

The status and identity of *Papyridea soleniformis* (Bruguière, 1789) (Bivalvia: Cardiidae)

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ABSTRACT

The name *Papyridea soleniformis* (Bruguière, 1789), as used by most authors, embraces two taxa of marine cardiids found in the tropical Atlantic Ocean. *Papyridea lata* (Born, 1778) occurs in the western Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. Born's specimen in the Zoologisches Museum, Vienna, labeled as variety "*roseo-maculata*" (891a), is here designated as the lectotype. *Papyridea soleniformis* (Bruguière, 1789) is sympatric with *P. lata*, but also occurs in the eastern Atlantic Ocean. Chemnitz, 1782, *Conchylien Cabinet*, page 65, plate 6, figures 49 and 50 are designated as the lectotype illustrations. *Cardium* (*Papyridea*) *spinosum* var. *turtoni* Dall, 1900 is a junior synonym of *P. soleniformis*.

Additional key words: Cardioidea, type specimen, Atlantic Ocean.

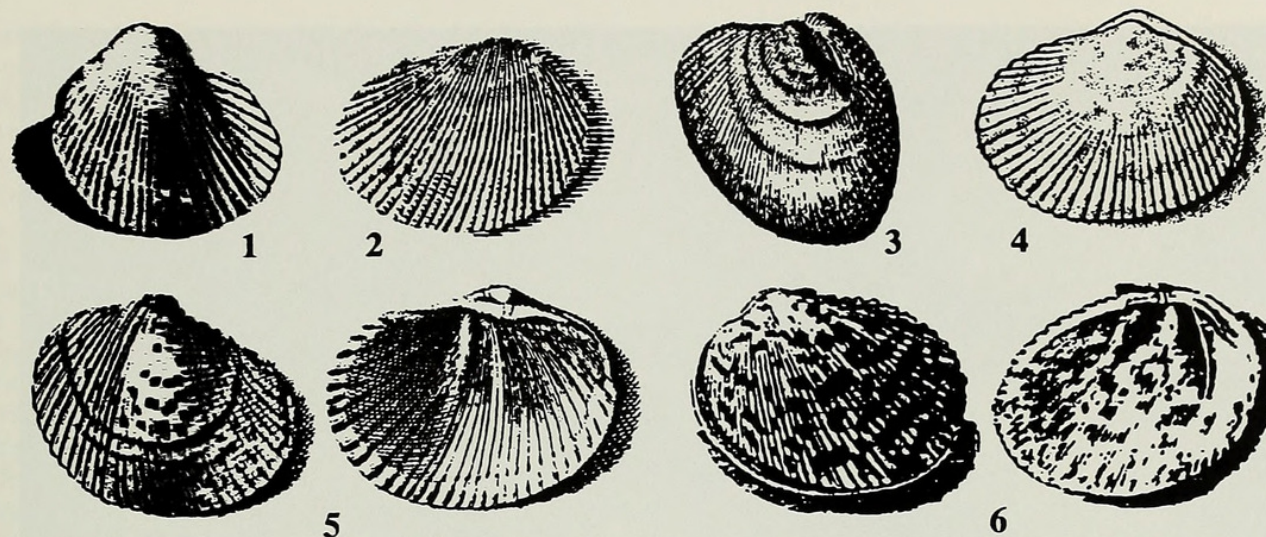
INTRODUCTION

The marine cardiid known as *Papyridea soleniformis* (Bruguière, 1789) is considered a fairly common, widespread species in the western Atlantic Ocean, Caribbean Sea, and portions of the eastern Atlantic Ocean. Additional study has revealed the presence of two taxa currently grouped under that name: *Papyridea soleniformis* (Bruguière, 1789) and *Papyridea lata* (Born, 1778). The source of the taxonomic confusion concerning these species may be traced to Linnaeus (1758). He described *Solen bullatus* from an unknown locale with reference to Rumphius's plate 44, fig. N (Figure 1). However, Linnaeus's brief description of *Solen bullatus* does not apply to this illustration. (I have cited Rumphius (1705) for this figure, but as Dodge (1952) pointed out, we cannot be sure which edition, or even which of Rumphius's two works, *Amboinische Rariteitkamer* or *Thesaurus imaginum piscium Testaceorum*, was involved. Regardless, the plates of the two works are identical.) The species depicted in Rumphius's fig. N also does not conform to Linnaeus's concept of *Solen* as evidenced by the other species originally included by him in that genus. Smith (1945) identified the figure with a Pacific species of *Ful-*

via. But the color plate in Rumphius is of an all-white shell, which would be rare for a *Fulvia*. Furthermore, Rumphius used the vernacular name Doublet or Dubbeld for other cardiids and the name Ark for arcids. Rumphius called the species later named by Linnaeus as the Bastaard Ark. Based on this evidence, Rumphius's species undoubtedly is an arcid. Schumacher (1817) believed Linnaeus's species was misplaced in *Solen* and suggested *Coeur* (a cardiid). Hanley (1855) agreed but suggested that the description applied to a *Fulvia* and the illustration to an arcid. Dodge (1952) concluded that Linnaeus mistakenly had given Rumphius's fig. N as representing this species. In any event, the species cannot be identified unambiguously from either the description or the illustration and no type exists in the Linnean collection (Dodge, 1952). The name *Solen bullatus* therefore is a *nomen dubium*. However, many subsequent authors retained *bullatus* for various species and ignored Linnaeus's incongruous description. Inasmuch as we do not know the identity of Linnaeus's species, no use of the name *Solen bullatus* can be accepted as a correct identification, and none of the subsequent authors may be considered the author of that name, even if placed in a different genus (ICZN, 1999: Art. 49). Finally, Rumphius's fig. N does not resemble either of the two *Papyridea* species discussed here and appears to be an arcid.

