

Descriptions of sixteen new species of the genus *Gibberula* Swainson, 1840 (Gastropoda: Cystiscidae) from the Caribbean

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ABSTRACT. A list of described Caribbean species of the genus *Gibberula* is given, together with the recognised synonyms. Sixteen new species are described for the first time: *G. celerae* n. sp., *G. conejoensis* n. sp., *G. fortis* n. sp., *G. gradatim* n. sp., *G. granulinaformis* n. sp., *G. oriens* n. sp. and *G. vitium* n. sp. from Venezuela, *G. aperta* n. sp. and *G. jenphillipsi* n. sp. from Curaçao, Spaanse Water, *G. arubagrandis* n. sp., *G. velox* n. sp. from Aruba, *G. fortisminor* n. sp. and *G. quatrefortis* n. sp. from West Indies, St. Vincent & Grenadines, Isle Quatre, *G. occidentalis* n. sp. and *G. stella* n. sp. from Honduras, and *G. belizensis* n. sp. from Belize.

INTRODUCTION

The name Caribbean is used herein to include south eastern U.S.A. south of Georgia, and the Bahamas in the north, Trinidad and Tobago in the south east (see plate).

Preceding the year 2000 only five recognised Caribbean *Gibberula* species had been described. *G. lavalleana* d'Orbigny, 1842, and *G. evadne* Dall & Simpson, 1901. Since then ten new species have been added to this number: Eight by Espinosa and Ortea (2000, 2006), one by Faber (2005), and one by Cossignani (2006). Faber renamed *G. minuta* Pfeiffer, 1840. Although sixteen new species are described herein, raising the number to twenty nine, it is probable that at least as many more remain to be discovered. Over the years many scientific expeditions have been carried out in the Caribbean, but most of the minute *Gibberula* species, being little bigger than a grain of sand, appear to have been overlooked.

During the years 1998, 1999, 2003 through 2007, the author carried out extensive sampling from Belize in the north west, through Honduras, Panama, Colombia, Venezuela, Aruba, Bonaire, and Curaçao (ABCs), Trinidad and Tobago, Windward Islands and Leeward Islands, British and US Virgin Islands, Puerto Rico, and Exumas in the Bahamas. Many lots of *Gibberula* were collected, but only a very small part of the Caribbean has been even partially sampled, and a vast amount of work remains to be done.

All described Caribbean *Gibberula* known to the author belong to one group with sizes ranging from approximately 1.2 mm to 3.9 mm, except for one species, *G. ocellus* Dall, 1927, from Georgia, U.S.A., a deep water species measuring between 5 and 5.5 mm which is almost twice as large. Otherwise, the larger *Gibberula*, such as the Mediterranean *G. oryza* Lamarck, 1822, appear to be absent.

Specific assignment has been based on the examination of shell and animal morphology. A number of radulae were examined, and in one case, *G.*

granulinaformis n. sp. (Fig. 29), this was found to be useful for confirmation of correct generic assignment.

As far as possible digital images of all shells and live animals of new species described herein have been figured in the plates. All images are reproduced at 18X magnification, unless otherwise stated, in order to give a true perspective and to assist in the recognition of some species where size is a significant factor.

Some common diagnostic features of the genus are not repeated in descriptions. These include 'external varix is absent', 'anterior notch present', 'posterior notch present', 'Type 4 animal', 'mantle not usually extending over external shell surface'. Where the term 'semi-transparent' is applied to the shell, this refers to live specimens - once animals die shells quickly become translucent white or opaque. In many cases descriptions are silent on the number of whorls in the protoconch and teleoconch as these features are often partially or totally obscured by callus deposits. Assessment of foot length of live animals is subjective - in their natural habitat external parts are normally fully extended, but in the aquarium, when being photographed, this is not often so. Live animals are photographed in dorsal view, therefore dorsal views of dried shells have not been figured.

METHODS AND MATERIALS

Hand dredging in sand or muddy substrates and the use of a hand operated suction pump on rocks and rubble substrates were the most productive methods of collecting *Gibberula* in shallow waters, down to approximately 30 metres. Night diving yielded some positive results as specimens could be picked up from sand and rubble, or off rocks. Many species were collected by dredging from the author's yacht "Marina Em" with the aid of a small hydraulically operated reel. The resultant grit from all methods of collection was screened into four grades. Finer screenings were placed in a bowl of sea water and covered. Live animals then crawled up the sides where they could be

picked up. Finer grades of grit from deep dredging were sorted visually for dead shells which comprised about 98 percent of all shells collected by this method. This is very slow and time consuming work which may partly account for the paucity of known deep water *Gibberula* to date.

Samples from live material were photographed in a small aquarium below a microscope with digital camera mounted on top. The same equipment was used for detailed imaging of dried shells. The system, is calibrated so that shell dimensions can be obtained from data displayed by the software. All relevant data, including a chosen shell image is entered into the author's database. One special feature of the database is a comparator which enables a simple and very effective means for comparing two or more shell images. This has been very useful in highlighting small morphological differences.

When extracting radulae from these minute shells a very small screw vice was used to crack the shells as the flushing method was found to be impossible to perform. Conventional methods were used to locate, clean and mount radulae in slides for imaging and study. Regrettably optical microscopy, used by the

author, has insufficient resolution for imaging these minute radulae. Although the images are generally unsuitable for reproduction it was possible to discern the plates and cusps, and to measure and record much useful data, but this was only carried out in a few specific cases.

ABBREVIATIONS

MNHN: Museum National d'Histoire Naturelle, Paris, France.

AWC: Andrew Wakefield Collection.

TMC: Tony McCleery Collection.

ad.: adult specimen.

juv.: juvenile specimen.

dd.: dead collected.

lv.: live collected.

L.: shell length.

W.: shell width.

TS.: Type species.

The author has, in general, followed terminology established by Coovert and Coovert (1995).



Map 1. Caribbean Sea and Type localities of new species

1. Curaçao, Spaanse Water, 12°04.4'N 68°51.0'W; 2. Aruba, Boca Grandi, 12°27.3'N 69°52.6'W; 3. Belize, 17°15.6'N 88° 02.5'W; 4. Venezuela, Isla Coche, 10°49.8'N 63°56.7'W, 35 m, shelly mud; 5. Venezuela, Islas Los Testigos, Isla Conejo, 11°22.6'N 63°05.1'W; 6. Venezuela, Monjes del Sur, harbour; 12°21.4'N 70°54.0'W; 7. West Indies, S.V.G., Isle Quatre, 12°57.6'N 61°15.0'W; 8. Venezuela, Aves de Sotavento, 12°03.5'N 67°40.5'W; 9. Venezuela, off Islas Los Testigos, 11°26.3'N 63°06.6'W; 10. Honduras, off to north east, 16°06.4'N 84°32.5'W; 11. Honduras, Cayos Vivarillo, 15°51.1'N 83°18.3'W; 12. Aruba, south west coast, 12°29.8'N 70°01.7'W.

SYSTEMATICS

Family **CYSTISCIDAE** Stimpson, 1865.

Subfamily **PERSICULINAE** Covert and Covert, 1995.

Genus *Gibberula* Swainson, 1840.

Type species. *G. zonata* Swainson, 1840, = *Volvaria oryza* Lamarck, 1822, West Africa, by monotypy.

List of the Caribbean *Gibberula* species

- Gibberula agricola* Faber, 2005. Margarita, Venezuela.
- Gibberula aldridgei* Usticke, 1968. *Nomen dubium*. Tortola B.V.I., 4 mm.
- Gibberula benyi* Espinosa & Ortea, 2005. Pinar del Rio, Cuba.
- Gibberula bribri* Espinosa & Ortea, 2000. Punta Mona, Manzanillo, Costa Rica.
- Gibberula evadne* Dall & Simpson, 1901. Mayaguez Harbour, Puerto Rico.
- Gibberula lavalleana* d'Orbigny, 1842. Jamaica. = *Marginella minima* Sowerby, 1846.
- Gibberula macarioi* Espinosa & Ortea, 2005. Pinar del Rio, Cuba.
- Gibberula mandyi* Espinosa & Ortea, 2005. Pinar del Rio, Cuba.
- Gibberula marioi* Espinosa & Ortea, 2000. Manzanillo, Costa Rica.
- Gibberula ocellus* Dall, 1927. Off Fernandina, Georgia. U.S.A.
- Gibberula olivai* Espinosa & Ortea, 2005. Pinar del Rio, Cuba.
- Gibberula pfeiffer* Faber 2004. *Nomen novum*. Cuba. = *Marginella minuta* Pfeiffer 1840, not *Marginella minuta* Gray 1829.
- Gibberula sierra* Espinosa & Ortea, 2000. Punta Mona, Manzanillo, Costa Rica.
- Gibberula tenera* Menke, 1830. *Nomen dubium*. Puerto Rico.
- Gibberula ubitaensis* Espinosa & Ortea, 2000. Punta Ubita, Manzanillo, Costa Rica.
- Gibberula yidii* Cossignani, 2006. La Guajira, Colombia.

Gibberula aperta n. sp.

Figs. 44, 45

Type material. Curaçao, Spaanse Water, 12°04.4'N 68°51.0'W, 1-2 m, rocks and rubble. Holotype, 1.58 x 1.04 mm, W:L 66%, ad. lv., MNHN 20465; Paratype 1. 1.90 x 1.25 mm, W:L 65%, ad. lv., MNHN 20481; Paratype 2. 1.57 x 1.00 mm, W:L 64%, ad. lv., AWC; Paratype 3. 1.93 x 1.21 mm, W:L 63%, ad. lv., TMC; Paratype 4. 1.77 x 1.11 mm, W:L 63%, ad. lv., TMC; Paratype 5. 1.67 x 1.12 mm, W:L 67%, ad. lv., AWC.

Other material. 7 ad. lv., 4 ad. dd., from lot of approximately 500 specimens. Curaçao, Spaanse

Water, 12°04.4'N 68°51.0'W, 1-2 m, rocks and rubble.

Type locality. Curaçao, Spaanse Water, 12°04.4'N 68°51.0'W. (Map: Ref. 1).

