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ハワイ諸島産タカラガイの1新種ならびに エダカラガイ種群について

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A New Species of *Cypraea* from the Hawaiian Islands and a Discussion of the *C. teres* Species Complex

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Introduction

Among the more than 30 species and varieties of *Cypraea* described by J. C. Melvill (1888a; 1888b) were three he related to *C. teres* Gmelin, 1791 (called by Melvill *C. tabescens* Solander): *C. latior* for Reeve's (1865) figure 66a (Pl. 24) of *C. tabescens*, *C. pellucens* from the Hawaiian Islands, and *C. rashleighana* from an "unknown" locale. *C. pellucens* has long been included in the synonymy of *C. teres* (Schilder, 1932). *C. rashleighana* has consistently been recognized as a valid species although there has been some confusion as to its habitat: Melvill and Standen (1895) recorded it from the Loyalty Islands; J. K. Taylor (1916), on the basis of a suggestion from Melvill, named two varieties from the Hawaiian Islands; and Kay (1979) and Burgess (in press) suggest that *C. rashleighana* is endemic to the Hawaiian Islands.

There remains the question of *C. latior*, considered an "ecological variety" of *C. teres* by Schilder and Schilder (1938–39), a "mutation which is liable to occur in any of the *teres* complex" by Steadman and Cotton (1946), and, somewhat dubiously by Burgess (1970), as a valid species found primarily in the Northwestern Hawaiian Islands such as Midway, Laysan and Pearl and Hermes Atoll. Burgess (1969) and Old (1963) had earlier suggested, however, that *C. latior* was a synonym of *C. teres*, and subsequently Burgess (1977) figured the types of *C. latior* from the Melvill collection now in the National Museum of Wales, showing that they clearly fall within the range of variation exhibited by shells of *C. teres*, and that *C. latior* must be considered a synonym of *C. teres*. The shells illustrated by Old (1963) and by Burgess (1970) as *C. latior* are, however, quite distinct from those of *C. teres* and the name *C. latior* has continued in use among shell collectors in Hawaii (see, for example, Schmeltz 1978a, 1978b) for similar shells with the marginal and basal spots of *C. rashleighana*

and the general shape of *C. teres*. Shells with these attributes are here described as a new species of *Cypraea* from the Hawaiian Islands.

Cypraea burgessi n. sp.*

(Fig. 1 A-D)

Dscription: *Color pattern.*—Dorsum gray-blue, peppered with brown, occasionally with an irregular medial brown blotch. Labial and columellar margins each with from 16 to 20 ($\bar{x}=20.7$; S.D.=4.7; N=22) dark brown spots, the spots 2–3 mm in diameter and extending as much as one half way across the labial and columellar lips of the white base.

Size and shape.—Mean shell length of 44 specimens examined was 31.8 mm (S.D.=4.8; Range=22.4–39.3 mm; See Fig. 2), width 19.4 mm (S.D.=3.14; Range=13–28 mm), height 14.6 mm (S.D.=2.5 mm; Range=7–18 mm). Solid, ovately cylindrical. Base flat, usually meeting dorsum at a moderately developed callus on the columellar margin. Anterior and posterior extremities slightly produced. Spire depressed and covered by a callus.

Apertural features.—Aperture narrow, almost straight; fossula shallow, sulcus only moderately developed. Labial teeth 16–22 ($\bar{x}=20.2$; S.D.=1.9; N=44), columellar teeth 17–22 ($\bar{x}=20.1$; S.D.=1.9; N=44). Internal denticles sharp, occurring the length of the columella.

Mantle and radula.—Mantle thin, not obscuring the dorsal pattern; carmine mottled with irregular yellow spots ringed in black. Papillae crowded, rising from the yellow spots, wide at the base, tapering to a black tip and with sharp spikelike branches. Siphon with long, dense, black projections. Foot spotted irregularly with yellow-orange; short, not extending beyond the siphon anteriorly and barely visible posteriorly.