MATERIALS AND METHODS

Fifty-six specimens of *P. soleniformis* and 325 specimens of *P. lata* were examined. Specimens were measured as the greatest length parallel to the hinge axis. Institutional acronyms are: ANSP, Academy of Natural Sciences, Philadelphia, USA; GTW, collection of G. Thomas Watters, Columbus, Ohio, USA; HGL, collection of Harry G. Lee, Jacksonville, Florida, USA; RV, collection of Ron Voskuil, Delft, The Netherlands; UF = Florida Museum of Natural History, Gainesville, Florida, USA; UMMZ = University of Michigan Museum of Zoology, Ann Arbor,



Figures 1–6. 1. Rumphius, 1705, pl. 44, fig. N. Type figure of *Solen bullatus* Linnaeus, 1758. 2. *Pectunculus tenuis pellucidus*. . . Lister, 1685, pl. 342, fig. 179. Type figure of *Coeur spinosum* Meuschen, 1787 = *Papyridea lata* (Born, 1778). 3. *Blasensarrige* Herz Knorr, 1772, pl. 7, fig. 6. Cited by Born as questionable figure of *Cardium latum* Born, 1778. 4. Born, 1780, pl. 3, fig. 8. Born's refiguring of *Cardium latum* Born, 1778. 5. *Chama H. inaequilatera, oblique striata*. . . Gualtieri, 1742, pl. 85, fig. H. Type figure of *Coeur hiatus* Meuschen, 1787 = *Papyridea soleniformis* (Bruguière, 1789). 6. *Solen bullatus* "Linnaeus." Chemnitz, 1782, 65, pl. 6, figs. 49, 50. Lectotype figure of *Cardium soleniforme* Bruguière, 1789, designated herein.

Michigan, USA; USNM = National Museum of Natural History, Washington, DC, USA.

SYSTEMATICS

Superfamily Cardioidea Lamarck, 1809

Family Cardiidae Lamarck, 1809

Subfamily Trachycardiinae Stewart, 1930

Genus *Papyridea* Swainson, 1840

Type Species: *Papyridea soleniforme* "Wood," non Bruguière, 1789, by subsequent designation of Gray (November, 1847). Swainson had included four species under *Papyridea*, including *Papyridea soleniforme* "Wood, 1815." Wood's figure (pl. 56, fig. 3) is of *Papyridea lata* (Born, 1778). Swainson's type species is therefore misidentified. But as both species are members of *Papyridea*, there is no threat to the stability of this genus name, and I have not referred the case to the Commission (ICZN, 1999: Art. 70 (b)). Herrmannsen (September, 1847) had earlier designated *Cardium bullatum* as type of *Papyridea*, but as that species was not included by Swainson in his original list, it is not eligible as the type species.

Papyridea lata (Born, 1778)
(Figures 2, 4, 7–13)

Pectunculus tenuis pellucidus, leviter purpurascens, dense striatus a Jamaica Lister, 1685: pl. 342, fig. 179 [pre-Linnean; type figure of *Coeur spinosum* Meuschen, 1787, by restriction of Clench and Smith, 1944, as first revisors].

Cardium latum Born, 1778: 37; 1780: pl. 3, fig. 9; Bruguière, 1789: 234–235 [partim].

Coeur spinosum Meuschen, 1787: 442 [non-binomial].

Cardium soleniforme "Bruguière".—Wood, 1815: 233, pl. 56,

fig. 3; 1835:56, fig. 3; 1856: 5, pl. 5, fig. 36 [all non Bruguière, 1789].

Papyridea soleniforme "Wood".—Swainson, 1840: 374.

Cardium (Papyridea) bullatum (Linnaeus).—Römer, 1869: 74–76, pl. 12, figs. 13–16.

Cardium latum "Chemnitz".—Brauer, 1878: 127.

Cardium (Papyridea) bullatum "Chemnitz".—Kobelt, 1880: 345, pl. 101, fig. 4.

Cardium spinosum var. *spinosum* (Meuschen).—Dall, 1900b: 1107–1108.

Papyridea spinosum (Meuschen).—Smith, 1937: 49, pl. 17, fig. 8; McLean, 1939: 164–165, pl. 24, figs. 3, 9; Vilas and Vilas, 1945: 38, pl. 3, fig. 15.

Papyridea hiatus (Meuschen).—Clench and Smith, 1944: 17, pl. 4, figs. 3–5 [partim].

Papyridea hiatus (Meuschen).—McLean, 1951: 71 [partim] [not pl. 15, fig. 1 = *Papyridea soleniformis* (Bruguière, 1789)].

