

A new species of the genus *Lithoglyptes* Aurivillius, 1892 (Crustacea: Cirripedia: Acrothoracica) from the Fiji Sea, with some data on its ultrastructure

Новый вид рода *Lithoglyptes* Aurivillius, 1892 (Crustacea: Cirripedia: Acrothoracica) из моря Фиджи, с некоторыми данными по его ультраструктуре

G.A. Kolbasov
Г.А. Колбасов

Biological Faculty, Moscow State University, Vorobyevy Gory, Moscow 119899 Russia.
Биологический факультет МГУ, Воробьевы горы, Москва 119899 Россия.

KEY WORDS: Cirripedia, Acrothoracica, morphology, systematic, SEM.

КЛЮЧЕВЫЕ СЛОВА: Cirripedia, Acrothoracica, морфология, систематика, СЭМ.

ABSTRACT: Four lithoglyptid females and a dwarf male, which may be referred to a new species of the genus *Lithoglyptes*, were found in the coral collections of the Zoological Institute (St.-Petersburg). Their morphology was examined under a light microscope and SEM. Their appearance is similar to that described by Tomlinson [1969] for *Balanodytes taiwanus* Utinomi, 1950. But the presence of two-segmented caudal appendages indicates the affinity of these specimens to the genus *Lithoglyptes*. The systematic position of the genus *Balanodytes* is discussed.

РЕЗЮМЕ: Четыре самки и карликовый самец, которые могут быть отнесены к роду *Lithoglyptes*, были обнаружены в коллекциях кораллов Зоологического Института (С.-Петербург). Их морфология была изучена с помощью светового и сканирующего электронного микроскопов. Их строение сходно со строением, описанным Томлинсоном [Tomlinson, 1969] для *Balanodytes taiwanus* Utinomi, 1950, но присутствие двучлениковых каудальных придатков указывает на их принадлежность к роду *Lithoglyptes*. Также обсуждается систематическое положение рода *Balanodytes*.

Introduction

The genus *Balanodytes* was erected by Utinomi [1950] for a single species *Balanodytes taiwanus* Utinomi, 1950. It is a lithoglyptid barnacle possesses four pairs of terminal cirri and no caudal appendages. He has obtained complete and incomplete females from *Balanus* (*Megabalanus*) *tintinnabulum* (*tintinnabulum*) (Linnaeus, 1758) from Formosa, which were lost in dissection.

Lately, Tomlinson [1969] described a single dried female without an attachment area and infected by a

fungus. It was found in the coral *Distichopora nitida* Verrill, 1864 from the Marshall Islands. But his specimen has another general appearance than Utinomi specimens.

In both cases the material has been lost or damaged by a fungus. Therefore, there is a necessity in the complete description, based on a new material. Such material (similar to Tomlinson's description) was obtained during the survey of the coral collections of the Zoological Institute, Russian Academy of Sciences (St.-Petersburg). It comes from the Fiji Sea, four intact females and a dwarf male were found in a hydrocoral colony. The investigation of this material under light and scanning electron microscopes revealed the presence of well-developed attachment disk and two-segmented caudal appendages.

Taxonomy

SUBCLASS CIRRIPEDIA BURMEISTER, 1834

SUPERORDER ACROTHORACICA GRUVEL, 1905

ORDER PYGOPHORA BERNDT, 1907

Family Lithoglyptidae Aurivillius, 1892

Genus *Lithoglyptes* Aurivillius, 1892

Lithoglyptes balanodytes Kolbasov, **sp.n.**
Figs. 1–3.

Balanodytes taiwanicus: Tomlinson, 1969: 84–87, fig. 20.

DIAGNOSIS: *Lithoglyptes* with two long opercular spines bent posteriorly (“carinally”) at the tips in adult and anteriorly (“rostrally”) in young specimens, without the lateral bars, the orificial knob area without denticles and spines. The attach-

