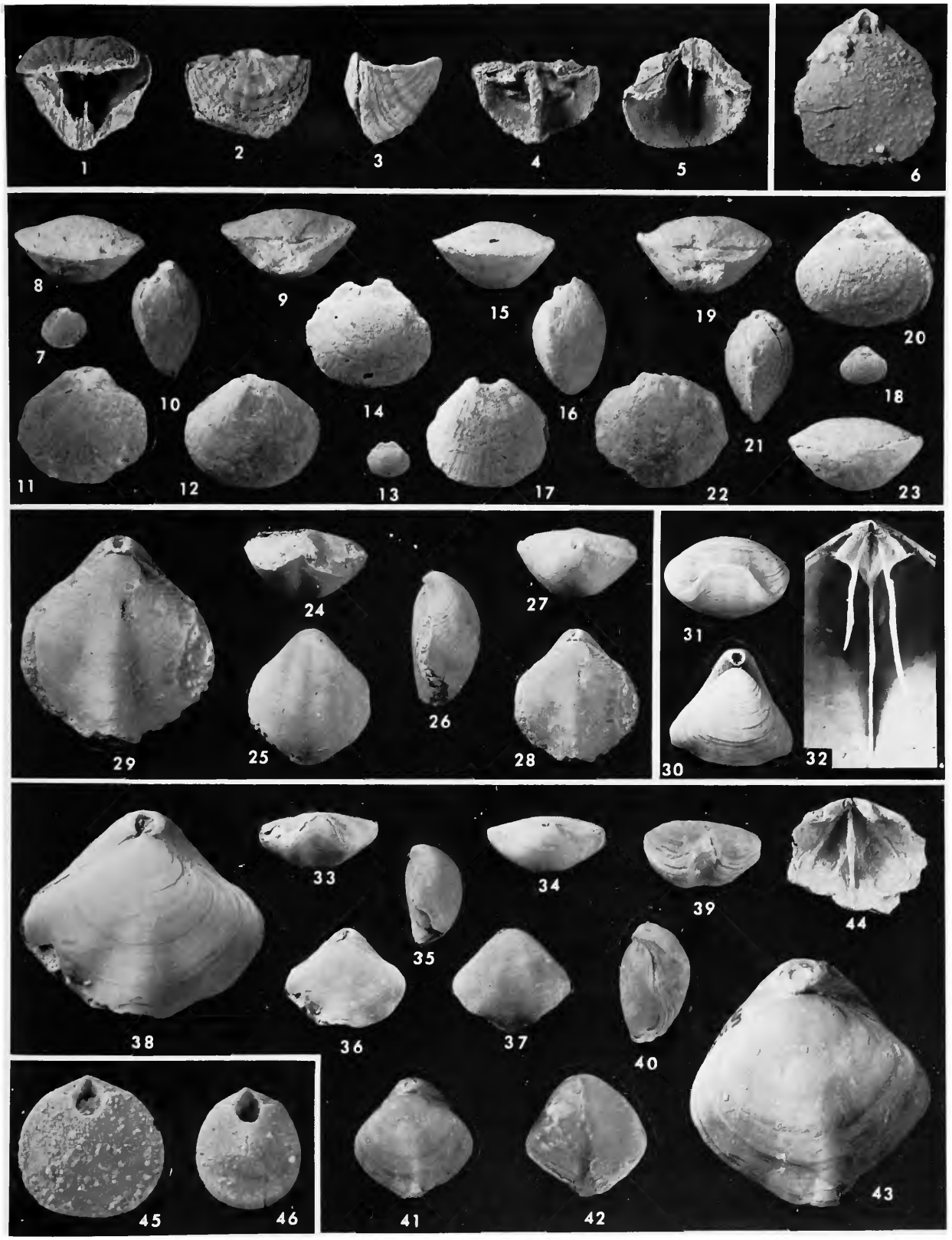
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PLATE 6

Argyrotheca

FIGURES 1–15.—*Argyrotheca inconstans,* new species: 1–5, Dorsal, anterior, side, posterior, and ventral views of the holotype, ×10, USNM 550455a; 6–10, anterior, ventral, side, posterior, and dorsal views of a paratype, ×10, USNM 550455b; 11–13, anterior, side, and ventral views of a paratype with narrow hinge, ×10, USNM 550455c; 14, interior of the dorsal valve showing median septum, ×10, paratype USNM 550455d; 15, interior of the ventral valve showing median septum and anterior row of pits, ×10, paratype 550455e. Pliocene, USNM 818g.