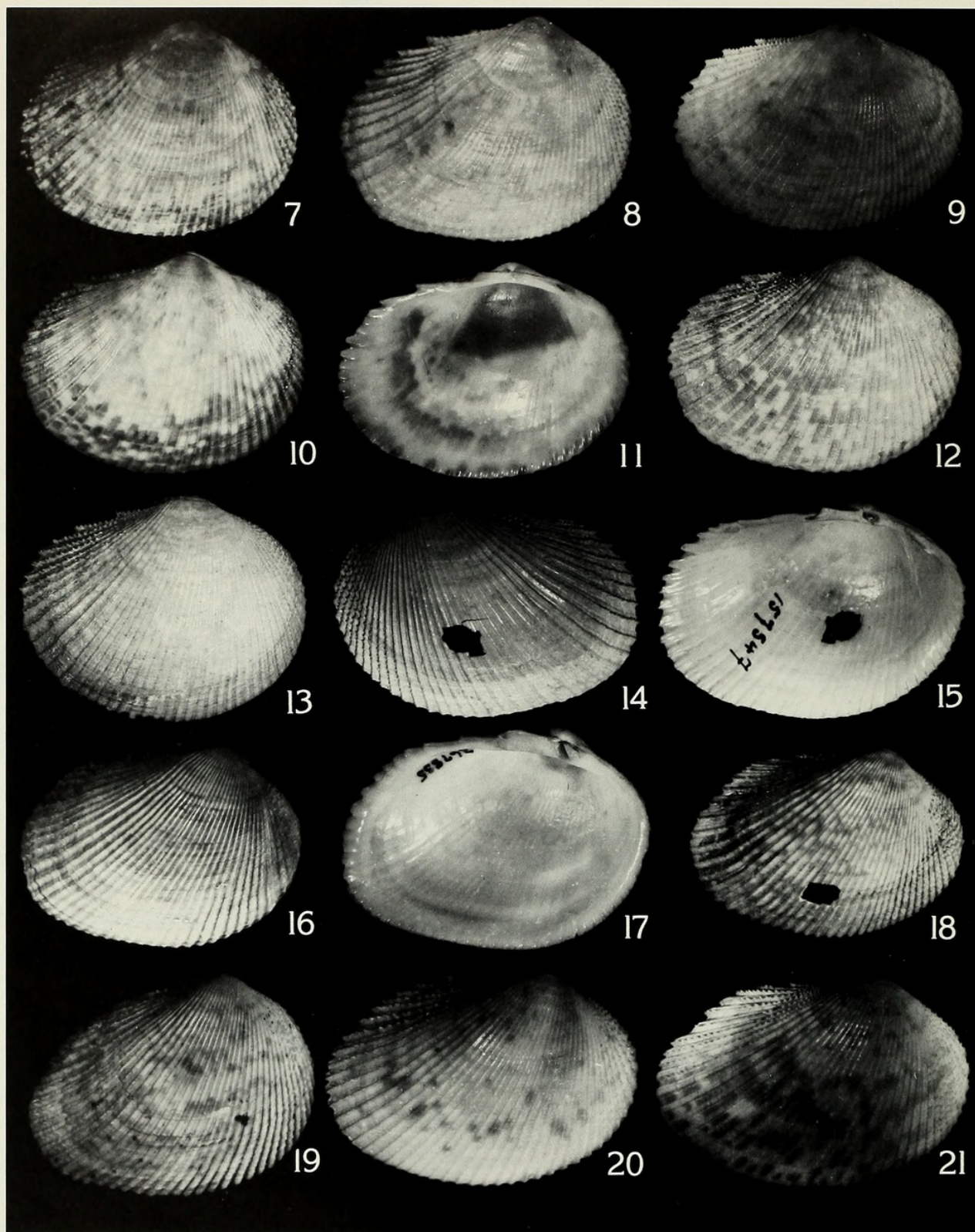
Papyridea soleniformis (Bruguière).—Keen, 1937: 14–15; Abbott, 1954: 398, pl. 39n [partim]; Perry and Schwengel, 1955: 68, pl. 13, fig. 74; Warmke and Abbott, 1961: 183, pl. 37j; Abbott, 1968: 228, fig. 7; Nordsieck, 1969: 103, pl. 15, fig. 57.10; Stanley, 1970: 157, 158, pl. 20, figs. 1–6; Porter and Tyler, 1971: 16, fig. 9; Clench, 1973: 57, pl. 23, fig. 16; [partim] Abbott, 1974:484, pl. 22, fig. 5555; Humfrey, 1975: 245, pl. 29, figs. 18, 18a.; Rios, 1975: 223, pl. 71, fig. 1072; Keen, 1980: pl. 5, fig. 7 [partim]; Vokes and Vokes, 1983: 40, 63, pl. 41, fig. 5; Rios, 1994: 263, pl. 90, fig. 1282 [all non Bruguière, 1789].

Cardium bullatum "Chemnitz".—Lamy, 1941: 462–463 [partim].

Papyridea (Papyridea) soleniforme (Bruguière).—Fischer-Piette, 1977: 69–70 [partim].

Papyridea lata (Born).—Voskuil and Onverwagt, 1991: 31 [partim].

Papyridea (Papyridea) lata (Born).—Kafanov, 1997: 3–4, pl. 1, figs. 3a, b, pl. 2, figs. 1a–d, 2a–e, pl. 3, figs. 1a–c.



Figures 7–13. *Papyridea lata* (Born, 1778). **7.** Lectotype, herein designated (Zoologisches Museum, Wien, 891a) (from original photograph of R. Voskuil). Locality unknown. **8.** Paralectotype, herein designated (Zoologisches Museum, Wien, 891a) (from original photograph of R. Voskuil). Locality unknown. **9.** 2–12 m, Cat Cay, Bimini, Bahamas (UF 176315) (47 mm). **10–11.** Beached, Sanibel Island, Florida, USA (GTW) (34 mm). **12.** Salvador, Bahía State, Brasil (HGL) (36 mm). **13.** Matanzas, Cuba (GTW) (31 mm).