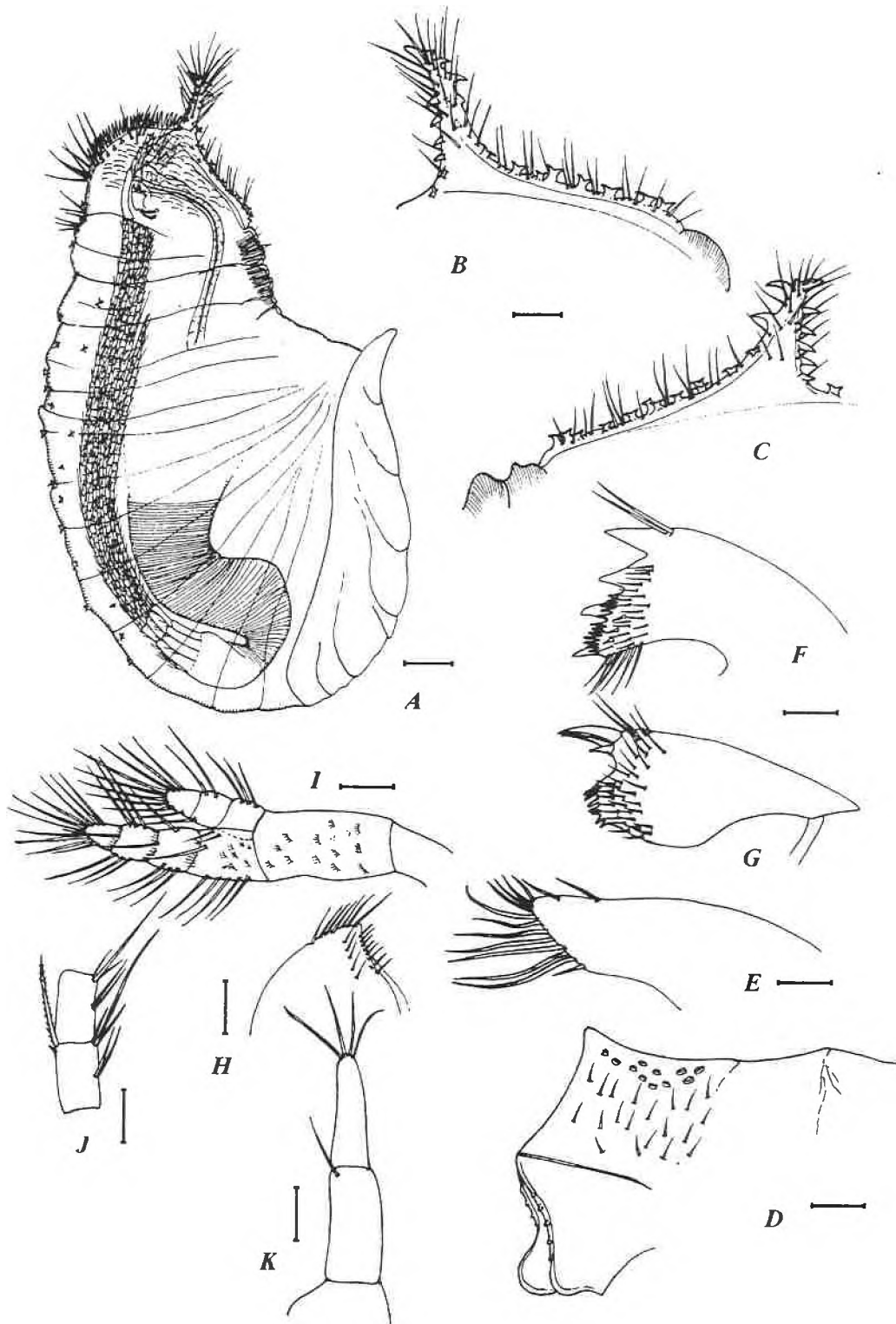
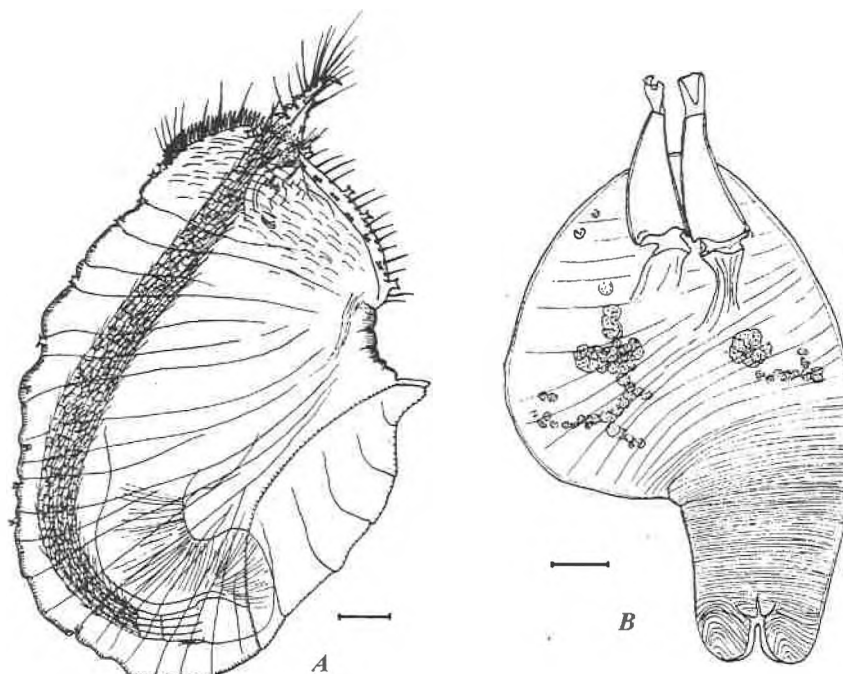


