Small Shells of the Classic Turridae from Taiwan
II. Clavidae

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Chen-Kwoh Chang (1999) Small shells of the classic Turridae from Taiwan. II. Clavidae. *Bulletin of Malacology, Taiwan, ROC*, 23:69-77 ◦ Montfort D established Genus *Clavus* in 1810 using Indo-Pacific *Clavus flammulatus* Montfort as type species. Gray JE proposed Genus *Drillia* in 1838 using West African *Drillia umbilicata* Gray as type species. H. and A. Adams (1858) put these shells under Subfamily Turritinae for their operculum having a terminal (at one end of the operculum) nucleus in separating this from Subfamily Clavatuliinae whose operculum has its nucleus at the center of its straight side. Powell (1942) established subfamily Clavinae including shells whose sinus is U-shaped with a parietal callus pad or tubercles in separating this family from Subfamilies Turrinae and Cochlespirinae (=Turriculinae Powell, 1942) which lack parietal callus pad. Morrison (1966) proposed Drilliinae (=Clavinae) restricted to turrids having radula exhibiting the rachiglossate, comb-like, lateral teeth. McLean (1971) and Kilburn (1988) separated those turrids (1942) having marginal radula of the modified wishbone type as Crassispirinae from Clavinae Powell. Taylor *et al.* (1993) suggested promoting Drilliinae to family level as Drilliidae (=Clavidae).

Key words: Turridae, Clavidae, Taiwan.

Diagnosis of Clavidae

1. Radula formula, 1+1+1+1+1 with a vestigial central tooth, comb-like laterals and a pair of slender margianls.
2. Claviform having a tall spire and normally, a truncated anterior canal.
3. Sinus, U-shaped to subtubular on shoulder slope with a parietal callus pad.
4. Sculpture usually of bold axial ribs with a polished or weakly sculptured surface.
5. Most having dorsal varix.
6. Protoconch, smooth or strongly carinate.
7. Operculum (ovate) with a terminal nucleus.

Key to Genera of Clavidae from Taiwan

1. Shell with peripheral tubercles, spines or wing-like process.....***Clavus***
   Shell without peripheral process.....2
2. Axials from suture to suture and to shell anterior part.....3
   Axials from subsutural fold or weaker over sulcus and on base.....4
3. Axials ridged; dorsal varix at about 3/8 whorl to labrum.....***Plagiostropha***
   Axials longitidinal fold-like; dorsal varix at 1/8-1/4 whorl if present.....***Iredalea***
4. Subsutural cord, present.....5
   Subsutural cord, absent.....6
5. Dorsal varix, present.....***Clathrodrillia***
   Dorsal varix, absent.....***Cymatosyrinx***
6. Fewer teleoconch whorls (3-4); whorls without shoulder sulcus.....***Orrmaesia***
   More teleoconch whorls (5+); whorl with shoulder sulcus.....7
7. Shell, nearly smooth without anterior fasciola.....***Tylotiella***

Shell with spiral striae and anterior fasciola.....***Elaeocyma***

Dorsal varix

A dorsal varix is a subcylindrical protrusion located on the back of body whorl only, but not on the ventral side. Normally it is so broad that it reaches about 1/12 of the periphery in width. Its color turns brown in most cases. But it is not developed in the juvenile shells and not well developed for the immature shells. Fig. 10. shows the dorsal varix of *Clavus pembertoni* Lowe. The dorsal varix is one of the important shell characters in generic classification. The genera of Family Clavidae can be placed into the following groups by the presence or absence of a dorsal varix.

A. **Genera without dorsal varix** such as *Elaeocyma*, *Cymatosyrinx*, *Splendrillia* and *Austrodrillia*.
B. **Genera with or without dorsal varix** such as *Clavus, Tylotiella* and *Iredalea*.
C. **Genera with dorsal varix** such as *Drillia, Plagiostropha, Orrmasia, Clathrodrillia, Regidrillia, Cerodrillia, Acinodrillia, Fenimorea, Crassopleura, Imaclava, Kylix, Leptadrillia, Globidrillia* and *Spirotropis* etc.

For **group B**, Powell (1966) treated Genus ***Brephodrillia*** as a synonym of Genus ***Iredalea***. All the other authors followed. In fact, there is something different between these two genera. Pilsbry and Lowe (1932) designated those of genus *Iredalea* having dorsal varix as genus*Brephodrillia* using *perfectus* Pilsbry and Lowe, 1932 as the type species leaving those lacking a dorsal varix as *Iredalea*. The prototype of the *Brephodrillia perfectusis* is shown as Fig. 11. *Regidrillia, Austrodrillia, Fenimorea* and *Splendrillia* are treated similarly. *Regidrillia* and *Fenimorea* have a dorsal varix while *Austrodrillia* and *Splendrillia* lack a dorsal varix.