Description. Shell smooth, glossy, semi-transparent, obovate, size range 1.57 x 1.00 mm to 1.93 x 1.21 mm, W:L 63-67%, spire smooth sided, very low, suture indistinct, apex rounded, 3.5 to 4 whorls including protoconch, suture sweeps up strongly to high insertion point, shoulder moderately strong, posterior notch weak. Lip almost straight, parallel to shell axis, slightly thickened, slightly raised posteriorly, flared anteriorly, labial denticles and lirae absent. Three columellar plications and two lirae fill half of aperture. Second strongest, short, third very weak, lirae get progressively weaker posteriorly. Anterior callus forms weak, short, almost vertical ridge between first plication and external end of second. Very light callus wash extends to posterior notch and over suture, parietal callus ridge present on slightly convex parietal wall. Aperture moderately wide posteriorly, widening evenly, becoming very wide anteriorly. Animal. Foot approximately 30% longer and same width as shell, semi-transparent with 4 weak white or slightly yellowish-white marking along sides, two stronger ones extending posteriorly, marks extend almost to edge of foot. Dull orange spots present on transparent areas of foot intermingled with fewer small black spots. Lobes of split head yellowish-white, translucent white edges and extremities, tentacles short, semi-transparent, without markings. Eyes black, some adjacent orange spots. Siphon short, opaque yellowish-white. General appearance of live specimens very dark. Mantle roof comprised of large dull brownish-green areas with dull orange and darker brown or black spots, and some yellowish areas intermingled with dull orange spots, same dull pattern present beneath early teleoconch whorls.

Distribution. Only known from Type locality.

Habitat. Rocks and rubble at approximately 1 metre deep, slight tidal current. Rocks generally heavily covered with various weed types and variable amounts of muddy sand. Spaanse Water is a large tidal lagoon with still, relatively shallow water. It is probable that the salinity of the water is slightly higher than surrounding open sea, because tidal flow is minimal, and the normally strong wind and sun must cause considerable evaporation.

Discussion. *Gibberula aperta* n. sp. must be compared with *Gibberula vitium* n. sp. (Figs. 68 to 73). The aperture of *G. aperta* n. sp. is moderately wide posteriorly, widening evenly throughout its length, becoming very wide anteriorly, labial denticles are absent. *G. vitium* n. sp. is larger, has a slightly narrower aperture, lip denticulate, less thickened, not parallel to axis of shell, different animal chromatism,

and in particular, is separated from *G. aperta* n. sp. by its distinctly kinked second plication. *Gibberula aperta* n. sp. is abundant and appears to be endemic to Spaanse Water, Curaçao. De Jong and Coomans (1988) make no reference to any species which could reasonably be compared with *G. aperta* n. sp.

Etymology. The name alludes to the wide aperture of *G. aperta* n. sp. The Latin 'apertus' can be translated as 'open'.

***Gibberula arubagrandis* n. sp.**

Figs. 1-2, 4-5

Type material. Aruba, Boca Grandi, 12°27.3'N 59°52.6'W, 1-2 m, clean sand. Holotype. 3.31 x 1.70 mm, W:L 51%, ad. lv., MNHN 20466; Paratype 1. 3.06 x 1.65 mm, W:L 54%, ad. lv., MNHN 20482; Paratype 2. 2.83 x 1.57 mm, W:L 56%, ad. lv., AWC; Paratype 3. 2.62 x 1.41 mm, W:L 54%, ad. lv., TMC; Paratype 4. 3.10 x 1.59 mm, W:L 50%, juv. lv., TMC; Paratype 5. 2.58 x 1.49 mm, W:L 58%, ad. lv., AWC.

Other material. 1 juv. lv., Aruba, Boca Grandi, 12°27.3'N 59°52.6'W, 1-2 m, clean sand.

Type locality. Aruba, Boca Grandi, 12°27.3'N 69°52.6'W. (Map: Ref. 2).

Description. Shell smooth, glossy, translucent white, ovate, size range 2.58 x 1.49 mm to 3.31 x 1.70 mm, W:L 51-58%, spire low, apex moderately pointed, suture slightly stepped caused by new growth overlapping it with fine, distinct growth marks, suture sweeps up to high labial insertion point clearly below suture on previous whorl, shoulder strong, angular (occasionally weak and sloping). Lip slightly curved, thickened, slightly flared anteriorly, strongly denticulate, 18 denticles filling inner edge. Three columellar plications and two lirae fill less than half aperture, first strong, thickened, raised medially with small keel, second strong, third and lirae progressively weakening. Anterior callus surrounds outer end of first two plications, slightly textured callus wash extends from third plication to posterior notch, weak parietal callus ridge present. Aperture moderately wide, widening slightly throughout length. Animal.

Foot translucent white anteriorly, semi-transparent posteriorly, approximately 20% longer, slightly wider than shell, five white marks on sides, two stronger white patches extending posteriorly, pale orange spots between. Split head translucent white, white medially, tentacles very small, translucent white, unmarked, one pale orange spot on head at base of each. Eyes black. Siphon very short, white. Mantle roof of live specimens strikingly white, one constant and distinctive mark, orange with black border present, finger shaped, positioned (in dorsal view with the head downwards) in anterior right quarter at side, pointing inwards and slightly downwards (additional, weaker, not constant marks occur on darker specimens).

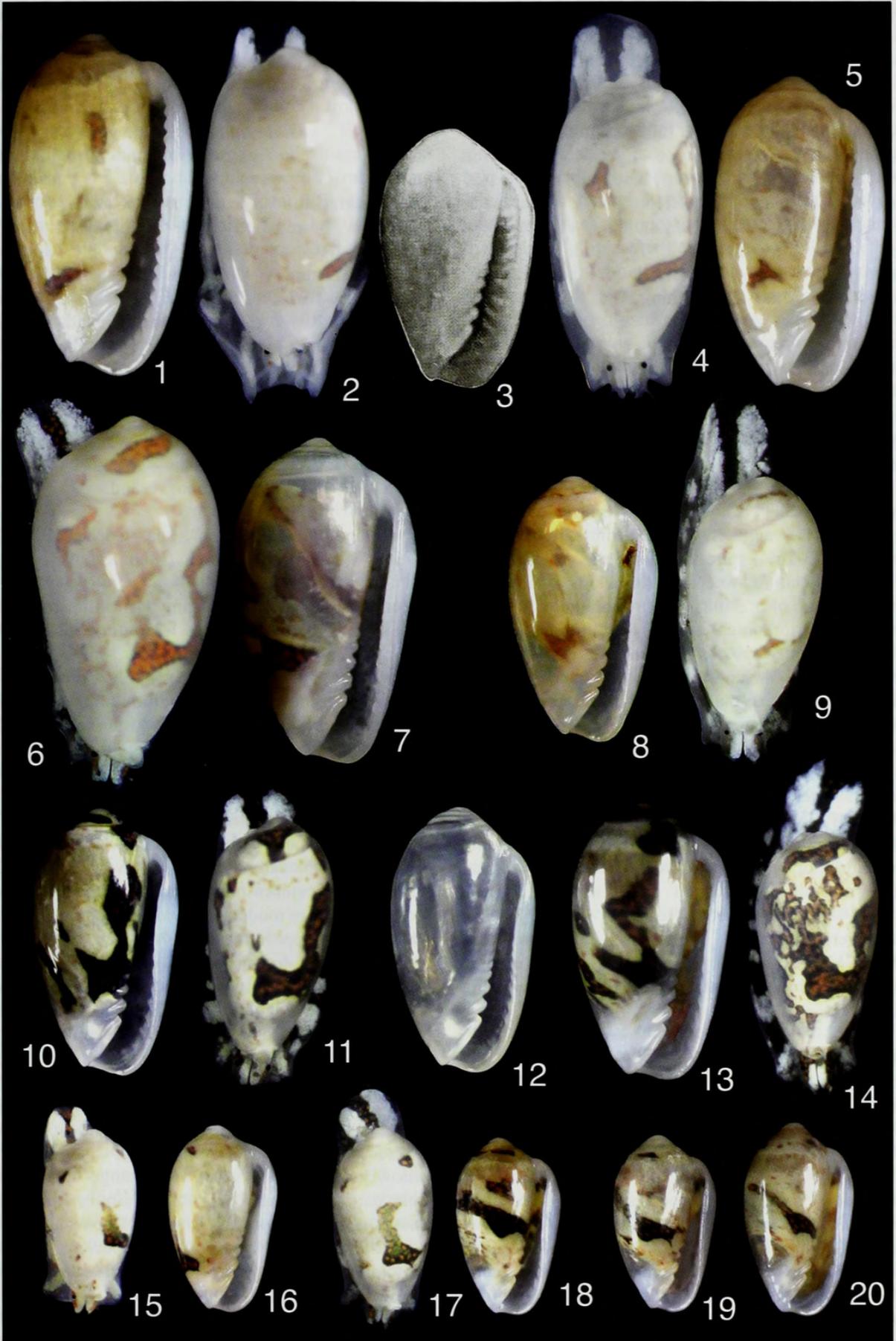
Distribution. Only known from Type locality

Habitat. Narrow lagoon, partially protected from easterly trade wind by broken reefs covered with moderately heavy weed growth, water, clean, turbulent. *G. arubagrandis* n. sp. inhabits clean, white sand, areas of finer sand being preferred.

Discussion. *Gibberula arubagrandis* n. sp. is a large, closely related species of *Gibberula evadne* Dall and Simpson, 1901, (Fig. 3) with many features being found in both species. In addition to its large size, differences are lower W:L ratio, almost straight inside edge of the lip, high labial insertion point, colour of animal, and simple, constant, distinctive mantle roof pattern. *G. evadne* Dall and Simpson, 1901, is more inflated, smaller, varying from 1.9 mm. to 2.5 mm, W:L ratio 59-64%, only rare specimens falling outside this range. Labial insertion point lower, shoulder generally very weak, sloping, aperture and lip more curved. Colour varies considerably, but rarely compares with that of *G. arubagrandis* n. sp. Mantle roof pattern is much more developed. Almost every colony of *G. evadne* Dall and Simpson, 1901, sampled in the south and eastern Caribbean, contains approximately 10 to 20 percent of animals with grey or black chromatism, which has not been recorded in *G. arubagrandis* n. sp. The author did not collect *G. evadne* Dall and Simpson, 1901, in Aruba. De Jong and Coomans (1988: 201, fig. 545) illustrate *G. evadne* Dall and Simpson, 1901, but do not give its locality which could well be Curaçao where the author also collected this species.

