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# Cirripedes from the middle Pleistocene Atsumi Group, Japan, with a reevaluation of the genus *Adna* Sowerby, 1823 (Balanoidea: Pyrgomatidae)

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## Abstract

Barnacles (Cirripedia, Thoracica) from the middle Pleistocene Atsumi Group, deposited in the Mizunami Fossil Museum, are classified. Sixteen species in 13 genera of barnacles are recorded and illustrated. *Platylepas hexastylus* (Fabricius) (Platylepadidae) and three archaeobalanids, *Acasta sulcata* Lamarck, *Euacasta dofleini* (Krüger), and *Pectinoacasta pectinipes* (Pilsbry), are first reported from the Pleistocene of Japan. *Adna* Sowerby, a coral-inhabiting barnacle genus of Pyrgomatidae, is reevaluated. As a result, *Pyrgomina* Bałuk and Radwański is synonymized with *Adna*, and *A. anglica* (Sowerby), a sole included species of the genus becomes a senior synonym of *Pyrgomina djanae* Ross and Pitombo, *Pyrgoma elargatum* Seguenza, *Pyrgoma oulastreae* Utinomi, *Pyrgomina seguenzai* Bałuk and Radwański, and *Pyrgoma sulcatum* Philippi.

**Key words:** Thecostraca, Calanticomorpha, Scalpellomorpha, Balanomorpha, Quaternary, fossil

## 1. Introduction

The middle Pleistocene (MIS 9) Toyohashi Formation of the Atsumi Group is distributed in the Pacific coast of the Atsumi Peninsula, Aichi Prefecture, Honshu, Japan, and contains rich barnacle fossils. Yamaguchi (1973) first reported a balanid, *Megabalanus rosa* (Pilsbry, 1916) (as *Balanus (Megabalanus) rosa*), from the formation. Subsequently, Yamaguchi (1977a, b; 1980) recorded two balanid species, *Fistulobalanus kondakovi* (Tarasov and Zevina, 1957) (as *Balanus kondakovi*) and *Fistulobalanus amaraquaticus* (Yamaguchi, 1980) (as *Balanus amaraquaticus*). Kobayashi et al. (2008) reported two additional species,

*Lepas anatifera* Linnaeus, 1758 (Lepadidae) and *Coronula* sp. (Coronulidae). Most recently, Karasawa (2020) recorded five species of pedunculate barnacles from the Atsumi Group.

The purpose of this paper is to report both new and previously recorded barnacles from the Toyohashi Formation of the Atsumi Group in Takamatsu [=locality of Karasawa et al. (2014; Fig. 1)], Tahara City, Aichi Prefecture, central Japan, based upon examinations of the paleontological collection in the Mizunami Fossil Museum (MFM). Additionally, the taxonomy of two pyrgomatid genera, *Adna* Sowerby, 1823, and *Pyrgomina* Bałuk and Radwański, 1967, is reconsidered.

## 2. Taxonomy

Order Calanticomorpha Chan, Dreyer, Gale, Glenner,  
Ewers-Saucedo, Pérez-Losada, Kolbasov, Crandall,  
and Høeg, 2021

Family Calanticidae Zevina, 1978

Genus *Smilium* Gray, 1825

### *Smilium scorpio* (Aurivillius, 1892)

(Pl. 1, Figs. 1–3b)

*Material examined*: MFM142685–MFM142685-3  
(carinae, scuta, terga).

Order Scalpellomorpha Buckeridge and Newman, 2006

Superfamily Lapadoidea Darwin, 1852 [1851]

Family Lepadidae Darwin, 1852 [1851]

Genus *Lepas* Linnaeus, 1758

### *Lepas anatifera* Linnaeus, 1758

(Pl. 1, Figs. 4a–8)

*Material examined*: MFM142473–142473-6 (cari-  
nae, scuta, terga).

### *Lepas pectinata* Spengler, 1793

(Pl. 1, Figs. 9a–15)

*Material examined*: MFM142687–142687-7 (cari-  
nae, scuta, terga).