About Genera *Clavus* and *Tylotiella,* their type species: *Clavus flammulatus* Montfort and *Tylotiella subobliquata* (Smith) have a dorsal varix, but some species of these genera lack a dorsal varix. In my observations, they can be listed as the following two groups. If Genus *Brephodrillia* is recognized, two other genera should be established for *Clavus* and *Tylotiella* without a dorsal varix. Thus, I think, the whole Family **Clavidae** could be divided distinctly into two parts, one whose members have a dorsal varix and the other which lacks a dorsal varix. This paper treats *Brephodrillia* as subgenus of Iredalea after Vaught (1989) putting *Fenimorea* as subgenus of *Splendrillia* and *Regidrillia* as subgenus of *Austrodrillia*.

Absence of Dorsal Varix	**Presence of Dorsal Varix**
Iredalea subtropicalis Oliver	*Brephodrillia perfectus* Pilsbry et Lowe
Iredalea exilis (Pease)	*Brephodrillia ella* Pilsbry et Lowe
Iredalea pygmaea (Dunker)	
Clavus hexagona Sowerby	*Clavus flammulatus* Montfort
Clavus vidualoides Garrett	*Clavus nodifera* Pease
Clavus beckii Reeve	*Clavus bilineata* Reeve
	Clavus formosus Reeve
	Clavus laeta Hinds
	Clavus unizonatus Lamarck
	Clavus unifasciata Smith
	Clavus canicularis Röding
Tylotiella humilis (Smith)	*Tylotiella subobliquata* (Smith)
Tylotiella pulchella (Reeve)	*Tylotiella acuminata* (Mighels)
Tylotiella pica (Reeve)	*Tylotiella pusilla* (Garrett)
Tylotiella decaryi (Dautzenberg)	*Tylotiella mighelsi* Kay
	Tylotiella burnupi (Sowerby)
	Tylotiella clavata (Sowerby)

Tylotiella powelli Kay
Tylotiella inclinata (Sowerby)

For **group C and part of group B**, the dorsal varix occurs in a limited region for each genus.
Genus *Regidrillia* has its dorsal varices adjacent to the labrum.
Genus *Ormaesia* has its dorsal varices near the sinus.
Genus *Clavus*, *Tylotiella*, *Clathrodrillia* and *Drillia* have their dorsl varices at 1/8 to 1/6 of a whorl f rom labrum.
Genus *Imaclave* has its dorsal varix about 1/4 whorl from the labrum.
Genus *Plagiostropha* has its dorsal about 3/8 whorl from the labrum.

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There are two specimens of *Clavus viduus* (Reeve) from Taiwan in my collection that looks somewhat different. One, 14x5.2 mm from the beach of Lutao has a brownish band and is without dorsal varix. The other, 17.6x6 mm is trawled off Dahli, on the north coast of Taiwan. It has a dark reddish band and a dorsal varix near the apex of sinus. The smaller from Lutao should be immature shell. They are shown as Figs. 13-14.

9. *Clavus canicularis* (Röding, 1789)

The shell in Fig 15 is 6x4 mm from Lutao. It is a juvenile since its spines are not well developed. Another specimen, Fig. 16., is a well developed 18 mm long shell and is from Pescados Is., West of Taiwan.

10. *Clavus hexagona* (Sowerby, 1833)

This shell, 13x6 mm, sharply pyramidal; whorls hexagonal, tubercles ranging down the shell in six oblique axial ribs. The color is reddish brown on the lower half of the body whorl and white at the upper

half, but the lower part of each spire whorl, somewhat is colored (Fig. 17).

11. *Clavus humilis* (Smith, 1879)

This specimen is 13.8x5 mm (Fig. 18), has an amber color and was collected from Lutao. Its ventral view has some nodules similar to *Clavus* but its dorsal view has arcuate axials of *Tylotiella*.

12. *Clavus bilineata* (Reeve, 1845)

This 6.9x3 mm specimen was collected from the beach of Lutao (Fig. 19). It has similar sculpture and coloration as the specimen, 15.5 mm in Fig. 20. from Bohol, the Philippines. But the Taiwanese specimen looks broader. Probably it is an immature shell.

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The beautiful specimen, 6x2 mm owned by Mr. Aquen Chang who collected it from Dahli, North Taiwan. It is maculated reddish brown and pink alternately on each whorl. It is shown as Fig. 21.

14. *Clavus* sp.

An unidentified *Clavus* sp. 7.3x4 mm is shown as Fig. 22. I doubt it is the juvenile of *Clavus formosus* (Reeve), but its sinus has been well developed. Its axials on each whorl is less than the *formosus*. Its apex is blunt while the protoconch of the *formosus* is taller of 3 convex whorls. *Clavus formosus* (Reeve) is shown as Fig. 23.