FIGURES 16–20.—*Argyrotheca sublamellosa,* new species: Posterior, ventral, side, dorsal, and anterior views of the holotype, ×4, USNM 550453. Miocene, Palmer 378.

FIGURES 21–25.—*Argyrotheca intercalata,* new species: Dorsal, posterior, side, anterior, and ventral views of the holotype, ×4, showing the distant, intercalated costae, USNM 550448. Middle Eocene, Palmer 1613.

FIGURES 26–30.—*Argyrotheca magnicostata,* new species: Ventral, posterior, side, anterior, and dorsal views of the holotype, ×4, showing the thick, anteriorly divided costae, USNM 550451. Eocene, Palmer 1479.

FIGURES 31–35.—*Argyrotheca serrata,* new species: Anterior, dorsal, side, ventral, and posterior views of the holotype, ×4, showing the crowded costae and closely scalloped margins, USNM 550456. Miocene, Palmer 377.

FIGURES 36–40.—*Argyrotheca aequicostata,* new species: Dorsal, anterior, side, posterior, and ventral views of the holotype, ×4, showing costae of nearly equal size at the margins, USNM 550452. Eocene, Palmer 727.

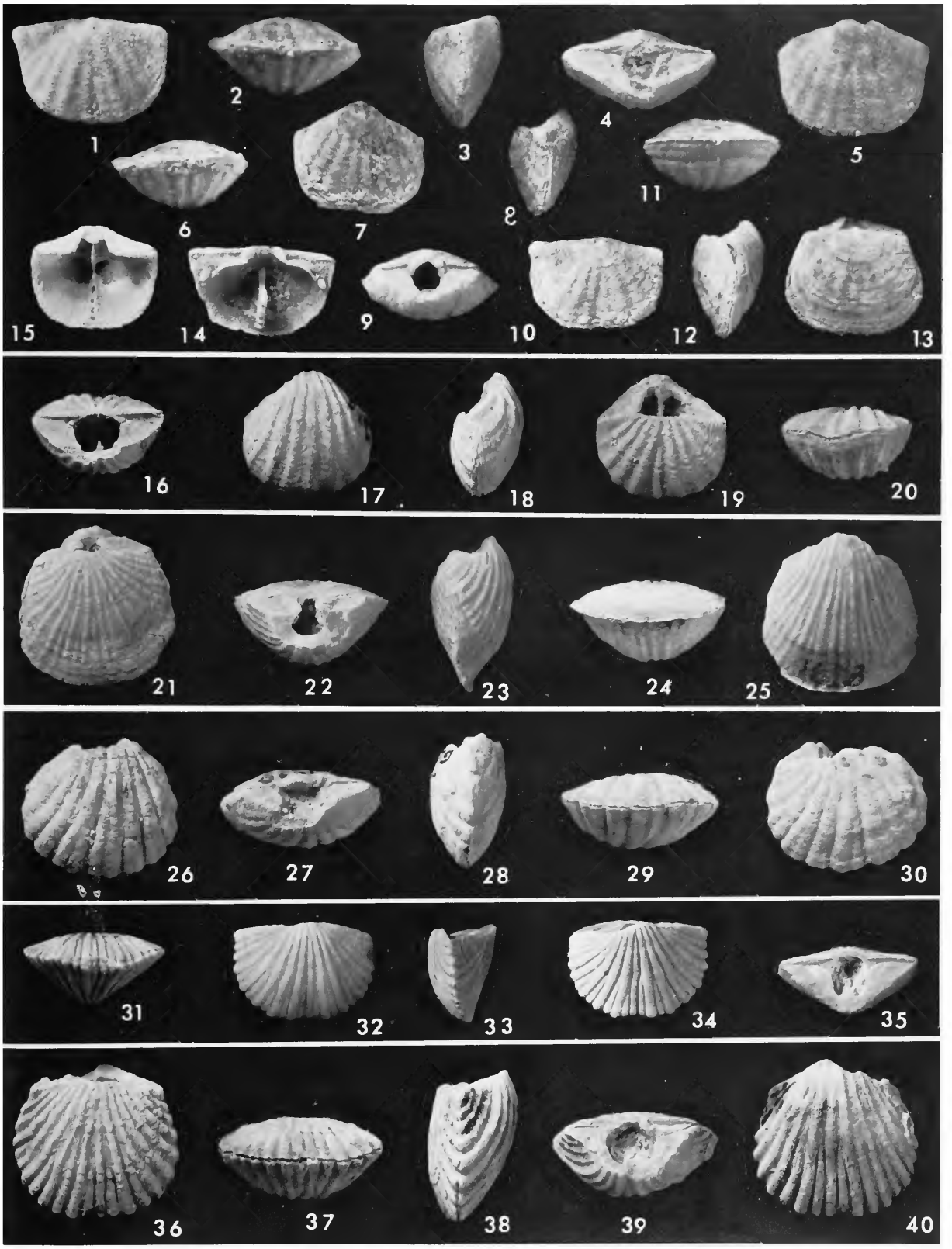
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PLATE 7