Family Oxynaspididae Gruvel, 1905

Genus *Oxynaspis* Darwin, 1852 [1851]

### *Oxynaspis* sp.

(Pl. 1, Figs. 16a–17)

*Material examined*: MFM142688–142688-2 (carinae).

Family Poecilasmidae Annandale, 1909

Genus *Octolasmis* Gray, 1825

### *Octolasmis orthogonia* (Darwin, 1852 [1851])

(Pl. 1, Figs. 18–27)

*Material examined*: MFM142680–142680-10 (ca-  
rinae, scuta, terga).

Order Balanomorpha Pilsbry, 1916

Superfamily Coronuloidea Leach, 1817

Family Coronulidae Leach, 1817

Genus *Coronula* Lamarck, 1802

### *Coronula* sp.

(Pl. 2, Figs. 1a–2c)

*Remarks*: Kobayashi et al. (2008) first reported a single carina or carinolateral of an unnamed species of *Coronula*. An additional specimen of the rostrum is recorded here. Both specimens are characterized by having a short sheath, a thick, very narrow radii, and low, longitudinal, flattened parietal ribs which are bifurcated. These characters readily distinguish the present specimens from compartments of *Coronula didema* (Linnaeus, 1767), a cosmopolitan species attached on whales (Hayashi, 2012; 2013). The specimens are somewhat similar to compartments of *Coronula reginae* Darwin, 1854, another species in the genus *Coronula*, but differ in having a thick, narrow radius. The specific identification of this species awaits the discovery of more well-preserved material.

*Material examined*: MFM142475 (lateral/carinola-  
teral), MFM142999 (carina).

Family Platylepadidae Newman and Ross, 1976

Genus *Platylepas* Gray, 1825

### *Platylepas hexastylus* (Fabricius, 1798)

(Pl. 2, Figs. 3a–13b)

*Lepas hexastylus* Fabricius, 1798; p. 35, pl. 10, figs.  
1–2.

*Platylepas hexastylus* (Fabricius); Pilsbry, 1916, p.  
285, pl. 67, figs. 1–1c; Chan et al., 2009, p. 177,  
figs. 151–153 (synonymy).

*Diagnosis*: Shell flattened, surface with strong stri-  
ations of growth lines, plate underneath with median  
longitudinal sulcus, base embedded into skin of turtles.  
Scutum and tergum narrow, wider than high. Maxilla  
bilobed; maxillule notched; mandible with 3 teeth, 2<sup>nd</sup>  
and 3<sup>rd</sup> teeth bidentated, lower margin short, mandib-  
ulatory palp rectangular with dense setae on inferior  
margin; labrum clefted with 3 strong sharp teeth on  
each side of cutting edge (after Chan et al., 2009, p.  
177).

*Remarks*: The present species is reported in the fos-  
sil record for the first time herein. This species is an  
obligate epibiont of sea turtles known from the Indo-  
Pacific Ocean, Mediterranean, and Atlantic Ocean

(Hayashi, 2012; 2013). The rostrum of an unnamed species of *Platylepas* is also known from the middle Pleistocene Hirano Formation of Kochi Prefecture, Shikoku, Japan (Mimoto, 1991).

*Material examined*: MFM143000-1–3 (rostra), MFM143000-4–6 (laterals/carinolaterals), MFM143000-7 (carina); MFM129150 (shell), extant specimen from the Pacific coast of the Atsumi Peninsula, central Japan.

Superfamily Tetracitoidea Gruvel, 1903

Family Tetracitidae Gruvel, 1903

Subfamily Tetracitellinae Newman and Ross, 1976

Genus *Tetracitella* Hiro, 1939

***Tetracitella chinensis* (Nilsson-Cantell, 1921)**

(Pl. 3, Figs. 1a–b)

*Tetracitella purpurascens chinensis* Nilsson-Cantell, 1921, p. 359, fig. 81, pl. 3, fig. 12.