Fig. 1. *Lithoglyptes balanodytes* sp.n., holotype, ♀: A — general view; B, C — left and right opercular bars; D — labrum; E — mandibular palp; F — mandible; G — maxillule; H — maxilla; I — mouth cirrus; J — middle segments of anterior ramus of IV pair of terminal cirrus; K — caudal appendages. Scale bars: A — 215 μ m; B, C — 100 μ m; D, I, J — 43 μ m; E, F, G, H, K — 30 μ m.

Рис. 1. *Lithoglyptes balanodytes* sp.n., голотип, ♀: A — общий вид; B, C — левое и правое оперкулярные утолщения; D — лабрум; E — мандибулярный щупик; F — мандибула; G — максилула; H — максилла; I — ротовая усоножка; J — срединные членики передней ветви IV пары терминальной усоножки; K — каудальные придатки. Масштаб: A — 215 μ m; B, C — 100 μ m; D, I, J — 43 μ m; E, F, G, H, K — 30 μ m.

Fig. 2. *Lithoglyptes balanodytes*:
A — young female, general view; B
— dwarf male, general view. Scale
bars: A — 151 μ m; B — 43 μ m.

Рис. 2. *Lithoglyptes balanodytes*:
А — молодая самка, общий вид; В
— карликовый самец, общий вид.
Масштаб: А — 151 μ m; В — 43 μ m.



ment area developed, with distinct attachment disk. Caudal appendages two-segmented. The dwarf male pear-shaped, without antennular stalk.

MATERIAL. Three females, one with a dwarf male and young female in the colony of the Hydrocorallia. Locality: The Fiji Sea, 29°29.5'S, 167°52.0'E, 40 m deep. Three females and dwarf male were boiled in KOH for light microscopy investigations. Adult and young females and a male were also examined under SEM. They were cleaned in TWEEN solution, post-fixed in 2% OsO₄ (osmium tetroxide) for 2 hr., dehydrated in acetone, and critical point dried in CO₂, sputter coated with platinum-palladium, and examined with a scanning electron microscope (HITACHI S405A) at 15 kV. Holotype and paratype are deposited in the Zoological Museum of the Moscow State University, (holotype ♀ Mg-1201, paratype ♀ Mg-1202).

DESCRIPTION. Female: Holotype (Fig. 1 A) 2.9 mm long, with an aperture of 0.77 mm measured straight across. Opercular area of adult barnacle slightly elongated, narrower than other part of mantle sac, whereas mantle sac of young female rounded, without elongated opercular area (Fig. 2 A). Opercular bars (Fig. 1 B, C) ca. 1/2 of length of whole apertural lips in adult specimens and 2/3 in young specimen, equipped with bifid teeth and setae. A pair of long, posteriorly (in adult specimens) or anteriorly (in young specimen) bent opercular spines, armed with simple curved teeth and long setae, at middle of apertural lips. Typical comb collar at anteroventral end of mantle sac (Fig. 1 A). With SEM, it appears as a palisade row of closely spaced cuticular projections (Fig. 3 D). These projections are united at their bases, but have free apical ends about 50 μ m long, with numerous villi on the lateral margins. This comb collar ultrastructure resembles that described by Smyth [1986] and Kolbasov [1999b]. Two clusters of scattered long setae of apertural area grouped at ventral (posterior) end of comb collar.