Gryphus, Discritothyris, Terebratulina?, Rugia?, and *Argyrotheca*

FIGURES 1, 2.—*Gryphus vaughani* (Cooke): 1, Interior of a silicified pedicle valve showing greatly thickened posterior area and tiny foramen, ×1, hypotype USNM 550618; 2, interior of the dorsal valve belonging to the preceding, ×1, showing cardinal process and thickened outer hinge plates. Eocene, USGS 6924.

FIGURES 3–8.—*Discritothyris cubensis,* new species: 3–7, Dorsal view, ×1, and ventral, anterior, side, and dorsal views, ×2, holotype, USNM 550460a. Cretaceous, Palmer 840.

8, Dorsal view, ×1, of a paratype, USNM 550459a. Cretaceous, Palmer 895p.

FIGURES 9–20.—*Terebratulina? palmeri,* new species: 9–12, Dorsal view, ×1, and dorsal, anterior, and side views, ×2, showing sulcus and carinate dorsal valve paratype USNM 550330e; 13, dorsal view, ×2, of a large specimen, paratype USNM 550330k; 14, interior of the dorsal valve of the preceding specimen showing excavated loop, broken on one side, ×3; 15, interior of a pedicle valve, ×2, showing large teeth, paratype USNM 550330h; 16, interior of a dorsal valve, ×3, showing cardinal process, socket ridges and crura, paratype USNM 550330j; 17, 18, dorsal valve with stout loop excavated, ×3, showing angular transverse band, stout blunt crural processes that could not have formed a ring, paratype USNM 550330i. Miocene, Palmer 932c.

