J. Conch., Lond. **35:** 223–235 (1995)

ANNULOBALCIS AURISFLAMMA, A NEW SPECIES OF EULIMIDAE (GASTROPODA, PROSOBRANCHIA) PARASITIC ON A CRINOID FROM BRAZIL

L. R. L. SIMONE[1] AND C. M. MARTINS[1]

(*Accepted for publication, 20th November, 1994*)

Abstract: A new species of Eulimidae, *Annulobalcis aurisflamma*, an ectoparasite on the crinoid *Tropiometra carinata* (Lamarck, 1816) is described from the Ubatuba coast, São Paulo, Brazil. Diagnostic anatomical characteristics of this species include the mantle colour, female period with penis persistence and a dorsal projection of the inner wall of proboscis, near the proboscis opening.

Key words: *Annulobalcis* Prosobranchia, Eulimoidea, Anatomy, Ectoparasitism, *Tropiometra carinata*, Crinoidea, Brazil.

INTRODUCTION

The genus *Annulobalcis* Habe, 1965 was hitherto unknown from the Atlantic Ocean. Warén (1983) examined several species of this genus, but in the literature only 3 species of *Annulobalcis* have been described: *A shimazui* Habe, 1965 (type species), *A. yamomotoi* Habe, 1974 (both from Japan) and *A. marshalli* Warén, 1981 (from New Zealand). In the last species the cephalo-pedal complex was figured. In this paper *Annulobalcis aurisflamma*, an ectoparasite of the crinoid *Tropiometra carinata* (Lamarck, 1816), is described from the São Paulo coast, Brazil. A brief anatomical description is included, the first such data for any member of this genus.

MATERIALS AND METHODS

The studied material, now deposited in the Museu de Zoologia da Universidade de São Paulo (MZUSP), was collected by diving in October and November 1991 at Ubatuba, the north coast of São Paulo State, at two sites: (1) 23°29′S 45°05′W, Enseada Beach, north coast, depth: intertidal to 5m; (2) 23°33′S 45°04′W, south beach, Anchieta Island, depth: intertidal to 8m. About 100 specimens were collected. Two additional specimens were collected at Praia Grande (south coast of São Paulo).

The removal of the crinoids from their shelters was necessary to find the snails. The collected gastropods were put in a transparent flask with seawater for behavioural observations; after a few hours they were fixed in 70% ethanol. The shells of specimens studied anatomically, were decalcified in Railliet-Henry fluid and examined directly; afterwards, they were dehydrated in ethanol, dyed in carmine, fixed and cleared in creosote.

[1] Seçao de Moluscos, Museu de Zoologia da Universidade de São Paulo, Caixa Postal 7172, CEP 01064–970, São Paulo, SP, BRAZIL

Some serial sections of 7 to 15 μm were made, dyed by H.E. (Fig. 15). SEM photographs were taken in the Laboratório de Microscropia Electrônica do IBUSP.

The crinoid identification is based on Tommasi (1957 and 1965). The systematic and anatomical terminology follow Warén (1981 and 1983), and Lützen (1972).

SYSTEMATIC DESCRIPTION

Family Eulimidae
Genus *Annulobalcis* Habe, 1965
Annulobalcis aurisflamma, sp. nov.
(Fig. 1 to 25)

Material Examined: holotype: MZUSP 27905; paratypes: MZUSP 27906, (1 specimen) MZUSP 27907, (1 specimen); MZUSP 27908, (1 specimen); MZUSP 27910, (1 specimen); MZUSP 27938, (10 specimens); all from type locality. MZUSP 27909, (1 specimen); MZUSP 27939, (10 specimens); both batches from the Anchieta Island site. Museu Nacional do Rio de Janeiro Col. Mol. MNRJ 6374 and MNRJ 6375, (2 specimens from type locality). Museu Oceanográfico da Fundação Universidade de Rio Grande MORG 29681 and MORG 29682, (2 specimens from type locality). Swedish Museum of Natural History SMNH Inv. Type Coll. 4511, (2 specimens from type locality). MZUSP 27974, (2 specimens, São Paulo, Praia Grande City, Fortaleza de Itaipu coast, 2 m deep, Nov 1993). USNM 860590 (2 specimens from type locality)

Type Locality: Brazil, São Paulo State, Ubatuba City, Enseada Beach, 23°29'S 45°05'W.

Diagnosis: Transparent shell, colour given by the tegument; mantle brown with 5 to 8 axial yellow stripes; minute snout; dorsal inner projection of proboscis near the proboscis opening, absence of muscular pumps; protandric hermaphroditism, female stage with penis remaining. Penis with irregular arrow-like projection at tip.

Shell: small (to 11mm), slender and pointed (apical angle about 35°), up to 10 distinctly convex whorls, thin, transparent, colourless (Figs. 1, 3, 4). Protoconch of 3 glassy, smooth, convex whorls; axis of protoconch slightly deviating from the axis of the teleoconch. (Fig. 2). Teleoconch up to 6 convex glassy whorls, with a conspicuous suture. Sculpture of extremely fine spiral and axial striae, only visible with stereomicroscope; spiral striae may be absent or vary from 1 to 6 per whorl; axial striae very numerous (with the SEM this sculpture is scarcely visible, except for a short portion near the suture) (Fig. 1c)). Elliptical aperture, sigmoid inner lip, reflected outer lip (Fig. 5). Columella sigmoid.