15. *Clavus unizonalis* (Lamarck, 1822)

This 12x6 mm shell is shown as Fig 24. It is oval, grayish-white with the last whorl encircled by a broad, olive-brown zone. The interior is olive-brown. It is longitudinally ribbed and is tuberculated in the middle. It is abundant in Lutao. Some specimens have dorsal varix and the others don't. They are mixture of mature and immature specimens.

16. *Clavus vidualoides* (Garrett, 1873)

The 9x3.8 mm shell, Fig. 25. is subclaviform with its spire, acute, ashy-white. The lower half of the last whorl is chestnut-brown. There are 7-8 mature whorls, concave beneath the suture, girdled with a spiral row of oblong nodules and a wart-like callosity next to the sinus. It is very close to the *C. unizonalis*.

17. *Tylotiella pica* (Reeve, 1843)

This 9.2x4 mm shell is thick, obtusely pyramidal, white, irregularly variegated with a few large squarish brown spots (Fig. 26). The whorls are elegantely ribbed and the sinus is broad. Though my specimen is rather beached. It completely corresponds with the above Reeve's original description.

18. *Tylotiella pulchella* (Reeve, 1845)

This specimen is 8x3 mm, clavi-form with turreted spire, and with 7 mature whorls that are depressed at the upper part, and plicately tubercled in the middle (Fig. 27). Tubercles are narrow, flowing downwards. The canal is short and broad. The sinus is broad. The color is orange with reddish brown line right above the angulation between axials. Reeve (1846) gave the habitat as a question mark, but now it is found on the beach of Lutao, Taiwan. Chang (1995) misidentified it as *Tylotiella mediocris* (Deshayes).

19. *Tylotiella pusilla* (Garrett, 1873)

This specimen in Fig. 28 is 6.6x3 mm, oblong, subfusiform, ashy-white with the lower portion of the whorls, grayish-brown. The spire is rather long and convex in outline, with a subacute apex. There are 6-7 whorls that are convex and slightly constricted beneath the suture. There is a stout dorsal varix near the labrum. It has axial, somewhat sinuous, subangular ribs with 13-15 ribs on the penultimate whorl. The base is spirally ridged and grooved. The sinus is large and rounded.

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This specimen in Fig. 28 is 6.6x3 mm, oblong, subfusiform, ashy-white with the lower portion of the whorls, grayish-brown. The spire is rather long and convex in outline, with a subacute apex. There are 6-7 whorls that are convex and slightly constricted beneath the suture. There is a stout dorsal varix near the labrum. It has axial, somewhat sinuous, subangular ribs with 13-15 ribs on the penultimate whorl. The base is spirally ridged and grooved. The sinus is large and rounded.

20. *Iredalea exilis* (Pease, 1865)

The shell shown as Fig. 29 is 5x2 mm looks like *Tylotiella pusilla* (Garrett). Kilburn (1988) treated *I. exilis* as a synonym. Howerver, (a) this shell has longitudinal axials with nearly equal interspaces, while axials of *T. pusilla* is slightly sinuous and interspaces are not nearly equal, and (b) the spire of this shell is conic not as elevated as the *pusilla*, (c) the subsuture of this shell is not tight while the subsuture of *pusilla* is tight, and (d) this species has no dorsal varix while *pusilla* does.

21. *Iredalea pygmaea* (Dunker, 1860)

The shell in Fig. 30 is 6x3 mm and looks like the above *I. exilis* but this shell is broader, with broader, close-set axials. Moreover, its proto-conch is much smaller than the *I. exilis*. The protoconch has proved of the utmost value in specific determination. *Iredalea pygmaea* (Maes, 1967) is *Iredalea exilis* (Pease) because its protoconch is large.

22. *Plagiostropha quintuplex* Melvill, 1927

The shell in Fig. 31 is 5.6x2 mm and is smooth, brown with a tall spire, angulately penta-ridged and twisted somewhat; and has 7-8 mature whorls. The dorsal varix is located about 3/8 whorl toward the labrum. This specimen is immature as its sinus is not well developed yet. An adult shell from Marshal ls. is shown as Fig. 32. Its sinus and dorsal varix are visible from the ventral view.

23. *Plagiostropha* sp.

The specimen shown as Fig. 33. is 5.6x2 mm and is from Lutao. It has 5 mature whorls and its sinus and dorsal varix are well developed. It seems to be a separate species from the *P. quintuplex*. More specimen or information are needed for deciding whether it is a new species or not.

24. *Clathrodrillia tasconium* (Melvill, 1903)

Fig. 34 shows a shell, 14.5x5 mm that has 7-8 mature whorls and was found of Bahdutze, North Taiwan. Its protoconch is conic with 3 smooth whorls. It has sculpture of rounded axials and spiral cords with a prominent nodulous subsutural fold and a dorsal varix near labrum. The sinus is deep U-shaped, and has a parietal callus. The color is white with a few reddish-brown spots on the subsutural fold and at the tip of anterior canal. This shell also occured in Persian Gulf.