Figures 1-20

1-2. *G. arubagrandis* n. sp. Holotype, Aruba, Boca Grandi, 1-2 m; **3.** *G. evadne* Dall & Simpson, 1901, Holotype, Kaicher card 6212, Type Locality: Mayaguez Harbour, Puerto Rico, 2.5 mm, approx., juvenile shell; **4-5.** *G. arubagrandis* n. sp. Paratype 1, Aruba, Boca Grandi, 1-2 m; **6-7.** *G. fortis* n. sp. Holotype, Venezuela, Los Monjes del Sur, harbour, 16 m; **8-9.** *G. fortis* n. sp. Paratype 1, Venezuela, Los Monjes del Sur, harbour; **10-11.** *G. quatrefortis* n. sp. Holotype, West Indies, S.V.G., Isle Quatre, 7-12 m; **12.** *G. quatrefortis* n. sp. Paratype 2, West Indies, S.V.G., Isle Quatre, 7-12 m; **13-14.** *G. quatrefortis* n. sp. Paratype 1, West Indies, S.V.G., Isle Quatre, 7-12 m; **15-16.** *G. fortisminor* n. sp. Paratype 1, West Indies, S.V.G., Isle Quatre, 2-3 m; **17-18.** *G. fortisminor* n. sp. Holotype, West Indies, S.V.G., Isle Quatre, 2-3 m; **19.** *G. fortisminor* n. sp. Paratype 3, West Indies, S.V.G., Isle Quatre, 2-3 m; **20.** *G. fortisminor* n. sp. Paratype 2, West Indies, S.V.G., Isle Quatre, 2-3 m.



Etymology. The name is taken from the Latin 'Grandis' meaning 'large' or 'tall' combined with the Type locality.

Gibberula belizensis n. sp.

Figs. 32-37

Type material. Belize, 17°15.6'N 88° 02.5'W, 115-142 m, muddy sand. Holotype. 1.96 x 1.45 mm, W:L 74%, ad. lv., MNHN 20467; Paratype 1. 2.07 x 1.53 mm, W:L 74%, ad. dd., MNHN 20483; Paratype 2. 1.74 x 1.30 mm, W:L 75%, ad. dd., AWC; Paratype 3. 1.78 x 1.31 mm, W:L 74%, ad. dd., TMC; Paratype 4. 1.76 x 1.33 mm, W:L 76%, ad. dd., TMC; Paratype 5. 2.00 x 1.46 mm, W:L 73%, ad. dd., AWC.

Other material. 34 ad. dd., 19 juv. dd., Belize, 17°15.6'N 88° 02.5'W, 115-142 m, muddy sand.

Type locality. Belize, 17°15.6'N 88° 02.5'W. (Map: Ref. 3).

Description. Shell smooth, shiny, translucent white, triangular, size range 1.74 x 1.30 mm to 2.07 x 1.53 mm, W:L 73-76%, spire very low, apex rounded, 3.5 to 4 whorls, suture sweeps up to high labial insertion point at suture of previous whorl, shoulder moderately strong, posterior notch weak. Lip straight, slightly raised, thickened posteriorly, not flared, 11 weak denticles fill whole length, extends below level of very weak anterior notch. Three moderately strong columellar plications and one weak lira fill less than half of aperture, anterior callus not strong, light wash extends to posterior notch, parietal callus ridge present. Aperture moderately wide, straight. Animal. Length of foot not observed, semi-transparent, several white marks on sides, two longer marks extending posteriorly, orange spots between. Lobes of split head white medially, transparent edges and extremities, orange marks present, tentacles short, semi-transparent, unmarked. Eyes black. Siphon short, white. Mantle roof variegated white, green, orange, and black, same chromatism extends below preceding whorls.

Distribution. Only known from the Type locality.

Habitat. Dredged outside vital reef at approximately 130 m in clear water with slight tidal current. Limited evidence suggests muddy sand substrate.

Discussion. This minute species is compared with *Gibberula occidentalis* n. sp. (figs. 46-49) from Honduras, N.E., a species of similar size, dredged in 65 m. Small, distinct differences exist between the two species. *Gibberula belizensis* n. sp. has an unusually weak anterior notch, weak labial denticles, shell relatively elongate, marks on foot solid white. *G. occidentalis* n. sp. has strong anterior notch, fewer

strong labial denticles, very inflated shell, marks on foot comprised of minute spots. Both species show the greenish hue associated, by the author, with sand or mud substrates at dredging depths.

Etymology. The name is taken from the Type locality.

Gibberula celerae n. sp.

Figs. 54-56

Type material. Venezuela, Isla Coche, 10°49.8'N 63°56.7'W, 35 m, shelly mud. Holotype. 2.02 x 1.29 mm, W:L 64%, ad. lv., MNHN 20468; Paratype 1. 1.91 x 1.21 mm, W:L 63%, ad. lv., MNHN 20484; Paratype 2. 1.97 x 1.25 mm, W:L 63%, ad. lv., TMC; Paratype 3. 1.99 x 1.24 mm, W:L 62%, ad. lv., AWC; Paratype 4. 2.20 x 1.30 mm, W:L 59%, ad. lv., AWC; Paratype 5. 2.02 x 1.22 mm, W:L 60%, ad. lv., TMC.

Other material. 3 ad. lv., Venezuela, Isla Coche, 10°49.8'N 63°56.7'W, 35 m, shelly mud; 21 ad. lv. and 3 juv. lv., Venezuela, Isla Cubagua, 10°50.2'N 63°58.4'W, 18 m, rubble amongst sand.

Type locality. Venezuela, Isla Coche, 10°49.8'N 63°56.7'W, 35 m, shelly mud. (Map: Ref. 4).

Description. Shell smooth, shiny, semi-transparent, sub triangular, size range 1.91 x 1.21 mm to 2.20 x 1.30 mm, W:L 59-64%, spire very low, smooth, straight sides, suture indistinct, apex slightly pointed, suture sweeps up strongly to labial insertion point at suture on previous whorl, shoulder strong, posterior notch weak. Lip straight, thickened posteriorly, flare extends below anterior notch, 7 moderately strong denticles fill half lip, strongest medially, weak on flare. Three columellar plications and one lira fill approximately 35% of aperture, first and second moderately strong, third weaker, anterior callus weak, light wash extends from plications to posterior notch, strong parietal callus ridge present. Aperture moderately wide, widening anteriorly. Animal. Foot approximately 30% longer, slightly wider than shell, semi-transparent, 5 yellowish-white marks on sides, two longer ones extending posteriorly, marks not extending to edge of foot, some orange spots present between marks. Lobes of split head semi-transparent, yellowish-white marks medially, orange marks laterally. Tentacles short, semi-transparent, unmarked (occasionally with orange marks). Eyes black. Siphon short, translucent white. Mantle roof extensively covered by green areas with orange spots and paler yellowish-white areas also with orange spots, darker areas partially outlined with black, similar chromatism present beneath teleoconch whorls. An outstanding trait is the speed at which this species moves - approximately twice that of other Caribbean *Gibberula* species.

Distribution. Known from Type Locality and adjacent deeper water north of Isla Cubagua.

Habitat. All specimens were dredged at 18 or 35 metres in shelly mud or sand. These two adjacent localities are situated in the Margarita Channel which has moderate tidal currents.

Discussion. This species should be compared with *Gibberula velox* n. sp. (Figs. 50-53) from Aruba, which is a closely related species. Both have approximately the same mantle roof pattern, similar shell shape and size, and similar speed of movement, otherwise there are some significant differences. *G. velox* n. sp. was collected from hard algal growth on rocks, at night, has more, finer labial denticles, chromatism has a whitish hue. In *G. celerae* n. sp. chromatism has a strong green hue which appears to be associated with habitat and was observed by the author in most live dredged *Gibberula*. The habitat of these two new species is very different.

Etymology. The name alludes to the speed at which *G. celerae* n. sp. moves, and is taken from the Latin 'celer' meaning 'quick'.

***G. conejoensis* n. sp.**

Figs. 21-25

Type material. Venezuela, Islas Los Testigos, Isla Conejo. Holotype. 11°22.6'N 63°05.1'W, 2 m, mossy sand on rocks, 2.55 x 1.66 mm, W:L 65 %, ad. lv., MNHN 20469; Paratype 1. 11°22.7'N 63°06.0'W, 18 m, rubble, 2.94 x 1.92 mm, W:L 65 %, ad. lv., MNHN 20485; Paratype 2. 11°22.6'N 63°05.1'W, 2 m, mossy sand on rocks, 2.60 x 1.70 mm, W:L 65 %, ad. lv., AWC; Paratype 3. 11°22.6'N 63°05.1'W, 2 m, mossy sand on rocks, 2.25 x 1.47 mm, W:L 65 %, ad. lv., TMC; Paratype 4. 1°22.6'N 63°05.1'W, 2 m, mossy sand on rocks, 2.32 x 1.51 mm, W:L 65%, ad. lv., TMC; Paratype 5. 1°22.6'N 63°05.1'W, 2 m, mossy sand on rocks, 2.31 x 1.52 mm, W:L 66%, ad. lv., AWC.

Other material. 5 ad. lv., 3 juv. lv., Venezuela, Islas Los Testigos, Isla Conejo, 11°22.6'N 63°05.1'W, 2m, mossy sand on rocks; 3 ad. lv., 7 juv. lv., Venezuela, Islas Los Testigos, Isla Conejo, 11°22.7'N 63°06.0'W, 18 m. rubble.

Type locality. Venezuela, Islas Los Testigos, Isla Conejo, 11°22.6'N 63°05.1'W. (Map: Ref. 5).

Description. Shell, smooth, glossy, semi-transparent, obovate, size range 2.25 x 1.47 mm to 2.94 x 1.92 mm, W:L 65-66%, spire very low, apex slightly pointed, suture indistinct, sweeps up to labial insertion point at suture on previous whorl, shoulder and posterior notch moderately strong. Lip straight internally, thickened, completely filled with 18 denticles located slightly below internal edge, weak posteriorly, and weak anteriorly on moderate flare. Three strong columellar plications and two lirae fill

approximately half aperture, first thickened medially, small keel present, heavy anterior callus deposit, light wash extends to posterior notch, thickened medially, weak parietal callus ridge present. Aperture wide, widening more anteriorly. Animal. Foot approximately 30% longer and slightly wider than shell, semi-transparent, 4 yellowish-white marks on sides and 2 longer white marks extending posteriorly, all extending to edges of foot, spaces between marks bear many dull orange spots. Split head and tentacles semi-transparent, head yellowish-white medially with many adjoining orange marks, tentacles unmarked. Eyes black. Siphon white, unmarked. Mantle roof with yellowish-white background variegated with fine reddish-orange spots, pattern with 4 constant irregularly shaped marks formed by many contiguous reddish orange spots, green areas centrally, edged with black, in dorsal view largest mark located slightly right of centre, smaller vertically elongate mark located on left side, 2 small marks located below suture, one to left, one to right, similar chromatism located under the teleoconch whorls, apex yellowish-white.

Distribution. Only known from the Type locality.

Habitat. Rock and rubble covered with mossy sand at 2 m, also rubble at 18 m (dredged).

Discussion. *Gibberula conejoensis* n. sp. is compared with *Gibberula jenphillipsi* n. sp. (Figs. 63-67), a more inflated shell with strong, anterior, axial, callus ridge which is diagnostic, and totally different mantle roof pattern, and *Gibberula fortis* n. sp. (Figs. 6-9), an elongate species with distinctive flat topped second plication and totally different mantle roof pattern. *Gibberula stella* n. sp. has similarities in mantle roof pattern which indicates a close relationship, but is otherwise distinctly different.