Radular teeth similar to those in *C. teres* (Fig. 3). (The terminology for the radular teeth follows that of Hickman (1980) and the terms utilized by Kay (1960) should now read: central tooth for the median tooth; lateral teeth for the admedian teeth; marginal teeth for the lateral teeth). The central tooth is dome-shaped, 160 μm in height, 160 μm in width, the anterior edge rounded, with three pendant cusps less than one-half the length of the shaft, and with a distinct dumbbell shaped internal bract at the base. Lateral teeth rectangular, wider than they are high, 140 μm in height, 160 μm in width, with three shallow cusps less than one-third the height of the shaft. Marginals sickleshaped, thin and close-set, with a long, narrow, acuminate central cusp flanked by a shorter pointed lateral denticle.

Type specimens: Holotype, B. P. Bishop Museum, Cat. No. 9903, length

* **Note added at the proof:** A preliminary description of *C. burgessi* appeared in the Hawaiian Shell News for November 1981. The description printed here is to be considered the published description.

32.8 mm, width 20.4 mm, height 15 mm. Paratypes: Maui, Hawaii, length 29.0 mm, B. P. Bishop Museum; Pearl and Hermes Atoll, length 28.4 mm, Thaanum Collection, B. P. Bishop Museum; Honolulu Harbor, Oahu, length 26.4 mm, B. P. Bishop Museum, Cat. No. 62349; Honolulu Harbor, Oahu, length 29.9 mm, B. P. Bishop Museum, Cat. No. 62349; Pearl and Hermes Atoll, length 29.9 mm, National Museum of Natural History, Washington, D.C. Other paratypes are in the collections of C. M. Burgess and S. Jazwinksi of Honolulu, Hawaii and R. Schmeltz of San Diego, California.

Type locality: Pearl and Hermes Atoll, Hawaii (27°50′N, 175°50′W).

Origin of name: This species is named for Dr. C. M. Burgess of Honolulu, Hawaii, who has given so much of his life to furthering knowledge of the cowries.

Comparisons

The shells of *C. burgessi* most closely resemble those of *C. rashleighana* (Fig. 1, E–H) and *C. teres* (Fig. 1, I–L) among the cowries. Shells of *C. rashleighana* and *C. teres* are shown in Fig. 1 and the distinguishing features of the three species are tabulated in Tables 1 and 2. The quantitative differences

Table 1. Morphometric characteristics of the shells of *Cypraea burgessi, C. rashleighana* and *C. teres*. N=number in sample, $\bar{x}$=mean, S. D.=standard deviation.
エダカラガイ種群3種の計測的比較

Characteristic	*Cypraea burgessi* ハワイエダカラガイ N=44	*C. rashleighana* ニセエダカラガイ N=31	*C. teres* エダカラガイ N=50
Shell length $\bar{x}$ (mm)	31. 8	21. 3	26. 6
Range	22. 4–39. 3	16–28	14–38
S. D.	4. 75	5. 65	3. 4
Shell width $\bar{x}$ (mm)	19. 4	14. 7	15. 2
Range	13–28	10–19	9–23
S. D.	3. 14	2. 3	3. 34
Shell height $\bar{x}$ (mm)	14. 6	10. 6	13. 8
Range	7–8	8–13	5–15
S. D.	2. 3	1. 3	2. 4
Shell length/width ratio ($\bar{x}$)	1. 6	1. 45	1. 7
S. D.	0. 13	0. 15	0. 14
Shell length/height ratio ($\bar{x}$)	2. 1	2. 2	2. 0
S. D.	0. 09	0. 16	0. 12
Number labial teeth ($\bar{x}$)	20. 2	17. 5	20. 8
S. D.	1. 9	2. 3	1. 8
Number columellar teeth ($\bar{x}$)	20. 1	17. 6	21. 3
S. D.	1. 9	2. 4	2. 7
Length/labial teeth ratio ($\bar{x}$)	1. 6	1. 1	1. 2
S. D.	0. 20	1. 5	0. 19
Length/columellar teeth ratio ($\bar{x}$)	1. 6	1. 3	1. 2
S. D.	0. 23	0. 17	0. 24