Figures 14–21. *Papyridea soleniformis* (Bruguière, 1789). **14–15.** Syntype of *Cardium* (*Papyridea*) *spinosum* var. *turtoni* Dall, 1900. [Pleistocene] of Caloosahatchee River, Florida, USA (USNM [USGS] 157547) (42 mm). **16–17.** Sao Tomé (ANSP 267835) (53 mm). **18.** St. Helena (USNM 777907) (43 mm). **19.** Cape Verde Islands (ANSP 309062) (45 mm). **20.** Water Island, Virgin Islands (GTW) (33 mm). **21.** Off Lake Worth, Florida, USA, 60 m (UF 12117) (34 mm).

Description: Shell to 44 mm in length, thin but solid, oval, compressed, slightly opisthogyrate, slightly inequilateral, with the umbo located 37–45% length back from the anterior margin. Posterior of umbones rounded, lacking a ridge or angulation. Shells gaping antero-ventrally and postero-dorsally, forming pedal and siphonal gapes respectively. Exterior of shell ornamented with 43–59 primary radial ribs. Ribs about as wide as inter-rib spaces on anterior of shell, becoming wider on posterior. Postero-dorsal margin dentate. Primary ribs triangular in cross-section on anterior of shell, becoming flattened on posterior of shell. Anterior-most primary ~18 ribs and posterior-most ~12 ribs ornamented with minute concave scales. Scales cross entire rib on anterior ribs, but are situated on a narrow medial line on the posterior ribs. Exterior color quite variable. Background white with large irregular patches of yellow, orange, rose, or purple, sometimes forming irregular concentric bands. Occasional specimens are uniformly colored with these shades. Some specimens have one or two vague, broad rays radiating from the umbones of the same color as the patches. These rarely persist on the exterior on specimens larger than 10 mm. Living and freshly dead specimens have a thin, tan-colored periostracum around the shell margin. Hinge occupying 1/2 of total length. Anterior laterals larger, more blade-like than posterior ones. Left and right laterals of equal size. Left laterals engage dorsal to right laterals. Small, peg-like left cardinal tooth fits into socket in right valve. Ligament external, small, approximately 1/6 or less of shell length. The arrangement of the teeth and ligament allows the shells to rock along an antero-postero axis (Watters, 1992). Interior of shell white, with exterior colors showing through. The two broad rays radiating from the umbo are much more conspicuous and noticeably longer on the interior than on the exterior. Preserved examples have not been seen.

Type Material: The Born collection in the Zoologisches Museum, Wien, has two syntypes of *Cardium latum* (891a), one labeled “*roseo-maculata*,” the other “*luteo-maculata*” (Voskuil, in litt.). The first, “*roseo-maculata*,” corresponds best to Born’s 1780 illustration and is here designated as the lectotype (Figure 7). The second specimen, “*luteo-maculata*,” is a paralectotype (Figure 8). ICZN (1999: Art. 72.4.1) does not allow specimens “expressly” excluded as distinct variants to remain part of the type series. Strictly speaking this might exclude Born’s two color variants from being primary types. However, it is clear that Born considered all of his specimens to belong to one or the other color variant; the two variants therefore compose the entire type series.

Type locality: *Cardium latum* Born, 1778: unknown.

Material examined: BERMUDA: 1.5–3.0 m, Coney Island (GTW, HGL). TEXAS: 46 m off Freeport (ANSP). SOUTH CAROLINA: Myrtle Beach, Orry Co. (GTW). FLORIDA [Atlantic Ocean]: dredged 90 m