25. *Orrmaesia ancilla* (Thiele, 1925)

This specimen, shown as Fig 35 is minute, 3.5x1.5 mm; claviform with few (3-4) mature whorls, convex without shoulder; has no fasciole or false umbilicus; and has a deep-U shaped sinus with a parietal nodule. Genus *Orrmaesia* was proposed by Kilburn (1988). Its operculum oblanceolate with terminal nucleus and its radula lacking rechdians. Many species of this genus occur in South Africa. This is the first time this shell or this genus has been found in Taiwan, in China or even in the Pacific.

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台灣產小型捲管螺科 II. 梳齒螺科

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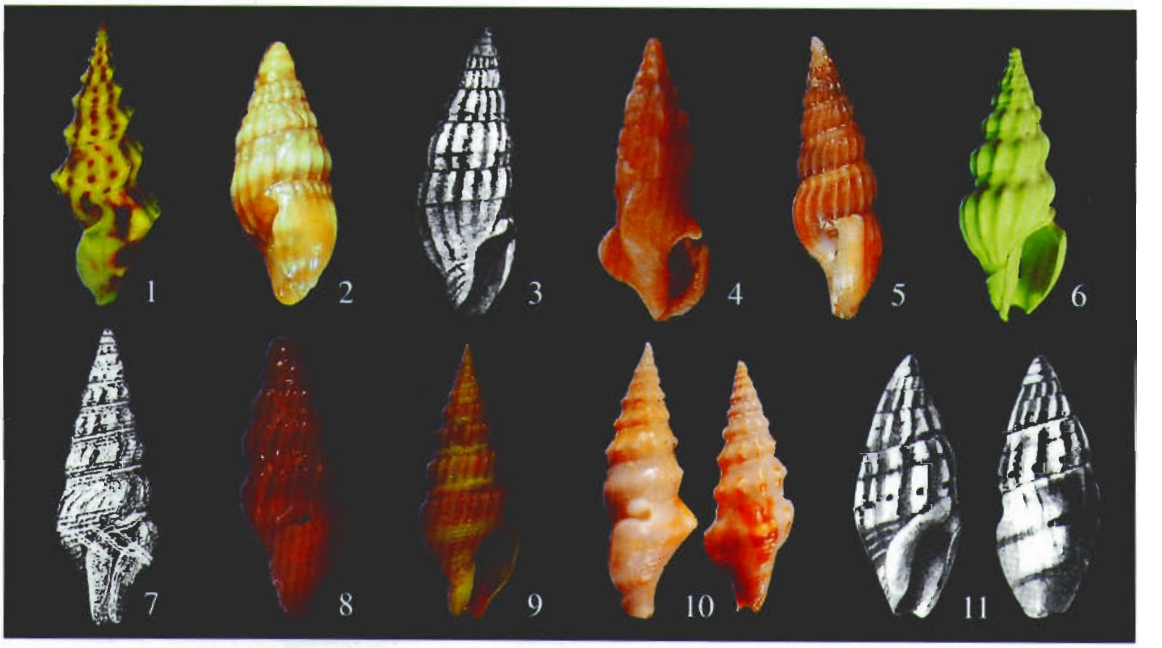
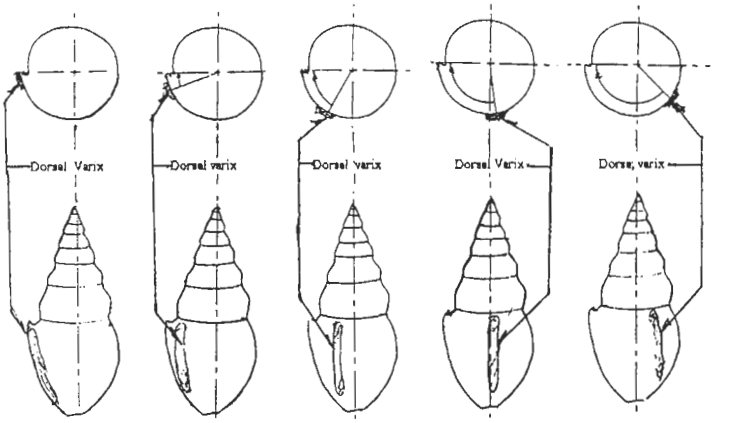
本文是台灣產小型捲管螺科的第二篇，主要是針對由傳統捲管螺科所分出來的梳齒螺科，作一整理。經由所收藏的標本，設計出本新科的簡要檢索表。梳齒螺科的重要特徵是體螺層背側的瘤肋，並整理出本科各屬的模式種。本文並介紹台灣產的梳齒螺科 6 屬 18 種的標本及圖片。