Operculum: elliptical, corneus, yellowish-transparent, thin. Subterminal nucleus (Figs. 6, 17). Occupies the whole aperture.

Mantle: visible through the transparent shell, reddish-brown in colour, with 5 to 8 wide, irregular, yellow axial stripes on the last whorl. These axial stripes are arranged directly below the ones of the preceding whorl, giving the effect that some stripes begin at the apex and finish at the base of the shell. Some specimens also have 1 to 3 similarly coloured spiral stripes in the lower half of the body whorl (Figs. 3, 4, 5). The penultimate whorl has a deep narrow axial furrow in preserved specimens (Fig. 7 and 16). Mantle edge simple, without siphon (Figs. 7 and 21).

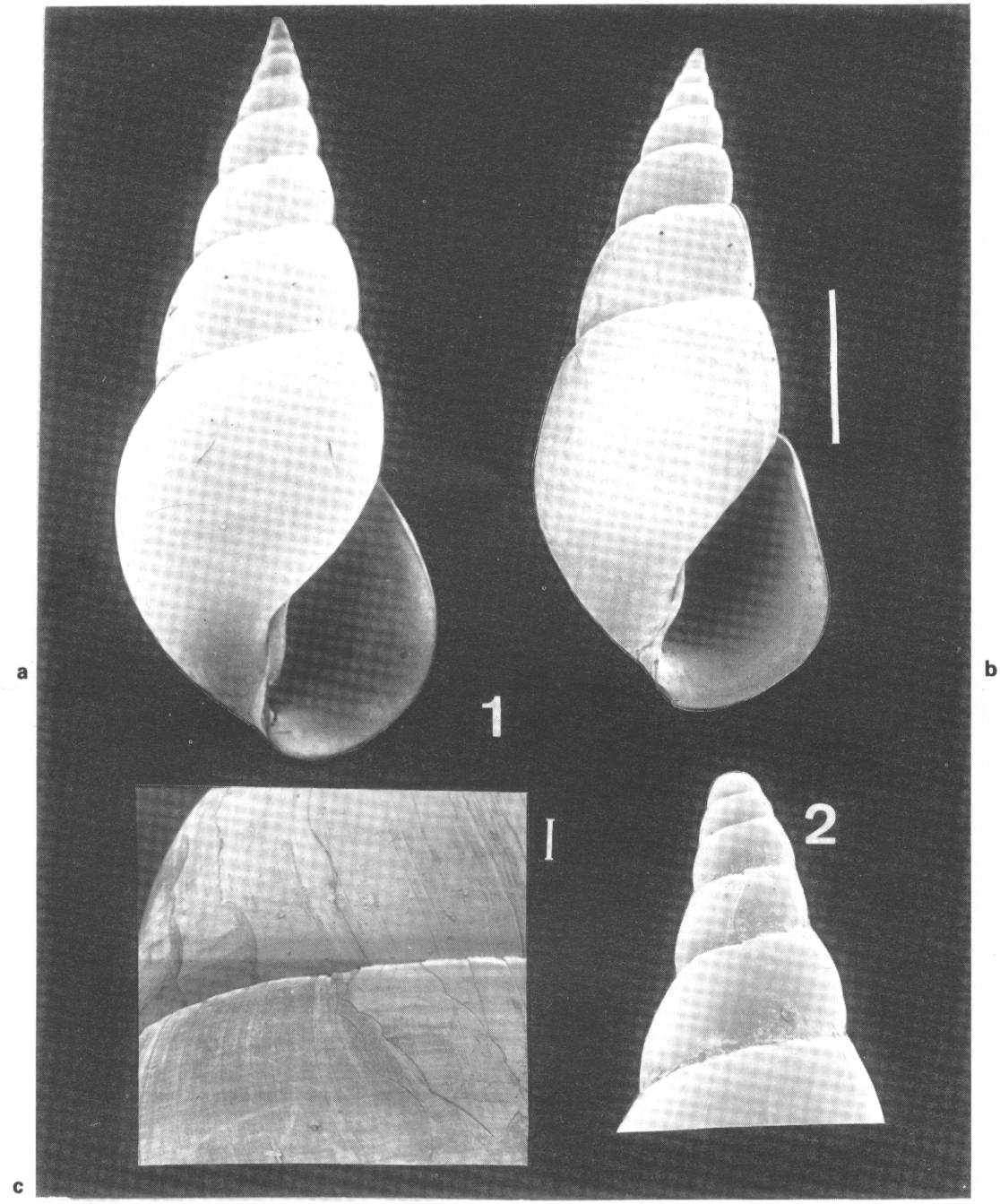
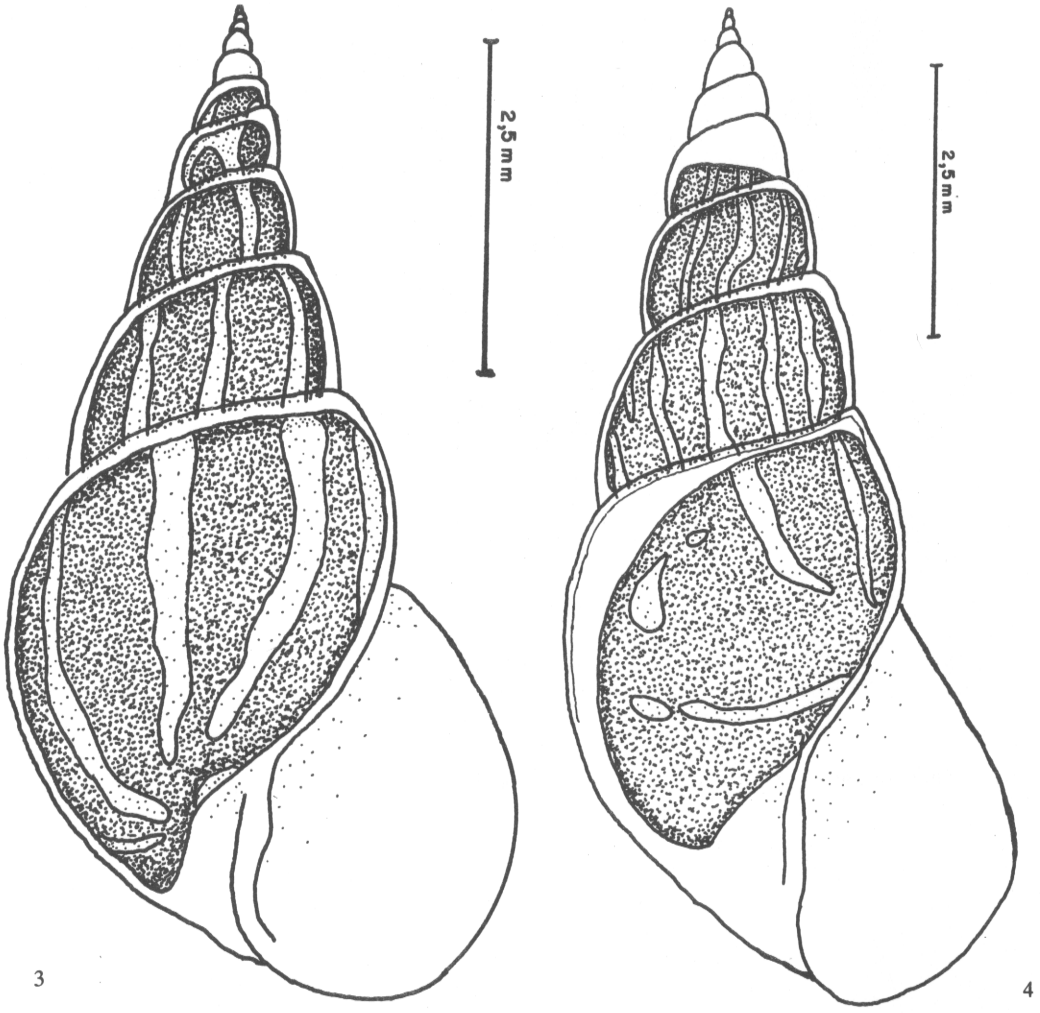