(RV); 21 m, 121 km E of St. Augustine, St. Johns Co. (UF); 320 m, off St. Augustine, St. Johns Co. (GTW); 23 km ENE of Mayport, Duval Co. (HGL); 27 m, 32 km E of Mayport, Duval Co. (HGL); 30–60 m, off Singers Id., Palm Beach Co. (UF); 30 m, Peanut Island, Palm Beach Co. (UF); Palm Beach, Palm Beach Co. (UF); Fish Haven, Lake Worth, Palm Beach Co. (UF); Lake Worth, Palm Beach Co. (ANSP, GTW, UF); S of Lake Worth Inlet, Palm Beach Co. (UF); 55 m, off Boynton Inlet, Palm Beach Co. (UF); 18 m, off Briny Breezes, Palm Beach Co. (UF); fill from 18 m, Pompano Beach, Broward Co. (UF); Finger Channels, Dade Co. (HGL); Bear Cut, Key Biscayne, Dade Co. (UF); Biscayne Bay, Dade Co. (GTW); 73 m, off Miami, Dade Co. (GTW); Little Duck Key, Monroe Co. (UF); W end Bahia Honda Key, Monroe Co. (UMMZ); Newfound Harbor Keys, Monroe Co. (UF); 117 m, Florida Straits, 24°23'15" N, 82°01'17" W (UF). [Gulf of Mexico]: 64 m, 150° off Pensacola, Escambia Co. (UF); off Destin, Okaloosa Co. (ANSP); 26 m, Destin, Okaloosa Co. (UF); 40 m, 225° off Panama City, Bay Co. (ANSP, UF); 8–11 km S of Alligator Point, Franklin Co. (UF); Boca Ciega Beach, Pinellas Co. (UF); St. Petersburg, Hillsborough Co. (UF); Longboat Key, Sarasota Co. (UF); 13–15 m, 15–18 km SW of Big Sarasota Pass, Sarasota Co. (UF); Ft. Myers Beach, Lee Co. (ANSP); Captiva Island, Lee Co. (UF); Point Ybel, Sanibel Id., Lee Co. (UF); Sanibel Id., Lee Co. (ANSP, GTW, UF); Boca Grande, Gasparilla Island, Lee Co. (ANSP); Little Gasparilla Island, Lee Co. (ANSP); 55 m, off Naples, Collier Co. (UF); Naples Beach, Collier Co. (GTW); Marco Id., Collier Co. (UF); 427 m, 241 km W of Cape Romano, Collier Co. (UF); Madiera/Pass-a-Grille Beach, Pinellas Co. (UF, UMMZ); dredged 30 m, Bradenton, Manatee Co. (RV); off Panama City, Bay Co. (HGL). BAHAMAS: 2–11 m, Cat Cay, Bimini (UF); Alicetown, Bimini (ANSP); drift, 300 m N of Current Cut, Current, Eleuthera (HGL); Parrot Cays, Great Abaco (ANSP); Hog Island (ANSP). CUBA: (GTW); Matanzas (GTW); Playa del Frances (GTW); Varadero (ANSP, GTW); 5–7 m, 0.8 km out from bay side of Icacos Peninsula (ANSP); Tarallones de Arena, near Santiago (ANSP). PUERTO RICO: (GTW); off Cabo Rojo Lighthouse (UF); Mayaguez (GTW); Punta Arenas (ANSP). VIRGIN ISLANDS: Devils Bay, Virgin Gorda (UF); St. Croix (UF); Water Id. (GTW); St. Thomas (ANSP). ST. MARTIN: (ANSP). GRENADA: 1 m, near Lance aux Epines (HGL); Grand Anse Beach (ANSP); 7–11 m, entrance of St. George Harbour (ANSP); 0.3–1 m, Prickly Bay (ANSP). MARTINIQUE: (ANSP, UF, UMMZ). ARUBA: (GTW). HONDURAS: 8 m, ESE of Punta Negro (ANSP); 8 m, N of Man of War Cay (ANSP); Hopkins, Commerce Bight (ANSP). BRAZIL: 3–6 m, off Clube Iate, Salvador, Bahia State (HGL); 1–3 m, Salvador, Bahia State (HGL); 9–10 m, Porto Belo, Santa Catarina State (HGL).

Distribution: Subtidal to at least 90 m. Western Atlantic Ocean from South Carolina to southern Brazil, Gulf of Mexico, Yucatan (Vokes and Vokes, 1983), Ber-

muda, and Caribbean Sea. Not recorded from the eastern Atlantic Ocean.

Remarks: Lister's (1685) figure 179 and description of the shell as "slightly purple" identifies it as *Papyridea lata* as no purple *P. soleniformis* are known to the writer. The rib count of the illustrated specimen is at the minimum for *P. soleniformis*, but only three less than the minimum for *P. lata*. Reliance on accurate rib counts for identification from a 17th century picture book may be unrealistic. The color pattern also suggests *P. lata* more so than *P. soleniformis*. This is the first mention of this species in the literature (Figure 2). Meuschen (1787) listed this taxon under the name "*Coeur spinosum*," based on this figure and that of Knorr (1772), but Meuschen's work is non-binominal. Knorr (1772) illustrated a shell that may refer to one of the two taxa discussed here, but the figure is too crude for accurate identification (Figure 3). Knorr's works also are non-binominal. Born (1778) cited Knorr's 1772 illustration, but did so with a question mark, in describing specimens in the collection of the Empress Maria Theresa as *Cardium latum*. Born redescribed this species with his own figure in 1780 (Figure 4). This was the first available name for this species: *Cardium latum* Born, 1778. Voskuil and Onverwagt (1991) and Kafanov (1997) also reached this conclusion, but included both *P. lata* and *P. soleniformis* under that name. Finally, Brauer (1878), working with Born's types, identified *latum* with Meuschen's *spinosum*.

Papyridea lata differs conchologically from *P. soleniformis* in several ways. The former is noticeably more equilateral and lacks the angulation on the umbones. The ribs on the posterior half of the shell of *P. lata* are flattened, while those of *P. soleniformis* are triangular. The scales on the posterior primary ribs are positioned in a narrow medial band in *P. lata*, but in *P. soleniformis*, they are situated on the postero-dorsal slope of the ribs. The consistent color pattern of *P. soleniformis* is rarely duplicated in the much more variable and brightly colored *P. lata*. *Papyridea soleniformis* grows to a larger size than *P. lata*.

Papyridea soleniformis (Bruguière, 1789)
(Figures 5, 6, 14–21)

Chama H. inaequilatera, oblique striata, margine interno dentata, ex candido and roseo variegata and fasciata Gualtieri, 1742: pl. 85, fig. H [pre-Linnean; type figure of "*Coeur hiatus*" Meuschen, 1787, by original designation].

Solen bullatus Linnaeus.—Chemnitz, 1782: 66, pl. 6, figs. 49, 50 [rejected work; type figure of *Cardium soleniforme* Bruguière, 1789, herein selected] [reproduced Richardson, Abbott and Davis, 1979]; Gmelin, 1791: 3226; Bosc, 1802:13; Dillwyn, 1817: 69 [all non Linnaeus, 1758].

Coeur hiatus Meuschen, 1787: 442 [non-binominal].

Cardium soleniforme Bruguière, 1789: 235; Bosc, 1802:107.

