OBSERVATIONS ON THE SYSTEMATICS AND BIOLOGY OF A TURRID GASTROPOD ASSEMBLAGE IN THE BRITISH VIRGIN ISLANDS

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OBSERVATIONS ON THE SYSTEMATICS AND BIOLOGY OF A TURRID GASTROPOD ASSEMBLAGE IN THE BRITISH VIRGIN ISLANDS

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ABSTRACT

Eight species of Turridae (Gastropoda: Prosobranchia) were collected from the upper surfaces of calcareous rocks lying in 2–4 m of water on fine calcareous sand at White Bay, Guana Island, near Tortola, British Virgin Islands (18°28′N, 64°34′W). The species are *Drillia cydia* (Bartsch, 1943), *Strictispira paxillus* (Reeve, 1845), *Pyrgospira candace* (Dall, 1919), *Buchema interstrigata* (E. A. Smith, 1882), *Crassispira apicata* (Reeve, 1845), *C. pellisphocae* (Reeve, 1845), *Pilsbryspira albomaculata* (Orbigny, 1842) and *P. leucocyma* (Dall, 1883). Their systematic positions and partial synonymies are given. Shell, feeding-related, reproduction-related and miscellaneous soft-part characters are compared. Foods, as analyzed from gut contents, of seven of the eight species from this microhabitat are recorded.

Strictispira and *Crassispira* have rather similar shells, but their foreguts are dissimilar. Radulae of different sizes and shapes are used to capture the same polychaete prey by three species.

A little-known ninth species, *Fenimorea culexensis* Nowell-Usticke, 1969, appears to replace *Drillia cydia* in a rather similar habitat in nearby Muskmelon Bay, Guana Island. Both these species appear to feed on Sipunculoidea. *Fenimorea culexensis* is figured and discussed but it is not included in the comparisons within the White Bay assemblage.

The Turridae (Gastropoda: Conacea) are the largest family in the phylum Mollusca. In the past, systematics of the family has been based largely upon shell characters. However, research on all Conacea has shown that the major adaptation of the superfamily is on feeding mechanisms (Endean and Rudkin, 1965, Kohn, 1966 on Conidae; Rudman, 1969 and Miller, 1980 on Terebridae; Smith, 1967a and Shimek and Kohn, 1981 on Turridae). Therefore, the systematist should consider feeding-related as well as other more conservative characters when dealing with the confused and confusing Turridae.

McLean (1971a) has shown that there are disparate radulae in some Turridae with rather similar shells and he based his revision of the systematics of the turrids in part on radular characters. But the question arises: are these shells ecophenotypes of rather distantly related species or are the different radulae the response of closely related animals to different diets?

Little is known of the composition of turrid assemblages. Animals that habitually occupy the exposed surface of a rock are subjected to different constraints than those living a few centimeters away in the shelter of the underside of that rock. Little is known of turrid diets. Until more data are accumulated, the systematics of the Turridae will continue to be confused by unrecognized convergences.

The limited material studied at Guana Island includes eight species from five turrid subfamilies. Three species from two subfamilies with differently shaped radular teeth feed upon the same species of polychaete worm. The names of five species of the assemblage are not commonly seen in lists of Caribbean mollusks. The assemblage includes: *Drillia cydia* (Bartsch, 1943), *Strictispira paxillus* (Reeve, 1845), *Pyrgospira candace* (Dall, 1919), *Buchema interstrigata* (E. A. Smith, 1882), *Crassispira apicata* (Reeve, 1845), *C. pellisphoacae* (Reeve, 1845), *Pilsbryspira*

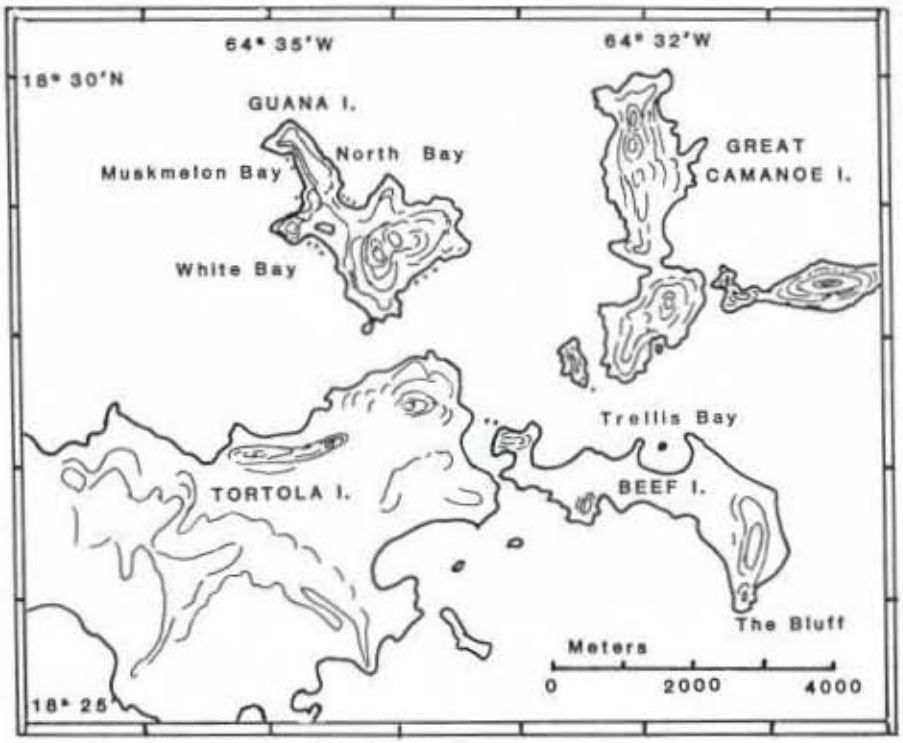


Figure 1. Map of Guana Island, British Virgin Islands, and environs.

albomaculata (Orbigny, 1842) and *P. leucocyma* (Dall, 1883). *Fenimorea culexensis* Nowell-Usticke, 1969, was not found in White Bay but appeared to replace *Drillia cydia* in nearby Muskmelon Bay where it was found in a rather similar habitat with other members of the assemblage. It is discussed and figured here because it is poorly known but it is not included in the comparisons of members of the White Bay assemblage.

Habitat

The assemblage considered here came from shallow water in White Bay, Guana Island near Tortola, British Virgin Islands, 18°28′24″N, 64°34′30″W (Fig. 1). Various combinations of the eight species were found on the upper surfaces of scattered slabs of rather flat coral rock. Most rocks were partially buried in soft sand and did not present suitable molluscan habitats except on their upper surface. The slabs lay between and outside patches of live coral in depths of 2–4 m. The slabs varied in size and shape but were usually about 0.5–1 m^2. All were drifted with 1–2 cm of fine white sand (56–92% passed through a 0.5-mm screen). Some slabs had a thin turf of filamentous algae growing through the sand.

White Bay is sheltered from heavy surf by Tortola Island but periods of ground swell, which are fairly frequent during December–March, create a strong surge over the slabs and cloud the water with shifting sediment. Water temperatures ranged from 26°–28°C during the months of February 1973–1979 and April 1979, when these studies were made.

Various combinations of the eight species were found together. Table 1 shows

Table 1. Turrid assemblage occurrences

Date (1973–79)	Depth in m	*D. cydia*	*S. paxillus*	*P. candace*	*B. interstrigata*	*C. apicata*	*C. pellisphocae*	*P. albomaculata*	*P. leucocyma*	Other Carnivore Molluscs
10 Feb.	1.5–2	–	–	–	–	–	–	2	3	–
10 Feb.	1.5–2	–	–	–	–	–	–	–	1	*Engina* (1) *Dolicholatirus* (2)
10 Feb.	1.5–2	–	–	–	–	–	–	–	1	–
10 Feb.	2	2	–	–	1	–	–	–	–	–
10 Feb.	2	3	–	–	–	2	1	1	–	–
11 Feb.	2	–	–	1	–	–	–	–	–	–
11 Feb.	2	–	–	–	–	–	–	–	1	*Dolicholatirus* (2)
11 Feb.	2	–	–	–	–	–	–	1	–	*Nassarius* (1)
11 Feb.	2	–	–	–	–	–	2	1	–	–
11 Feb.	1–2	3	–	–	–	–	–	–	–	*Conus* (1)
13 Feb.	3–4	–	–	–	–	–	–	–	1	*Nassarius* (2)
15 Feb.	2–3	–	–	–	–	1	1	–	–	*Conus* (1)
15 Feb.	3	–	–	1	–	–	–	–	–	–
17 Feb.	1.5	1	–	–	–	–	–	–	–	–
17 Feb.	3	1	–	–	–	–	–	–	–	–
17 Feb.	2	–	–	–	–	–	–	1	–	*Engina* (1)
20 Feb.	1.5	–	1	–	–	–	–	–	–	*Leucozonia* (1)
21 Feb.	1.5	1	–	–	–	–	–	–	–	–
17 Apr.	2	5	1	1	–	1	–	1	–	*Nassarius* (3) *Dolicholatirus* (4) *Conus* (2)
18 Apr.	2	–	–	–	–	–	1	–	–	*Nassarius* (1)
19 Apr.	2	1	1	–	–	–		1	1	–
19 Apr.	2	2	–	–	–	–	1	–	–	–

some representative occurrences. *Drillia cydia* and the uncommon *Pyrgospira candace* were only found in this microhabitat at Guana Island. *Buchema interstrigata, Pilsbryspira albomaculata,* and *P. leucocyma* were most common on these sand-drifted slabs but were occasionally encountered elsewhere at Guana. *Strictispira paxillus, Crassispira apicata* and *C. pellisphocae* were equally common in shallower, rockier substrates such as North Bay and the reef sections of Muskmelon Bay.

Methods

Mollusks were handpicked or scraped from individual slabs of rock in the study area. Most Turridae were promptly transferred to 10% formalin in seawater buffered with $CaCO_4$. They were fixed for 24 h before preservation in 70% ethanol buffered with either $CaCO_4$ or borax. Substrate samples were scraped from some slabs occupied by the turrids and non-molluscan invertebrates were relaxed in 7% $MgCl_2$ before fixing and preserving as above.

Polychaetes from these substrate samples were identified by Dr. Tran Ngoc Loi, formerly of the Department of Limnology, Academy of Natural Sciences, Philadelphia. I compared setae from the turrid guts with setae from the identified material. Large, more-or-less complete polychaetes and sipunculids from the foreguts of turrids were preserved whole. Stomach and rectum contents of the turrids were scraped onto micro-slides and mounted in Aquamount[1] (Gurr) directly from water.

Some of the turrids were kept alive for up to 3 months for unsuccessful feeding experiments. Dissections were made of living as well as preserved material. Serial sections of all the species except *Pyrgospira candace* were made of material relaxed in $MgCl_2$, fixed in Bouins and stained with standard hematoxylin and eosin.

The measurements included in Tables 2–9 were taken from sexually mature specimens as determined by the development of the capsule or prostate gland. A few of these individuals did not have a thickened

[1] Registered trademark.

Table 2. Turrid assemblage shell characters. N = number of individuals measured, $\bar{x}$ = mean ± one standard deviation. Lower line is observed range. Ratios of aperture area to total area and operculum area to aperture area are expressed as percent. See Figure 2 for dimensions measured

Species	Length (mm)	No. Whorls	Aperture/ Total Area	Operculum/ Aperture	Spire Angle
Drillia cydia	N = 13 $\bar{x}$ = 15.1 ± 1.9 11.1–18.2	N = 13 $\bar{x}$ = 7.7 ± 2.7 7–8.3	N = 11 $\bar{x}$ = 19 ± 1.2 16–20	N = 11 $\bar{x}$ = 43 ± 2.6 38–47	N = 11 $\bar{x}$ = 29 ± 1.1 28–31
Strictispira paxillus	N = 8 $\bar{x}$ = 10.8 ± 1.5 9.1–13.6	N = 8 $\bar{x}$ = 7.2 ± 1.1 7.5–8	N = 8 $\bar{x}$ = 17 ± 1.1 15–18	N = 7 $\bar{x}$ = 51 ± 6.6 42–62	N = 7 $\bar{x}$ = 39 ± 1.5 37–41
Pyrgospira candace	N = 5 $\bar{x}$ = 7.7 ± 1.9 5.7–10.4	N = 5 $\bar{x}$ = 7.5 ± 0.9 7–9	N = 5 $\bar{x}$ = 14 ± 2.6 10–16	N = 2 $\bar{x}$ = 54 ± 2.8 52–56	N = 5 $\bar{x}$ = 30 ± 2.9 28–34
Buchema interstrigata	N = 9 $\bar{x}$ = 9.8 ± 0.9 8.8–11.1	N = 9 $\bar{x}$ = 6.6 ± 1.1 7–7.3	N = 7 $\bar{x}$ = 15.7 ± 0.8 15–17	N = 6 $\bar{x}$ = 52 ± 4.7 46–59	N = 5 $\bar{x}$ = 36 ± 3.9 31–41
Crassispira apicata	N = 9 $\bar{x}$ = 15.9 ± 1.1 14.5–18.1	N = 11 $\bar{x}$ = 8.6 ± 0.6 8.5–9.3	N = 11 $\bar{x}$ = 17 ± 2.0 15–21	N = 10 $\bar{x}$ = 47 ± 5.7 39–57	N = 11 $\bar{x}$ = 29 ± 2.3 26–34
C. pellisphocae	N = 10 $\bar{x}$ = 7.6 ± 0.4 6.9–8.1	N = 9 $\bar{x}$ = 7.4 ± 0.6 6–8.3	N = 10 $\bar{x}$ = 16 ± 1.9 14–20	N = 9 $\bar{x}$ = 56 ± 5.0 48–64	N = 10 $\bar{x}$ = 32 ± 2.9 27–37
Pilsbryspira albomaculata	N = 11 $\bar{x}$ = 8.9 ± 1.9 7.6–13.3	N = 19 $\bar{x}$ = 6.9 ± 1.0 6–9	N = 11 $\bar{x}$ = 14 ± 1.9 12–18	N = 9 $\bar{x}$ = 58 ± 8.7 46–72	N = 11 $\bar{x}$ = 34 ± 3.7 27–39
P. leucocyma	N = 15 $\bar{x}$ = 11 ± 0.9 9.6–13.2	N = 15 $\bar{x}$ = 7.6 ± 1.1 6–9	N = 15 $\bar{x}$ = 15 ± 0.4 15–16	N = 15 $\bar{x}$ = 53 ± 3.1 48–59	N = 15 $\bar{x}$ = 31 ± 4.0 26–40

shell lip. The dimensions measured are shown in Figure 2. Measurements were calculated from camera lucida projections made with a Wild dissecting microscope on 0.1-inch quadrille-paper. Measurements of area were made by counting the number of quadrille units contained within the shell's outline, 0.5 or more of a unit counted as 1. In linear determinations 0.25 or more counted as 0.5. The size of the quadrille unit at the given magnification was calculated with a stage micrometer.