Fig. 1. *a*, and *b*, frontal view of the shell of two specimens, scale = 1 mm; c, detail of the shell surface of *a*, scale = 0·2 mm.
Fig. 2. Detail of protoconch and two teleoconch whorls, in profile, scale = 0·1 mm



Figs. 3 and 4. Shell and mantle colour variation, 2 females

Head-foot complex: basic colour reddish-brown with yellow band on tentacles and foot margins. Tentacles fused centrally (Figs. 7, 8); a dark sphaerical eye on outer base of each tentacle, with an elevation of tegument around of each eye (Fig. 20). The lens is hollow. Penis always present, attached beside the right tentacle. Snout small and conic. Foot well-developed, long, divided into propodium, mesopodium and metapodium (Figs. 7, 8A). The foot has a slight constriction between the anterior and the mid regions and a median longitudinal, narrow furrow (Fig. 8B). Pedal gland well-developed, causing a swelling behind and to the right of the head. In section this gland has a central duct, that opens in the anterior region of the sole furrow (Fig. 14). No other pedal gland was found.

Pallial complex: rather-deep mucous-filled pallial cavity (1 whorl), posterior part covered by the anterior part of the kidney (Figs. 10, 16); in the female it is mainly occupied by a large oviduct (Fig. 21). Hypobranchial gland well-developed and pyriform. Gill long with