Etymology. The name is taken from Type locality

***Gibberula fortis* n. sp.**

Figs. 6-9

Type material. Venezuela, Los Monjes, 12°21.4'N 70°54.0'W, 16 m, muddy sand. Holotype. 3.17 x 1.82 mm, W:L 58%, ad. lv., MNHN 20470; Paratype 1. 3.38 x 1.88 mm, W:L 56%, ad. lv., MNHN 20486; Paratype 2. 3.59 x 1.93 mm, W:L 54%, ad. dd., AWC; Paratype 3. 3.25 x 1.83 mm, W:L 56%, ad. lv., TMC. Columbia, San Andres, 12°33.6'N 81°40.8'W, 2 m, coarse sand. Paratype 4. 2.58 x 1.47 mm, W:L 57%, ad. lv., AWC; Paratype 5. 2.76 x 1.62 mm, W:L 59%, ad. lv., TMC.

Other material. 1 ad. lv., Venezuela, Los Monjes, 12°21.4'N 70°54.0'W, 16 m, muddy sand; 6 ad. lv., 12 juv. lv., Columbia, San Andres, 12°33.6'N 81°40.8'W, 2 m, coarse sand

Type locality. Venezuela, Monjes del Sur, harbour, 12°21.4'N 70°54.0'W. (Map: Ref. 6).

Description. Shell smooth, glossy, translucent white, obovate, size range 2.58 x 1.47 mm to 3.59 x 1.93 mm, W:L 54-59%, spire low, apex pointed, suture slightly stepped with new growth overlapping previous turn with fine, distinct growth lines, suture sweeps up to labial insertion point at previous turn, shoulder weak and rounded. Lip very straight, thickened, slightly flared anteriorly, 8 weak denticles on inside, fill half. Three strong columellar plications and three lirae fill approximately half of aperture, first slightly thickened medially, small keel present, second very strong with a distinctly flattened top, anterior callus light, extending posteriorly as wash, thickening at and above posterior notch, weak parietal callus ridge present. Aperture straight, moderately wide. Animal. Foot approximately 30% longer and same width as shell, semi-transparent, six white marks on sides, two longer marks extending posteriorly, orange spots between white marks. Split head semi-transparent, white medially, orange spots at sides, tentacles short, semi-transparent, without markings. Eyes black. Siphon short, white. Mantle roof white, background variegated with faint orange markings, two strong, distinctive marks comprised of bright orange spots, edged with black, one small, approximately horizontal at lower right side, another beneath penultimate whorl.

Distribution. Known from Type locality and San Andres, Columbia.

Habitat. Monjes del Sur specimens collected in muddy sand at approximately 15 m. San Andres specimens collected in large lagoon on east side of island in clean sand patches close to coral heads in 1 to 2 m, some wave action and current caused by sea coming over vital reef.

Discussion. *Gibberula fortis* n. sp. appears to be related to *G. arubagrandsis* n. sp. (Figs. 1-2 and 4-5), with which it is compared, as common features are present. Distinguishing features are the large size, distinctive markings on mantle roof, very straight inner edge to lip, weak denticles, and particularly the very flat topped second plication. *G. fortis* n. sp. is the second largest Caribbean species of *Gibberula* collected by the author.

Etymology. The name alludes to the size and robust nature of this species. The Latin word 'fortis' translates as 'strong' and 'sturdy'.

***Gibberula fortisminor* n. sp.**

Figs. 15-20

Type material. West Indies, St. Vincent & Grenadines, Isle Quatre, 12°57.6'N 61°15.0'W, 2-3 m,

mossy sand on rocks. Holotype. 1.72 x 1.03 mm, W:L 60%, ad. lv., MNHN 20471; Paratype 1. 1.63 x 0.94 mm, W:L 58%, ad. lv., MNHN 20487; Paratype 2. 1.87 x 1.07 mm, W:L 57%, ad. lv., AWC; Paratype 3. 1.71 x 1.01 mm, W:L 59%, ad. lv., TMC; Paratype 4. 1.76 x 1.01 mm, W:L 57%, ad. lv., TMC; Paratype 5. 1.69 x 0.98 mm, W:L 58%, ad. lv., AWC.

Other material. 12 ad. lv., West Indies, St. Vincent & Grenadines, Isle Quatre, 12°57.6'N 61°15.0'W.

Type locality. West Indies, St. Vincent & Grenadines, Isle Quatre, 12°57.6'N 61°15.0'W. (Map: Ref. 7).

Description. Shell smooth, glossy, translucent white, obovate, size range 1.63 x 0.94 mm to 1.87 x 1.07 mm, W:L 57-60%, spire low, apex moderately pointed, suture smooth, teleoconch whorls slightly convex, suture sweeps up slightly to labial insertion point slightly below previous turn, shoulder moderately strong, posterior notch weak. Lip straight, slightly curled inwards and raised, thickened, slightly flared anteriorly, 8 very weak denticles fill more than half. Three columellar plications and two lirae fill half of aperture, first two strong, third and lirae getting progressively weaker, moderately strong anterior callus wash extends to posterior notch, weak parietal callus ridge present. Aperture moderately wide, slightly more so anteriorly. Animal. Foot approximately 20% longer and slightly wider than shell, semi-transparent, 6 whitish marks along sides, two longer ones extending posteriorly, markings extend to edge of foot, all interspersed with orange and black spots. Lobes of split head semi-transparent, extensive whitish marks medially, orange on edges, tentacles semi-transparent, without markings. Eyes black. Siphon short, white. Mantle roof with white background, three constant and distinctive marks - a medium sized mark located anterior right quarter with weakening extension extending upwards, two smaller marks below suture, one on left side, one on right side. The marks are green or black, intermingled with dull orange spots, the black tending to encircle the green.

Distribution. Only known from the Type locality.

Habitat. West shore of Isla Quatre, on rocks covered with mossy sand and some weed at 2-3 m. Water clean, some wave action.

Discussion. *Gibberula fortisminor* n. sp. most closely resembles *Gibberula quatrefortis* n. sp. (Figs. 10-14). These two species live in adjacent habitats - the former being mossy sand covering rocks at 2-3 m, the latter being sand around the rocks at 7-12 m. Two significant differences separate the species, firstly size: length of adult specimens of *G. fortisminor* n. sp. range from 1.63 mm to 1.87 mm, and of *G. quatrefortis* n. sp. from 2.49 mm to 2.82 mm, secondly: animal chromatism is significantly different in the two species.

Etymology. The name is taken from the Type locality and close relationship to *G. quaterfortis* n. sp.

***G. gradatim* n. sp.**

Figs. 57-62

Type material. Holotype. Venezuela, Aves de Sotavento, 12°03.5'N 67°40.5'W, 1-2 m, sand, 2.33 x 1.26 mm, W:L 54%, ad. lv., MNHN 20472; Paratype 1. Venezuela, Aves de Barlovento, 11°59.6'N 67°25.2'W, 22 m, fine sand, 2.63 x 1.42 mm, W:L 54%, ad. lv., MNHN 20488; Paratype 2. Venezuela, Aves de Sotavento, 12°03.5'N 67°40.5'W, 1-2 m, sand, 2.26 x 1.21 mm, W:L 54%, ad. lv., AWC; Paratype 3. Venezuela, Aves de Barlovento, 11°59.6'N 67°25.2'W, 1-2 m, sand, 2.18 x 1.22 mm, W:L 56%, ad. lv., TMC; Paratype 4. Venezuela, Aves de Barlovento, 12°03.5'N 67°40.5'W, beach, 2.48 x 1.26 mm, W:L 51%, ad. lv., TMC; Paratype 5. Venezuela, Aves de Sotavento, 12°03.5'N 67°40.5'W, beach, 2.46 x 1.37 mm, W:L 56%, ad. lv., AWC.

Other material. 1 juv. lv., Venezuela, Aves de Barlovento, 11°59.6'N 67°25.2'W.

Type locality. Venezuela, Aves de Sotavento, 12°03.5'N 67°40.5'W. (Map: Ref. 8).

Description. Shell, finely striate body whorl, otherwise smooth, glossy, semi-transparent, sub-cylindrical, size range 2.18 x 1.22 mm to 2.63 x 1.42 mm, W:L 51-56%, spire low, apex moderately pointed, suture very strongly stepped, teleoconch whorls convex, suture does not sweep up to labial insertion point slightly below previous turn, shoulder strong, posterior notch moderately deep. Lip straight, thickened and slightly raised posteriorly, slightly flared anteriorly, denticles and lirae absent. Three columellar plications and one lira fill approximately 35 % of aperture, plications not strong. Anterior callus forms uneven ridge at distal end of plications, leaning towards aperture, ridge reduces in strength at third plication, continuing posteriorly as parietal callus ridge, callus present around and above posterior notch. Aperture moderately wide, slightly wider posteriorly, more so anteriorly. Animal. Foot approximately 20% longer, slightly wider than shell, semi-transparent, six white marks on sides, anterior three being larger than posterior three, two stronger white patches extending posteriorly, all interspersed with dull translucent orange spots. Split head white medially, orange spots or patches present, tentacles semi-transparent, unmarked. Eyes black. Siphon short, solid white. Mantle roof with white background and some very small weak orange markings.

Distribution. Known from the Type locality and adjacent Aves de Barlovento.

Habitat. *Gibberula gradatim* n. sp. is a sand dwelling species. Depths varied from 1 or 2 m inside lagoon to below 20 m in sand patches, between coral heads on vital reef drop-off.

Discussion. *Gibberula gradatim* n. sp. with its combination of strongly stepped sutures and convex whorls is unique amongst known Caribbean *Gibberula* species. It has proved to be rare with only occasional specimens being found over several years. At first it was thought to be a freak, but evidence of it being a distinct species gradually built up and eventually four live specimens were found. No colony has yet been found, all specimens were collected singly. *G. gradatim* n. sp. is endemic to Las Aves, Venezuela.

Etymology. The name alludes to the stepped sutures. The Latin 'gradatim' translating as 'step by step'

***Gibberula granulinaformis* n. sp.**

Figs. 26-31

Type material. Venezuela, off Islas Los Testigos, 11°26.3'N 63°06.6'W, 73 m, muddy sand. Holotype. 1.76 x 1.22 mm, W:L 69%, ad. lv., MNHN 20473; Paratype 1. 1.94 x 1.32 mm, W:L 68%, ad. lv., MNHN 20489; Paratype 2. 1.88 x 1.32 mm, W:L 70%, ad. lv., AWC; Paratype 3. 1.87 x 1.37 mm, W:L 73%, ad. lv., TMC; Paratype 4. 1.86 x 1.30 mm, W:L 70%, ad. lv., AWC; Paratype 5. 1.89 x 1.22 mm, W:L 67%, ad. lv., TMC.