Shell and soft parts were measured at 12× magnification except for the width of the cerebral ganglia and the length of the major marginal tooth. The cerebral ganglia were measured at 50× and the length of the tooth was measured with an ocular micrometer on a compound microscope at 430×. Soft part measurements were made of preserved material dissected out and pinned as flat and similarly oriented as possible.

Radulae were cleaned with commercial grade sodium hypochlorite (5.25%) rinsed and mounted directly from water in Aquamount[1]. They were not stained.

The following abbreviations are used in this paper: AMNH—American Museum of Natural History, ANSP—Academy of Natural Sciences of Philadelphia, BMNH—British Museum (Natural History), USNM—United States National Museum, ab—albumin, ag—anal gland, al—albumin gland, an—anus, as—anterior sperm sac, ba—base of egg capsule, bc—buccal cavity, bm—buccal mass, ca—caecum of stomach, cp—capsule gland, ct—ctenidium, dd—duct of the digestive gland, dp—duct of the poison gland, ds—duct of the salivary gland, ea—escape aperture, eg—egg, gp—gonopore, in—intestine, mb—muscular bulb, mc—muscular chamber, nr—nerve ring, od—odontophore, oe—oesophagus, or—odontophoral retractor muscle, os—osphradium, ot—oral tube, ov—ovary, ovd—oviduct, pb—proboscis, pc—polychaete, pe—penis, pg—poison gland, pr—prostate gland, rp—retractile papilla, rs—radula sac, rt—radula tooth, sg—salivary gland, sr—seminal receptacle, st—stomach, td—testis duct, te—testis and vd—vas deferens.

Systematics

The arrangement and nomenclature of this paper agree with those of McLean (1971a) with two exceptions. The subfamily Strictipirinae follows Clavinae here,

Table 3. Shell characters—2. Ratios of body whorl length to total length etc., are expressed as percent. See Figure 2 for dimensions measured

	Body Length	Body/Total Length	Width/Body Length	Major Axials	Major Spirals	Axials Predominant	Clathrate	Dark Predominant
Drillia cydia	N = 11 x̄ = 9.3 ± 1.5 6.5–12.8	N = 11 x̄ = 60 ± 2 58–63	N = 11 x̄ = 74 ± 3 70–79	N = 13 x̄ = 7.5 ± 1.5 5–10	none	+		–
Strictispira paxillus	N = 8 x̄ = 7.0 ± 1.1 5.8–9.0	N = 7 x̄ = 64 ± 2 61–66	N = 8 x̄ = 68 ± 2 65–71	N = 8 x̄ = 20.6 ± 1.4 20–23	N = 7 x̄ = 13.1 ± 1.4 12–16	+		+
Pyrgospira candace	N = 5 x̄ = 4.0 ± 0.9 3.2–5.3	N = 5 x̄ = 55 ± 2 51–60	N = 4 x̄ = 79 ± 2 77–80	N = 5 x̄ = 14 ± 3.5 12–17	N = 5 x̄ = 7.8 ± 0.7 7–9	+		+
Buchema interstrigata	N = 7 x̄ = 6.2 ± 0.5 5.6–6.7	N = 7 x̄ = 63 ± 4 58–68	N = 7 x̄ = 73 ± 2 69–77	N = 9 x̄ = 10.2 ± 1.0 9–12	N = 7 x̄ = 9.4 ± 1.3 8–11	+		–
Crassispira apicata	N = 11 x̄ = 9.6 ± 1.3 7.9–12.6	N = 11 x̄ = 60 ± 3 57–68	N = 11 x̄ = 64 ± 2 62–68	N = 11 x̄ = 20.4 ± 2.1 18–25	N = 11 x̄ = 12.8 ± 1.0 11–14	+		+
C. pellisphocae	N = 10 x̄ = 4.6 ± 0.3 4.1–5.2	N = 10 x̄ = 61 ± 3 58–66	N = 10 x̄ = 72 ± 4 66–78	N = 9 x̄ = 25.7 ± 4.1 18–30	N = 9 x̄ = 12.1 ± 1.5 9–14		+	+
Pilsbryspira albomaculata	N = 11 x̄ = 4.2 ± 0.7 3.5–5.7	N = 11 x̄ = 61 ± 3 56–65	N = 11 x̄ = 79 ± 4 75–87	N = 24 x̄ = 8.9 ± 0.9 7–10	N = 11 x̄ = 8.4 ± 1.1 7–10	+		+
P. leucocyma	N = 15 x̄ = 6.6 ± 0.6 5.5–7.6	N = 15 x̄ = 60 ± 3 56–67	N = 15 x̄ = 70 ± 2 65–73	N = 15 x̄ = 10.6 ± 0.9 9–12	N = 15 x̄ = 8.8 ± 0.5 8–10	+		+

Table 4. Area of shell expressed in mm² (see Fig. 2)

	No.	x̄ Area (mm²)	*paxillus*	*candace*	*inter-strigata*	*apicata*	*pellis-phocae*	*alboma-culata*	*leuco-cyma*
Clavinae									
Drillia cydia	11	57 ± 14.4	+++	+++	+++	n.s.	+++	+++	+++
Strictispirinae									
Strictispira paxillus	8	28 ± 4.6		+++	n.s.	+++	+++	n.s.	n.s.
Cochlespirinae									
Pyrogospira candace	5	15 ± 6.1			+++	+++	n.s.	+	+++
Crassispirinae									
Buchema interstrigata	7	29 ± 3.7				+++	+++	n.s.	n.s.
Crassispira apicata	11	55 ± 10.8					+++	+++	+++
C. pellisphocae	10	16 ± 1.7						++	+++
Zonulispirinae									
Pilsbryspira albomaculata	11	24 ± 10.2							n.s.
P. leucocyma	15	30 ± 5.2							

+++ = .01%, ++ = .02%, + = .057% chance of random probability, n.s. = no significant difference.

not Crassispirinae where McLean placed it because of similar shell shape. I have done this because the foregut of Strictispirinae has evolved tangentially from the primitive clavinid form by the loss of the poison gland and muscular bulb and the lack of an oral tube anterior to the buccal mass. I believe that the similar shells are the result of convergence. Crassispirine-shaped shells are also found in the subfamilies Cochlespirinae and Zonulispirinae.

The second exception is a nomenclatural one. Cochlespirinae replaces Turriculinae because the latter subfamily name was based on the non-molluscan genus *Turricula* Fabricius, 1823 not *Turricula* Schumacher, 1817, as shown by Cernohorsky, 1972.

Subfamily CLAVINAE Powell, 1942

The subfamily is used here as McLean restricted it to those taxa with a radula formula 1.1.1.1.1.

Table 5. Shell size of males and females (expressed as area of shell outline in mm²; see Fig. 2)

Species	♂	No.	♀	No.	
Drillia cydia	x̄ = 40 ± 4.2 35–43	3	x̄ = 68 ± 5.8 58–76	7	+++
Strictispira paxillus	x̄ = 25 ± 1.0 24–26	3 1	x̄ = 30 ± 4.7 24–35	5 1	+
Pyrgospira candace	x̄ = 8		x̄ = 25		–
Buchema interstrigata	x̄ = 26 ± 2.2 24–27	2	x̄ = 30 ± 3.6 26–34	5	n.s.
Crassispira apicata	x̄ = 62 ± 9.0 53–71	3	x̄ = 63 ± 11.8 53–76	3	n.s.
C. pellisphocae	x̄ = 15 ± 2.1 13–17	4	x̄ = 17 ± 1.1 16–19	6	n.s.
Pilsbryspira albomaculata	x̄ = 20 ± 7.0 16–36	7	x̄ = 34 ± 8.5 26–48	4	++
P. leucocyma	x̄ = 26 ± 1.6 23–30	7	x̄ = 32 ± 4.6 23–41	11	+++

Table 6. Feeding- and reproductive-related characters

	Feeding-related characters									Reproductive-related characters					
	Oral tube Muscular bulb & poison gland	Salivary gland (small)	Central tooth	Lateral tooth	Teeth (No. rows)	Length major marginal tooth (µm)	Tooth length / Shell area (%)	Tubular stomach	First whorl diameter (µm)	No. protoconch whorls	Penis (long, round)	Penis opening retractible pap.	Vas deferens (convolute)	Anterior sperm sac present	Albumin gland (lining ciliate)
CLAVINAE															
Drillia cydia	+ +	-	+	+	X̄=36±2(7) 32-37	X̄=309±46(9) 240-380	X̄=0.53±.06(8) 0.46-0.62	-	X̄=691±38(17) 650-750	X̄=2.0±0.1(15) 1.9-2.3	-	-	-	+	+
STRICTISPIRINAE															
Strictispira paxillus	- -	+	-	-	X̄=78±11(6) 66-94	X̄=146±13(8) 130-170	X̄=0.52±.04(8) 0.45-0.58	+	X̄=553±21(15) 525-600	X̄=2.1±0.1(14) 1.9-2.3	+	+	-	-	-
COCHLESPIRINAE															
Pyrgospira candace	+ +	-	-	-	no data	X̄=71 (2) 70-72	X̄=0.59 (2) 0.29-0.88	+	X̄=450 (1)	X̄=2.1 (1)	+	-	-	n.d.	n.d.
CRASSISPIRINAE															
Buchema interstrigata	+ +	+	-	-	X̄=45±3(4) 43-48	X̄=104±8(7) 90-110	X̄=0.37±.04 0.34-0.46	+	X̄=558±42(12) 500-625	X̄=1.9±0.1(12) 1.9-2.1	+	+	-	n.d.	+
Crassispira apicata	+ +	+	-	+	X̄=50±7(8) 41-63	X̄=110±16(9) 90-130	X̄=0.21±.03(9) 0.18-0.27	+	X̄=600±23(8) 550-625	X̄=2.1±0.1(8) 2.0-2.3	+	+	+	n.d.	n.d.
C. pellisphocae	+ +	+	-	-	X̄=61±6(7) 52-67	X̄=91±8(8) 70-100	X̄=0.54±.06(8) 0.45-0.65	+	X̄=530±38(23) 450-600	X̄=1.5±0.1 1.4-1.8	+	+	-	+	n.d.
ZONULISPIRINAE															
Pilsbryspira albomaculata	+ +	+	-	-	X̄=47±8(8) 31-53	X̄=130±16(11) 110-170	X̄=0.57±.13(11) 0.34-0.71	+	X̄=549±35(18) 500-600	X̄=2.1±0.1(18) 1.9-2.3	+	+	-	+	+
P. leucocyma	+ +	+	-	-	X̄=42±6(11) 30-50	X̄=145±16(13) 120-180	X̄=0.48±.07(13) 0.42-0.63	+	X̄=483±31(16) 425-500	X̄=1.9±0.1(15)	+	+	-	n.d.	n.d.