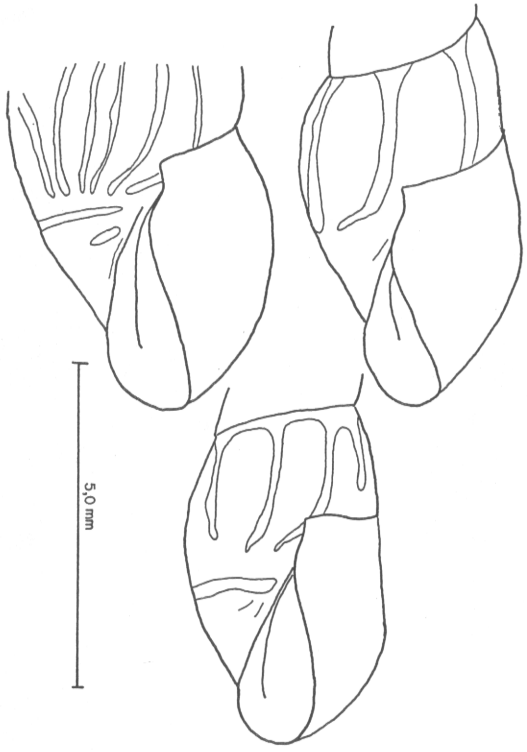


Fig. 5. Outer lip and mantle colour variation of three females

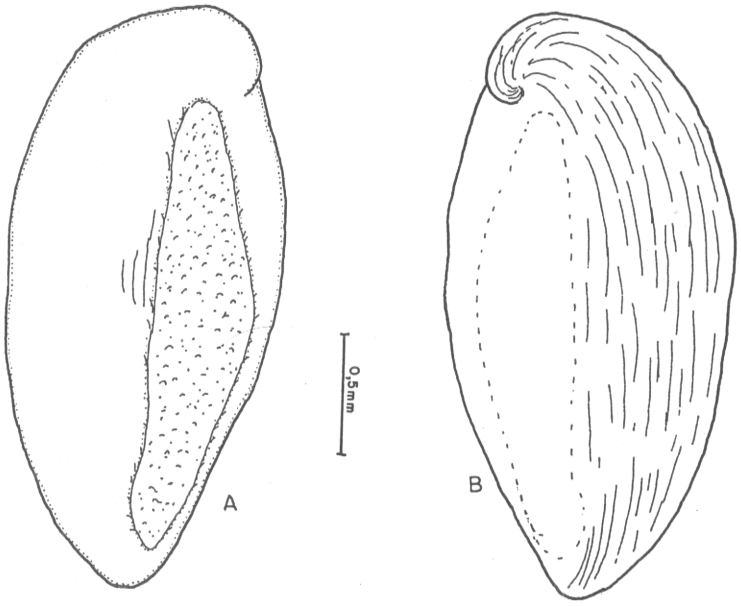


Fig. 6. Operculum: A: inner view; B: outer view

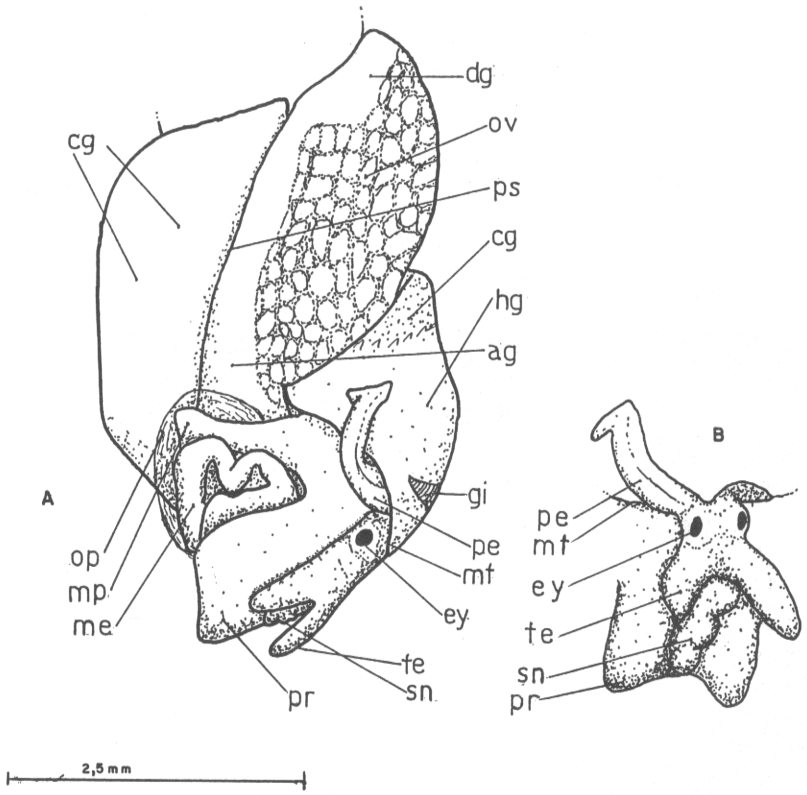


Fig. 7. Topography and outer morphology of a female. A: lateral view; B: frontal view of head-foot

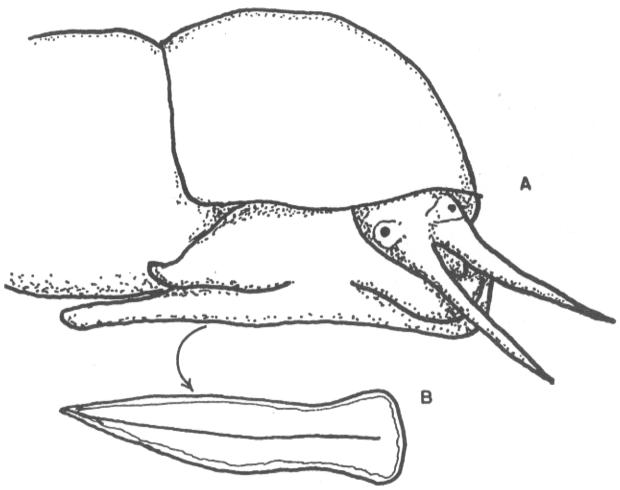


Fig. 8. Crawling specimen. A: latero-frontal view; B: ventral view of mesopodian sole, moving on a glass, anterior region at right