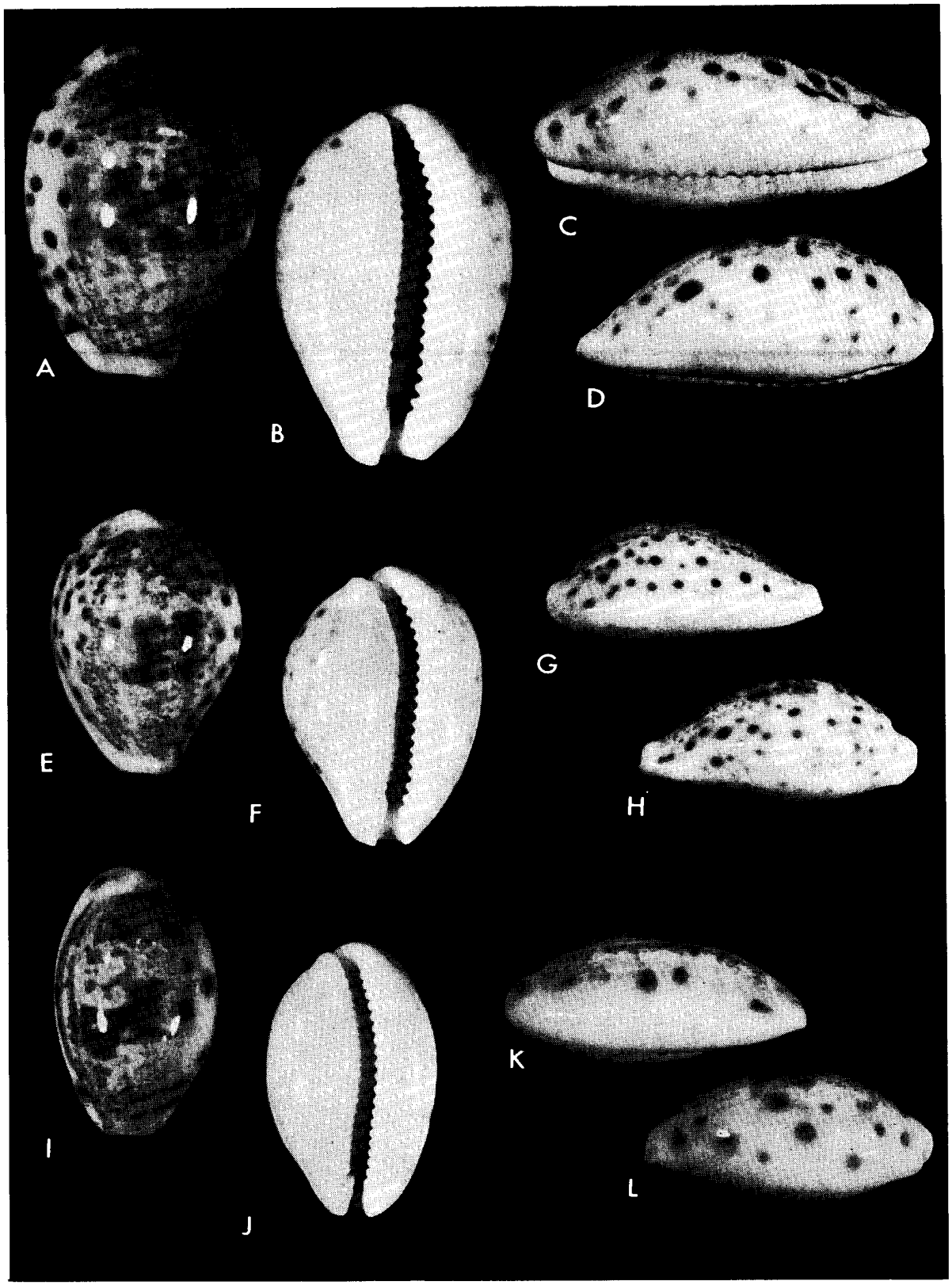

Fig. 1. **A–D.** *Cypraea burgessi*, n. sp. ハワイエダカラガイ (B. P. Bishop Museum 9903), length 31.3 mm. A. Dorsal view. B. Ventral view. C–D. Lateral view.
E–H. *C. rashleighana* ニセエダカラガイ, length 25.6 mm. Dorsal, ventral and lateral views.
I–L. *C. teres* エダカラガイ, length 25 mm. Dorsal, ventral and lateral views.