Table 7. Length of major marginal tooth (to left and below diagonal*) and marginal tooth length/area of shell (above diagonal†)

	cydia x̄ = 0.53 ± 0.06 (8)	*paxillus* x̄ = 0.52 ± 0.04 (8)	*candace* x̄ = 0.59 (2)	*inter-strigata* x̄ = 0.37 ± 0.04 (7)	*apicata* x̄ = 0.21 ± 0.03 (9)	*pellis-phocae* x̄ = 0.54 ± 0.06 (8)	*alboma-culata* x̄ = 0.57 ± 0.13 (11)	*leucocyma* x̄ = 0.48 ± 0.07 (13)
Clavinae								
Drillia cydia x̄ = 309 ± 46 (9)		n.s.	n.s.	+++	+++	n.s.	n.s.	n.s.
Strictispirinae								
Strictispira paxillus x̄ = 146 ± 13 (8)	+++		n.s.	+++	+++	n.s.	n.s.	n.s.
Cochlespirinae								
Pyrgospira candace x̄ = 71 (2)	+++	+++		+	+++	n.s.	n.s.	n.s.
Crassispirinae								
Buchema interstrigata E,P x̄ = 104 ± 8 (7)	+++	+++	+++		+++	+++	+++	+++
Crassispira apicata x̄ = 110 ± 16 (9)	+++	+++	+++	n.s.		+++	+++	+++
C. pellisphocae P x̄ = 91 ± 8 (8)	+++	+++	+++	+++	+++		n.s.	n.s.
Zonulispirinae								
Pilsbryspira albo-maculata E,P x̄ = 130 ± 16 (11) E,P	+++	n.s.	+++	+++	+++	+++		+
P. leucocyma x̄ = 145 ± 16 (13)	+++	n.s.	+++	+++	+++	+++	n.s.	

* x̄ = mean expressed as μm.
† x̄ = mean expressed as %.
E = feeds on *Eunice kinbergi*; P = feeds on *Perinereis anderssoni*.

Genus *Drillia* Gray, 1838

Type Species.—*Drillia umbilicata* Gray, 1838

Drillia (*Drillia*) *cydia* (Bartsch, 1943)
Figures 7, 8, 19, 28, and 35

Neodrillia cydia Bartsch, 1943: 84, pl. 7, fig. 6, pl. 10, fig. 3; pl. 14, fig. 1. Holotype USNM 411099, 15.5 mm. From off Fowey Light, Florida.

N. antiguensis Bartsch, 1943: 88, pl. 7, fig. 1; pl. 14, fig. 5. Holotype USNM 516298, 23 mm. From 6 fm., Falmouth, Antigua.

N. barbadensis Bartsch, 1943: 89, pl. 7, fig. 7; pl. 15, fig. 1. Holotype USNM 516302, 9.3 mm. From shallow water, Barbados.

N. encia Bartsch, 1943: 87, pl. 7, fig. 2; pl. 14, fig. 4. Holotype USNM 214261, 10.4 mm. From beach at St. Thomas.

"*Neodrilla euphanes* Melvill" Bartsch, 1943: 86, pl. 7, fig. 4; pl. 14, fig. 2. Voucher specimen USNM 411101, from 100–150 fm., Ensenda de Cochinos, Cuba. This misidentification is *Drillia cydia*, not Melvill's poorly figured crassispirine species.

N. jamaicensis Bartsch, 1943: 86, pl. 7, fig. 8; pl. 14, fig. 3. Holotype USNM 103394, 11.6 mm. From Jamaica.

Drillia (*Neodrillia*) *cydia* Bartsch, Abbott, 1958: 96. The variability of the species is recognized and all of Bartsch's *Neodrillia* species are synonymized.

Neodrillia cydia Bartsch, Nowell-Usticke, 1959: 82. Uncommon north of Frederiksted, St. Croix.

Table 8. Miscellaneous characters

	Head Foot Dark	Foot Outline (rectangular)	Eyes on Distal ½ of Tentacle	Length Ctenidium* / Shell Area (%)	Length Osphradium / Shell Area (%)	Width Cerebral Ganglia / Shell area (%)
Clavinae						
Drillia cydia	–	+	–	$\bar{x}$ = 16 ± 6 (7) 9–24	$\bar{x}$ = 7 ± 3 (8) 3–13	$\bar{x}$ = 1.4 ± 0.4 (6) 1.0–2.0
Strictispirinae						
Strictispira paxillus	+	+	+	$\bar{x}$ = 20 ± 1 (7) 18–21	$\bar{x}$ = 12 ± 8 (7) 10–15	$\bar{x}$ = 2.1 ± 0.3 (5) 1.7–2.5
Cochlespirinae						
Pyrgospira candace	+	+	+	$\bar{x}$ = 27 (1)	$\bar{x}$ = 11 (1)	$\bar{x}$ = 1.9 (1)
Crassispirinae						
Buchema interstrigata	±	+	+	$\bar{x}$ = 18 ± 2 (7) 15–21	$\bar{x}$ = 10 ± 2 (7) 8–13	$\bar{x}$ = 2.2 ± 0.3 (7) 1.9–2.7
Crassispira apicata	+	+	+	$\bar{x}$ = 14 ± 2 (10) 11–16	$\bar{x}$ = 8 ± 1 (10) 6–10	$\bar{x}$ = 1.3 ± 0.2 (9) 1.1–1.7
C. pellisphocae	+	+	+	$\bar{x}$ = 29 ± 4 (8) 24–34	$\bar{x}$ = 15 ± 3 (9) 10–20	$\bar{x}$ = 3.2 ± 0.3 (8) 2.8–4.0
Zonulispirinae						
Pilsbryspira albomaculata	+	+	+	$\bar{x}$ = 23 ± 7 (7) 18–29	$\bar{x}$ = 13 ± 3 (11) 7–16	$\bar{x}$ = 2.6 ± 0.6 (11) 1.4–3.3
P. leucocyma	+	+	+	$\bar{x}$ = 18 ± 4 (11) 15–27	$\bar{x}$ = 10 ± 2 (14) 7–14	$\bar{x}$ = 2.0 ± 0.5 (11) 1.5–3.3

* See Figure 4.

Inodrillia ustickei Hayes in Nowell-Usticke, 1959: 82, pl. 4, fig. 12. Holotype AMNH 195463. From north of Frederiksted, St. Croix.

Drillia (*Neodrillia*) *cydia* Bartsch, 1943, Warmke and Abbott, 1961: 136, pl. 25, fig. s. From shallow dredgings, Mayagüez, Puerto Rico.

Neodrillia cydia Bartsch, 1943, Abbott, 1974: 271, fig. 3020. Depth range 1–70 fm.

Drillia cydia Bartsch, 1943, Humfrey, 1975: 183, pl. 22, fig. 8. Uncommon in Jamaica in about 25 ft., on and under rocks.

Neodrillia cydia Bartsch, Porter, 1975: 33. Frequently found in sea-star stomachs in shallow water, offshore North Carolina.

Range.—North Carolina throughout the eastern Caribbean.

The predominantly white shell, broad, rounded axial ribs and uniformly fine spiral sculpture distinguish *Drillia cydia* from other members of the assemblage.

This species appears to have been misidentified in early lists of the Caribbean fauna and probably appears as *Pleurotoma paria, P. fucata* or *P. augustae.* It is quite similar to *Drillia sinuosa* (Montagu, 1803) from St. Helena. Individual variants spotted or banded with light brown and a size sexual dimorphism are the causes of the numerous synonyms. Females of this and other species of the assemblage are larger than the males (Table 5).

The foot of *Drillia cydia* and of the other members of this assemblage is broad and rectangular in outline. Unlike the others, however, the foot and head are cream white without any sooty markings. There are traces of light chestnut on the eye pedicle and around the edge of the mantle.

Drillia cydia is functionally operculate as are all other members of the assemblage.

Table 9. Prey and potential prey species

Prey and Potential Prey Species	*D. cydia*	*S. paxillus*	*P. candace*	*B. interstrigata*	*C. apicata*	*C. pellisphocae*	*P. albomaculata*	*P. leucocyma*
Chrysopetalum occidentale Johnson, 1897	–	–	–	–	–	–	–	–
Typosyllis cf. *prolifera* (Krohn, 1852)	–	–	–	–	1	–	–	–
Odontosyllis sp.	–	–	–	–	–	–	–	–
Neanthes sp.	–	–	–	–	–	–	–	–
Nereis sp.	–	–	–	–	–	–	–	–
Perinereis anderssoni Kinberg, 1866	–	–	–	2	–	1	4	–
Eunice kinbergi Webster, 1884	–	–	–	3	–	–	2	–
Eunicid sp. A	–	–	–	1	–	–	–	–
Dorvilliae rubrovittatus (Grube, 1855)	–	–	–	–	–	–	–	–
Polycirrus sp.	–	–	–	–	–	–	–	3
Terebellidae sp. A	–	–	–	–	1	–	–	–
Terebellidae sp. B	–	–	–	–	–	–	–	1 *
Polychaete ?	–	–	–	–	–	–	–	1 *
Chone sp.	–	–	–	–	–	–	–	–
Polychaete sp. A	–	1	–	–	–	–	–	–
Polychaete sp. Aa	–	1	–	–	–	–	–	–
Polychaete sp. C	–	–	–	–	6	–	–	–
Polychaete sp. D	–	–	–	–	1	–	–	–
Polychaete sp. E	–	–	–	–	–	1	–	–
Polychaete sp. F	–	–	–	–	–	1	–	–
Sipunculoidea sp.	3							
Soft matter and detritus	4	1	–	1	2	–	3	1
Number of guts examined	8	9	0	7	12	8	12	15

* In foregut and rectum of same individual.

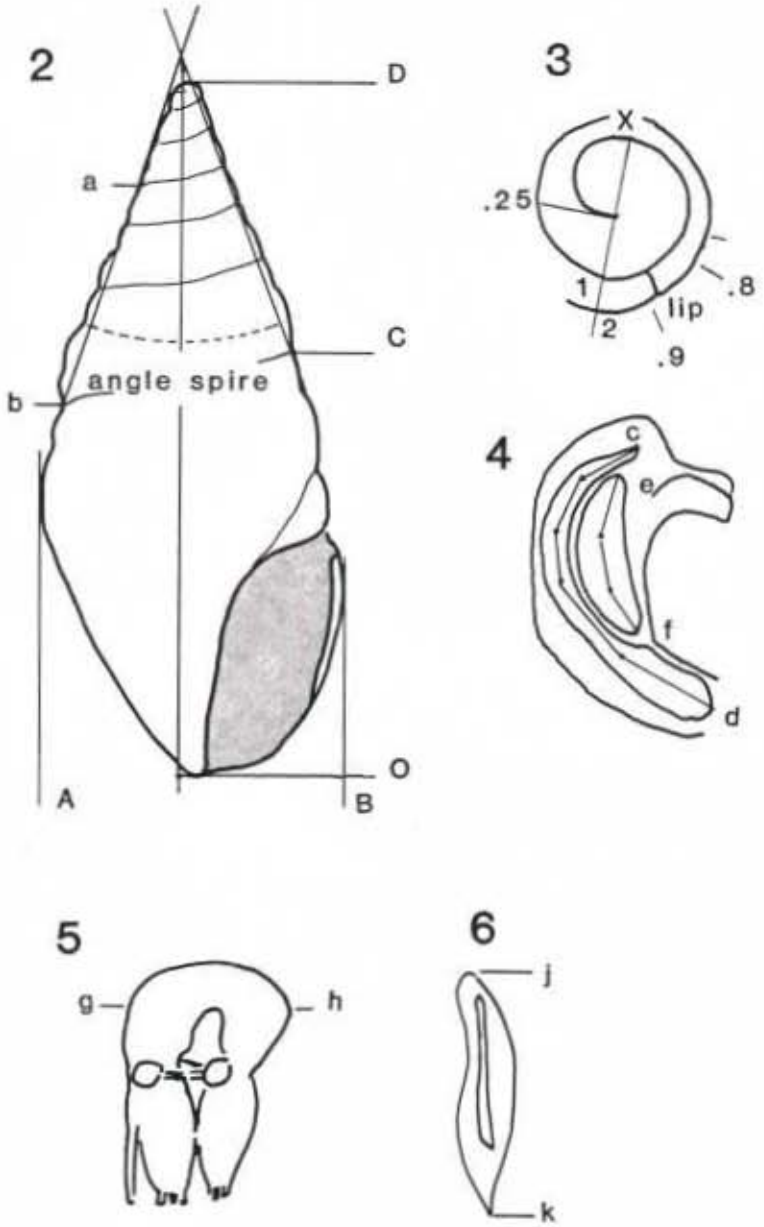
The radula (Figs. 28, 35) is broad, short and consists of rows of a narrow central tooth, arched, cusped laterals and long, solid marginal teeth. Intact prey in the posterior oesophagus of *Drillia cydia* indicate that the radula is used for gripping and/or pricking, not rasping or tearing.

Seven of eight specimens collected for gut content study contained food. Three contained unidentified sipunculids, two others contained matter that was possibly sipunculid and two others unidentified animal material. Only one contained a small bundle of polychaete setae which may have been adventitiously ingested with sipunculid prey. *Drillia cydia* is the only member of the assemblage to feed upon sipunculids. However another clavinid from nearby Muskmelon Bay, *Fenimorea culexensis*, also feeds on sipunculids.