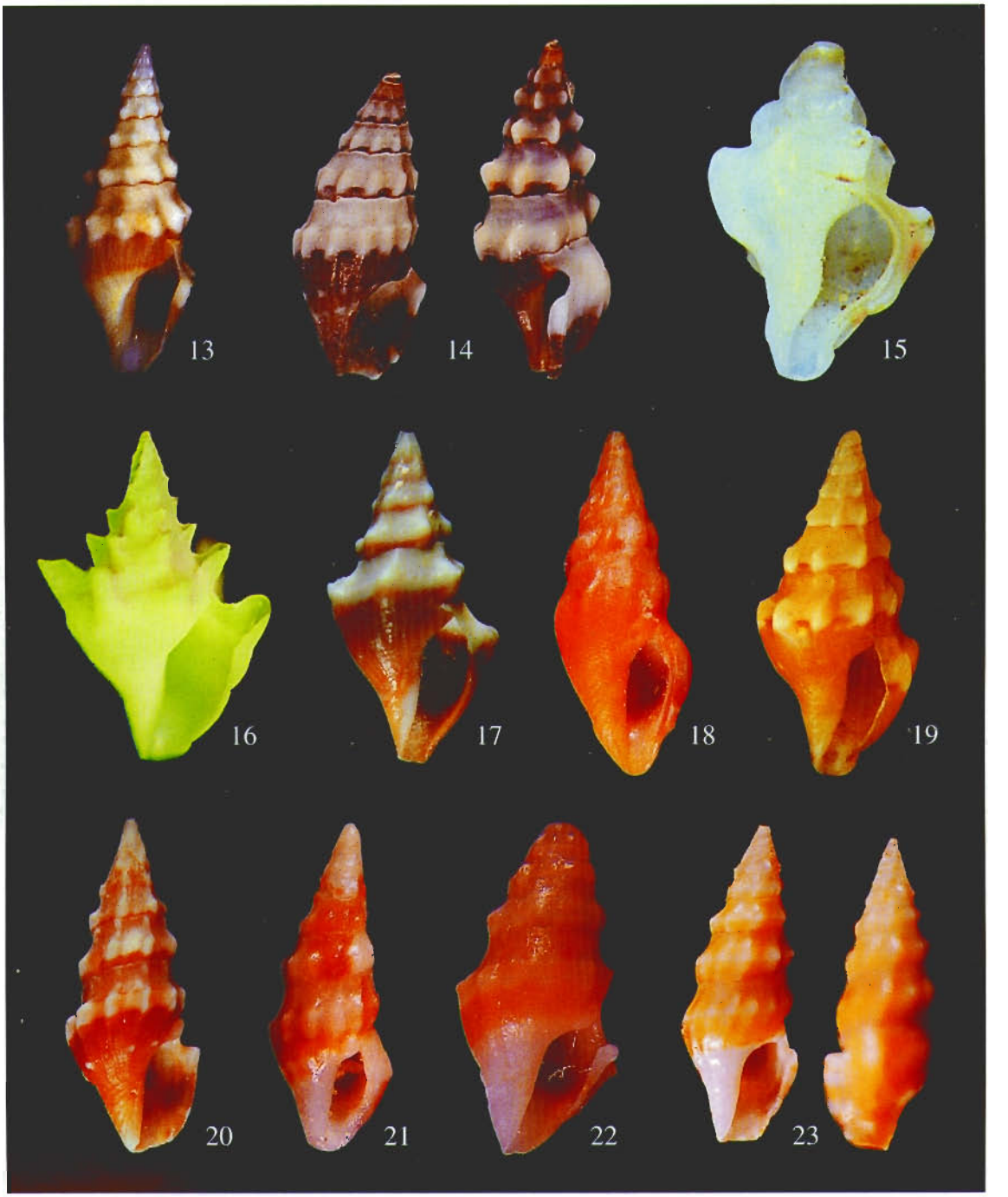
Pictures of Type Species of Taiwanese Genera



1. ***Clavus flammulatus*** Montfort, 1810, 43 mm, Solomon Is. **2.** ***Tylotiella subobliquata*** (Smith,1879), 5 mm, Reunion. **3.** ***Iredalea subtropicalis*** Oliver, 1915, 6.2 mm, after (Powell, 1966). **4.** ***Plagiostropha quintuplex*** Melvill, 1927, 8.2 mm, Cebu, PI. **5.** ****Horaiclavus splendida*** (A. Adams, 1867), 20.4 mm, N.Taiwan. *Oringinally in Family Turridae. **6.** ***Cymatocyrinx lunata*** (Lea, 1843), 26 mm, Florida. **7.** ***Elaeocyma empyrosia*** (Dall, 1899), 31 mm, Prototype. **8.** ***Orrmaesia dorsicosta*** Kilburn, 1988, 5.2 mm, S. Africa. **9.** ***Clathrodrillia gibbosa*** (Born, 1778), 35 mm, W. Indies. **10.** Dorsal varix of *Imaclava pembertoni* (Lowe), 29 mm, California. **11.** *Brephodrillia perfectus* Pilsbry et Lowe, prototype, 5.8 mm.