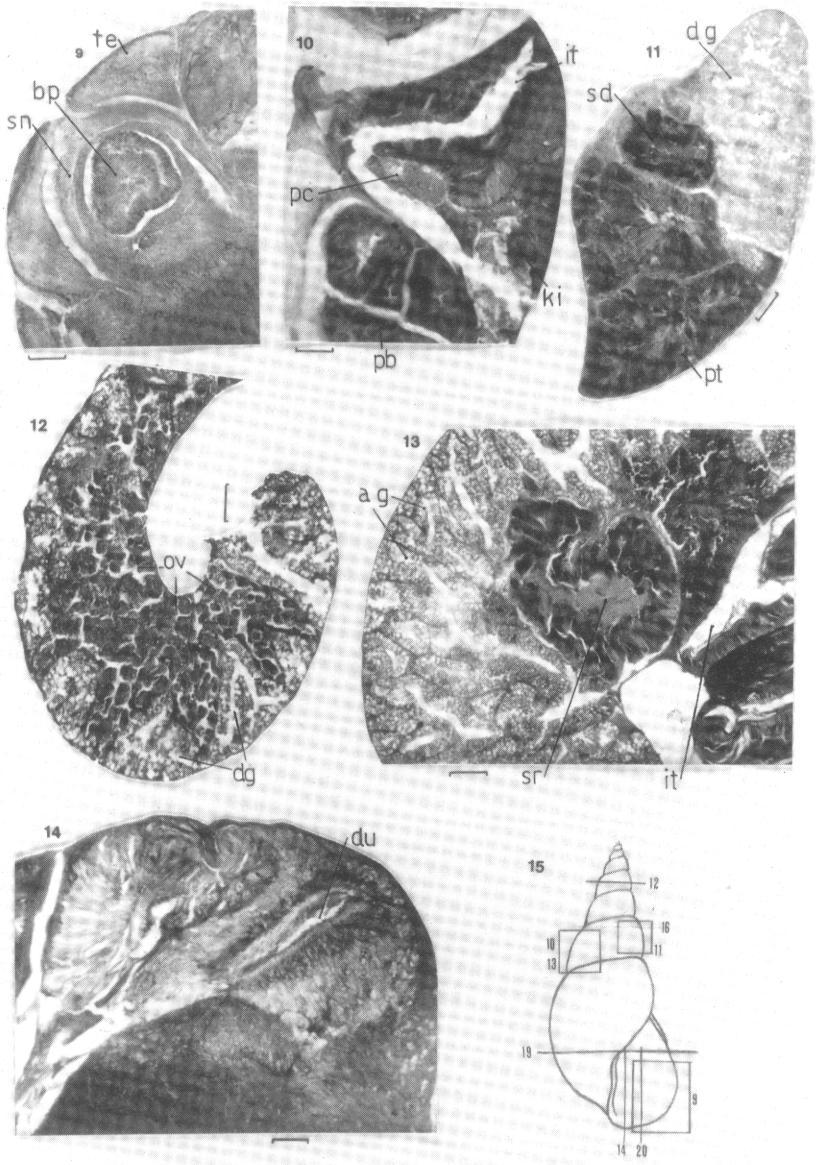


Fig. 9. Axial section in snout region. HE, 15 μm
Fig. 10. Axial section, beginning of last whorl. HE, 15 μm
Fig. 11. Axial section, beginning of penultimate whorl in male. HE, 15 μm
Fig. 12. Transverse section of first whorls in female. HE, 7 μm, the same specimen of Fig. 19
Fig. 13. Axial section, beginning of penultimate whorl in female. HE, 7 μm
Fig. 14. Transverse section just over the foot. HE, 7 μm
Fig. 15. Schematic representation of approximate section level of Figs. 9 to 20. Scales Figs. 9 to 14 = 0·1 mm