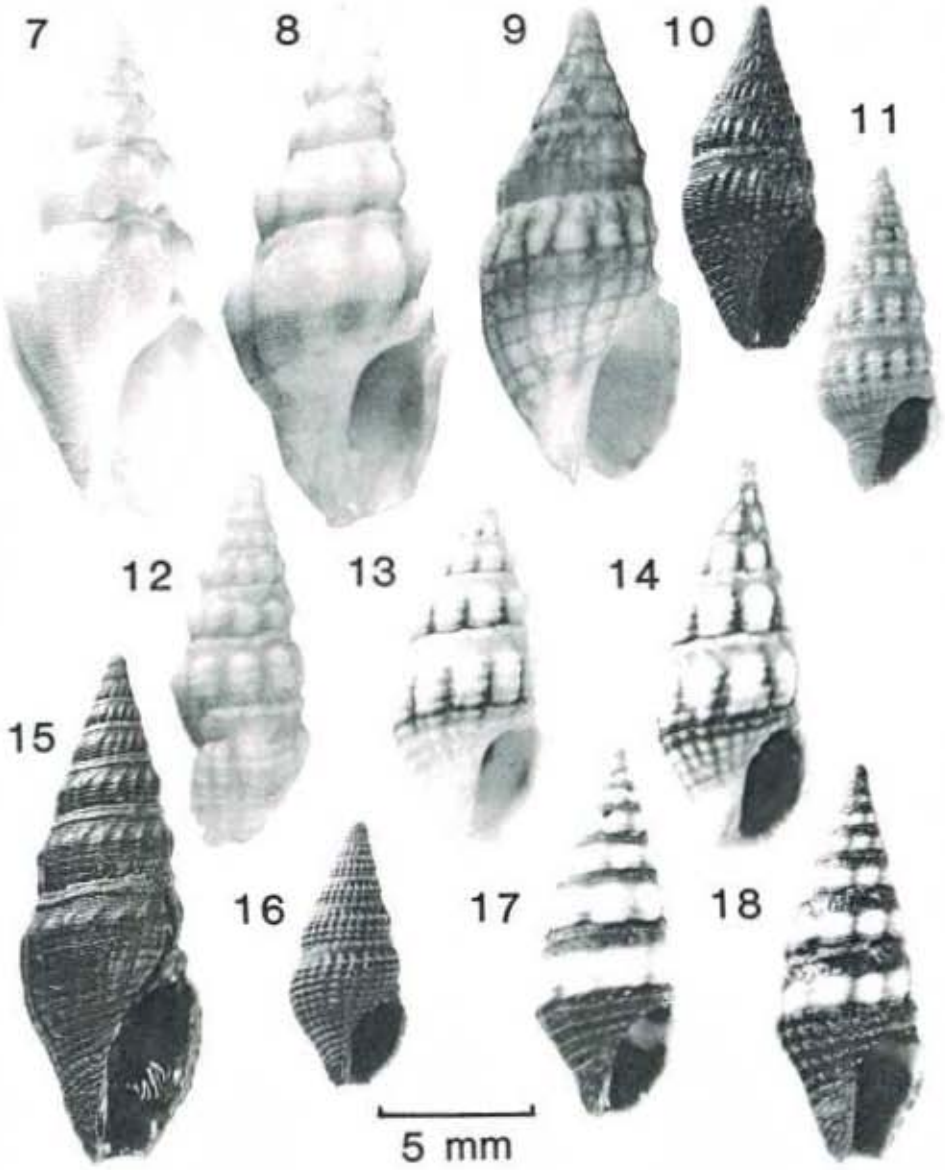
Drillia cydia had the largest first whorl diameter of the assemblage with a mean of 691 μm (Table 6). The large, smooth protoconch of about two whorls and simple ill-defined protoconch lip suggest full capsule development of the young (Fig. 19). Protoconchs of all the Guana Island specimens were abraded but protoconchs from deeper water at other localities are glassy.

Genus *Fenimorea* Bartsch, 1934

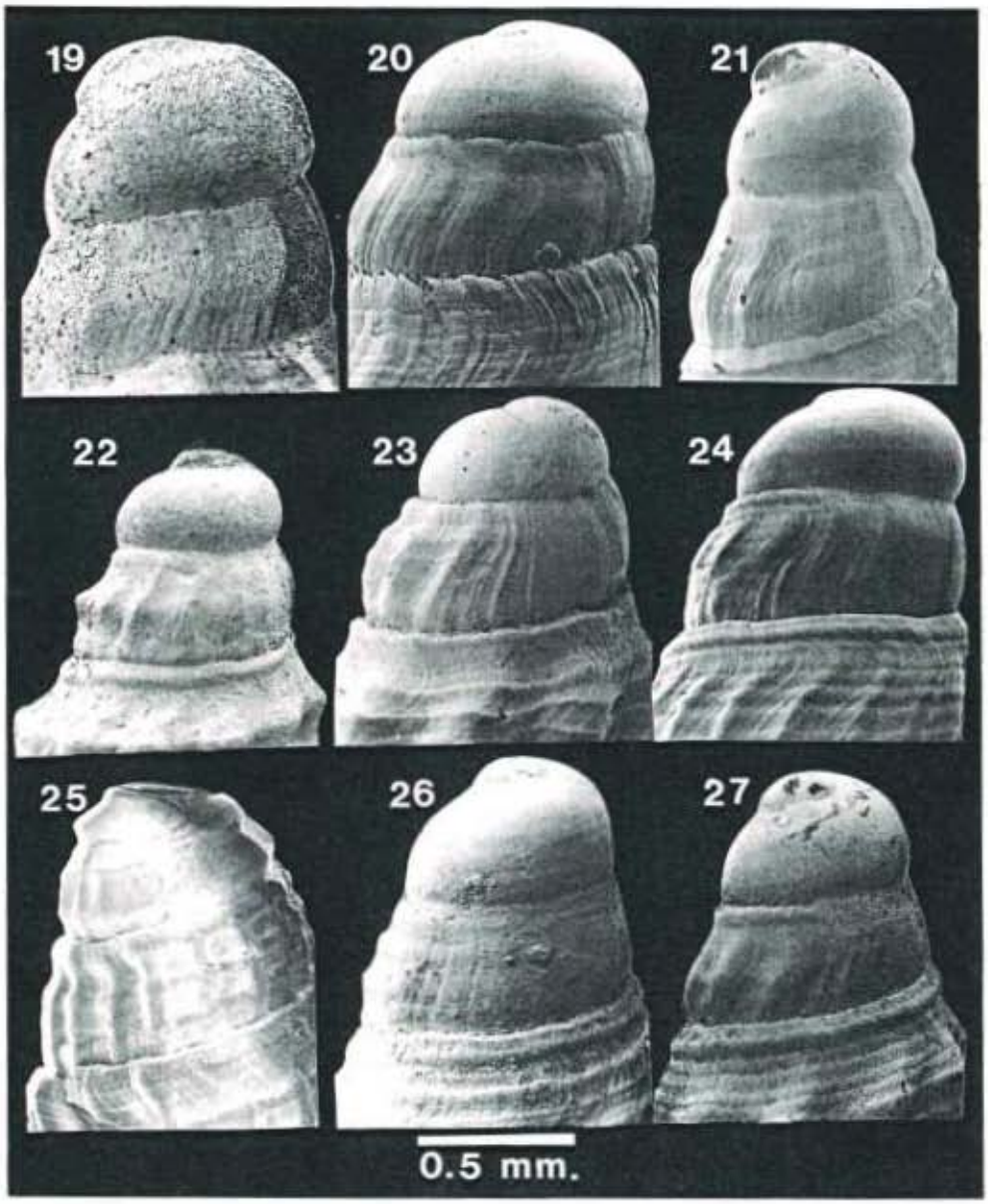
Type Species.—*Fenimorea janetae* Bartsch, 1934.



Figures 2–6. Dimensions measured: (2) Shell measurements: length = DO; total area is area enclosed by outline of shell; aperture area is shaded; angle of the spire is the angle between two lines extended from both ends of whorl suture a and body whorl suture b; body whorl length = CO; width = AB; (3) Protoconch measurements: diameter of the first whorl = X 1; number of whorls are counted along the extension of line X 1; (4) Ctenidium length is the sum of straight line lengths between c and d and osphradium length between e and f; (5) Width of the cerebral ganglia = gh; (6) Length of the major marginal radular tooth = jk.



Figures 7–18. Shells of British Virgin Island Turridae: (7 and 8) Color forms of *Drillia cydia*, ANSP 354998, from White Bay, Guana Island, 15.6 and 16.0 mm respectively; (9) *Fenimorea culexensis*, ANSP 355001, from Muskmelon Bay, Guana Island, 14.3 mm; (10) *Strictispira paxillus*, ANSP 342987, from White Bay, Guana Island; (11) *Pyrgospira candace*, ANSP 355003, from White Bay, Guana Island, 10.1 mm; (12 and 13) Color forms of *Buchema interstrigata*, ANSP 355005, from White Bay Guana Island, 10.9 and 11.4 mm respectively; (14) *Buchema interstrigata*, ANSP 350581, dark form from Trellis Bay, Beef Island, 12.2 mm; (15) *Crassispira apicata*, ANSP 355011, from White Bay, Guana Island, 16.0 mm; (16) *Crassispira pellisphocae*, ANSP 355013, from White Bay, Guana Island, 8.1 mm; (17) *Pilsbryspira albomaculata*, ANSP 355017, from White Bay Guana Island, 11.3 mm; (18) *Pilsbryspira leucocyma*, ANSP 355021, from White Bay, Guana Island, 11.9 mm. All figures to same scale.



Figures 19–27. Protoconchs of British Virgin Island Turridae: (19) *Drillia cydia*, ANSP 354998, White Bay, Guana Island; (20) *Fenimorea culexensis*, ANSP 355001, Muskmelon Bay, Guana Island; (21) *Strictispira paxillus*, ANSP 354997, White Bay, Guana Island; (22) *Pyrgospira candace*, ANSP 355003, White Bay, Guana Island; (23) *Buchema interstrigata*, ANSP 355005, White Bay, Guana Island; (24) *Crassispira apicata*, ANSP 355010, White Bay, Guana Island; (25) *Crassispira pellisphocae*, ANSP 355013, White Bay, Guana Island; (26) *Pilsbryspira albomaculata*, ANSP 355017, White Bay, Guana Island; (27) *Pilsbryspira leucocyma*, ANSP 355021, White Bay, Guana Island. All figures to same scale.

Fenimorea culexensis Nowell-Usticke, 1969
Figures 9 and 20

Fenimorea culexensis Nowell-Usticke, 1969: 28, fig. 1124. Holotype AMNH 195462. From Virgin Gorda, B.V.I. Although the type-locality reads "Mosquito Island," the label of the holotype and figured specimen reads "The Baths" which is near the opposite end of Virgin Gorda.

Range.—Puerto Rico and the Virgin Islands.

This species was not found in White Bay and is not considered a member of the assemblage. It is included in this section because it is little known and appears to replace *Drillia cydia* in Muskmelon Bay, Guana Island.

The basically white shell has varying amounts of chestnut lines and flames. Thin chestnut lines mark the lighter anterior half of the body whorl into regular squares. Axial sculpture is limited to weak folds. It is almost obsolete on some individuals. The angle of the spire is relatively wide: N = 11, $\bar{x}$ = 38 ± 2,35–40° (compare with Table 2). The body whorl is large and rounded. This character, the lack of strong axial sculpture and the pencilled squares distinguish this species from other Caribbean Turridae.

The head and foot are similar to those of *Drillia cydia* in shape and color. The radula is also rather similar but one side of the hardened tip of the major marginal extends more than half the length of the shaft. It extends about one-third its length in *Drillia cydia.*

One *Fenimorea* had sipunculid neck-hooks in its rectum. No polychaete setae were seen.

Protoconch characters indicate full capsule development of the young (Fig. 20). The first whorl diameter was greater than that of *Drillia cydia* N = 14, $\bar{x}$ = 732 μm, 700–750 μm).

Subfamily STRICTISPIRINAE McLean, 1971
Genus *Strictispira* McLean, 1971

Type Species.—*Crassispira ericana* Hertlein and Strong, 1951.

Shell similarities between these and some crassispirine species have caused much confusion. The restricted posterior sinus which McLean used to differentiate *Strictispira* from *Crassispira* is not always a good character. Some Caribbean *Crassispira* have restricted sinuses. The two groups are easily distinguished if soft parts are available. Strictipirinae lack a poison gland and muscular bulb, their solid, dagger-shaped radular teeth differ from the crassispirine "duplex" teeth (Figs. 29–32) and the thickly muscled foregut (Fig. 43) lacks an oral tube anterior to the buccal mass.

Strictispira paxillus (Reeve, 1845)
Figures 10, 21 and 29

Pleurotoma paxillus Reeve, 1845, pl. 31, fig. 285. Holotype BMNH 79.2.264, 9.0 mm. Described without locality but "West Indies" is on the label of the holotype.

Pleurotoma nigrescens (Gray MS) Reeve, 1845 (Nov.), not C. B. Adams, 1845 (Jan.), pl. 26, fig. 235. 2 syntypes BMNH 75.4.26.27, figured syntype 9.8 mm. From St. Vincent, West Indies.

Pleurotoma nigrescens Gray, Krebs, 1864: 10.