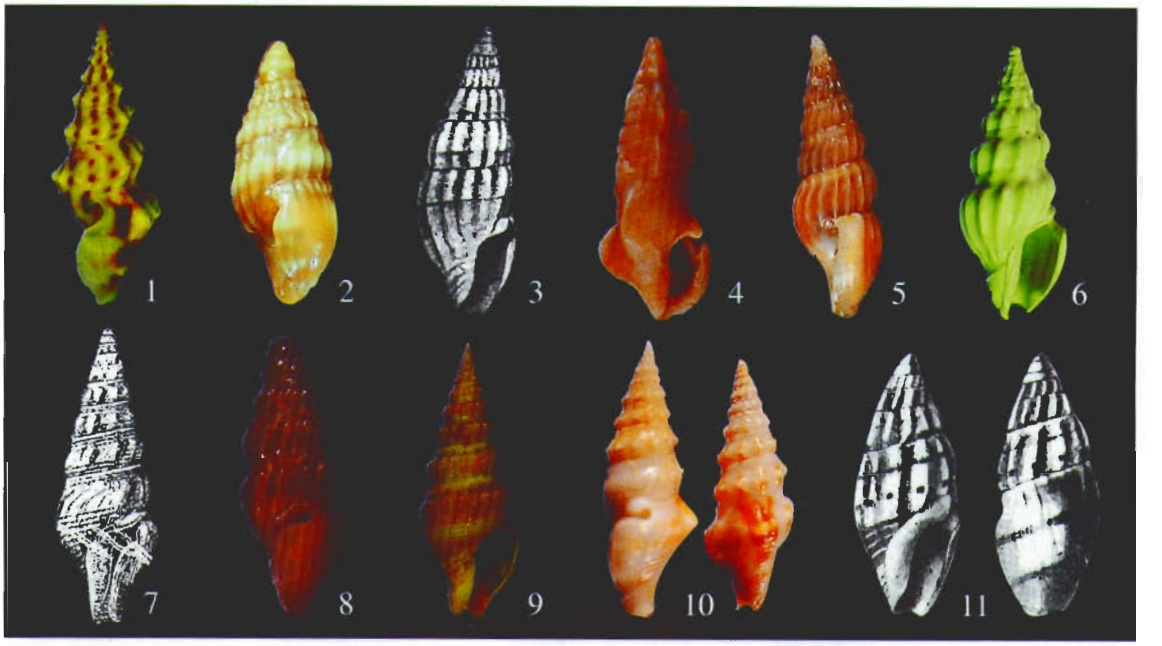


12. Chart for Position of Dorsal Varices vs Genera.



13. *Clavus viduus* (Reeve), 14 mm, Lutao, Taiwan. **14.** *Clavus vuduus* (Reeve), 17.6 mm, N. Taiwan. **15.** *Clavus canicularis* (Röding), 6 mm, Lutao. **16.** *Clavus canicularis* (Röding), Pescados Is. **17.** *Clavus hexagona* (Sowerby), 13 mm, Lutao. **18.** *Clavus humilis* (Smith), 13.8 mm, Lutao. **19.** *Clavus bilineata* (Reeve), 6.9 mm, Lutao. **20.** *Clavus bilineata* (Reeve), 15.5 mm, Bohol, PI. **21.** *Clavus tessellata* (Reeve), 6 mm, off N. Taiwan. **22.** *Clavus* sp., 7 mm, Lutao. **23.** *Clavus formosus* (Reeve), 18 mm, Lutao.

Pictures of Type Species of Taiwanese Genera



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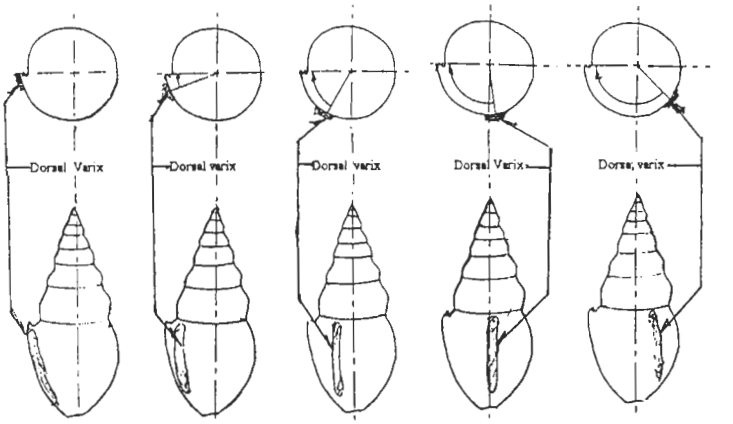