Table 2. Conchological and anatomical characters of *Cypraea burgessi*, *C. rashleighana* and *C. teres*.
エダカラガイ種群3種の貝殻学的，解剖学的形質比較

Characteristic	*Cypraea burgessi* ハワイエダカラガイ	*C. rashleighana* ニセエダカラガイ	*C. teres* エダカラガイ
Conchological Features			
Shape	Elongate, anterior extremity slightly produced	Almost circular, anterior extremity prominent	Variable: circular to cylindrical
Spotting	Small (2–3 mm) spots extending 1/3 or more across labial and columellar base	Small (2–3 mm) spots extending 1/3 or more across labial and columellar base	Large (4–5 mm) spots confined to labial and columellar margins
Columellar margin	Columellar callus present	Columellar callus sharp and prominent	No columellar callus
Labial margin	No labial callus	No labial callus	Labial callus sharp and prominent
Inner denticles	Prominent, extending length of aperture	Fine, extending only along anterior half of aperture	Prominent, extending length of aperture
Anatomical Features			
Mantle texture	Thin, does not obscure dorsal pattern	Thick, almost obscures dorsal pattern	Thick, almost obscures dorsal pattern
Papillae	Dense; wide at base, tapering, with spikelike branches	Sparse; wide at base, smooth, finger-like, no tufts or branches	Sparse; columnar, tufted at tips
Siphon	Densely fringed with long, black processes	With long, white processes	With short, beaded, white processes
Foot	Barely visible anteriorly and posteriorly	Barely visible anteriorly and posteriorly	Extending posteriorly at least 1/3 of the length of the shell
Female genitalia	Not known	Not known	Bursa copulatrix present

summarized below derive from application of *t*-tests for *log*-transformed data with the null hypothesis that the population means are not different from zero.

The shells of *C. burgessi* are, in general, larger than are those of either *C. rashleighana* or *C. teres*. Mean shell length in *C. burgessi* is nearly 32 mm compared with a mean shell length of 21 mm in *C. rashleighana* and 27 mm in *C. teres*, and the shells of *C. burgessi* are similarly wider and higher than are those of the other two species. Probabilities from *t*-tests show that the differences are all significant at the $P=0.001$ or $P=0.005$ level. Shells of *C. burgessi* are intermediate between those of *C. rashleighana* and *C. teres* in length/width ratios, and again the *t*-tests yield probabilities at the $P=0.001$ level. The shells of *C. burgessi* are also intermediate between the shells of *C. rashleighana* and *C. teres* for numbers of labial and columellar teeth, with the probabilities from *t*-tests at the $P=0.05$ level. The length/labial teeth ratio is greatest for shells of *C. burgessi* among the three species, with probabilities from *t*-tests at the $P=0.001$ level.

In other features of the shell, the shells of *C. burgessi* resemble those of *C. rashleighana* in some characters, those of *C. teres* in others. The marginal spots