Faces of opercular area with conspicuous massive scales [Kolbasov, 1999b] discernible as transverse rows of fine dots at a light microscope. Each scale of massive multifids is 10–15 μ m in length and 3–6 μ m in height, and consists of 20–30

short sharp denticles fused together, leaving only the apical ends free. They are denser at the lateral surfaces, just under opercular bars and spines (Fig. 3 B), than at ventral side of opercular area (Fig. 3 A). These scales may act like an abrasive or file in burrowing process [Kolbasov, 1999b]. The lateral bars absent. The rest of mantle sac is mostly equipped with rare simple, bifid, but occasionally trifid teeth (Fig. 1 A).

No distinct and armed orificial knob, its area covered with wrinkled cuticle, without conspicuous spines or teeth (Fig. 1 A, B, C). Surface of orificial knob area bears small setae and rare feeble multifid scales (according to Kolbasov, 1999) consisting of 5–10 variable separate denticles about 5 μ m long (Fig. 3 C). This type of scales together with setae may serve for burrow cleaning [Kolbasov, 1999b]. Horny attachment disk (Fig. 1 A) drop-like, developed and represented by thin cuticle.

Appendages are typical for genus: pedicles of mouth cirri (Fig. 1 I) bear four-segmented anterior and three-segmented posterior rami, respectively. Labrum (Figs. 1 D; 3 G, H) saddle shaped, with stub setae and bushy multifid scales along upper margin (Figs. 1 D, 3 H), lateral faces covered with short simple setae and arc-shaped multifid scales (Fig. 3 H), distal margins bear conate denticles (Fig. 3 G). Such structure of labrum is typical for genus *Lithoglyptes*. Mandibles (Fig. 1 F) with 4 teeth, lower half of blade with a row of 12–13 sharp spines, half of lower margin with setae. Superior angle of maxillule (Fig. 1 G) with a pair of large and one small spines, following by a notch without spines, inferior half of distal margin with a row of small spines; lateral faces distally setose. Maxilla (Fig. 1 H) triangular, lateral margins and anterior face with long setae.

Four terminal cirri have a typical structure for genus: anterior side of each article with 3 distal (one long and two short) setae and 2 middle ones at midlength. Long biserrate seta on posterior margin of each second or third article. Caudal appendages two-segmented (Figs. 1 K; 3 E), distal segment with tuft of 4 setae, basal one with 2 setae.