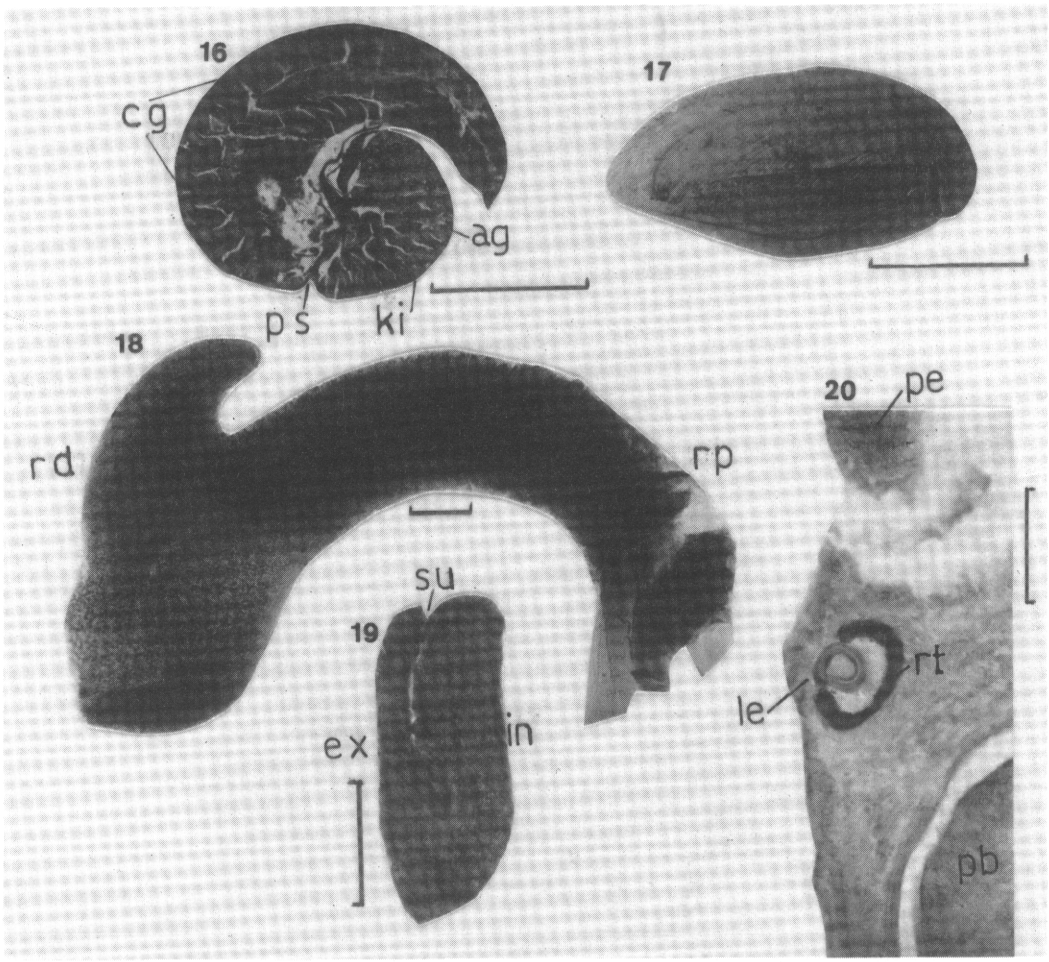


Fig. 16. Transverse section, penultimate whorl in female. HE, 7 μm
Fig. 17. External view of operculum, scar view. Congo red
Fig. 18. Total outer view of cleared penis. Carmin
Fig. 19. Transverse section of basal region of penis. HE, 7 μm
Fig. 20. Transverse section of head, on the right eye. HE, 7 μm Scales Figs. 16 and 17 = 1·0 mm; Figs 18 to 20 = 0·1 mm

transverse leaflets, blunt anteriorly, leaflets pointing posteriorly. Osphradium narrow and long. Pericardium shown in Fig. 10.

Digestive system: proboscis opening located at anterior extremity of the snout, rounded anteriorly and blunt posteriorly (Fig. 22). There is an inner projection of the dorsal wall of proboscis, adjacent and dorsal to the proboscis opening (Figs. 22 and 23). Its surface is irregular, and inner tissue muscular (Fig. 9). Proboscis of acrembolic type, long and thick (Fig. 22), without internal structures except the anterior projection. Oesophagus long and slender, anteriorly united with adjacent wall by thin muscle fibres (Fig. 22). Rest of digestive