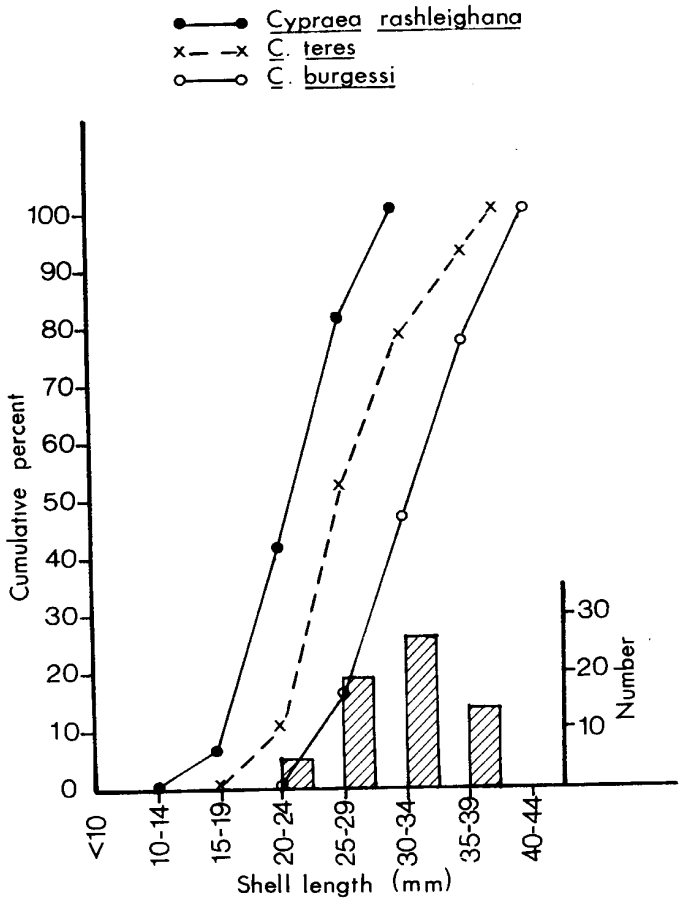

Fig. 2. Shell length-frequency distribution of *Cypraea burgessi* plotted in histograms and as a cumulative curve (open circles). Also shown are cumulative shell length-frequency distributions of *C. rashleighana* (solid circles) and *C. teres* (dashed line) from the Hawaiian Islands. エダカラ種群3種の殻長累積曲線。