Other material. 14 ad. lv. 7 juv. lv., Venezuela, off Islas Los Testigos, 11°26.3'N 63°06.6'W.

Type locality. Venezuela, off Islas Los Testigos, 11°26.3'N 63°06.6'W. (Map: Ref. 9).

Description. Shell, smooth, glossy, semi-transparent, broadly elliptic, size range 1.76 x 1.22 mm to 1.94 x 1.32 mm, W:L 67-73%, spire very low, apex rounded, suture callused over, obscured, suture sweeps up slightly to labial insertion point at apex, shoulder strong, raised, posterior notch weak. Lip thickened, curled inwards medially, slightly flared anteriorly, 8 widely spaced weak denticles fill anterior half, very weak on flare. Three strong plications and two lirae fill approximately 40% of aperture. Anterior callus light, extending posteriorly as a wash, thickens strongly around posterior notch and apex, moderately strong parietal callus ridge present. Aperture curved, narrow medially, wider posteriorly, more so anteriorly. Animal. Foot approximately 20% longer and slightly wider than shell, semi-transparent, undetermined number of diffuse yellowish-white marks on sides, two longer ones extending posteriorly, some marks extending to edge, some orange spots between marks. Split head yellowish-white medially, adjacent small orange patches, tentacles semi-transparent, unmarked. Eyes black. Siphon short,

solid, yellowish-white. Mantle roof randomly covered with predominantly pale, dull, greenish-yellow background, small, pale, off white, yellow, and orange spots, some small black areas with orange spots. Same chromatism present beneath teleoconch whorls. Radula, type 3, typical of *Gibberula*.

Distribution. Only known from Type locality.

Habitat. 73 m, grit brownish yellow with strongly stained, broken shells.

Discussion. *Gibberula granulinaformis* n. sp. is uniquely shaped among known Caribbean *Gibberula* species, and shells can easily be confused with those of genus *Granulina* Jousseaume, 1888. The closest comparable species is *Gibberula ubitaensis* Espinosa & Ortea, 2000, Punta Ubita, Manzanillo, Costa Rica. This western Caribbean species also has a very high labial insertion point, but is not granulinaform in shape.

Etymology. The name is taken from the shape of the shell which closely resembles that of genus *Granulina* Jousseaume, 1888.

***Gibberula jenphillipsi* n. sp.**

Figs. 63-67

Type material. Curaçao, Spaanse Water, 12°04.4'N 68°51.1'W, <1-2 m, weedy rocks. Holotype. 2.43 x 1.64 mm, W:L 68%, ad. lv., MNHN 20474; Paratype 1. 2.35 x 1.62 mm, W:L 69%, ad. lv., MNHN 20490; Paratype 2. 2.60 x 1.69 mm, W:L 65%, ad. lv., AWC; Paratype 3. 2.61 x 1.73 mm, W:L 66%, ad. lv., AWC; Paratype 4. 2.61 x 1.68 mm, W:L 64%, ad. lv., TMC; Paratype 5. 2.28 mm, Juv., ad. lv., TMC.

Other material. 23 ad. lv., 7 juv., lv., Curaçao, Spaanse Water, 12°04.4'N 68°51.1'W, <1-2 m, weedy rocks.

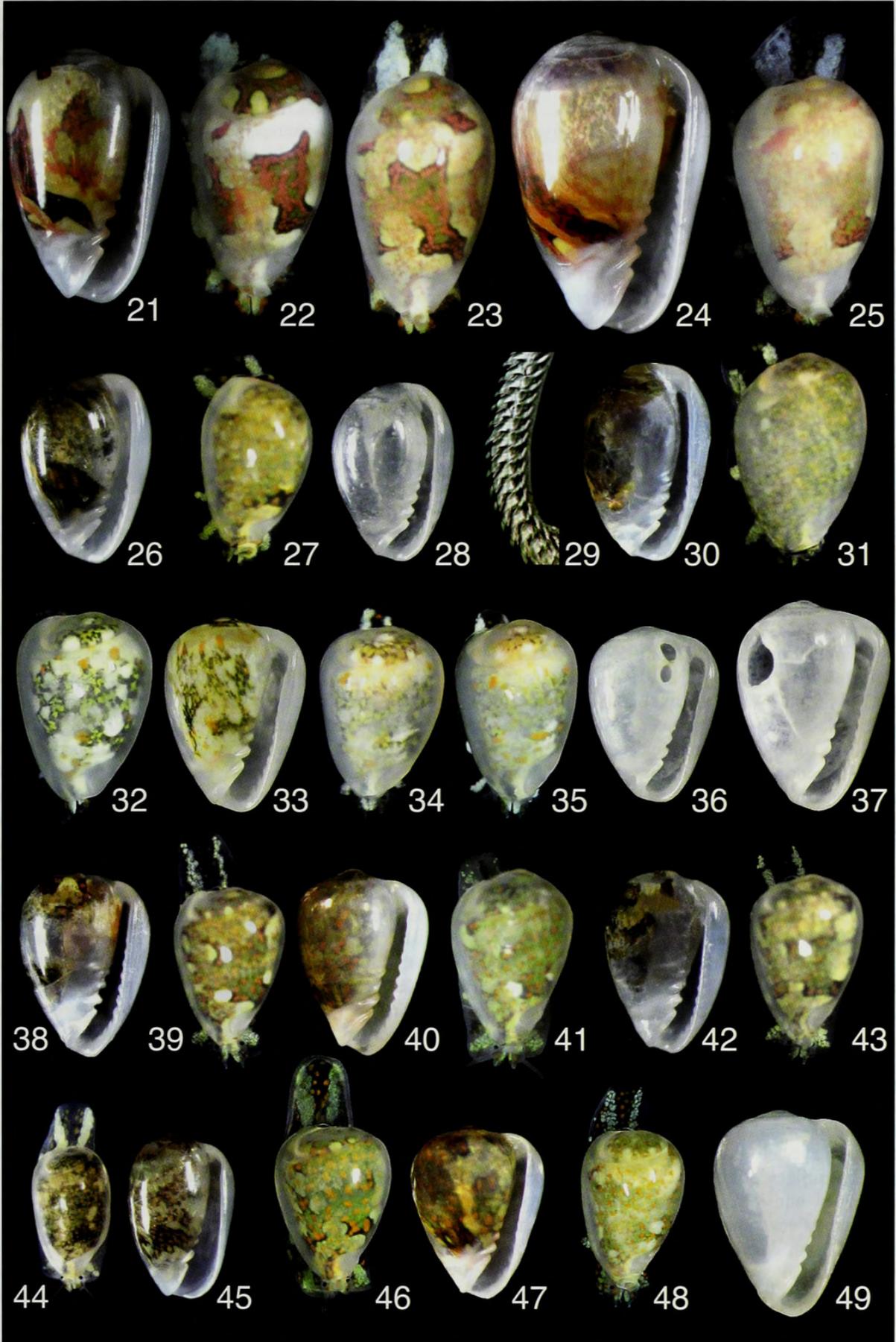
Type locality. Curaçao, Spaanse Water, 12°04.4'N 68°51.1'W. (Map: Ref. 1).

Description. Shell, smooth, glossy, semi-transparent, globose, size range 2.35x1.62 mm to 2.61x1.73 mm, W:L 64-69%, spire low, apex slightly pointed, suture smooth, indistinct, early teleoconch whorls slightly convex, suture sweeps up slightly to labial insertion point at previous turn, shoulder moderately strong, posterior notch weak. Lip slightly curved, more so anteriorly, slightly curled inwards, raised, thickened posteriorly, slightly flared anteriorly, 18 fine well defined denticles fill complete length, located close to edge posteriorly, remote from edge anteriorly, weak on flare. Three columellar plications and one lira fill half of aperture, plications merge distally with anterior callus to form distinct, short, strong, approximately vertical ridge, ridge sharply curved at junction with first plication, callus wash extends to posterior notch where it thickens, parietal callus ridge present. Aperture curved, moderately wide, widening anteriorly. Animal. Foot approximately 30% longer and slightly wider than shell, translucent white, six diffuse pale yellowish marks along sides, two longer marks extending posteriorly, marks interspersed with small black, and fewer orange spots. Lobes of split head translucent white, pale yellow marks medially, greyish-black patches, and orange spots laterally, tentacles translucent white, unmarked. Eyes black, surrounded by irregularly shaped translucent white rings. Siphon short, solid, pale yellow. Mantle roof, pale yellow background, ill-defined, predominantly dull green pattern with some orange spots, some small black areas, background appears through green pattern as approximately twelve large, more or less round marks, often merging to form larger pale yellowish background areas, same chromatism present beneath teleoconch whorls.

Distribution. Only known from the Type locality.

Figures 21-49

21-22. *G. conejoensis* n. sp. Holotype, Venezuela, Islas Los Testigos, Isla Conejo, 2-3 m; **23.** *G. conejoensis* n. sp. Paratype 2, Venezuela, Islas Los Testigos, Isla Conejo, 2-3 m; **24-25.** *G. conejoensis* n. sp. Paratype 1, Venezuela, Islas Los Testigos, Isla Conejo, 18 m; **26.** *G. granulinaformis* n. sp. Paratype 2, Venezuela, off Islas Los Testigos, 73 m; **27-28.** *G. granulinaformis* n. sp. Holotype, Venezuela, off Islas Los Testigos, 73 m; **29.** *G. granulinaformis* n. sp. Holotype, Venezuela, off Islas Los Testigos, 73 m. *Gibberula*, type 3, radula; **30-31.** *G. granulinaformis* n. sp. Paratype 1, Venezuela, off Islas Los Testigos, 73 m; **32-33.** *G. belizensis* n. sp. Holotype, Belize, 130 m; **34.** *G. belizensis* n. sp. Paratype 3, Belize, 130 m; **35.** *G. belizensis* n. sp. Paratype 4, Belize, 130 m; **36.** *G. belizensis* n. sp. Paratype 1, Belize, 130 m; **37.** *G. belizensis* n. sp. Paratype 2, Belize, 130 m; **38-39.** *G. oriens* n. sp. Holotype, Venezuela, off Isla Cubagua, 18 m; **40-41.** *G. oriens* n. sp. Paratype 1, Venezuela, off Cumana, 38 m; **42-43.** *G. oriens* n. sp. Paratype 5, Venezuela, off Isla Cubagua, 18 m; **44-45.** *G. aperta* n. sp. Holotype, Curacao, Spanish Water, 1 m; **46-47.** *G. occidentalis* n. sp. Holotype, Honduras, 65 m; **48.** *G. occidentalis* n. sp. Paratype 3, juv. Panama, off Chagres, 62 m; **49.** *G. occidentalis* n. sp. Paratype 1, Honduras, 65 m.