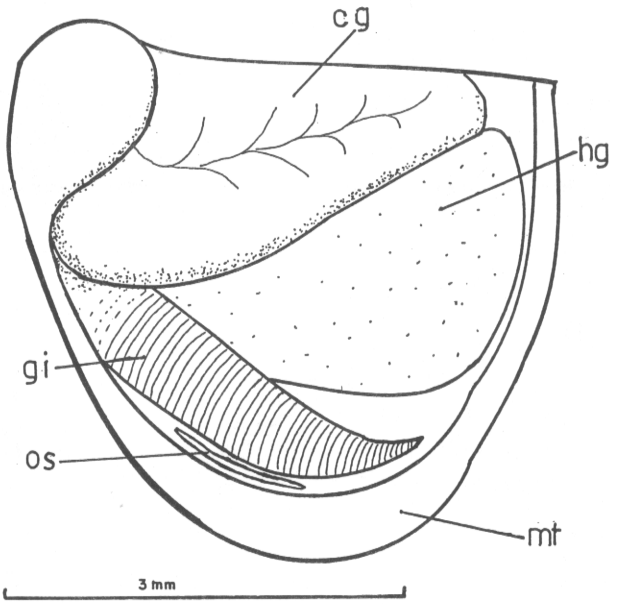


Fig. 21. Schematic view of the pallial organs in female, inner view

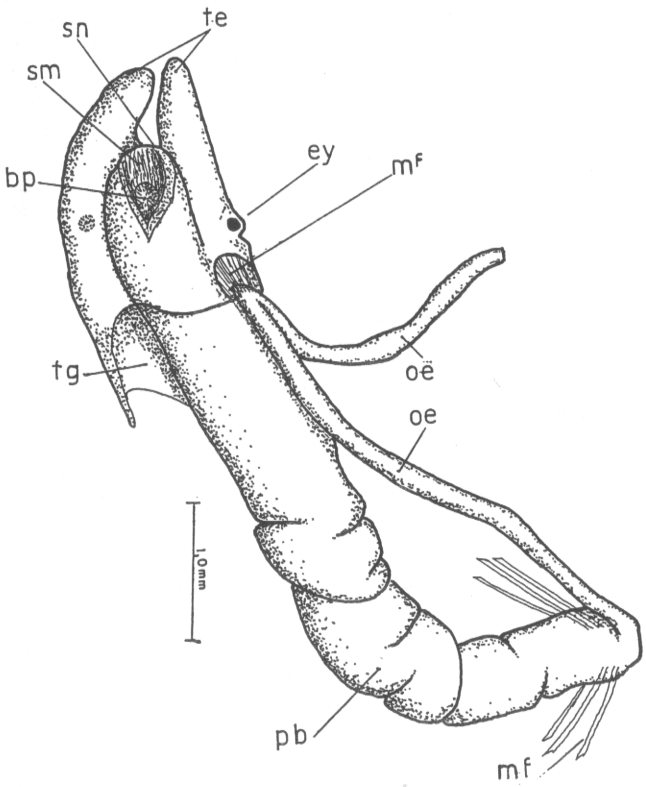


Fig. 22. Ventral view of head and anterior region of digestive system

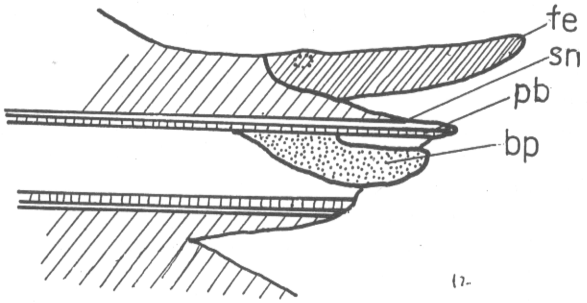


Fig. 23. Schematic representation of a sagital section of head

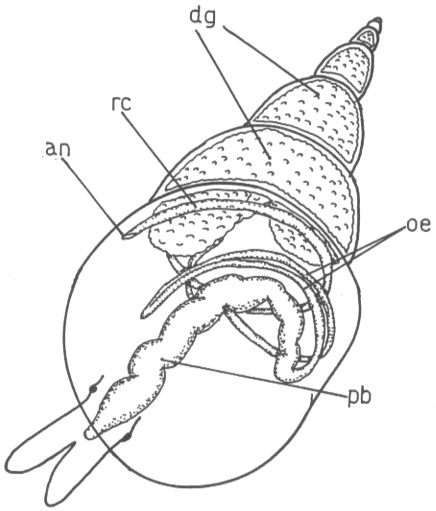


Fig. 24. Schematic representation of digestive system

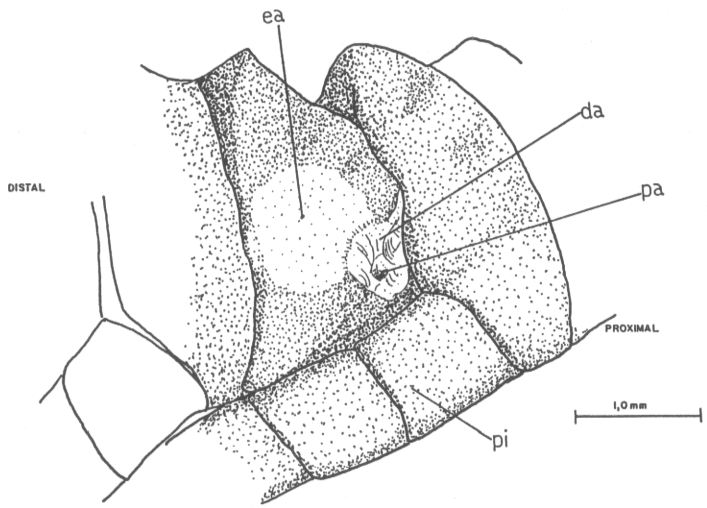


Fig. 25. Scar left by *A. aurisflamma* on the aboral-proximal face of the arm of *Tropiometra carinata*

tube and digestive gland present, but radula, pumps and developed stomach are lacking (Fig. 24).

Genital system: sex only determined from serial sections (and presence of developed pallial oviduct) since all specimens have penis. The largest specimens have ovarian and the smallest have testicular gonads, suggesting protandric hermaphroditism. Undifferentiated or simultaneously hermaphroditic gonad was not found.

Male: testis lies close to the columella, occupies 3 to 4 whorls in length, in the penultimate whorl it involves 1 to 3 small glands (prostate – Fig. 10, and also probably immature female glands). Seminal vesicle well-developed (Fig. 11). Penis long and flattened, with an expanded, irregular, arrow-shaped tip (Fig. 7 and 18) transverse section of basal region of penis (Fig. 19) shows a deep sperm gutter, and no inner duct. No duct uniting the penis and genital glands was found.

Female: penis present, similar to that of males (Fig. 7). The ovary occupies most of the whorls, with projections through the digestive gland (Fig. 12). Seminal receptacle developed (Fig. 13). Albumen gland shown in Fig. 13. Capsule gland large and conic (Fig. 21), with a central main channel (Fig. 16); the capsule gland sometimes contains, several small, sphaerical white eggs.