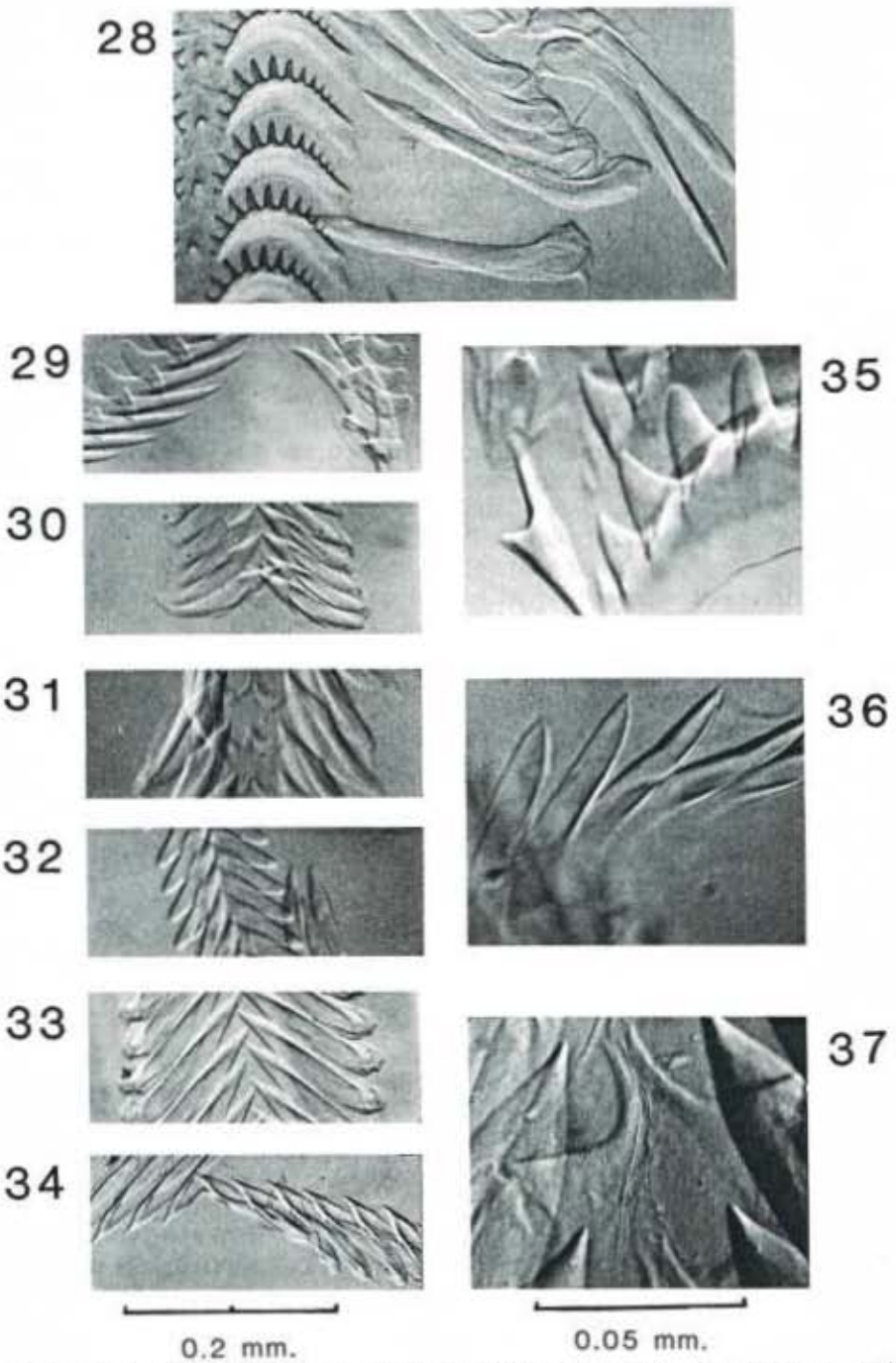
Pleurotoma paxillus Reeve, ibid.: 11. Synonymized in error with *P. fuscescens* and *P. harpula* but correctly with *P. nigrescens* "Gray."

Pleurotoma jamaicensis Guppy, 1866: 290, pl. 16, fig. 6. Holotype BMNH (Geology) 64066. From Jamaica Miocene.

Crassispira jamaicensis Guppy, 1866, Woodring, 1928: 149, pl. 4, fig. 8. Commonest "*Crassispira*" of the Bowden Formation, Jamaica.

"*Clathrodrilla solida* (C. B. Adams, 1830)," Rios, 1975: 130, pl. 39, fig. 583. A misidentification. The Brasilian shell figured is *S. paxillus.*

Range.—Cuba and the eastern Caribbean to Brasil.



Figures 28–37. Radulae of Guana Island Turridae: (28) *Drillia cydia*, ½ rows; (29) *Strictispira paxillus*; (30) *Buchema interstrigata*; (31) *Crassispira apicata*; (32) *C. pellisphocae*; (33) *Pilsbryspira albomaculata*; (34) *P. leucocyma*, scale bar refers to Figures 28–34; (35) *Drillia cydia*, enlarged profile of central tooth; (36) *Pyrgospira candace*, ½ rows; (37) *Crassispira apicata*, enlargement of 1 row of lateral teeth. Scale bar refers to Figures 35–37. Radular teeth of Figures 30, 32 and 33 are used on the same polychaete prey species.

The holotypes of *Strictispira paxillus* and *S. nigrescens* are the low- and high-spired forms, respectively, of a species in which spire height is individually variable. Guppy's *Pleurotoma jamaicensis* is the high-spired form and placed the species historically in the Caribbean Miocene or, as many believe, Pliocene (Robinson, 1967). Confusion of *Strictispira paxillus* with *S. solida* (C. B. Adams, 1850), *Crassispira apicata* and *C. fuscescens* makes literature records useless unless voucher specimens are available. Therefore, many records have not been included in the above synonymy.

Strictispira paxillus may be distinguished from these species by the combination of the following shell characters: rather wide spire angle ($\bar{x}$ = 39° (37–41°)); flat anal sinus scar; numerous axial ribs ($\bar{x}$ = 20.6 (19–23)) which reflect slightly at the anal sinus scar. Fresh shells are uniformly dark brown or black, intercostal areas are dark as the ribs.

The head and foot are dark, covered with sooty blotches and are similar to those of many crassispirine turrids. The muscular foregut, lacking a poison apparatus, will be discussed in a later part of this paper. It is significantly different from that of the crassispirine turrids.

The radula (Fig. 29) consists of solid awl-like teeth which protrude from the buccal mass like a pair of ice-tongs. No intact prey was found in the guts of *S. paxillus* suggesting a different mode of feeding in this group.

Nine individuals were preserved for gut content study. One contained setae from polychaete species A and one contained setae and tissue from polychaete species Aa. A third contained wads of soft tissue which might have been polychaete cirri in its foregut. Neither prey species was taken by other members of the assemblage.

The large, paucispiral brown protoconch suggest full capsule development of the young *Strictispira paxillus* (Fig. 21).

Subfamily COCHLESPIRINAE Powell, 1942

Genus *Pyrgospira* McLean, 1971

Type Species.—*Pleurotoma obeliscus* Reeve, 1843 not Desmoulin, 1842 = *Crassispira aenone* Dall, 1919.

Pyrgospira candace Dall, 1919

Figures 11, 22 and 36

"*Drillia cancellata* Gray," Krebs, 1864: 8. A misidentified single specimen given to R. Swift by Krebs (ANSP 15493) is *Pyrgospira candace*.

Crassispira candace Dall, 1919: 22, pl. 6, fig. 6. Holotype USNM 73929, 7.0 mm. From the Stearns collection, the label reads "Gulf of California."

Crassispira candace Dall, 1919, McLean in Keen, 1971: 907. Locality corrected to the Caribbean.

Range.—Eastern Caribbean.

The small size, pale gray-brown shell with a dark brown aperture, high spire and pinched anterior body whorl are diagnostic of this species. It is uncommon but may be fairly widespread in the Caribbean.

The head and foot are dark with sooty blotches, similar to those of crassispirine turrids, thickly distributed on a pale gray-white ground.

The solid, narrowly spatulate marginal teeth of the radula are firmly attached to the edge of the radular ribbon with tips opposing (Fig. 36). The teeth are the smallest of the assemblage but not proportionately smaller if shell size is considered.

None of the four specimens collected alive at Guana Island were preserved for gut content study.

The protoconchs of all specimens were in poor condition. However, they appear to have a fairly large first whorl diameter and suggest full capsule development of the young (Fig. 22).

Subfamily CRASSISPIRINAE Morrison, 1966
Buchema Corea, 1934

Type Species.—*Carinodrilla* (*Buchema*) *tainoa* Corea, 1934.

Buchema interstrigata (E. A. Smith, 1882)
Figures 12–14, 23 and 30

Pleurotoma (*Clavus*) *interstrigata* E. A. Smith, 1882: 208. Holotype (red dot with 2 syntypes) BMNH not registered, 11.2 mm. From St. Thomas, West Indies.

Pleurotoma (*Crassispira*) *caribbaea* E. A. Smith, 1882: 211, not Orbigny, 1842. Holotype BMNH 1964231, 10.8 mm. A beach-worn invalid syntype of *Pleurotoma albomaculata* Orbigny is a dark individual of this species.

"*Drillia interpleura* Dall and Simpson, 1901," Humfrey, 1975: 184, pl. 22, fig. 10. A misidentification. The figure is of *Buchema interstrigata*.

Range.—Puerto Rico, the eastern Caribbean to Brasil.

This species name does not appear in Caribbean faunal lists because of lack of illustration and brevity of the original description. It has been confused with *Buchema interpleura*. It may be distinguished from that species by its more robust form and coarser shell sculpture. The ribs of *Buchema interstrigata* are broadly rounded and subdued spiral threads are evenly distributed on the body whorl.

Shell color in this species is quite variable. Assemblage specimens varied from pure cream color to cream with interrib splashes of dark brown (the holotype's coloration). Specimens from nearby Trellis Bay, Beef Island, were darker brown while specimens taken from Gorda Sound, B.V.I. had interrib splashes of bright orange-brown. Some of this color fades in museum specimens.

The head and foot color is lighter than that of most crassispirine turrids because the blotches of dark pigment are more thinly distributed over the paler gray ground color.

The radular teeth are small proportionate to shell size (Fig. 30). The "duplex" marginal teeth are rather broad. There are no central or lateral teeth.

Seven animals were examined for gut content: three contained the polychaete *Eunice kinbergi*, two contained *Perinereis anderssoni* and one an unidentified eunicid species. *Pilsbryspira albomaculata* also feeds on *Eunice* and *Perinereis* and *Crassispira pellisphocae* feeds on *Perinereis*.

One specimen of *Buchema interstrigata* from White Bay had several parasitic flukes in its intestine (Fig. 52).

Protoconch characters indicate full capsule development of the young (Fig. 23).

Crassispira Swainson, 1840
Subgenus *Crassiclava* McLean, 1971

Type Species.—*Pleurotoma turricula* Sowerby, 1834.

This subgenus was erected for *Crassispira* species having what McLean believed to be a central radular tooth. He misinterpreted two unhardened lateral teeth (Fig. 37). The radula formula for this subgenus should be 1.1.0.1.1.

Crassispira (*Crassiclava*) *apicata* (Reeve, 1845)
Figures 15, 24, 31 and 37

Pleurotoma apicata (Gray MS) Reeve, 1845: pl. 33, fig. 305 (listed in error in the text as species 177). 3 syntypes, BMNH 1875.4.26.14. Only the figured shell is in good condition.

Range.—Puerto Rico and the eastern Caribbean to Venezuela and Brasil.

Reeve described this species without locality. The figured specimen is a rather rare light color form of one of the commonest crassispirines in the Caribbean. The species is frequently misidentified as *Strictispira solida* and *Crassispira fuscescens* and probably appears on most faunal lists under the latter name.

Mature *Crassispira apicata* are larger than the majority of *Strictispira* and have a higher, more acute spire than *S. paxillus*. The posterior sinus scar is flat and shallow in *C. apicata*, deeply concave in *S. solida* whose geographic distribution is allopatric. The same deep sinus scar separates *Crassispira fuscescens* from *C. apicata*. The former also has coarser, straighter axial ribs. However, young *C. apicata* shells are quite similar to young *Strictispira paxillus* with which they are often found.

All of the Guana Island *Crassispira apicata* had uniformly dark brown shells.

The head and foot of *Crassispira apicata* is similar in shape and color to *Strictispira* and the majority of crassispirine turrids.

The radula has short, firm duplex marginal teeth and soft lateral teeth (Figs. 31 and 37). It is very similar to the radula of *Crassispira turricula*, type-species of the subgenus.

Twelve animals were examined for gut contents. Nine of these contained polychaete remains of four different species and two contained unidentified soft matter. None of the prey species were included in the diets of other members of the assemblage.

The protoconch of *Crassispira apicata* suggests full capsule development of the young (Fig. 24).

Subgenus *Monilispira* Bartsch and Rehder, 1939

Type Species.—*Drillia monilifera* Carpenter, 1857.

Crassispira (*Monilispira*) *pellisphocae* (Reeve, 1845)
Figures 16, 25 and 32

Pleurotoma pellisphocae Reeve, 1845: pl. 29, fig. 263. Holotype BMNH 79.2.26.43, 9.1 mm. Described without locality and with a very misleading figure.

Pleurotoma cancellata (Gray MS) Reeve, 1846, not Eichwald, 1833, pl. 35, fig. 317. 2 syntypes BMNH 75.4.26.17, fig'd syntype 9.1 mm. From St. Vincent, W. Indies.

Pleurotoma pellisphocae Reeve, Krebs, 1864: 11. From St. Thomas, R. Swift: 2 specimens, ANSP 15558, from the Swift collection are correctly identified. "*P. cancellata*" was misidentified in the same paper (see *Pyrgospira candace*).