Cardium bullatum (Linnaeus).—Lamarck, 1819: 6; Anton, 1839: 11; Sowerby, 1841: 2; Reeve, 1845: pl. 2, fig. 8; Reibisch, 1865: 126 [all non Linnaeus, 1758].

Cardium bullatum "Lamarck".—Dunker, 1853: 51.

Papyridea spinosa (Meuschen).—Adams and Adams, 1858: 456.

Papyridea (Fulvia) bullata (Linnaeus).—Chenu, 1862: 109, figs. 500–502 [non Linnaeus, 1758].

Cardium (Fulvia) bullata (Linnaeus).—Tryon, 1894: 193, 437, pl. 116, fig. 78 [non Linnaeus, 1758].

Cardium (Papyridea) spinosum var. *turtoni* Dall, 1900b:1108; Schuchert et al., 1905:132; Boss et al., 1968: 328 [non *Cardium turtoni* Sowerby (II), 1894 = *Parvicardium turtoni* (Sowerby (II), 1894)].

Cardium bullatum "Chemnitz".—Lamy, 1941: 462–463 [partim].

Papyridea hiatus [partim] Clench and Smith, 1944: 17.

Papyridea bullata "Chemnitz".—Nicklès, 1950: 170.

Papyridea hiatus (Meuschen).—McLean, 1951: 71, pl. 15, fig. 1 [partim].

Papyridea soleniformis (Bruguière).—Abbott, 1954: 398 [partim] [not pl. 39n = *Papyridea lata* (Born, 1778)]; Abbott, 1974: 484 [partim] [not pl. 22, fig. 5555 = *Papyridea lata* (Born, 1778)]; Keen, 1980: pl. 6, fig. 11 [partim]; Abbott and Dance, 1982: 329, text figure; Voskuil and Onverwagt, 1989: 63, 64, figs. 2.1, 2.1.01, pl. 3, fig. 1; Vermeij and Rosenberg, 1993: 185, 194.

Papyridea (Papyridea) soleniforme (Bruguière).—Fischer-Piette, 1977:69–70 [partim].

Description: Shell to 60 mm in length, thin but solid, elongate-oval, compressed, slightly opisthogyrate, inequilateral, with the umbo located 26–33% back from the anterior margin. Posterior of umbones angled with a ridge. Shells gaping antero-ventrally and postero-dorsally, forming pedal and siphonal gapes respectively. Exterior of shell ornamented with 40–48 primary radial ribs, equal in width to the inter-rib spaces anteriorly, becoming wider than inter-rib spaces posteriorly. Postero-dorsal margin dentate. There is a tendency to form secondary ribs posteriorly, particularly along the dorsal side of the primary ribs. Primary ribs triangular in cross-section. Anterior-most primary ~16 ribs and posterior-most ~14 ribs usually ornamented with minute concave scales. Scales cross entire rib on anterior ribs, but are situated on the postero-dorsal side on the posterior ribs. Exterior color consistent on all specimens seen, with white or yellowish background marked with irregular, interspersed rose or purple blotches and flecks that may form vague concentric bands. Some specimens have one or two well-defined, broad rays radiating from the umbones of the same color. These rarely persist on the exterior on specimens past 20 mm. Living and freshly dead specimens have a thin, tan-colored periostracum around the shell margin. Hinge occupying less than 1/2 of total length. Anterior and posterior lateral teeth of equal size. Left laterals small, short, and blade-like. Right laterals slightly larger. Otherwise, lateral teeth and ligament as in *P. lata*. Interior of shell white, with exterior colors showing through. Preserved examples have not been seen.

Type material: *Cardium soleniforme* Bruguière, 1789: Lectotype illustrations, herein selected, Chemnitz, 1782: 65, pl. 6, figs. 49, 50 (see ICZN, 1999: Art. 74.4) (Figure 6). *Cardium (Papyridea) spinosum* var. *turtoni*

Dall, 1900: Syntypes USNM [USGS] 157547, one whole valve, one fragment (figs. 14, 15).

Type locality: *Cardium soleniforme* Bruguière, 1789, based herein on Chemnitz, 1782: unknown. *Cardium (Papyridea) spinosum* var. *turtoni* Dall, 1900: [Pleistocene] of Caloosahatchee River, Florida.

Material examined: BERMUDA: 1.5–3.0 m, Coney Island (GTW, HGL). FLORIDA [Atlantic Ocean]: Palm Beach Co. (UF); 27 m, N of Dodge Estate, Palm Beach Inlet, Palm Beach Co. (UF); 36–46 m, Dodge Estate, Palm Beach Inlet, Palm Beach Co. (UF); Lake Worth, Palm Beach Co. (ANSP, UF); off Breakers Hotel, Palm Beach, Palm Beach Co. (UF); off radio tower, Palm Beach, Palm Beach Co. (UF); 1 m, Bear Cut, Key Biscayne, Dade Co. (GTW, UF); Stiltsville Finger Channels, Dade Co. (HGL, RV, UF); Newfound Harbor Keys, Monroe Co. (UF); Middle Sambo Shoals, Key West, Monroe Co. (UF); off Key West, Monroe Co. (HGL); Fort Jefferson, Garden Key, Dry Tortugas (UF); 1.2 m, 0.27 km S of Fort Jefferson, Garden Key, Dry Tortugas (UF); 1.6 km S of Garden Key, Dry Tortugas (UF); 0–68 m, Dry Tortugas (ANSP). [Gulf of Mexico]: off Tarpon Springs, Pinellas Co. (UF); Little Sarasota Bay (ANSP). BAHAMAS: 20 m, off reef NE of North Point, Great Abaco (ANSP); Grunt Drop, Bimini Lagoon, Bimini (ANSP). PUERTO RICO: Mayaguez (GTW); off Cabo Rojo Lighthouse (UF). VIRGIN ISLANDS: (ANSP); Water Id. (GTW); Honeymoon Bay, St. Thomas (UF); St. Thomas (ANSP). LESSER ANTILLES: 1 m, S side of Long Point, Grenada (ANSP); 7 m, Martinique (ANSP, RV). VENEZUELA: Santa Fé (RV). BRAZIL: 3–6 m, off Clube Iate, Salvador, Bahia State (HGL); 1–3 m, Salvador, Bahia State (HGL). SAO TOMÉ: (ANSP). CAPE VERDE ISLANDS: (ANSP). ST. HELENA: (USNM).