Habitat. *Gibberula jenphillipsi* n. sp. is a rock dwelling species, found in tidal channel connecting Spaanse Water with open sea and inside lagoon in areas close to entrance. This seems to indicate a preference for reasonably clean water. Many of rocks have a dense covering of various types of weed, often mixed with fine sediment. Depth was <1 to 2 metres. It was not found in the adjacent sandy areas.

Discussion. *Gibberula jenphillipsi* n. sp. stands apart from all other described Caribbean *Gibberula* species on account of three distinctive features: large globose shape of shell, pattern with numerous round yellowish white marks, and uniquely shaped short anterior callus ridge.

Etymology. The name acknowledges the help received from Jen Phillips, an enthusiastic collector of marginellids and close friend of the author.

***G. occidentalis* n. sp.**

Figs. 46-49

Type material. Holotype. Honduras N.E., 16°06.4'N 84°32.5'W, 65 m, mud, 1.71 x 1.34 mm, W:L 78%, ad. lv., MNHN 20475; Paratype 1. Honduras N.E., 16°06.4'N 84°32.5'W, 65 m, mud, 1.86 x 1.37 mm, W:L 74%, ad. lv., MNHN 20491; Paratype 2. Panama, Veraguas, 9°11.9'N 81°41.3'W, 50 m, mud, 2.02 x 1.55 mm, W:L 77%, ad. dd., AWC; Paratype 3. Panama, Chagres, 9°20.7'N 80°08.9'W, 62 m, mud, 2.08 mm, juv. dd., TMC; Paratype 4. Panama, Bocas del Toro, 9°22.9'N 82°08.4'W, 55 m, mud, 1.82 x 1.42 mm, W:L 78%, ad. dd., TMC; Paratype 5. Panama, Bocas del Toro, 9°19.5'N 82°00.5'W, 66 m, mud, 2.09 x 1.56 mm, W:L 75%, ad. dd., AWC.

Other material. 1 ad. lv., 12 ad. dd., 5 juv. dd., Honduras N.E., 16°06.4'N 84°32.5'W, 65 m, mud; 3 ad. lv., 55 ad. dd., 10 juv. dd., Panama, Chagres, 9°20.7'N 80°08.9'W, 62 m, mud; 18 ad. dd., 5 juv. dd., Panama, Veraguas, 9°11.9'N 81°41.3'W, 50 m, mud; 1 ad. lv., 1 ad. dd., 2 juv. dd., Panama, Bocas del Toro, 9°22.9'N 82°08.4'W, 55 m, mud; 9 ad. dd., 4 juv. dd., Panama, Bocas del Toro, 9°19.5'N 82°00.5'W, 66 m, mud.

Type locality. Honduras, off to north east, 16°06.4'N 84°32.5'W. (Map: Ref. 10).

Description. Shell smooth, glossy, semi-transparent, triangular, inflated, size range 1.71 x 1.34 mm to 2.09 x 1.56 mm, and W:L 74% to 78%, spire very low, apex almost flat. Suture sweeps up to very high labial insertion point level with apex. Shoulder strong, posterior notch weak. Lip straight, wide, curled inwards, slightly flared, extends below level of strong anterior notch, approximately 6 weak denticles fill anterior half, very weak on flare. Three columellar plications and one lira fill slightly less than half of

aperture, first strong, raised with small keel, second and third weaker, anterior callus moderately strong, light callus wash extends to posterior notch, with little parietal wall thickening. Aperture is moderately wide, slightly wider anteriorly. Animal. Foot approximately 50% longer and narrower than shell, semi-transparent, undetermined number of yellowish-white marks, interspersed with bright orange spots. Lobes of split head with yellowish marks medially and semi-transparent extremities, orange marks present, short tentacles are unmarked. Two black eyes encircled with light greyish rings are located posteriorly at base of tentacles. Siphon short, translucent yellowish-white. Mantle roof randomly covered with predominantly green background with many orange spots, and a few large yellowish-white spots. Where orange spots are grouped they are edged in black. Same chromatism present beneath the early teleoconch whorls.

Distribution. Only known in western Caribbean, from Type locality and south to Panama.

Habitat. *Gibberula occidentalis* n. sp. was dredged at a number of stations over a wide area, substrate was always soft and muddy. Dredging depths varied from 37 to 66 m, dredgings from the Chagres area of Panama were noted to contain much rotted wood debris washed out from Rio Chagres.

Discussion. This minute species is located geographically between the Type localities of *Gibberula belizensis* n. sp. (Figs. 32-37), and *Gibberula oriens* n. sp. (Figs. 38-43), and is compared with both. All are deep water species and approximately the same size. *G. belizensis* n. sp. has an unusually weak anterior notch, relatively elongate shell, and solid white marks on foot. *G. oriens* n. sp. has a heavy callus ridge at the emergent edge of a deep flat parietal wall, very strong plications which are excavated, wide lip which is curled inwards, and a distinctive elongated black mark medially at posterior end of foot. *G. occidentalis* n. sp. has a strong anterior notch, shell very inflated and marks on foot are comprised of minute spots. All three species are distinctly different.

Etymology. The name alludes to the western Caribbean distribution of *Gibberula occidentalis* n. sp. The Latin adjective for 'west' is 'occidentalis'.

***Gibberula oriens* n. sp.**

Fig. 38-43

Type material. Holotype. Venezuela, Isla Cubagua, 10°49.7'N 64° 06.1'W, 18 m, rubble, 1.84 x 1.28 mm, W:L 70%, ad. lv., MNHN 20476; Paratype 1. Venezuela, off Cumana, 10°26.5'N 64°15.8'W, 134 m, mud, 1.89 x 1.37 mm, W:L 72%, ad. lv., MNHN 20492; Paratype 2.

Venezuela, Islas Los Testigos, 11°17.0'N 62°51.7'W. 60 m, mud, 1.76 x 1.29 mm, W:L 73%, ad. dd., AWC; Paratype 3. Tobago, 11°15.3'N 60°47.0'W. 86 m, mud, 1.87 x 1.43 mm, W:L 76%, ad. dd., TMC; Paratype 4. Venezuela, Isla Cubagua, 10°49.7'N 64° 06.1'W, 18 m, rubble, 1.85 x 1.34 mm, W:L 72%, ad. lv., TMC; Paratype 5. Venezuela, Isla Cubagua, 10°49.7'N 64° 06.1'W, 18 m, rubble, 1.79 x 1.26 mm, W:L 70% ad. lv., AWC.

Other material. 3 ad. lv., 2 ad. dd., Venezuela, Isla Cubagua, 10°49.7'N 64° 06.1'W, 18 m, rubble; 3 ad. dd., Venezuela, Islas Los Testigos, 11°17.0'N 62°51.7'W, 60 m. mud; 1 ad. lv., 1 juv. lv., 1 juv. dd., Venezuela, off. Cumana, 10°26.5'N 64°15.8'W, 134 m, mud; 63 ad. dd., 5 juv. dd., Tobago, 11°15.3'N 60°47.0'W, 86 m, mud.

Type locality. Venezuela, Isla Cubagua, 10°49.7'N 64° 06.1'W. (Map: Ref. 4).

Description. Shell smooth, shiny, semi-transparent, triangular, size range 1.76 x 1.29 mm to 1.89 x 1.37 mm, W:L 70-76%. Spire very low, sides smooth, apex slightly pointed, suture very indistinct, suture sweeps up to very high labial insertion point almost level with apex. Shoulder and posterior notch moderately strong. Lip straight, wide, strongly curled inwards, extends well below level of strong anterior notch, 9 denticles fill more than half, strong medially, very weak on flare. Three very strong columellar plications and one lira (occasionally up to 4) fill more than half of aperture, anterior callus strong, light callus wash extends to posterior notch, strong parietal callus ridge present, parietal wall deep, plications excavated. Aperture, straight, relatively narrow. Animal. Foot approximately 50% longer and narrower than shell, semi-transparent, undetermined number of amorphous yellowish-white marks on sides and two longer ones extending posteriorly, interspersed with some dull orange spots and black marks, distinct elongated black mark posterior medially. Lobes of split head with greenish-yellow marks medially and semi-transparent extremities, orange and black spots present, tentacles short, semi-transparent, unmarked. Eyes black. Siphon short, translucent yellowish-white. Mantle roof with predominantly greenish-brown background and orange spots, interspersed with larger round yellowish-white marks, many small marks are edged with black, same chromatism present beneath teleoconch whorls.

Distribution. An eastern Caribbean species known to range from off Cumana, Venezuela, through the Type locality, to off Islas Los Testigos, and Tobago.

Discussion. This species is compared with *Gibberula occidentalis* n. sp. (Figs. 46-49), and *Gibberula*

belizensis n. sp. (Figs. 32-37), which are of similar size and are also deep water species. The heavy parietal callus ridge, deep flat parietal wall, distinct black mark on posterior end of foot, and unusually amorphous foot markings, distinguish *G. oriens* n. sp. from all other Caribbean *Gibberula*.

Etymology. The name alludes to the eastern Caribbean distribution of *Gibberula oriens* n. sp. The Latin translation for 'east' is 'oriens'.

Gibberula quatrefortis n. sp.

Figs. 10-14

Type material. West Indies, St. Vincent & Grenadines, Isle Quatre, 12°57.6'N 61°15.0'W, 7-12 m, sand.

Holotype. 2.62 x 1.45 mm, W:L 55%, ad. lv., MNHN 20477; Paratype 1. 2.72 x 1.58 mm, W:L 58%, ad. lv., MNHN 20493; Paratype 2. 2.49 x 1.36 mm, W:L 55%, ad. dd., AWC; Paratype 3. 2.52 x 1.39 mm, W:L 55%, ad. lv., TMC; Paratype 4. 2.68 x 1.53 mm, W:L 57%, ad. dd., TMC; Paratype 5. 2.82 x 1.73 mm, W:L 61%, ad. lv., AWC.

Other material. >100 ad. lv., West Indies, St. Vincent & Grenadines, Isle Quatre, 12°57.6'N 61°15.0'W, 7-12 m, sand.

Type locality. West Indies, St. Vincent & Grenadines, Isle Quatre, 12°57.6'N 61°15.0'W. (Map: Ref. 7).