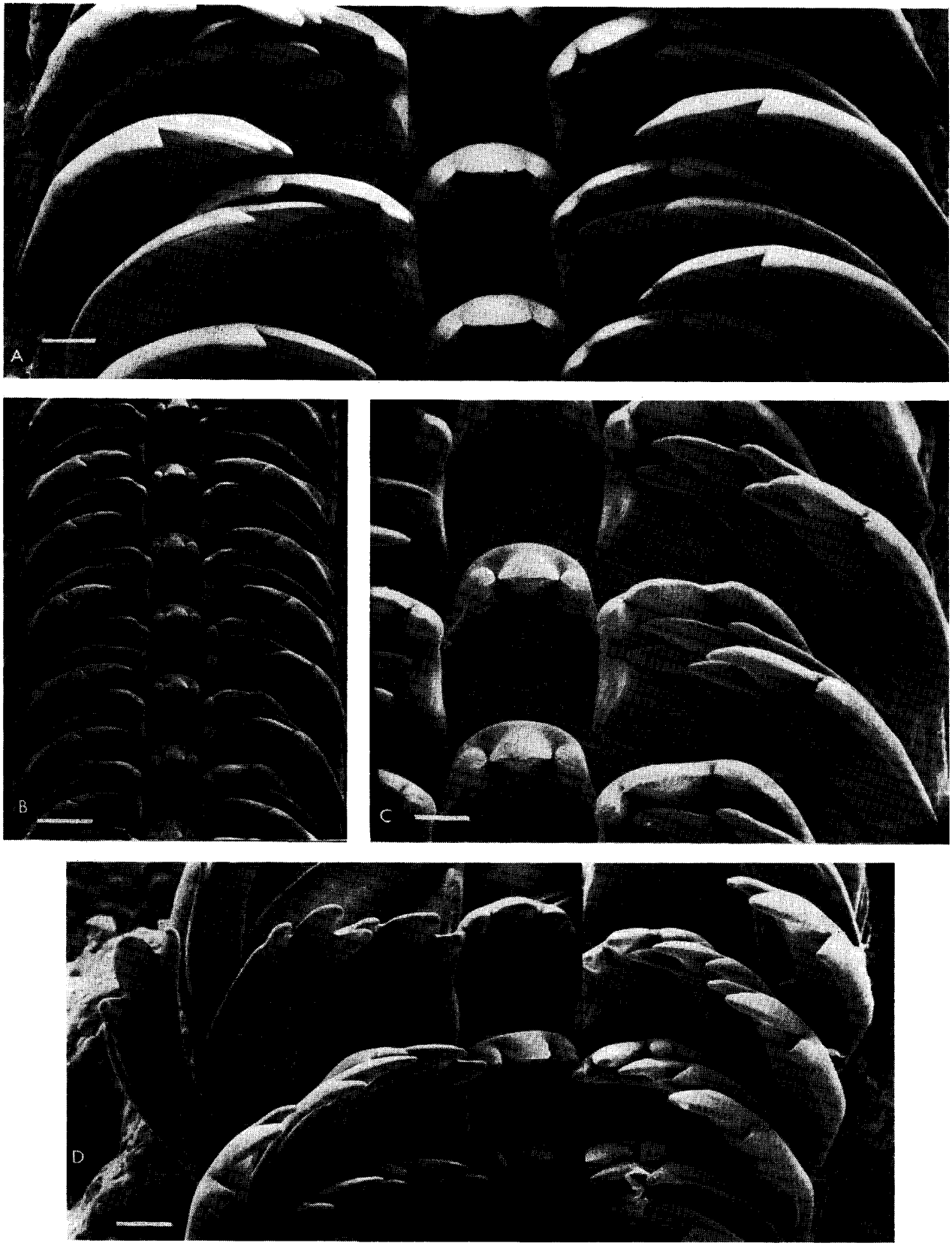

Fig. 3. Scanning electron micrographs of *Cypraea* radular teeth. A. *C. burgessi.* Bar=38 μm. B. *C. teres.* Bar=63 μm. C. *C. teres.* Bar=25 μm. D. *C. rashleighana.* Bar=34 μm. エダカラ種群3種の歯舌

on the shells of *C. burgessi*, for example, are similar to those on the shells of *C. rashleighana* in number, size and distribution on the margin and base. The spots on the shells of *C. teres* are less numerous (11–14 vs 13–20), they average 4–5 mm in diameter rather than 2–3 mm in diameter, and they do not extend on to the base of the shell. Another distinguishing conchological feature shared by the shells of *C. burgessi* and *C. rashleighana* is a columellar callus. In contrast, the columellar margin of the shells of *C. teres* is smooth but the labial edge projects sharply. The shells of *C. burgessi*, on the other hand, resemble those of *C. teres* in that there is a full suite of internal denticles; the inner denticles on the shells of *C. rashleighana* occur only on about half the length of the columella.

The thin mantle with dense, branched papillae in *C. burgessi* is in contrast to the thick mantle with scattered papillae in *C. rashleighana* and *C. teres*. In *C. rashleighana* the papillae are fingerlike and smooth with rounded white tips; in *C. teres* the papillae are columnar, spotted with black on the column and tufted only at the black tips.

The radula in *C. burgessi* is similar to that in *C. teres*, with a domelike central tooth; in *C. rashleighana* the leading edge of the central tooth is less rounded (Fig. 3).

The distribution of *C. burgessi* in the Hawaiian archipelago also invites comparison with the distribution of *C. rashleighana* and *C. teres*. *C. burgessi* is predominantly found in the Northwestern Hawaiian Islands: 60% of the 90 shells of *C. burgessi* for which there are data are from Kure to Pearl and Hermes Atoll; of the remaining 30 shells, 28 are from Kauai and Oahu and only two shells are from Maui. None has been recorded from the island of Hawaii. In contrast, shells of *C. teres* are apparently restricted to the southeastern islands: none of the hundreds of shells of *C. teres* from the Hawaiian Islands for which there are locality data is from an island north of Kauai. Schilder (1933), describing the collection of 594 cowries made by Dr. Victor Pietschmann, Icthyologist of the Museum of Vienna, Austria, from the beaches of Pearl and Hermes Atoll, Laysan Island and French Frigate Shoals, questionably listed specimens of *C. teres* in the collection; I suggest the shells are those of *C. burgessi*. The shells of *C. rashleighana* are the rarest of the three species, found in about the same numbers from north to south in the Hawaiian archipelago.

All three species are found at similar depths. Schmeltz (1978b) reports *C. burgessi* under coral in the lagoon at Midway and *C. rashleighana* at 18 m outside the lagoon. C. M. Burgess (personal communication) reports animals of *C. teres* and *C. burgessi* both on the reef at Fort Kamehameha, Oahu.