Measurements: holotype: length: 8·7 mm, width: 3·3 mm. Paratypes: MZUSP 27906: 9·6 × 4·5 mm; MZUSP 27905: 8.8 × 3.8 mm; MZUSP 27908: 9·2 × 3·6 mm; MZUSP 27909: 10·6 × 4·4 mm; and MZUSP 27910: 8·7 × 3·3 mm.

Range: known from coast of São Paulo State, Brazil.

Habitat and behaviour: the host of this species is the crinoid *Tropiometra carinata* (Lamarck, 1816); The gastropods were generally found on the proximal aboral region of the crinoid arms, but some young specimens were collected on mid region of the arms, and only one on the cirri. At Enseada Beach, about 25% of the crinoid specimens were parasitized, some individuals having up to 5 snails. The small snout is used to attach the snail to the host, the snail stays within a viscous, transparent mucus, but it leaves its host immediately when disturbed. Except for minor scarring, no apparent injury to parasitized crinoids was observed. The scars produced by the snail are found near arm joints of the host (Fig. 25), and have 3 regions: (1) the outer region (diameter about 1 mm), where only the surface of host wall is eroded; (2) an intermediate region (diameter about 0·5 mm), with decalcification and only soft tissues preserved; and (3) the inner region, where there is perforation into the host tissues.

There is a little variation in the colour of the snails especially when compared to the large colour variation of their host, but camouflage is provided by the pattern of the gastropod mantle, which blends with the pinnules of crinoid arms.

The snails are very active and move quickly. *A. aurisflamma* was found from the intertidal zone to 8 m depth.

Etymology: the specific name refers to the irregular yellow (Latin. *auris*) banding of the mantle, like a flame (Latin *flamma*).

DISCUSSION

Annulobalcis aurisflamma has the tegument elevation around the eye, observed by Warén (1981) in *A. marshalli*, but it differs from this New Zealand species by its small snout, mantle

colour and by its host. *A. aurisflamma* differs from the Japanese species *A. yamomotoi* Habe, 1974 and *A. shimazui* Habe, 1965 in lacking spiral sculpture of the shell, by mantle colour, host and habitat. The shell characters of all *Annulobalcis* species are very similar.

Annulobalcis aurisflamma has conchological similarities to the West American deep-water species *Eulima ptilocrinicola* Bartch, 1907, which differs in mantle colouration, and in having a different host and habitat. The shell character and crinoid parasitism show that *E. ptilocrinicola* belongs to *Annulobalcis*.

Within the Eulimidae *sensu* Warén (1983), *A. aurisflamma* occupies an intermediate state of morphological modification to parasitism. It has an almost complete digestive system, but radula, salivary glands and stomach are absent. The following characters appear to be exclusive to *A. aurisflamma*: (1) the host; (2) the mantle colouration; (3) the inner projection of the proboscis near the mouth; and (4) female phase with persistent penis.

ACKNOWLEDGEMENTS

We thank Dr. J. L. M. Leme of MZUSP for critical reading of an earlier version, also Dr. J. H. Leal, University of Miami, for sending references.

REFERENCES

BARTSCH, P. 1907. A new parasitic mollusk of the genus *Eulima*. *Proc. U.S. Nat. Mus. Washington* **32** (1548): 555–556 + pl. 53.

HABE, T. 1965. Description of *Annulobalcis schimazui* n.gen. et sp. (Eulimidae). *Venus* **24**: 106–107.

—— 1974. Five new gastropodous species parasitic on the Japanese Echinoderms. *Venus* **32**: 117–123.

LÜTZEN, J. 1972. Records of parasitic gastropods from crinoids, with description of a new genus, *Goodingia* (Gastropoda, Prosobranchia). *Steenstrupia* **2** (16): 233–246.

TOMMASI, L. R. 1957. Os Equinodermos do Litoral de São Paulo I. Echinoidea, Crinoidea e Holothuroidea do Bentos Costeiros. *Papéis Dep. Zool. S. Paulo* **13** (2): 19–44.

—— 1965. Lista dos Crinoides Recentes do Brasil. *Contrções Inst. oceanogr. Univ. S. Paulo.* Ser. *Oceanogr. biol.* **9**: 1–33.

WARÉN, A. 1981. Eulimid gastropods parasitic on echinoderms in the New Zealand Region. *N. Zealand J. Zool.* **8**(3): 313–324.

—— 1983. A generic revision of the Family Eulimidae (Gastropoda, Prosobranchia). *J. Moll. Stud.* supp. **13**: 1–96.

ABBREVIATIONS

ag = albumen gland
an = anus
bp = buccal projection
cg = capsule gland
da = decalcified area
dg = digestive gland
du = duct of pedal gland
ea = eroded area
ey = eye
ex = external face of the penis
gi = gill
hg = hypobranchial gland
in = inner face of the penis
os = osphradium
ov = ovary
pa = perforation area
pb = proboscis
pc = pericardium
pe = penis
pi = pinnule
pr = propodium
ps = pallial sulcus
pt = prostate gland
rc = rectum
rd = distal region of the penis
rp = proximal region of the penis

it = intestine
ki = kidney
le = lens
me = mesopodium
mf = muscle fibres
mp = metapodium
mt = mantle border
oe = oesophagus
op = operculum
rt = retina
sd = seminal duct
sm = proboscis opening
sn = snout
sr = seminal receptacle
su = sperm gutter
te = tentacle
tg = tegument