Dorsal Varix behind labrum.	Dorsal varix near labrum.	Dorsal varix 1/8-1/6 whorl From labrum.	Dorsal varix 1/4 whorl from labrum.	Dorsal varix about 3/8 whorl from labrum.
Regidrillia	*Orrmaesia*	*Clavus* *Tylotiella* *Drillia* *Clathrodrillia* *Brephodrillia*	*Imaclava*	*Plagiostropha*

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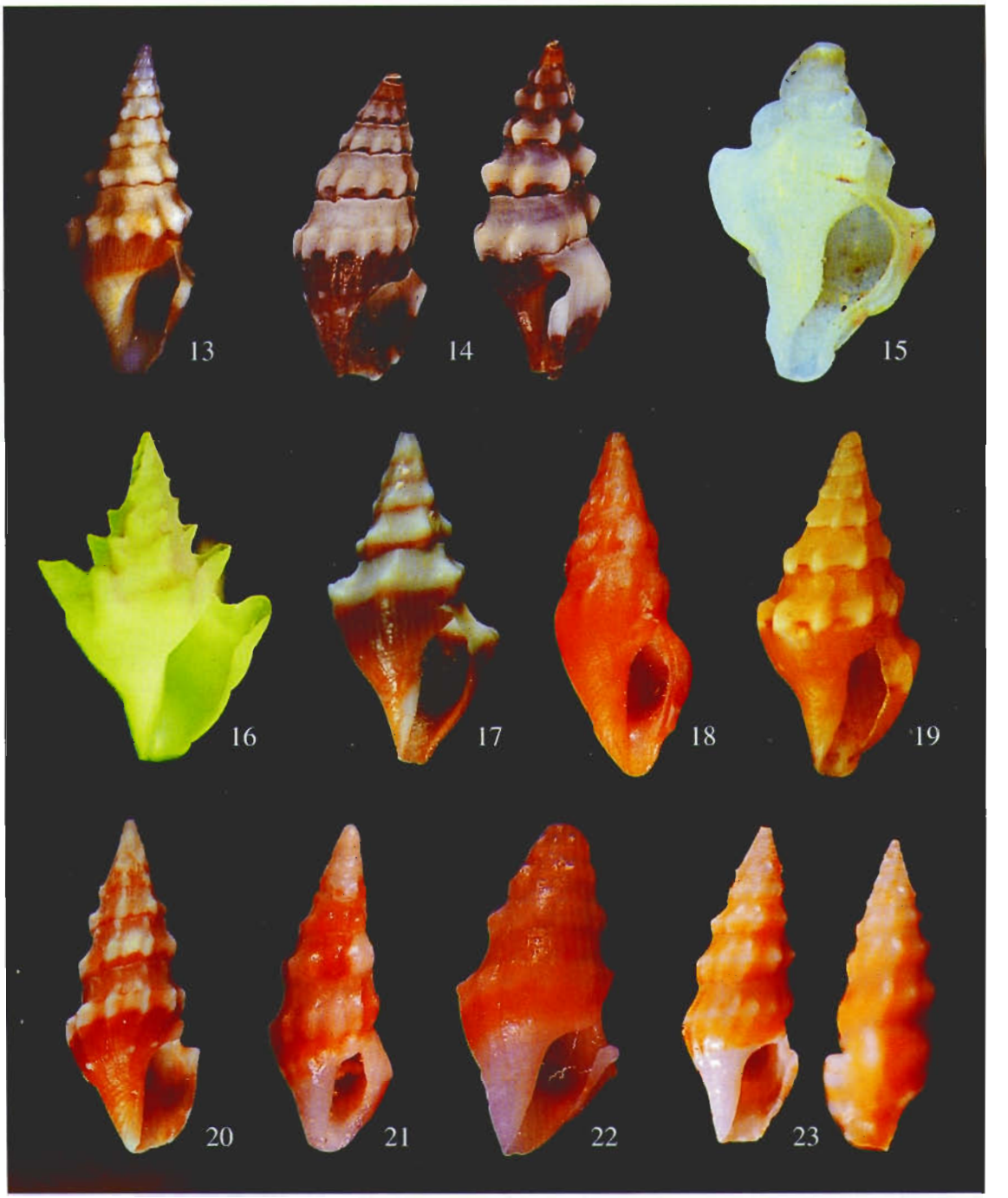