The *Cypraea teres* Species Complex

Cypraea burgessi is apparently a fourth member of a group of cowries which

includes *C. rashleighana*, *C. subteres* and *C. teres*. The four species of cowries display a consistent set of conchological and anatomical features which distinguishes the group as a species complex, distinct from other such complexes (i.e., genera or subgenera depending on author) among the cowries. The shells are ovate to cylindrical, margined either on the labial or columellar edge, the aperture is narrow, and the teeth are relatively fine and confined to the aperture. The dorsum is blue-gray, freckled or spotted with brown and the base is white. The ground color of the mantle is a shade of red. The mantle papillae differ in density but are in general columnar or fingerlike, tufted or branched in all but *C. rashleighana*, and the siphon is fringed. Only in *C. teres* of the four species have females been examined. A bursa copulatrix is present, lying on the axis of the genital aperture where it forms a swollen, rounded structure. In other cowries the bursa is a small sac posterior to the genital aperture (Kay, 1963). The radular tooth pattern is also distinctive, the central tooth conspicuously domed (Fig. 3). The protoconchs of *C. rashleighana* and *C. teres*, illustrated by Ranson (1967), are also similar, consisting of broad, globose cones with five or six whorls. J. B. Taylor (1975) found veliger larvae of *C. rashleighana* and *C. teres*, with shells like those of Ranson's illustrations, in the plankton of Kaneohe Bay, Oahu, and commented on their similarity.

The species complex appears to be concentrated in the Pacific Ocean. Only *C. teres* is found beyond the bounds of the Pacific, reaching from the east coast of Africa to Hawaii and Clipperton Island off the west coast of the Americas. Of the other species, two are endemic to Hawaii (*C. burgessi* and *C. rashleighana*) and one is endemic to southern Polynesia (*C. subteres*).

The three species previously described in the complex have been treated in a variety of ways in the vagaries of cowrie taxonomy. Jousseaume (1884) included *C. teres* in his genus *Stolida* with *C. stolida*, *C. erythraeensis*, and *C. goodalli*, among others. Iredale (1931), without providing either reasons or a generic diagnosis, separated *C. teres* in the genus *Talostolida*. Schilder (1932) and Schilder and Schilder (1938–39) included four species, *C. goodalli*, *C. rashleighana*, *C. subteres* and *C. teres*, in *Talostolida*, and recognized it as a subgenus of *Cribraria*, thus allying the *C. teres* complex with *C. cribraria* and *C. chinensis*. Cernohorsky (1960) retained the four species in the subgenus *Talostolida* but transferred it to *Bistolida* (as *nomen pro Stolida* Jousseaume, 1884). Most recently Schilder and Schilder (1971) have included *C. goodalli*, *C. rashleighana*, *C. subteres* (as a subspecies of *C. teres*) and *C. teres* in the genus *Blasicrura* with *C. coxeni*, *C. quadrimaculata*, *C. pallidula* and *C. interrupta*, with *Talostolida* as a synonym.

None of the arrangements is satisfactory in that each includes cowries with conchological differences; with mantles of different textures, color and decoration; with radular teeth of different styles; and with female genitalia of different

types. Jousseaume's (1884) *Stolida* includes shells with coarse apertural teeth extending across the base of the shell (for example, *C. stolida*); animals with pale yellow mantles and sparse, fine papillae (for example, *C. goodalli*); and *C. erythraeensis*). Schilder's (1932) *Cribraria* includes species with the mantle rough and textured and with the central radular teeth with denticles (for example, *C. cribraria*), and species with the radular tooth with a single anterior cusp and lacking a bursa copulatrix in the females (for example, *C. chinensis*).

In contrast to the mixture of characters found in the species complexes mentioned above, the four species considered here—*C. burgessi*, *C. rashleighana*, *C. subteres*, and *C. teres*—are distinguished by a consistent set of conchological and anatomical characters, and it is suggested that the four species are usefully distinguished as a species complex. Whether the complex is recognized as a subgenus within the genus *Cypraea* or a separate genus remains to be determined as the taxonomy of the cowries is clarified by further anatomical studies.