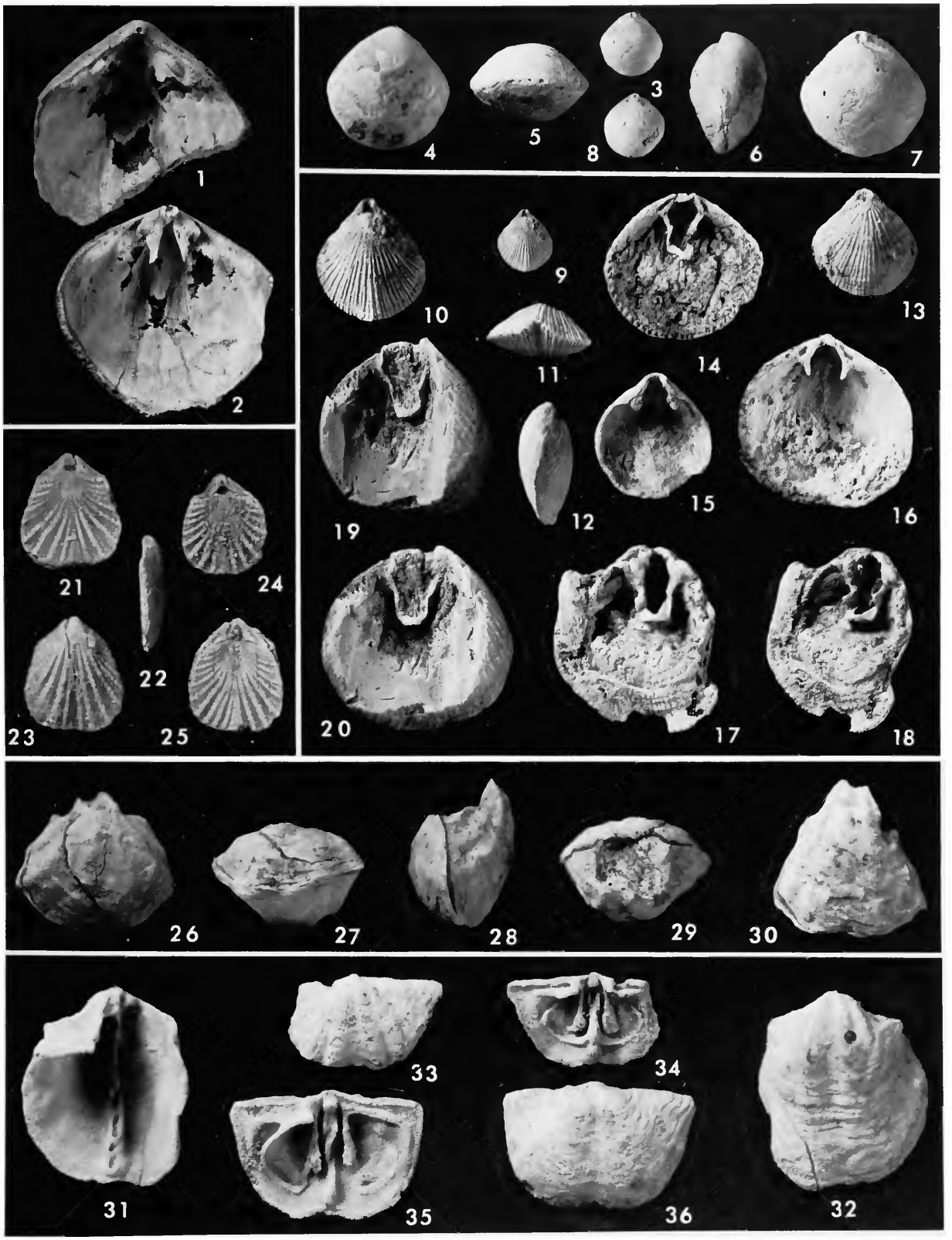
19, 20, Laterally tilted and ventral views, ×3, of another excavated dorsal valve showing the stout loop without ring, paratype, USNM 550329f. Miocene, USNM 818c.

FIGURES 21–25.—*Rugia?* sp.: 21–23, Dorsal, side, and ventral views, ×10, of a large specimen, figured specimen USNM 550575. Palmer 440.

24, 25, Dorsal views of two complete individuals, ×10, figured specimens USNM 550574a, b. Upper Cretaceous, USNM 818.

FIGURES 26–30.—*Argyrotheca peculiaris,* new species: Dorsal, anterior, side, posterior, and ventral views of this aberrant species, ×4 holotype USNM 550449. Probably Miocene, Palmer 1245.

FIGURES 31–36.—*Argyrotheca anomala,* new species: 31, 32, Interior and exterior of the ventral valve, ×10, showing pits in anterior extension of median septum and nearly smooth exterior, paratype USNM 550454a; 33, 34, exterior and interior, ×10, of a dorsal valve showing median thickening, paratype USNM 550454b; 35, 36, interior and exterior of a dorsal valve, ×10, showing nearly smooth exterior and internal thickenings, holotype USNM 550454c. Middle Oligocene, USNM 818n.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