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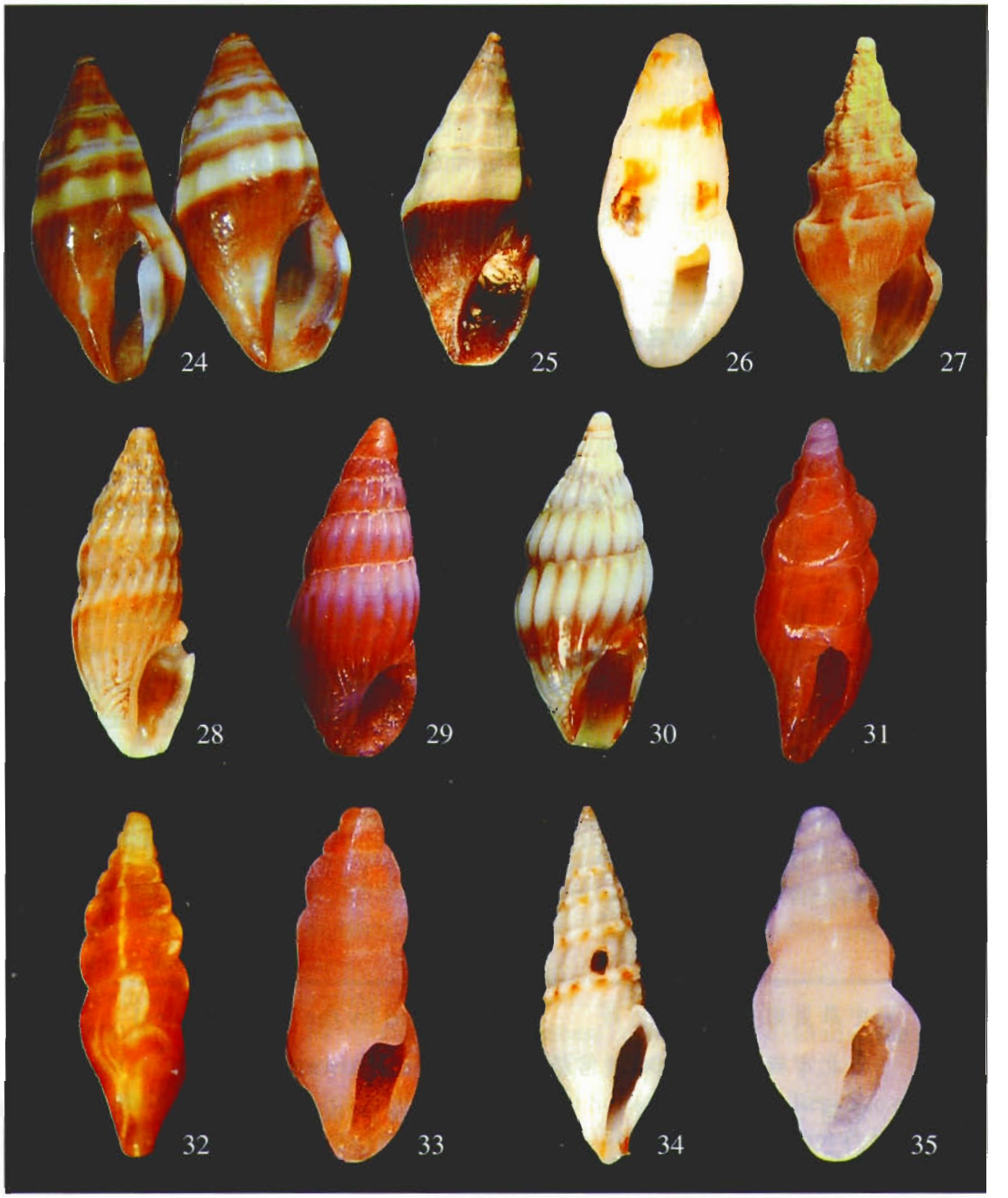

24. *Clavus unizonalis* (Lamarck), 12 mm, Lutao. **25.** *Clavus vidualoides* (Garrett), 9 mm, Lutao. **26.** *Tylotiella pica* (Reeve), 9.2 mm, Lutao. **27.** *Tylotiella pulchella* (Reeve), 8.8 mm, Lutao. **28.** *Tylotiella pusilla* (Garrett), 6.6 mm, Lutao. **29.** *Iredalea exilis* (Pease), 5 mm, Yihliu, Taiwan. **30.** *Iredalea pymaea* (Dunker), 6 mm, Lutao. **31.** *Plagiostropha quintuplex* Melvill, 5.6 mm, Lutao. **32.** *Plagiostropha quintuplex* Melvill, 9 mm, Marshal Is. **33.** *Plagiostropha* sp., 5.6 mm, Lutao. **34.** *Clathrodrillia tasconium* (Melvill), 14.5 mm, off N. Taiwan. **35.** *Orrmaesia ancilla* (Thiele), 3.5 mm, Lutao.