Lachesis pellisphocae Tryon, 1884: 225, pl. 27, fig. 3. The figure is moderately good.

Clathrodrillia limans Dall, 1919: 14, pl. 13, fig. 3. Holotype USNM 56218, 7.6 mm. The locality "Gulf of California" is erroneous. The worn holotype agrees with the Swift collection material from St. Thomas.

Pleurotoma pellisphocae Reeve, Tomlin, 1934: 39. The species was incorrectly placed in Buccinidae: *Chauvetia*.

Pleurotoma cancellata Reeve, Tomlin, 1934: 40. Correctly synonymized this species with *P. pellisphocae*.

Clathrodrillia limans Dall, 1919, McLean in Keen, 1971: 907. Rejected the Eastern Pacific locality.

Crassispira? sp. Gibson-Smith, 1972: 475. The species collected on the offshore Venezuelan Islands. Noted the diagnostic "keeled" protoconch.

Range.—Virgin Islands, Eastern Caribbean to Tobago and the Netherlands Antilles.

Crassispira pellisphocae usually has a dark brown shell, but the spiral cords, which vary individually in thickness, may be lighter. Sometimes the posterior half of the body whorl is light gray with the anterior half dark gray. However, all the Guana Island specimens are brown. Axial and spiral sculpture are of equal strength: a character that separates the species from all other members of the assemblage.

Crassispira pellisphocae is often confused with *C. nigrescens* (C. B. Adams, 1845) (not Reeve) but lacks the wide channeled posterior sinus scar. Its ridged protoconch (Fig. 25) has not previously been reported in Turridae. It is similar to that of the muricid genus *Risomurex*.

The head and foot of *Crassispira pellisphocae* are similar in shape and color to *C. apicata*.

The radula has short, broad duplex marginal teeth only (Fig. 32).

Three out of eight individuals studied contained three different species of polychaetes respectively. One worm, *Perinereis anderssoni*, which is common in the substrate samples, is also eaten by *Buchema interstrigata* and *Pilsbryspira albomaculata*. The other two unidentified polychaetes were not found in the guts of other members of the assemblage.

The protoconch of *Crassispira pellisphocae* suggests full capsule development of the young (Fig. 25).

Subfamily ZONULISPIRINAE McLean, 1971

The shells of many species in three of four zonulispirine genera *Compsodrillia*, *Pilsbryspira*, and *Ptychobela* resemble crassispirine genera *Carinodrilla*, *Crassispira* (*Monilispira*), and *Inquisitor* respectively with which they are frequently found. But the zonulispirine radula approaches the hollow, rolled shape of the typical toxoglossate tooth even though all teeth are attached to the radula ribbon and work over a small odontophoral cartilage within the buccal cavity (Figs. 45 and 53).

Genus *Pilsbryspira* Bartsch, 1950

Type Species.—*Pilsbryspira pilsbryi* Bartsch, 1950.

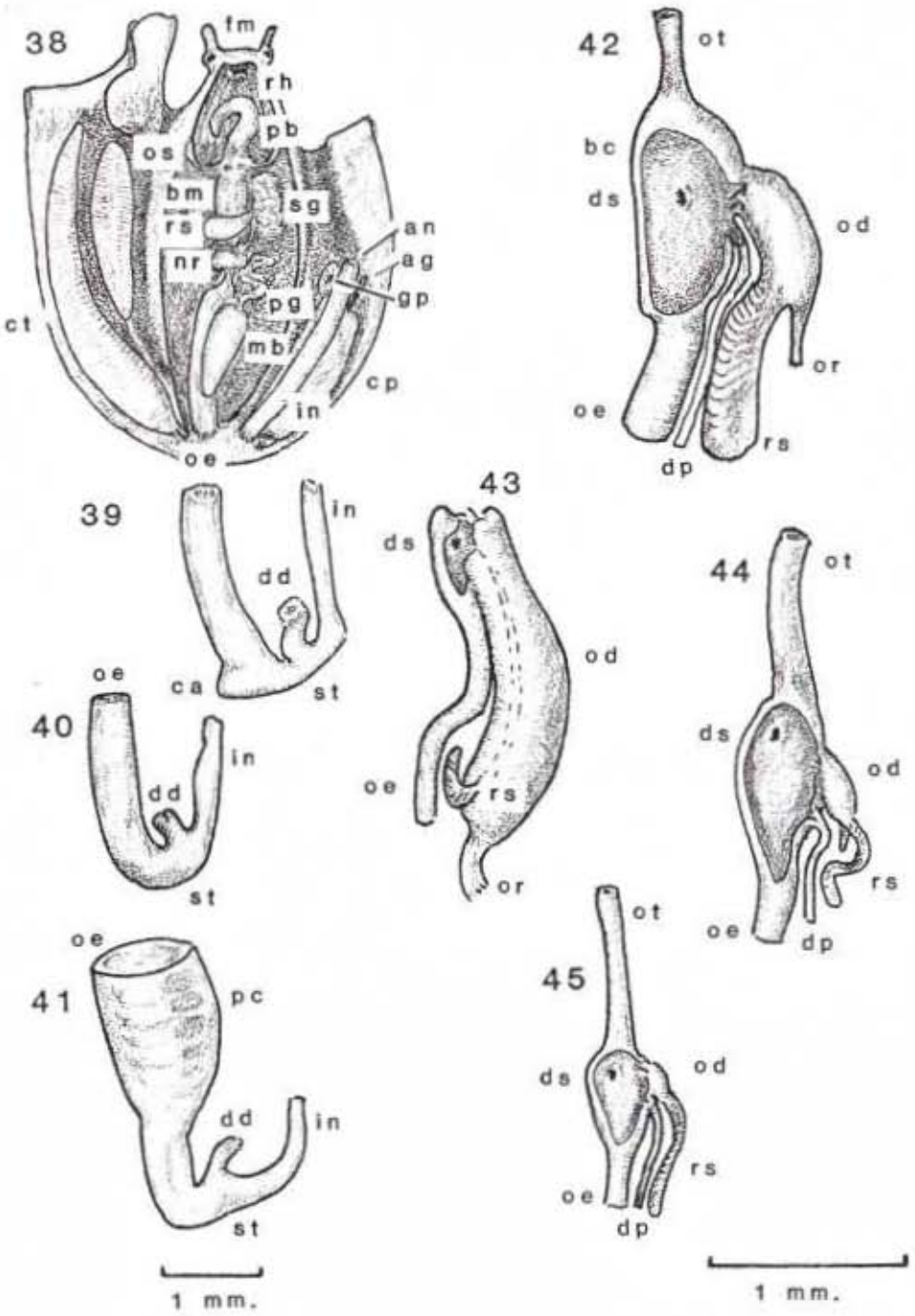
Bartsch and Rehder, 1939 erected a new genus *Monilispira* for a natural group that included their new species *M. monilis* as well as many common shallow water species from both the Caribbean and Panamic faunal provinces. Unfortunately, they chose *Crassispira monilifera* (Carpenter, 1856) as the type-species. McLean showed profound radula differences between the *M. monilis* and *M. monilifera* groups of turrids and resurrected the name *Pilsbryspira* for the former.

This genus was founded on a single specimen supposedly collected by Pilsbry in Panama in the Eastern Pacific, ANSP 153869. The species has not been collected in the Eastern Pacific since. McLean and I discussed the identity of *Pilsbryspira pilsbryi* and I identified it as the common Caribbean species *P. albomaculata* because I believed at the time *P. jayana* (C. B. Adams, 1850) was a junior synonym of the Orbigny species. I now think that the two species are distinct but that they are congeneric. McLean's usage of the name remains unchanged even though *Pilsbryspira pilsbryi* = *P. jayana* not *P. albomaculata*.

Pilsbryspira albomaculata (Orbigny, 1842)
Figures 17, 26 and 33

Pleurotoma albomaculata Orbigny, 1842, not C. B. Adams, 1845, pl. 24, figs. 16–18. Lectotype BMNH 1854.10.4.424, 10.5 mm.

Pleurotoma nodata C. B. Adams, 1850: 64. Holotype MCZ 186004.



Figures 38–45. Diagrams of the digestive system: (38) Mantle and cephalic cavities of *Drillia cydia* opened dorsally. Left salivary gland and poison gland have been pushed aside to show the nerve ring; (39) *Drillia cydia* stomach, dorsal view; (40) *Pilsbryspira leucocyma* stomach; (41) *Buchema interstrigata* stomach. Oesophageal pseudocrop is distended by a whole polychaete worm. Scale below Figure 41 refers to Figures 38–41; (42) *Drillia cydia* buccal mass from right. Buccal wall has been cut

Pleurotoma albomaculata Orbigny, Krebs, 1864: 7.
"*Pleurotoma albocincta* C. B. Adams," Krebs, 1864: 12. A lot from the Swift collection, presumably seen by Krebs, ANSP 58077, contained 3 commonly confused species including *P. albomaculata.*
"*Pleurotoma* (*Crassispira*) *ornata* D'Orbigny," Weinkauff in Martini and Chemnitz, 1876: 111, pl. 24, figs. 7, 8 only. Figs. 9a and 10 are unrecognizable.
Pleurotoma albopustulata E. A. Smith, 1882: 211. An unnecessary new name for *P. albomaculata* Orbigny.
Drillia albomaculata D'Orbigny non C. B. Adams, Tryon, 1884: 197, pl. 14, fig. 11. Incorrectly listed as a synonym of *Drillia zebra* Lamarck.
Drillia albomaculata Orbigny, Dall, 1890: 36. Range extended to the Pliocene of Florida. Noted that Recent specimens were found in "similar situations" as *P. leucocyma.*
Pleurotoma nodata C. B. Adams, 1850, Clench and Turner, 1950: 362, pl. 29, fig. 14. Holotype figured for the first time.

Range.—Florida to Guadeloupe.

Large white peripheral nodes, an absence of beads on the evenly spaced anterior spiral threads of the body whorl separate *Pilsbryspira albomaculata* from other western Atlantic members of the genus.

The head and foot color and shape of both species of *Pilsbryspira* in the Guana Island assemblage were the same as their crassispirine compatriots.

The radular teeth of *Pilsbryspira albomaculata* are longer, and more lightly built than those of the crassispirine members of the assemblage. They form a semicircle in anterior cross-section (Fig. 33). They are not barbed.

Six out of 12 specimens had polychaete worms in their guts. Four had eaten *Perinereis anderssoni* and two had eaten *Eunice kinbergi.* These common worms were also prey of *Buchema* and *Crassispira pellisphocae* at Guana Island.

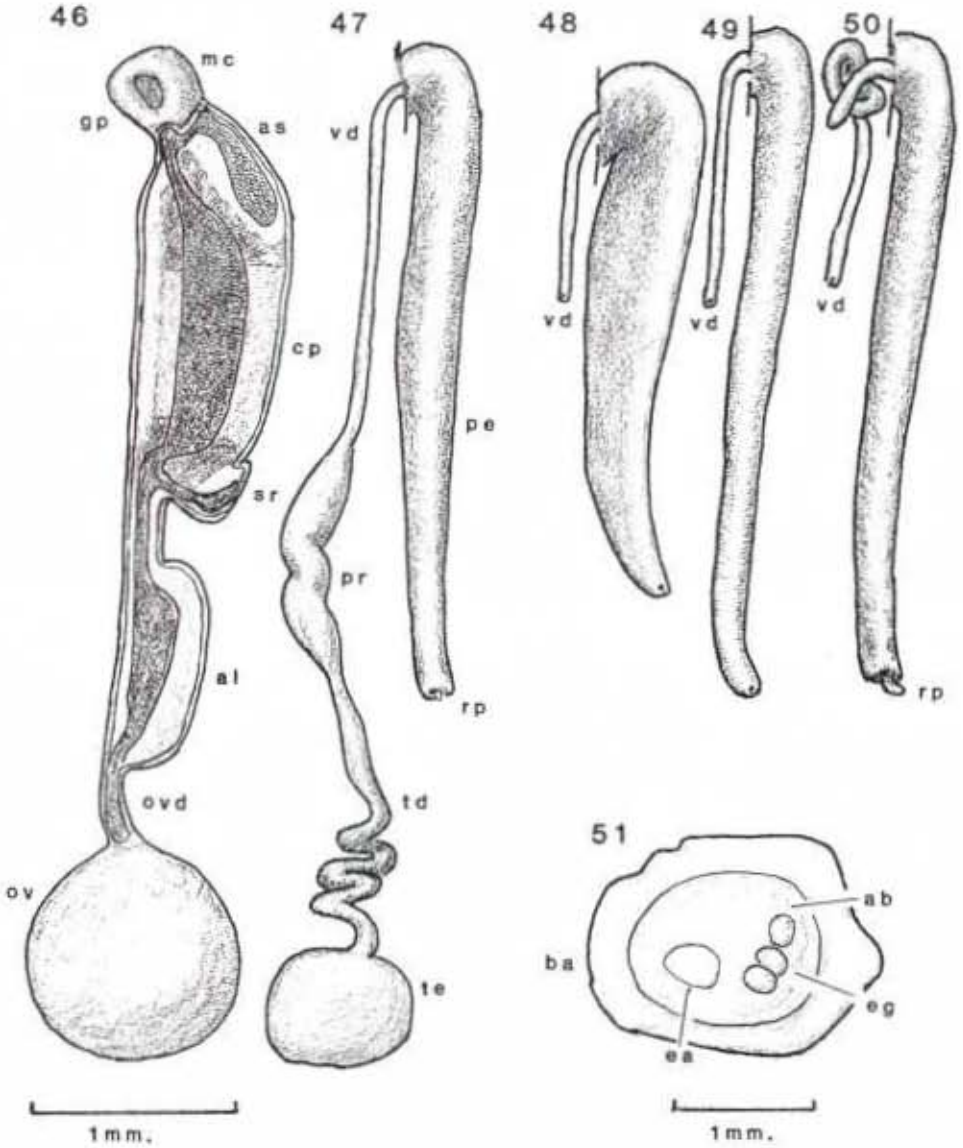
The protoconch of *Pilsbryspira albomaculata* suggests full capsule development of the young (Fig. 26).