*Tetracitella chinensis* (Nilsson-Cantell); Utinomi, 1970, p. 347; Kim et al., 2019, p. 141, figs. 1, 7–13 (synonymy).

*Diagnosis*: Shell with 2 major forms, hollowed and multicostate. Completely hollowed form with 6 hollows (carina and rostrum with 2 hollows each, 2 laterals each with single hollow), shell surface with weak longitudinal ribs, radii smooth with horizontal striations. Intermediately hollowed form with fewer than 6 hollows; some plates without hollows having longitudinal ribs on surface. Multicostate form with longitudinal ribs on surface, often 4 major ribs on rostrum, 3 major ribs on carina, with accessory ribs extending from major ribs; radii smooth with horizontal striations, striations pronounced on uneroded specimens (after Kim et al., 2019, p. 143).

*Remarks*: The present species is also known from the middle Pleistocene Hirano Formation of Kochi, central Japan (Mimoto, 1991). *Tetracitella chinensis* is attached to intertidal rocks in the Indo-West Pacific Ocean (Chan et al., 2009).

*Material examined*: MFM143002 (tergum).

Superfamily Balanoidea Leach, 1817

Family Archaeobalanidae Newman and Ross, 1976

Subfamily Archaeobalaninae Newman and Ross, 1976

Genus *Solidobalanus* Hoek, 1913

***Solidobalanus socialis* (Hoek, 1883)**

(Pl. 3, Figs. 2a–5d)

*Balanus socialis* Hoek, 1883, p. 150, pl. 13, figs. 23–28.

*Solidobalanus socialis* (Hoek); Liu and Ren, 2007, p. 376, fig. 168 (synonymy).

*Diagnosis*: Shell small, low-conical, white, thin; parietes smooth externally; orifice relatively large, slightly toothed; radii narrow; alae relatively wide with upper margin parallel to basis. Scutum with growth ridges, lacking longitudinal striae on outer surface; articular ridge prominent; adductor ridge weak. Tergum with short, bluntly truncated spur; crests for depressor muscles distinct; articular furrow shallow (modified and translated from Liu and Ren, 2007, p. 378).

*Remarks*: The fossil record of this species is known from the upper Pleistocene Kioroshi Formation of the Shimosa Group of Chiba Prefecture (Yamaguchi, 1988) and the middle Pleistocene Hirono Formation of Kochi Prefecture (Mimoto, 1991).

*Material examined*: MFM143003 (opercular plates), MFM143004-1–2 (shell attached to the echinoid, *Hemicentrotus* sp.), MFM143005 (shells attached to the pelecypod, *Pecten albicans*).

Genus *Striatobalanus* Hoek, 1913

***Striatobalanus tenuis* (Hoek, 1883)**

(Pl. 3, Figs. 6a–b)

*Balanus tenuis* Hoek, 1883, p. 154, pl. 13, figs. 29–33.

*Striatobalanus tenuis* (Hoek); Jones, 2004, p. 152; Pitriana et al., 2020, p. 688, fig. 38 (synonymy).

*Diagnosis*: Shell whitish to yellowish; parietes smooth, glossy; orifice pentagonal shaped, deeply toothed; radii narrow, summits very oblique, slightly concave; basis solid; scutum with longitudinal striations; tergum with short, rather broad spur (after Pitriana et al., 2020, p. 688).

*Remarks*: The specimen attached onto the surface of a gastropod. The previously known fossil record is from the upper Pleistocene Kioroshi Formation of the Shimosa Group of Chiba Prefecture (Yamaguchi, 1988). The species is known from the Indo-West Pacific at depth of between 7–551 m (Jones and Hosie, 2016).

*Material examined:* MFM143006 (shell attached to the tereberid gastropod, *Punctoterebra japonica*).

Subfamily Acastinae Kolbasov, 1993

Genus *Acasta* Leach, 1817

***Acasta sulcata* Lamarck, 1818**

(Pl. 4, Figs. 1a–8b)

*Acasta sulcata* Lamarck, 1818, p. 668; Yu et al., 2017, p. 177, figs. 25–31 (synonymy).