Distribution: Subtidal to at least 46 m. Western Atlantic Ocean and Gulf of Mexico from central Florida to at least Baía de Todos os Santos, Brazil; Bermuda; Caribbean Sea from Cuba to Venezuela. Eastern Atlantic Ocean from Angola (Voskuil and Onverwagt, 1989), Ascension Island (Packer, 1968), St. Helena (Smith, 1890; Dall, 1900b), St. Vincent (Dall, 1900b), Sao Tomé, and Cape Verde Islands. Pleistocene of Florida.

Remarks: In 1787, Meuschen described "*Coeur hiatus*" based on Gualtieri's work (1742: plate 85, figure H), which probably depicts this species (Figure 5). I base this conclusion on the characteristic color pattern of small, separated spots found in *P. soleniformis*. Other aspects of the figure suggest *P. lata*, but overall I believe the figure is closer to *P. soleniformis*. Meuschen also described "*Coeur spinosum*," from two figures, one of which (Knorr) is unidentifiable. The other figure (Lister) clearly is *P. lata*. Meuschen thus was the first worker to recognize that these were two different taxa. Unfortunately, his work was non-binominal, and subsequent use of them by later authors obliterated his original insight. The name *hiatus* remained unused until resurrected by

Clench and Smith (1944), who believed they had uncovered the earliest name for this taxon. Because a non-binominal rejected name does not enter into homonymy (ICZN, 1999: Arts. 11.4, 54.2), their illustration and description resulted in their authorship of the name *Papyridea hiatus*. Their concept included both taxa recognized here, but fortunately earlier names are available for both species. A similar situation exists for Adams's and Adams's 1858 authorship of *spinosum*. Because Adams and Adams introduced the species name in *Papyridea*, there is no conflict with the common *Cardium spinosum* Lightfoot, 1786 [= *Acanthocardia spinosa*]. Clench and Smith (1944) also (?inadvertently) restricted Meuschen's *Coeur spinosum* to Lister's figure.

Chemnitz (1782) illustrated this species as Linnaeus's *Solen bullatus* (Figure 6), but this work is non-binominal and rejected. In 1789 Bruguière described *Cardium soleniforme* based on a list of illustrations that included both taxa, giving a description sufficiently vague as to apply to either species. The name was largely ignored until its use by Keen (1937). It gained immediate popularity with Abbott's use in the 1954 edition of *American Seashells*, and now it is the most widely used of the several names applied to these species. However, that name, as used by Bruguière and later authors, encompassed two species. I hereby restrict the type figure of *Cardium soleniforme* to Chemnitz, 1782, pl. 6, figs. 49, 50 (ICZN, 1999: Art. 74.4), which is clearly identifiable as the species discussed here (Figure 6). This enables this widely used name to continue to be applied to only one of the two taxa.

Dall (1900b) introduced this species as *Cardium spinosum* variety *turtoni*, despite the earlier name *Cardium turtoni* Sowerby (II), 1894. Because varieties proposed before 1961 are considered to be of subspecific rank (ICZN, 1999: Art. 45.6.4), and species and subspecies names may compete as homonyms, Dall's name is a junior homonym. Dall's species was described from the "Pliocene" of the Caloosahatchee River, Florida, now believed to be Pleistocene in age.

Kafanov (1997) placed *Cardium hiulcum* Reeve, 1845, as a synonym of *P. lata* (his concept contained both *P. lata* and *P. soleniformis*). I have not seen Reeve's unlocalized specimen but it seems closest to *P. mantaensis* Olsson, 1961, as suggested by Voskuil and Onverwagt (1991). Both *P. lata* and *P. soleniformis* have cognates in the eastern Pacific Ocean, indicating a Tethyan distribution for their common ancestors. *Papyridea crokeri* Strong and Hertlein, 1937, is the homologue of *P. lata*, and *P. aspersa* (Sowerby, 1833) is the homologue of *P. soleniformis*.

See under *Papyridea lata* for comments on identifying *P. lata* and *P. soleniformis*.

UNIDENTIFIED NAMES AND MISIDENTIFICATIONS

Many references cannot be paired with one or the other species, as evidenced from the following references to *P. lata* and *P. soleniformis* as defined here.