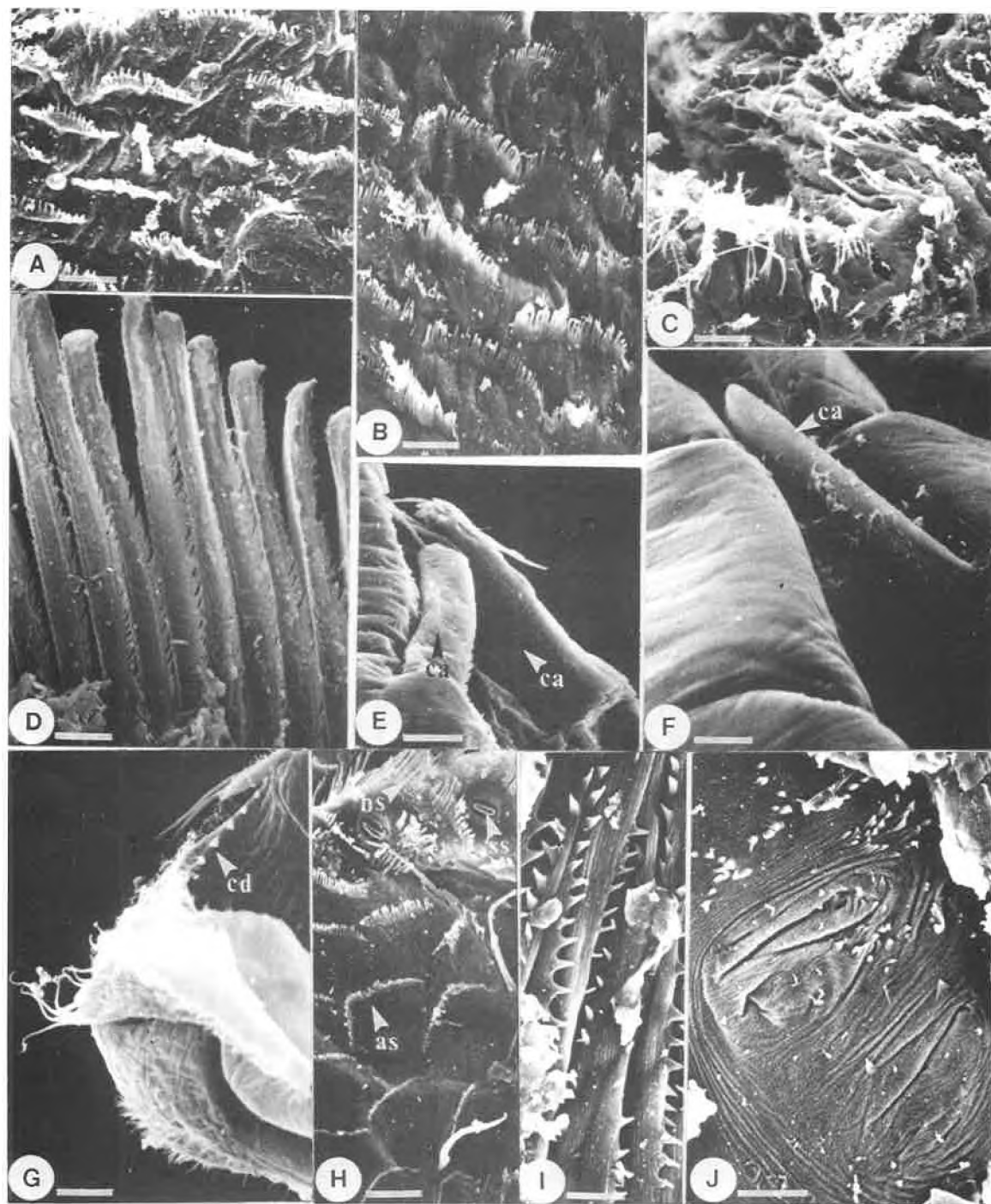


Fig. 3. *Lithoglyptes balanodytes* A-E — ♀, G-J — ♂; *Cryptophialus variabilis* F: A — massive multifid scales at ventral part of opercular area; B — massive multifid scales under opercular spine; C — area, corresponding to orificial knob; D — comb collar; E — caudal appendages; F — rudimentary caudal appendage; G — distal part of labrum and mandibular palps; H — lateral surface of labrum; I — cuticle of middle part of dwarf male; J — pustule-like cuticular structures near distal end. Abbreviations: as — arc-shaped multifid scales; bs — bushy multifid scales; ca — caudal appendages; cd — conate denticles; ss — stub setae. Scale bars: A, B, D, J — 6 μm ; C, F, H — 8 μm ; E — 12 μm ; G — 24 μm ; I — 4 μm .

Рис. 3. *Lithoglyptes balanodytes* A-E — ♀, G-J — ♂; *Cryptophialus variabilis* F: A — массивные чешуйки на вентральной части оперкулярной области; B — массивные чешуйки под оперкулярным шипом; C — область, соответствующая устьевому бугорку; D — гребневидный воротничок; E — каудальные придатки; F — рудиментарный каудальный придаток; G — дистальная часть лабрума и мандибулярных щупиков; H — боковая поверхность лабрума; I — кутикула срединной части карликового самца; J — сосочковидные кутикулярные структуры около дистального конца. Обозначения: as — арковидные чешуйки; bs — кустистые чешуйки; ca — каудальные придатки; cd — массивные (conate) шипики; ss — пеньковидные щетинки. Масштаб: A, B, D, J — 6 мк; C, F, H — 8 мк; E — 12 мк; G — 24 мк; I — 4 мк.

Male with pear-shaped body, without lateral lobes, 403 μm long, 274 μm high (Fig. 2 B), with two antennules at anterior end. Posterior end elongated, wrinkled, with distinct apertural slit. Cuticle with fine annular striation, without setae or mantle teeth, bears sharp denticles assigned into transverse rows at anterior and middle parts of the body (Fig. 3 I). Several paired pustule-like cuticular structures were observed near the distal end (Fig. 3 J). Neither a long stalk between body and antennules nor an appendage similar to penis were found.

Burrow apertures are keyhole shaped, 0.6–1.0 mm long, the carinal end is rounded, the rostral end is sharp.

ETYMOLOGY. A new species is dedicated to *Balanodytes taiwanus*, erroneously described as belonging to a new acrothoracican genus.

COMPARISON. The females of a new species resemble that of *L. scamborachis* Tomlinson 1969, *L. wilsoni* Tomlinson, 1969 and *L. stirni* Turquier, 1987 in having long curved opercular spines and absence of an armed orificial knob. But these spines curved anteriorly in adult specimens of *L. wilsoni* and *L. stirni*, whereas they bent posteriorly in a new species. Besides of this, *L. wilsoni* possesses a very long attachment disk reaching the opercular spines. From *L. scamborachis* it differs in absence of a stout toothed cone on the left side of the opercular bars. The male of a new species has a typical structure for the genus.