Pilsbryspira leucocyma (Dall, 1883)
Figures 18, 27 and 34

? *Buccinum zebra* Lamarck, 1822: 275. Figure reference: Lister 929, fig. 23 (a poor figure).
? *Pleurotoma zebra* Kiener, 1840: 61, pl. 23, fig. 5. Type locality, Mauritius. Kiener cited Lamarck's *Buccinum zebra* as a poor example of his species and referred to the same Lister figure.
"*Pleurotoma zebra* Lamarck" Krebs, 1864: 12. The first use of this name for West Indian material. A specimen from the R. Swift collection (ANSP 15484), presumably seen by Krebs, is a large *P. leucocyma* from St. Martins.
Drillia leucocyma Dall, 1883: 328, pl. 10, fig. 8. Holotype USNM 35973, 7.5 mm. From Key West, Florida. The figured specimen was deformed by a repaired break of the body whorl. The holotype, which agrees with Dall's published measurements, is not deformed.
Drillia zebra var. *leucocyma* Dall, Tryon, 1884: 197, pl. 34, fig. 2. The figure is fairly good.
Drillia leucocyma Dall, Dall, 1890: 36. Stated that it did not intergrade with *Drillia zebra* and extended its known range to the Florida Pliocene.
Monilispira leucocyma (Dall), Olsson and McGinty, 1958: 18. Extension of known range to Colon, Panama.
Crassispira (*Compsodrillia*) *leucocyma* Dall, 1883, Warmke and Abbott, 1961: 35, pl. 25, fig. q.
Pilsbryspira leucocyma (Dall, 1883), Rios, 1975: 136, pl. 41, fig. 617. Range extension to about 20°S on the Brasilian coast.
Crassispira (*Compsodrillia*) *leucocyma* Dall, 1883, Humfrey, 1975: 183, pl. 22, fig. 9. "Very common in 1–6 ft. on eel grass beds."
Monilispira leucocyma Dall, Emerson and Jacobson, 1976: 171, pl. 24, fig. 25. Sand bar habitat.

←

away to show entrance of the radula, poison gland and left salivary gland duct; (43) *Strictispira paxillus* buccal mass. Note the lack of an oral tube and poison gland. Massive musculature covers the odontophore; (44) *Crassispira apicata* buccal mass; (45) *Pilsbryspira albomaculata* buccal mass. Scale below Figure 45 refers to Figures 42–45.



Figures 46–51. Diagrams of the reproductive system: (46) the female system of *Drillia cydia* from the left. Anterior sperm chamber, capsule gland. Seminal receptacle and albumin gland have been dorsally bisected to show the glandular lumens; (47) The male system of *Strictispira paxillus*, dorsal view; (48) Penis of *Drillia cydia*; (49) Penis of *Pyrgospira candace*; (50) Penis and coiled vas deferens of *Crassispira apicata*; (51) Egg capsule of *Pilsbryspira leucocyma*, ANSP 314453, from Crawl Key, Florida.

Range.—Florida, Gulf of Mexico, Caribbean to Panama and Brasil.

Lamarck referred to the non-binomial work of Müller, 1774 for his *Buccinum zebra* and both he and Kiener recorded the species in the Indian Ocean. Kiener's combination *Pleurotoma zebra* was preoccupied by Perry, 1811 for an Indo-West

Pacific *Turris*. As type material is lacking and doubt surrounds the Lamarck-Kiener name it seems best to accept *Drillia leucocyma* as the earliest name for this common and widely distributed western Atlantic turrid.

Pilsbryspira leucocyma has the proportionately highest spire and narrowest body whorl of the western Atlantic *Pilsbryspira*. The brown or blackish shell has two rounded spiral threads at the periphery of each spire whorl. These are white where they cross over the axial sculpture. The spirals of the anterior body whorl are somewhat beaded and though they may be lighter brown than the rest of the shell they are not a contrasting light-on-dark pattern of *P. albocincta*, *P. jayana* or *P. zebroides* Weinkauff.

The radula teeth are rather similar to those of *Pilsbryspira albomaculata* but are slightly longer and have a weak barb on the distal flange (Fig. 34). This latter character should place the species in the subgenus *Pilsbryspira* (*Nymphispira*) but unlike that colorful eastern Pacific group, *P. leucocyma* has a deep, constricted anal sinus when mature.

Fifteen *Pilsbryspira leucocyma* were examined for gut contents. Three had fed on *Polycirrus* sp., one had ? polychaete sp. in the foregut and the setae of Terebellidae sp. B in the rectum. One contained soft cirri only. The species does not appear to compete with its congener or other members of the assemblage for food.

The protoconch suggests full capsule development of the young (Fig. 27).

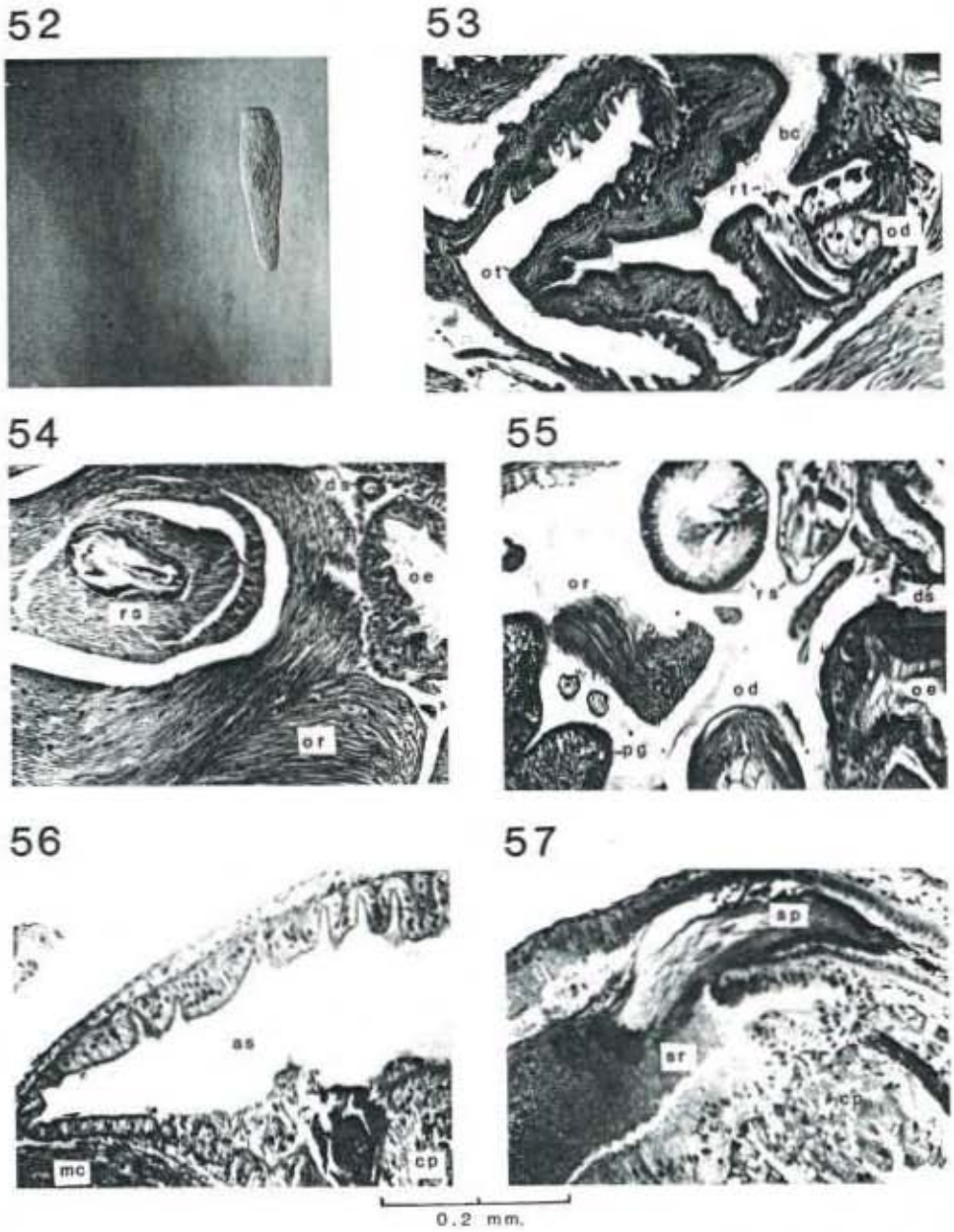
One egg-capsule containing three eggs was deposited by a *Pilsbryspira leucocyma* from Crawl Key, Florida, on the wall of an aquarium 2 or 3 May 1968. The capsule was blister-shaped 2.7 × 2.3 mm (Fig. 51). The eggs were about 680 μm in longest diameter. The eggs were surrounded by albumin. They did not develop.

Digestive System

The work of Smith (1967a; b and c) and of Sheridan et al. (1973) suggested that further characters of taxonomic value might be found in parts of the digestive system other than the radula. For this reason I studied the gross anatomy and general histology of members of the Guana Island assemblage. My findings are summarized in Table 6 and Figures 38–45 and 53–57.

All species of the Guana Island assemblage have a simple, tubular, U-shaped gut. Glands entering it are paired salivary glands (Fig. 38 sg) which are large in *Drillia cydia* and *Pyrgospira candace* and small in the other species, and a tubular convolute poison gland and muscular bulb (Fig. 38 pg and mb) in all species except *Strictispira paxillus*. Ducts of these glands enter the buccal cavity. Ducts from the two lobes of the digestive gland join to enter the stomach through a single duct (Figs. 39–41 dd) and a small anal gland (Fig. 38 ag) enters the rectum near the anus in all species. The oesophagus (oe) is a thin-walled, longitudinally folded tube without any specialized grooves or specialized glandular areas. Entire prey, or in the case of *Strictispira* wads of food, in firm condition are stored in the posterior oesophagus which forms a pseudocrop (Fig. 41 pc).

The stomach (Figs. 39–41 st) is a small, narrow, scarcely differentiated area at the U bend of the gut. A deeply folded lining leads from the oesophagus to a less folded pocket under the duct from the digestive gland. Here ingested prey turns dark brown and disintegrates. Two low typhlosoles lead into the intestine. Sectioned material showed some difference in staining of the granules in gland cells concentrated in and near the typhlosoles in some species but my material was limited and the differences may merely indicate more starved or less starved animals. The outer wall of the stomachs are thinly muscled except *Drillia cydia* (Fig. 39) and *Fenimorea culexensis* where the walls are thick and muscular. Both



Figures 52–57. Parasite and serial sections: (52) Fluke from the rectum of *Buchema interstrigata*. The gut of this individual also contained setae from the polychaete, *Eunice kinbergi*; (53) Longitudinal section of the buccal mass of *Pilsbryspira albomaculata* viewed from the left. Note the tooth and odontophoral cartilage open into the buccal cavity behind the oral tube; (54) *Strictispira paxillus* section posterior to the buccal cavity and odontophoral cartilage. Note the layer of muscle around the radula and the thickness of the odontophoral retractor muscle. Note the absence of a poison gland; (55) *Pilsbryspira albomaculata* section at approximately the same level as Figure 54. Note the absence of a muscle layer around the radula and the small odontophoral retractor muscle; (56) *Pilsbryspira albomaculata* section of the anterior sperm sac; (57) *Drillia cydia* section of the seminal receptacle. Note the oriented sperm at the distal end of the duct.

these clavinid species also have a small caecum (ca) not found in other members of the assemblage or mentioned in the literature. But there are no other major differences, such as two digestive gland ducts entering at either end of the typhlosoles, as Smith found in the crassispirine *Haedropleura* and *Philbertia* and *Cenodagreutes* of the subfamily Raphitominae.

The foreguts (Figs. 42–45 and 53–55) provide worthwhile taxonomic characters beside the radula. Smith (1967a) and Sheridan et al. (1973) showed major differences between the foreguts of Mangeliinae and Raphitominae (Daphnellinae) species such as the development of a "pseudoproboscis" from the muzzle of the latter subfamily plus loss of the radula and poison gland in one genus. Sheridan et al. (1973) found an odontophoral cartilage in their only Crassispirinae species but not in Mangeliinae.

All of the Guana Island species representing subfamilies Clavinae, Strictispirinae, Cochlespirinae, Crassispirinae and Zonulispirinae lack a "pseudoproboscis" although the lips of the false mouth are broad and muscular. All the Guana Island species have an odontophoral cartilage but it varies in degree of development between the subfamilies. All the Guana Island species except *Strictispira paxillus* have an oral tube (Figs. 42, 44 and 45 ot) anterior to the buccal mass.