Description. Shell smooth, glossy, semi-transparent, obovate, size range 2.49 x 1.36 mm to 2.82 x 1.73 mm, W:L 55-61%, spire low, apex rounded, sutures slightly stepped with new growth overlapping previous turn, suture sweeps up to labial insertion point slightly below previous turn, shoulder sloping. Lip slightly sinuous, slightly curled inwards, raised posteriorly, thickened, flared anteriorly, 9 weak denticles fill anterior half, very weak on flare. Three strong columellar plications and three lirae fill less than half aperture, anterior callus light extending as light wash to posterior notch and suture, weak parietal callus ridge present. Aperture moderately wide and straight. Animal. Foot approximately 30% longer, slightly wider than shell, semi-transparent, seven variously sized white marks on sides, two stronger white patches extending posteriorly, dull orange spots between. Split head white medially, with orange spots, semi-transparent sides. Tentacles semi-transparent, unmarked. Eyes black. Siphon short, translucent white. Mantle roof, white background, distinctive, strong markings, black with orange spots, largest located in anterior right quarter at side, shaped somewhat like reversed 'L', similar coloured, smaller mark beneath penultimate whorl.

Distribution. Only known from the Type locality.

Habitat. *Gibberula quatrefortis* n. sp. is a sand dwelling species, preferring fine undisturbed sand. The grey sand at Type locality is comprised of a mixture of black and white sand and a small amount of other colours.

Discussion. *Gibberula quatrefortis* n. sp. appears to be closely related to *Gibberula fortis* n. sp. (Figs. 6-9), and both are sand dwellers (muddy sand in the case of *G. fortis* n. sp.). Distinguishing features are: *G. fortis* n. sp. has a distinctive strong, flat topped second plication. *G. quatrefortis* n. sp. has weaker, rounded plications, and significantly stronger mantle roof pattern. They are geographically separated by approximately 300 miles.

Etymology. The name is taken from the Type locality and close relationship to *G. fortis* n. sp.

***Gibberula stella* n. sp.**

Figs. 74-79

Type material. Holotype. Honduras, Cayos Vivarillo, 15°51.1'N 83°18.3'W, 1-2 m, rocks, 1.80 x 1.19 mm, W:L 66%, ad. lv., MNHN 20478; Paratype 1. Honduras, Cayos Vivarillo. 15°51.1'N 83°18.3'W, 1-2 m, rocks, 1.66 x 1.11 mm, W:L 67%, ad. lv., MNHN 20494; Paratype 2. Honduras, Cayos Vivarillo, 15°51.1'N 83°18.3'W, 1-2 m, rocks, 1.88 x 1.22 mm, W:L 65%, ad. lv., AWC; Paratype 3. Nicaragua, Great Corn Island, 12°10.5'N 83°03.9'W, 6 m, rubble amongst grass, 1.69 x 1.14 mm, W:L 68%, ad. lv., AWC; Paratype 4. Honduras, Roatan, Mud Hole swash, 16°21.7'N 86°31.3'W, 1-2 m, rocks and rubble, 1.71 x 1.10 mm, W:L 64%, ad. lv., TMC; Paratype 5. Honduras, Roatan, Mud Hole swash, 16°21.7'N 86°31.3'W, 1-2 m, rocks and rubble, 1.65 x 1.06 mm, W:L 64%, ad. lv., TMC.

Other material. >50 ad. lv., Honduras, Cayos Vivarillo, 15°51.1'N 83°18.3'W; 3 ad. lv., 4 juv. lv., Nicaragua, Great Corn Island, 12°10.5'N 83°03.9'W; 12 ad. lv., 4 juv. lv., Honduras, Roatan, Mud Hole swash, 16°21.7'N 86°31.3'W.

Type locality. Honduras, Cayos Vivarillo, 15°51.1'N 83°18.3'W. (Map: Ref. 11).

Description. Shell smooth, glossy, semi-transparent, apex opaque white, triangular, size range 1.88x1.22 mm to 1.65x1.06 mm, W:L 64-68%, spire low, apex sharply pointed, sutures smooth, glazed over, indistinct, suture sweeps up to labial insertion point fractionally below previous turn, shoulder wide, sloping, posterior notch weak. Lip straight, thickened, curled inwards, slightly raised posteriorly, flared anteriorly, 4 very weak, widely spaced denticles on anterior half, not on flare. Three widely spaced columellar plications and one lira fill half of aperture, first slightly raised medially forming small keel. Anterior callus thick, short, strong axial ridge where

first and second plications merge into it, light callus wash extends to posterior notch and over adjacent suture, parietal callus ridge present. Aperture moderately wide posteriorly, widening evenly, becoming wide anteriorly. Animal. Foot approximately 30% longer, slightly wider than shell, semi-transparent, five solid white marks along sides, two longer marks extending posteriorly, all reaching to edges of foot, white marks interspersed with small orange spots. Lobes of split head solid white medially, some adjacent orange spots. Tentacles semi-transparent, unmarked. Eyes black, some adjacent orange marks. Siphon short, solid white. Mantle roof predominantly white, comprised of 15, broadly round, contiguous, white areas forming solid white background, two brightly coloured, large, irregularly star shaped marks, and two very small marks are constant. Stars located medially, comprised of green centres, without or without orange spot, centres surrounded by contiguous orange spots extending onto points of stars, orange outlined in black, concave sides of stars each filled with one round white mark, adjacent round white marks merge at points of stars. Small marks located closely anterior to suture, one at each side, orange, outlined in black. Round white marks, separated by faint orange lines present beneath penultimate whorl.

Distribution. Western Caribbean, Nicaragua, Great Corn Island. 12°10.5'N 83°03.9'W, through the Type Locality to Honduras, Roatan, Mud Hole swash.

Habitat. Weedy or sandy rocks and rubble, shallow. This species seems to be tolerant of varied conditions.

Discussion. *Gibberula stella* n. sp. stands alone amongst the species so far described in the genus on account of its very small size, striking pattern, and striking white appearance when live. *Gibberula conejoensis* n. sp. (Figs. 21-25), has similarities in mantle roof pattern which indicates a close relationship, but is otherwise distinctly different. Redfern (2001) illustrates in colour a live specimen (Pl. 111, fig. 469C) which is closely related to *G. stella* n. sp., and two shells (Pl. 50, figs. 469 A = 469C, and B), as yet undescribed species from the Bahamas. The author has many lots of similar closely related specimens covering a wide range of shell morphology. Further study is required to establish whether *G. stella* n. sp. is a very variable species, or a member of a group of closely related species.

Examination of live animals revealed that the mantle roof pattern is three dimensional, and not a thin layer of pigmentation attached to a single flat, flexible membrane. Spots, particularly the broadly round white ones appear to be saucer shaped, floating in a transparent fluid along with all other mantle roof components, the whole of which appears to be contained within a thin transparent sack-like membrane.

Movement of components is limited so that they retain their relative positions to other components, but the whole mantle roof is very flexible, and round spots can become very distorted. At magnifications greater than X40 very fine dividing lines can be seen between the individual white spots which form the white areas on the mantle roof of *G. stella* n. sp.

Etymology. The name alludes to the star shaped pattern on the mantle roof. The Latin for 'star' being 'stella'.

***Gibberula velox* n. sp.**

Figs. 50-53.

Type material. Aruba, 12°29.8'N 70°01.7'W, 20 m, algae on rocks. Holotype. 1.73 x 1.12 mm, W:L 65%, ad. lv., MNHN 20479; Paratype 1. 2.12 x 1.40 mm, W:L 66%, ad. lv., MNHN 20495; Paratype 2. 1.73 x 1.11 mm. W:L 64%. ad. lv., TMC;

Other material. 1 juv. lv., Aruba, 12°29.8'N 70°01.7'W, 20 m., algae on rocks.

Type locality. Aruba, south west coast, 12°29.8'N 70°01.7'W. (Map: Ref. 12).

Description. Shell smooth, glossy, semi-transparent, sub triangular, size range 1.73 x 1.12 mm to 2.12 x 1.40 mm, and W:L 64- 66%, spire very low with smooth, straight sides, 3.5 to 4 whorls, apex slightly pointed, suture sweeps up strongly to high labial insertion point at suture on previous whorl, shoulder strong, posterior notch weak. Lip slightly curved, slightly thickened, flare extending below anterior notch, 10 denticles fill more than half lip, stronger anteriorly, weak on flare. Three columellar plications and one lira fill half of aperture, first and second strong, third weaker. Anterior callus not strong, light wash extends to posterior notch, thickening and widening considerably to form an elongated pad. Aperture straight, moderately wide. Animal. Foot approximately 30% longer, slightly wider than shell, semi-transparent with 5 white marks on sides, two longer ones extending posteriorly, no other pigmentation present, marks extend to edge of foot. Lobes of split head white medially, edges and extremities transparent, some orange spots present. Tentacles short, semi-transparent, without markings. Eyes black. Siphon, short, translucent white. Mantle roof whitish with some pale dull markings comprised of orange spots on darker background. An outstanding trait of this species is the speed at which it moves.

Distribution. Only known from the Type locality.

Habitat. Taken crawling on smooth hard algae on dead coral rocks during night dive at 20 metres on steep drop-off outside vital reef. The area is extremely clean and water still.

Discussion. Considered to be closely related to *Gibberula celerae* n. sp. (Figs. 54-56), from Venezuela, Isla Coche with which it is compared. Both have approximately the same mantle roof pattern, similar shell shape and size, and similar speed of movement, otherwise they differ significantly. *G. celerae* n. sp. pigmentation has a strong green hue which appears to be associated with its deep water habitat. *G. velox* n. sp. has more, finer labial denticles, and pigmentation with a whitish hue. The habitats of these two new species are different. The bifurcated first plication of Paratype 1, (Fig. 53), is considered to be a freak occurrence, seldom seen in Caribbean *Gibberula*.

Etymology. The name alludes to the speed at which *G. velox* n. sp. moves, 'velox' being the Latin for 'rapid'.

***Gibberula vitium* n. sp.**

Figs. 68-73

Type material. Venezuela, Islas Los Testigos, Isla Conejo, 11°22.6'N 63°05.1'W, 2 m, mossy sand on rocks. Holotype. 2.14 x 1.31 mm, W:L 61%, ad. lv.; MNHN 20480; Paratype 1. 1.93 x 1.20 mm, W:L 62%, ad. lv., MNHN 20496; Paratype 2. 2.02 x 1.25 mm, W:L 62%, ad. lv., AWC; Paratype 3. 2.18 x 1.37 mm, W:L 63%, ad. lv., TMC; Paratype 4. 2.32 x 1.41 mm, W:L 61%, ad. lv., TMC. Trinidad, Scotland Bay, 10°41.7'N 61°40.0'W, 3-4 m, rubble. Paratype 5. 2.11 x 1.39 mm, W:L 66%, ad. lv., AWC.