- non* Rumphius, 1705:pl. 44, fig. N [= an arcid.?).
- non* *Solen bullatus* Linnaeus, 1758: 673; Hanley, 1855: 31, 32 [= *nomen dubium*, *fide* Dodge, 1952].
- non* *Cardium spinosum* Lightfoot, 1786. [= *Acanthocardia spinosa* (Lightfoot, 1786)].
- non* *Cardium latum* "Born".—Bruguière, 1789: 234 [*partim*]; Gmelin, 1791: 3255; Bosc, 1802: 106; Link, 1807: 151; Wood, 1815: 236; Dillwyn, 1817: 125; Lamarck, 1819:13; Wood, 1825: 27 [all based on Chemnitz, 1782:pl. 19, figs. 192–193 = ? *Maoricardium pseudolatum* Voskuil and Onverwagt, 1991].
- non* *Cardium latum* "Gmelin".—Röding, 1798: 190 [based on Chemnitz, 1782: pl. 19, figs. 192–193 = ? *Maoricardium pseudolatum* Voskuil and Onverwagt, 1991].
- non* *Cardium latum* "Born".—Reeve, 1845: pl. 6, fig. 21 [= *Maoricardium setosum* (Redfield, 1846)].
- non* *Cardium (Papyridea) bullatum* (Linnaeus).—Herrmannsen, 1849:200 [= *nomen dubium*, *fide* Dodge, 1952].
- non* *Afrocardium latum* "Born".—Kirtisinghe, 1978: 28, pl. 11, fig. 12 [= *Maoricardium pseudolatum* Voskuil and Onverwagt, 1991, *fide* Voskuil and Onverwagt, 1991].
- non* *Plagiocardium (Maoricardium) latum* "Born".—Lamprell and Whitehead, 1983: 8 [= *Maoricardium pseudolatum* Voskuil and Onverwagt, 1991, *fide* Voskuil and Onverwagt, 1991].
- ? *Anomalocardia, quæ pectunculus tenuis pellucidus, leviter purpurascens Listeri, in latum oblique expansus vertice obtuso* Klein, 1753: 144 [rejected work].
- ? *Blasenarrige Herz* Knorr, 1772: 15, pl. 7, fig. 6; also as *Coeur enflé* in Knorr, 1773 and *Blaasagtig Hart* in Knorr, 1775 [rejected work].
- ? *Cardium soleniforme* "Bosc".—Schumacher, 1817: 159.
- ? *Cardium bullatum* (Linnaeus).—d'Orbigny, 1842: 337; Hanley, 1843: 130–131; Potiez and Michaud, 1844: 184–185; Conrad, 1846: 393; Beau, 1853:415; Carpenter, 1857: 364.
- ? *Fulvia bullata* (Linnaeus).—Adams and Adams, 1858: 457.
- ? *Cardium spinosum* Meuschen.—Krebs, 1864: 116; Krebs in Clench *et al.*, 1947: 29.
- ? *Cardium bullatum* "Lamarck".—Schramm, 1869: 21; Bordaz, 1899: 182.
- ? *Papyridea bullata* (Linnaeus).—Tryon, 1872: 267; Dall, 1889: 54; Marche-Marchad, 1958: 50.
- ? *Papyridea soleniforme* (Bruguière).—Tryon, 1872: 26; Olsson and McGinty, 1958: 21; Vokes, 1977: 164–165, 168.
- ? *Papyridea spinosum* (Meuschen).—Tryon, 1872: 26; Johnson, 1934: 46; McLean, 1936: 118.
- ? *Cardium (Papyridea) bullatum* "((Linn.?) Chemnitz)".—Smith, 1885: 161–162.
- ? *Cardium (Papyridea) spinosum* (Meuschen).—Arango, 1887: 259; Dall, 1900a: 387; "M.B.W." 1901: 9–10.
- ? *Cardium aff. papyraceum* "Chemnitz".—Lorié, 1887: 125.
- ? *Cardium (Papyridea) bullatum* (Linné).—Smith, 1890: 302–303; Dautzenberg, 1900: 245.
- ? *Cardium (Fulvia) bullatum* (Linné).—Cockerell, 1894: 105.
- ? *Cardium (Fulvia) apertum*.—Cockerell, 1894: 105 [*non* Chemnitz, 1782 (*non*-binominal), *nec* Lightfoot, 1786 (*nomen nudum*), *nec* Bruguière, 1789, *nec* Bosc, 1801].
- ? *Cardium spinosum* (Meuschen).—Anonymous, 1901: 106.
- ? *Cardium (Papyridea) spinosum* (Meuschen).—Dall and Simpson, 1902: 489.
- ? *Papyridea soleniformis* (Bruguière).—Tomlin and Shackelford, 1915: 273; Parker, 1956: 309; Parker and Curray, 1956: 2434; Nowell-Usticke, 1959: 13; Olsson, 1961: 250; Arnow, St. Clair and Arnow, 1963: 170; Matthews and Rios, 1967: 118; Kempf and Matthews, 1968: 90; de Jong and Kristensen, 1968: 23; Rios and Oleiro, 1968: 22–23; Hoerle, 1970: 58 [Lower Pleistocene]; Rosewater, 1975: 33–34; Treece, 1980: 565; Turgeon *et al.*, 1988: 39; Turgeon *et al.*, 1998: 42.
- ? *Papyridea spinosa* (Meuschen).—Clench and McClean, 1937: 39; Morretes, 1949: 34.
- ? *Papyridea hiatus* (Meuschen).—Aguayo and Jaume, 1947: No. 21; Poirier, 1952: 28; Morretes, 1954: 41; Coomans, 1963: 170.
- ? *Papyridea spinosum* (Meuschen).—Baker, 1950: 124.
- ? *Papyridea (Papyridea) spinosum*.—Haas, 1953: 203.
- ? *Papyridae [sic] soleniformis* (Bruguière).—Porter and Wolfe, 1971: 100.

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