The odontophore in *Drillia* (and *Fenimorea*) and *Strictispira* is massive. It is reduced in size in all three of the Crassispirinae and it is almost obsolete with an attendant reduction of the opening into the buccal cavity and of odontophoral musculature in the two species of *Pilsbryspira* (Fig. 55).

All of the turrid foreguts studied to date have been of animals who swallow their prey whole and pass it to the stomach whole except for *Strictispira*. All turrid marginal radular teeth are adapted for pricking or harpooning either singly at the end of the proboscis as in Mangeliinae or in pairs within the buccal cavity as in most of the subfamilies included in this study. The central and lateral teeth of the Clavinae grip the prey. They do not rasp or tear as shown by whole, untorn sipunculids in the posterior oesophagus. Except for *Strictispira* the muscles of the odontophore and buccal mass are thin (Fig. 53). They are sufficient only to prick already ingested prey introducing venom before the whole prey is passed through the nerve ring and into the pseudocrop.

Strictispira paxillus, on the other hand, has a heavy layer of circular muscle around the radula and large odontophoral cartilage. The odontophoral retractor muscle (Fig. 54 or) is very thick. Both histological sections and dissections of the animal suggest a powerful pinching and pulling habit of feeding. The narrow diameter of the oesophagus and its constricted passage through the nerve ring suggest that only particulate matter is ingested and, in fact, only fragments of animal matter were found in the guts examined. Loss of the poison gland and muscular bulb is not surprising. Their space in the cephalic cavity of *Strictispira* is occupied by the massive odontophoral and proboscis retractor muscles.

Reproduction

The general plan of the reproductive systems of all members of the assemblage is similar to that of *Drillia cydia* and *Strictispira paxillus* (Figs. 46 and 47). It is a conservative plan found in other toxoglossans (Terebridae, Marcus, 1960 and Rudman, 1969; Turridae, Robinson, 1960 and Smith, 1967d) as well as many neogastropods.

In the female system, the ovary occupies the tip of the spire with the digestive gland. Anteriorly, the oviduct has three major regions: the albumin gland (al) the large capsule gland (cp) and, distally, a muscular region or pouch here called the

muscular chamber (mc) ("terminal pouch" of Marcus and of Rudman, "glandular chamber" of Robinson, "bursa copulatrix" of Smith). A small to fairly large gland, the seminal receptacle (sr) ("sperm pouch" and "ingesting gland" of Marcus and Smith) is joined to the oviduct between the albumin and capsule glands by a short duct. Sperm is stored in the seminal receptacle and/or its duct over long periods of time. Specimens of Guana Island turrids isolated for over a month had oriented sperm in the seminal receptacle and distal opening of the duct (Fig. 57).

All the above characters are constant but the magnitude of the muscular chamber varies from a folded pouch as large as the capsule gland in some Terebridae to a sphincter-like thickening in some Turrids. *Drillia cydia* has this latter condition. The rest of the Guana Island species have a moderately developed pouch just posterior to the muscular lips of the gonopore.

A variable character is the presence or absence of an anterior sperm sac (Figs. 46 and 56). This sac is present in *Drillia cydia, Crassispira pellisphocae* and *Pilsbryspira albomaculata.* It was not found in *Strictispira paxillus.* According to Marcus, Rudman, and Smith, who found it in *Hastula, Pervicacia,* and *Philbertia,* sperm is stored here immediately after copulation. No sperm was found here in my animals which had been isolated for several weeks before sectioning. The anterior sperm sac was not found in nine mangeliid and two raphitomid species studied by Robinson and Smith.

The male reproductive system presents a few specifically variable characters. The shape of the penis in *Drillia cydia* (and *Fenimorea culexensis*) is broad at the base and tapers to the tip. It is laterally flattened. The internal sperm duct opens as a simple pore at the tip (Fig. 48). This type of opening is also found in *Pyrgospira candace* but that species has a uniformly slender rounded penis (Fig. 49). All the rest of the Guana Island species have a slender, rounded penis but the sperm duct opens through a retractable papilla at the tip (Figs. 47 and 50).

The rest of the male system of the Guana Island species is similar to that of *Strictispira paxillus* (Fig. 47) with the exception of *Crassispira apicata* where the vas deferens (vd) is convolute just before passing through the body wall to the base of the penis (Fig. 50). Robinson's figure 4 shows a similar condition in *Bela brachystoma* (referred to in that paper as *Mangelia*).

Various reproductive related characters of the Guana Island turrids are compared in Table 6.

Unfortunately, no egg-capsules of the Guana Island turrid assemblage were found. It is presumed they are simple blister-shape as in *Pilsbryspira leucocyma* from Florida (Fig. 51). This shape is known in *Bela* (called *Mangelia*) and *Philbertia* (Lebour, 1934), *Drillia* (Knudsen, 1950), *Crassispira* and *Carinodrillia* (personal observation).

Large ova were found in ovaries of *Drillia cydia, Strictispira paxillus, Buchema interstrigata,* and *Pilsbryspira albomaculata* sectioned in March. Yolky material but no ova were found in a somewhat starved individual of *Crassispira pellisphocae* sectioned at the same time. I did not see sectioned ovaries of *Crassispira apicata* or *Pilsbryspira leucocyma* from Guana Island.

I presume at least some part of the breeding season of the two *Pilsbryspira* species coincides as juveniles of the approximately same number of whorls are often seen together. The two young shells of 5.0 and 4.8 whorls used for protoconch Figures 26 and 27 were collected within a few centimeters of each other on the same rock.

Miscellaneous characters such as soft-part color, shape and size are compared in Table 8.

There is little color difference except in *Drillia cydia*. Like many other Caribbean and Eastern Pacific Clavinae, this *Drillia* has a white head and foot. It has slender tentacles with dark eyes set on low pedicles near the base. The broad, rectangular outline of the foot is known in most turrid subfamilies except Mangeliinae where the foot is often acutely triangular.

The ctenidium and osphradium are comparatively smaller in larger species and the osphradium is about 0.5 the length of the ctenidium ($\bar{x}$ all species 53%, range 41–60%). The width of the cerebral ganglia is also conversely correlated with size.

As it is difficult to measure these soft parts precisely, no significance should be attached to the differences between the Guana Island species. It is sufficient here to establish approximate ratios for comparison with assemblages from other habitats and localities.

Discussion

Shell dimensions and characters of the Guana Island assemblage are compared in Tables 2 and 3. Although statistically significant differences are shown between many of the species in Table 4, they are all rather small species between 8 and 18 mm in length with a mean length for the assemblage of about 11 mm. All species have solid shells with strong axial sculpture. There is also considerable uniformity in the narrow angle (29–39°, $\bar{x}$ 33°) and moderate height of the spire (55–65%, $\bar{x}$ 61% as seen in the ratio; body length/total length).

These are shell characters of rather unspecialized rock and/or sand dwellers and may be found in shallow water (intertidal to ± 10 m) assemblages of living as well as fossil Muricidae, Costellariidae, Columbellidae, Fasciolariidae and Mitridae. The numbers of living species with this shell form have proven its efficiency. One wonders if its repetition in the turrid subfamilies of the Guana Island assemblage should be termed "convergence." Probably there was never any pressure on the ancestral stock for divergence.

A puzzling character of the Guana Island assemblage is shell color. All of the species except *Drillia cydia* and *Buchema interstrigata* are predominantly dark and the dark tips of the shell spires are conspicuous when they protrude from the white sand on the slabs. One would expect selection by predators like fishes and crabs against the dark-shelled individuals.

There were numerous gastropod-eating fishes, mainly *Haemulon* and *Halichoeres* species (Randall, 1967), around the study area. However, most of these seemed to hunt and feed along more nearly vertical (greater than 45°) rock faces or in the soft sand between the slabs. Perhaps they do not exploit the thinly sand-covered horizontal slabs of the turrid micro-habitat.

Thirty-four or 51% of 74 live-taken members of the assemblage had repaired major breaks on one or more of the three anterior whorls. Most of these repaired breaks are axially oriented along the anterior side of a rib and do not involve more than one rib. The breaks may be the result of attempted crab predation although crabs were not common in the microhabitat. They do indicate the structural advantage of axial ribs. The damage was probably limited to a broken shell lip, an accident that would not threaten the security of the animal. All the turrids in the assemblage are able to retract their soft parts to the dorsal half of the body whorl; three or more ribs behind the aperture.

Possibly, dark shells are structurally stronger which might, with lessened predator pressure, offset the advantage of cryptic coloration. The light-colored *Drillia cydia* does not produce dark shell pigment as is the case with most western Atlantic

and eastern Pacific clavinids. But the other light-colored member of the assemblage, *Buchema interstrigata* does produce dark pigment in populations from other localities. Why does it not do it at Guana?

Protoconch characters of all species of the assemblage suggest full capsule development of the young. This restriction, the lack of free-swimming veliger larvae, upon gene flow between micropopulations of these species could explain some of the shell color and shape variation but not the reasons for them. The light colored Guana Island *Buchema interstrigata* and the dark ones at Beef Island are an example; or the relatively high spire of Guana Island *Strictispira paxillus* as opposed to the squat form from Anegada Island.

At least some species in all six genera discussed here do have planktotrophic larvae, suggested by protoconch characters: *Drillia aerope* (Dall, 1919), *D. clavata* (Sowerby, 1834), *D. roseacea* (Reeve, 1845), *Strictispira ericana* (Hertlein and Strong, 1951), *Pyrgospira aenone* (Dall, 1919), *Crassispira* (*Crassiclava*) *unicolor* (Sowerby, 1834), *C.* (*Monilispira*) *nigrescens* (C. B. Adams, 1845), *Pilsbryspira collaris* (Sowerby, 1834) or observed free-swimming larvae: *C. kluthi* (E. K. Jordan, 1936). It would seem, therefore, that lecithotrophic development has been selected for in this small assemblage of carnivores.

The radulae and prey species of the Guana Island turrid assemblage have been discussed and figured in the systematic section of this paper (Figs. 28–37). Use of the radula as a character of phylogenetic value is supported here. There is considerable difference in the size and shape of the teeth of *Buchema interstrigata* and *Pilsbryspira albomaculata*, unrelated snails with similar prey, and the similarity of *P. albomaculata* and *P. leucocyma* teeth, related snails with dissimilar diets.

Prey species found in the guts of the turrids and polychaetes taken from the substrate samples are listed in Table 9. All polychaetes preyed upon by more than one species of turrid were common to several samples.

I was not able to determine whether *Drillia cydia* fed on one or several species of sipunculid but all six of the other turrids whose food was studied, had eaten more than one species of polychaete. However, the limited material at hand suggests they prey upon either active or sedentary worms, not both. *Buchema interstrigata* and *Pilsbryspira albomaculata*, for example, eat active hunting and crawling *Perinereis* and *Eunice*; *P. leucocyma* eats sedentary deposit or filter-feeding terebellids.

The gradual reduction in size of the odontophoral cartilage from *Drillia* (Clavinae) through *Crassispira* (Crassispirinae) to *Pilsbryspira* (Zonulispirinae) is important to the consideration of higher taxonomic categories of Turridae. It is not difficult to extrapolate a toxoglossan foregut similar to that of a mangeliid or *Conus* by carrying the reduction of the *Pilsbryspira* cartilage on to obsolescence and limiting the entrance to the buccal cavity to a narrow sac beyond the bend of the radula. This, plus similarity of the hind gut, plus similarity of the basic plan of the reproductive system and of many shell characters make the splitting of the family into two: Turridae and Mangeliidae, as proposed by Morrison (1966), unwarranted.

Conclusion

Eight species from five turrid subfamilies occupy the same shallow-water microhabitat at Guana Island. Two of these, *Strictispira paxillus* and *Crassispira apicata*, have rather similar shells. However, their foreguts are dissimilar. The shells may reflect lack of pressure for change on an eminently suitable shell form

for the habitat. The animals have adapted their foreguts for two entirely different methods of feeding.

Drillia cydia feeds on Sipunculoidea. Six of the other seven members of the assemblage feed on more than one species of polychaetes. The food of one species is not known. Three species feed on one or two of the same common polychaetes. Two of these, *Buchema interstrigata* and *Crassispira pellisphocae,* are in the subfamily Crassispirinae. The third species, *Pilsbryspira albomaculata,* is in the subfamily Zonulispirinae. Two closely related species do not compete for food. *P. albomaculata* feeds on actively crawling species and *P. leucocyma* feeds on sedentary worms.

The shapes of radular teeth are valuable taxonomic characters not unduly affected by diet. Differently shaped teeth were used by distantly related snails in the capture of the same prey and similar teeth from two congeners captured different polychaetes.

All species of the assemblage have an odontophoral cartilage. It is most highly developed in *Drillia* and *Strictispira* and is very small in *Pilsbryspira.* Further reduction of the cartilage and associated muscles could have produced a foregut similar to that of the "true" toxoglossans like Mangeliinae. These intermediate foregut characters plus similarities of shells, digestive and reproductive systems support placement of all the subfamilies from Clavinae to Mangeliinae and Raphitominae in one family Turridae.

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