Other material. >40 ad. lv., Venezuela, Islas Los Testigos, Isla Conejo, 11°22.6'N 63°05.1'W, 2 m, mossy sand on rocks; 9 ad. lv., Trinidad, Scotland Bay, 10°41.7'N 61°40.0'W, 3-4 m, rubble.

Type locality. Venezuela, Islas Los Testigos, Isla Conejo. 11°22.6'N 63°05.1'W. (Map: Ref. 5).

Description. Shell smooth, glossy, semi-translucent, obovate, size range 1.93 x 1.20 mm to 2.32 x 1.41 mm, W:L 61-66%, spire low, apex moderately pointed, suture smooth, glazed over, indistinct, suture sweeps up slightly to labial insertion point slightly below previous turn, shoulder strong, posterior notch weak. Lip straight, thickened, slightly curled inwards, slightly raised posteriorly, weakly flared anteriorly, 7 low, weak denticles fill anterior half, not present on flare. Three widely spaced columellar plications followed by three lirae fill more than half aperture, second strongest, sharply turned downwards distally to join first, weak third and subsequent lirae do not emerge significantly, anterior callus unusually heavy, slightly textured, callus wash extends to posterior notch, parietal callus ridge present. Aperture wide posteriorly, wider anteriorly. Animal. Foot approximately 30% longer, slightly wider than shell, semi-transparent, six irregularly spaced white

marks on sides, two longer marks extending posteriorly, interspersed with small orange spots, all marks reach to edges of foot. Lobes of split head semi-translucent, white marks medially, orange spots adjacent. Tentacles semi-transparent, unmarked. Eyes black, encircled by greyish rings. Siphon short, solid white. Mantle roof randomly covered with either dull orange spots or ill-defined small greyish marks on black background and a number of whitish, generally round, larger marks located around edges. Many specimens have large orange-red patch medially which appears to be comprised of many very small spots merged together, similar colouring, except for red, present beneath teleoconch whorls.

Distribution. Type Locality and Trinidad, Scotland Bay, 10°41.7'N 61°40.0'W.

Habitat. Weedy rocks and rubble in locations with movement of water either from wave action, tidal current, or both. Depth 2 to 4 m. The sea can be greenish at times in the area bounded by Trinidad, the northern Venezuelan coast and Islas Los Testigos, and water temperature can be significantly lower than in other areas of the Caribbean. The author has experienced these phenomena as far westwards as Islas Tortugas. It is probable that the greenish water is rich in nutrients as the area is known to have a rich fauna – this is certainly the case with regards to Cystiscidae and Marginellidae.

Discussion. *Gibberula vitium* n. sp. most closely resembles *Gibberula aperta* n. sp. (Figs. 44-45), from Curaçao, Spaanse Water, with which it is compared. It is distinguished by its unusual, sharply turned down second plication, lower labial insertion point, narrower aperture (particularly anteriorly), and to a lesser extent its larger size. Approximately 50% of individuals show some degree of red on mantle roof (Figs. 68-69).

The reason for this is not known to the author, but is believed to be, at least partly, environmental, because other undescribed *Gibberula* species and some *Granulina* species from the eastern Caribbean also show red patches in their chromatism. It is believed that this is not a specific feature. *G. vitium* n. sp. is one of several Caribbean *Gibberula* species which show a melanistic tendency (Figs. 72-73), most as yet undescribed.

Etymology. The name alludes to the sharply turned down (kinked) second plication - the Latin word for 'kink' being 'vitium'.

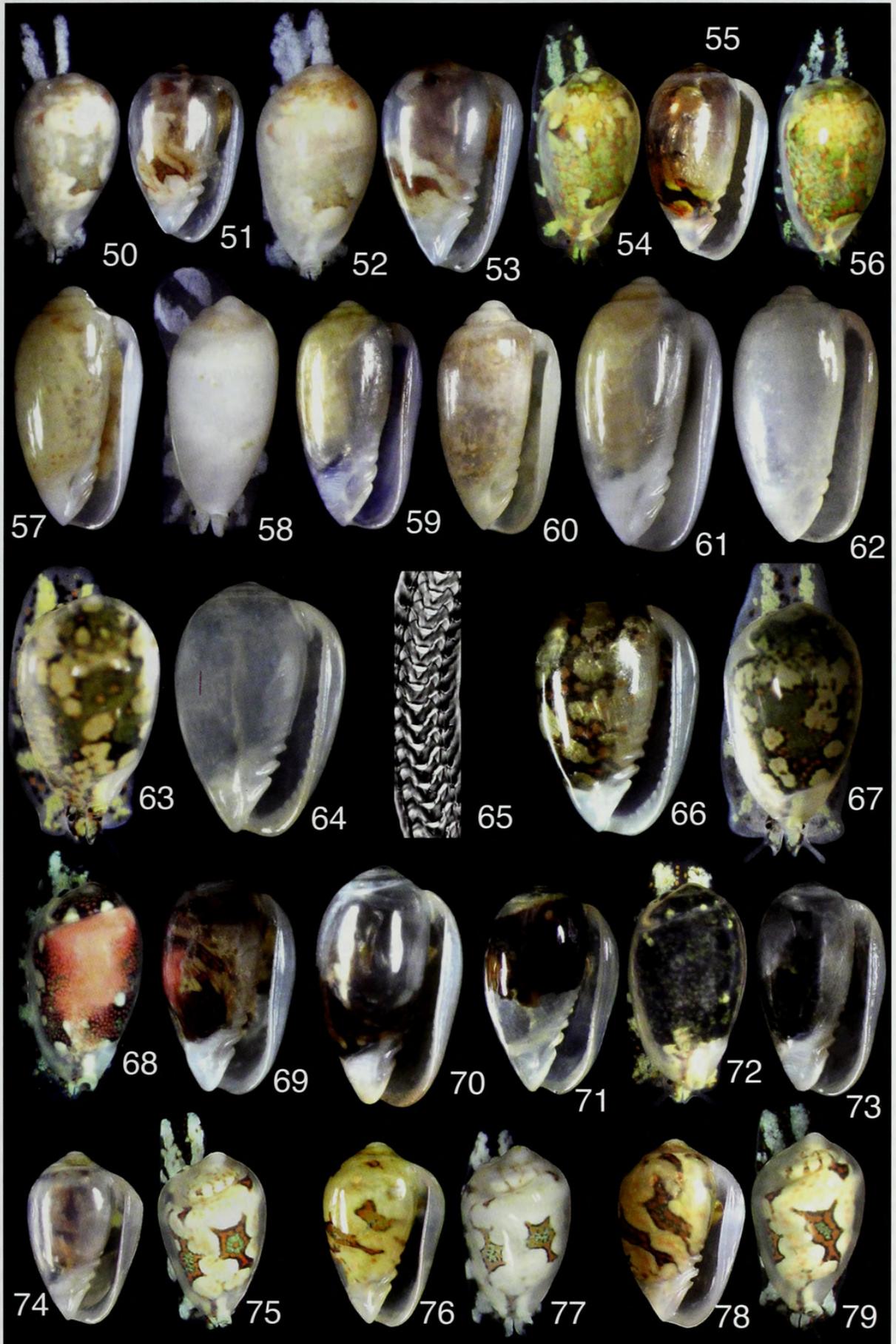
DISCUSSION

All Caribbean *Gibberula* species known to the author fall within the size range 1.23 mm to 3.95 mm (the latter being a specimen of an unidentified species, not featured in this paper), and are referred to as minute (less than 2.4 mm) to small. They are all unmarked, with one exception, *Gibberula agricola* Faber, 2005, known from Isla Margarita, Venezuela, and Tobago, a minute deep water species with five spiral rows of widely spaced brownish spots on the dorsum and one larger brown spot anterior medially on the lip. They are generally semi-transparent, occasionally translucent white, or opaque when fresh, occasionally very slightly tinted.

Large intra-colonial variations occur in shell morphology with spire height and shoulder curvature showing greatest extremes. Chromatism is generally constant except for intensity which can show extreme variations, and is an essential aid for specific assignment except in those few species with distinct specific morphological features, such as *Gibberula gradatim* n. sp. (Figs. 57-62), with its unique spire morphology.

Figures 50-79

50-51. *G. velox* n. sp. Holotype, Aruba, 20 m; **52-53.** *G. velox* n. sp. Paratype 1, Aruba, 20 m; **54-55.** *G. celerae* n. sp. Holotype, Venezuela, Isla Coche, 18 m; **56.** *G. celerae* n. sp. Paratype 1, Venezuela, Isla Coche, 18 m; **57-58.** *G. gradatim* n. sp. Holotype, Venezuela, Aves de Sotavento, shallow; **59.** *G. gradatim* n. sp. Paratype 3, Venezuela, Aves de Sotavento, shallow; **60.** *G. gradatim* n. sp. Paratype 2, Venezuela, Aves de Sotavento, shallow; **61.** *G. gradatim* n. sp. Paratype 1, Venezuela, Aves de Barlovento, shallow; **62.** *G. gradatim* n. sp. Paratype 5, Venezuela, Aves de Sotavento, shallow; **63-64.** *G. jenphillipsi* n. sp. Holotype, Curacao, Spanish Water, 1 m; **65.** *G. jenphillipsi* n. sp. Holotype, Curacao, Spanish Water, 1 m, Radula; **66-67.** *G. jenphillipsi* n. sp. Paratype 1, Curacao, Spanish Water, 1 m; **68-69.** *G. vitium* n. sp. Holotype, Venezuela, Islas Los Testigos, Isla Conejo, 2 m; **70-71.** *G. vitium* n. sp. Paratype 1, Venezuela, Islas Los Testigos, Isla Conejo, 2 m; **72-73.** *G. vitium* n. sp. Paratype 2, Venezuela, Islas Los Testigos, Isla Conejo, 2 m; **74-75.** *G. stella* n. sp. Paratype 3, Nicaragua, Great Corn Island, 1-2 m; **76-77.** *G. stella* n. sp. Holotype, Honduras, Cayos Vivarillo, 1-2 m; **78-79.** *G. stella* n. sp. Paratype 4, Honduras, Roatan, Mud Hole Swash, 1-2 m.



The distribution ranges of some species described herein are probably understated as the relevant data are not yet established. Unless otherwise stated endemism is not intentionally implied. Closely related species of most are believed, by the author, to exist and are not described in this paper. If all apparently, closely related species were lumped together, then ranges would be much greater and in some cases could possibly include the whole Caribbean. It would be easy to lump them together, but small shell and animal morphological differences which can be seen between colonies need to be carefully studied before conclusions are reached.

The shells of Caribbean *Gibberula* are perhaps the least aesthetically interesting of all marginellid species, but this is more than compensated for when the live animals are seen - almost every imaginable colour is manifest in a wide variety of beautiful patterns.

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