Discussion

When describing a new genus and a new species *Balanodytes taiwanus* Utinomi [1950] wrote: "Owing to the scantiness of material as well as to poor preservation, I could not observe the internal structure in details." Meanwhile he indicated the absence of such internal structures as caudal appendages and retractor orificii muscle. This information looks a doubtful one, and after re-examination of Utinomi description (an original material was unfortunately lost) I concluded that his *B. taiwanus* is rather a form of other species *Lithoglyptes habeii* (Tomlinson, 1963), firstly described as *Kochlorine habeii*. This points to the fact that sometimes it may be difficult to determine the generic affinity of a species. Both *L. habeii* and Utinomi's material possess similar opercular bars (longer than $\frac{1}{2}$ of the aperture and armed with bifid teeth), long anteriorly bent opercular spines with 1–2 curved simple teeth and a well developed and armed orificial knob. I also suppose that Utinomi could not find caudal appendages due to poor preservation of the material. Considering the absence of retractor orificii in Utinomi's specimens, it must be noted that there is still no complete information on the presence or absence of this muscle within the genus *Lithoglyptes*. Besides of this, this genus probably is not monophyletic [Grygier & Newman, 1985; Kolbasov, 1999a].

Tomlinson specimen is very similar to the specimens described herein: they have similar morphology of opercular bars and opercular spines, both of them lack of orificial knob. Tomlinson [1969] referred his specimen to the *Balanodytes* because he did not find any caudal appendages, but the barnacle was damaged by a fungus and caudal appendages probably were lost due to infestation.

All these facts indicate that *B. taiwanus* Utinomi, 1950 should be reckoned as a form of *L. habeii* and Tomlinson's specimen identified as *B. taiwanus* probably belongs to a new species described herein.

Recently I have found structures similar to rudimentary caudal appendages in a cryptophialid species, tentatively identified as *Cryptophialus variabilis* Stubbing, 1961 (Fig. 3 F). Thus we also should exclude an absence of caudal appendages from the family Cryptophialidae diagnosis. Probably only two acrothoracican genera *Berndtia* Utinomi, 1950 and *Trypetesa* Norman, 1903 lack caudal appendages.

Acknowledgements. I would like to express my deep gratitude to the collaborators of the Zoological Institute, Russian Academy of Sciences (St.-Petersburg): V.M. Koltun, S.D. Stepanjantz, K.V. Savitskaja, S.D. Grebelny and A.S. Plotkin for an opportunity to work with coral collections and help. I am indebted to the Editorial Board of the Arthropoda Selecta for comments and corrections. I also thank the Russian Foundation for Basic Research (grant N 99-04-48404) for the main support of this work in the Moscow State University.

References

- Grygier, M.J. & W.A. Newman 1985. Motility and calcareous parts in extant and fossil Acrothoracica (Crustacea: Cirripedia), based primarily upon new species burrowing in the deep-sea scleractinian coral *Enallopsammia* // Trans. San Diego Soc. Nat. Hist. Vol.21. P.1–22.
- Kolbasov, G.A. 1999a. A new species of the genus *Lithoglyptes* (Cirripedia: Acrothoracica) from Indian Ocean (Isl. Java) // Arthropoda Selecta Vol.7 (for 1998). No.3. P.175–178.
- Kolbasov, G.A. 1999b. The external mantle morphology of burrowing barnacles of the families Lithoglyptidae and Cryptophialidae (Cirripedia, Acrothoracica) // Crustaceans and the Biodiversity Crisis // Proc. 4th Int. Crustacean Congress, 1998. Vol.1. P.139–149.
- Smyth, M.J. 1986. *Cryptophialus coronophorus*, new species (Cirripedia: Acrothoracica), a boring barnacle from Guam, Mariana Islands, with new insights into cryptophialid ultrastructure // J. Crust. Biol. Vol.6. No.1. P.143–157.
- Tomlinson, J.T. 1969. The burrowing barnacles (Cirripedia: Order Acrothoracica) // Bull. U.S. Natn. Mus. Vol.296. P.1–162.
- Utinomi, H. 1950. On another form of Acrothoracica, newly found from Formosa // Mem. Coll. Sci., Univ. Kyoto, Ser.B. Vol.19. No.3. P.91–96.