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要　　約

ハワイ諸島に分布するエダカラガイ *Cypraea teres* 種群中の1新種を記載する。

Cypraea burgessi n. sp. ハワイエダカラガイ（新称）

外観エダカラガイと酷似していて，背面は青灰色に褐斑を散らし殻底の半ばまで及ぶ。殻口唇には直径2～3mmの16～20の暗褐色点がある。殻形は卵円形で，殻底は平坦で，軸唇滑層が背方へ拡がる。前後端は僅かに突出し，螺塔は滑層に覆われる。殻口は狭く外唇歯16～22，軸唇歯17～22。

外套膜は薄く，背斑が透けてみえる。カーミン色に黒丸で囲まれた不規則な黄色斑がある。突起は密で，黄斑点から立ち上り，先端黒く分岐する。水管は黒くて長い突起がある。足は橙黄斑をもち，短い。

歯舌はエダカラガイのそれに似ていて，中歯は僧帽型160μm×160μm，前端丸く3歯尖があり，側歯は方形，140μm×160μm 3歯尖がある。縁歯は鎌形である。

模式標本：殻長32.8mm，殻径20.4mm，殻高15mm。ビショップ博物館 No. 9903。

模式産地：パール・ヘルメス環礁（27°50′N，175°50′W）。

比較：本新種はエダカラガイ及び *C. rashleighana* ニセエダカラガイ（新称）に似るが，3種中最大となるが殻長／殻幅，殻長／殻高比，外唇歯数，軸唇歯数では両種の中間に位置する。しかし本新種は殻高／外唇歯比で他の2種より大きい。殻の上からは更にエダカラガイにもニセエダカラガイにも似ているが，褐色点はエダカラガイの方が少なく（11～14対13～20），径が大きく（4～5mm）殻底には及ばない。またニセエダカラガイは軸唇内小歯は軸唇長の半長しか存在しないが，本種とエダカラガイは全長に及ぶ。外套膜が薄く突起が密な点，外套膜が厚く，疎らな突起しかもたないエダカラガイとニセエダカラガイとは異なる。又，ニセエダカラガイの外套膜突起は指状で先端白く，エダカラガイのそれは円筒形で黒点があり先端のみ総状。歯舌の差異は非常に少ない。

本新種はハワイ諸島北西方に主に分布し，エダカラガイは南東域に集中している。

エダカラガイ種群には，エダカラガイ，ニセエダカラガイ，ハワイエダカラガイ及びポリネシア南部にすむ *subteres* の4種から成る。しかしこれらは（一部或いは他種と共に）*Stolida* (Jousseaume, 1884), *Talostolida* (Iredale, 1931, Schilder, 1932, Schilder & Schilder, 1938–39), *Bistolida* (Cernohorsky, 1960), *Blasicrura* (Schilder, 1971) 等におかれ，それぞれ貝類の特徴，動物体の特徴や歯舌の特徴からみて異質のものを含ませていて満足出来ない。しかし，貝殻学上及び解剖学上の特徴からみて前述の4種のみが，この種群（species complex）としてまとまっていると考えるのが妥当で，これを *Cypraea* 属下の亜属とすべきかどうかは将来の研究に俟つ。

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ボークス著：二枚貝綱の属——その分類と文献 Vokes, Harold E. (1980) Genera of the Bivalvia: A Systematic and Bibliographic Catalogue (Revised and Updated). i—xxvii, 1—307.

ボークス博士は1968年の Jour. of American Paleontology, Vol. 51, No. 232, pp. 111—394 に上記題名の二枚貝綱属名表を発表した。しかし，10年余も経るとその後に発表された新属も多く，また拾い忘れられた属名，その後の研究で分類上科（Family）が変更になった属名もあって，前版が絶版になったせいもあって改訂版が出版された。前版は1960年までに発表されたものであるがこの版は1980年6月までを収録している。しかし，219頁までは前版を修正して分類上の位置を改めており，その後の追加42頁はその後に発表された属や脱落した属である。従って相模湾産貝類の中の新属は追加の中にある。なお，太字ゴジックになっているのは成立する属であって，分類学上から見た有効名という意味でないから異名とされる属も成立する属として太字になっているので，分類学上の判断はこれを利用する研究者にゆだねられる。二枚貝綱の研究者には必携の書である。

（波部忠重）