*Diagnosis:* Shell white to pale yellow, orifice rather small, with toothed edge. Basis saucer- or cup-shaped, pointed towards central umbo, rim crenate. Shell in adults often with membrane-covered clefts between plates. Externally, scutum with horizontal growth ridges, articular furrow shallow. Spur of tergum broad, square-shaped, truncated at end, width slightly more than 1/2 of basal margin. Sheath extending approximately half of parietes, with internal vesicular structure, inner shell surface below sheath with longitudinal ribs. Proximal segments of anterior ramus and basis of cirrus IV with curved teeth (after Yu et al., 2017, p. 177).

*Remarks:* The present species is first recognized as a fossil. *Acasta sulcata* inhabiting in sponges is widely distributed in the Indo-West Pacific at depth of between 5–25 m (Jones and Hosie, 2016).

*Material examined:* MFM143011-1 (rostrum), MFM143011-2 (lateral), MFM143011-3 (carina), MFM143011-4 (carinolateral), MFM143011-5–6 (bases), MFM143011-7 (tergum), MFM143011-8 (scutum).

***Acasta s.l. sp.***

(Pl. 3, Figs. 7a–10b)

*Remarks:* This species differs from *Acasta sulcata* and *Euacasta dofleini* (Krüger, 1911) by having characterized by having parietes sparsely ornamented with small, irregular-sized projections leaving basal pores. A further specific identification must await the discovery of more well-preserved materials.

*Material examined:* MFM143007 (rostrum), MFM143008 (carina), MFM143009–MFM143010 (carinolaterals).

Genus *Euacasta* Kolbasov, 1993

***Euacasta dofleini* (Krüger, 1911)**

(Pl. 4, Figs. 9a–18)

*Acasta dofleini* Krüger, 1911, p. 56, pl. IV, figs. 39a–d. *Euacasta dofleini* (Krüger); Kolbasov, 1993, p. 409, fig. 8; Jones and Hosie, 2016, p. 276 (synonymy).

*Diagnosis:* Shell conical or cylindrical, usually white, but sometimes pinkish. Parietes, except for carinolaterals, with some hairs and pores on external surface. Orifice large. Carinolaterals very narrow. Raddii broad, with fine striae longitudinally and horizontally; summit of radii steeply oblique. Basis circular, convex, with denticulated periphery. Sheath half or less than half length of parietes. External surface of scutum with growth ridges intersected with longitudinal ridges; basi-tergal angle round; articular ridge long; adductor ridge absent; adductor muscle pit faint; pit for lateral depressor large, deep. Spur of tergum wider than long; spur furrow indistinct; articular ridge indistinct; crests for depressor muscle absent (modified from Kim, 2011, p. 85).

*Remarks:* The present specimens represent the first fossil record of *Euacasta dofleini*. Mimoto (1991) illustrated an unnamed species of *Acasta* from the middle Pleistocene Hirano Formation of Kochi Prefecture, Japan. His specimen (Mimoto, 1991, figs. 5-10a–b) may be assigned to the rostrum of *E. dofleini* by having the paries covered with irregularly arranged pores. This species embedded in sponges is known from the West Pacific Ocean ranging from Japan to North Australia (Jones and Hosie, 2016).

*Material examined:* MFM143012–MFM143013 (shells), MFM143014-1 (rostrum), MFM143014-2 (lateral), MFM143014-3 (carina), MFM143014-4 (tergum), MFM143014-5 (scutum), MFM143014-6–7 (bases), MFM143014-8 (carinolateral).

Genus *Pectinoacasta* Kolbasov, 1993

***Pectinoacasta pectinipes* (Pilsbry, 1912)**

(Pl. 4, Figs. 19a–b)

*Acasta pectinipes* Pilsbry, 1912, p. 294.

*Pectinoacasta pectinipes* (Pilsbry); Kolbasov, 1993, p. 411, fig. 14; Hosie et al., 2021, p. 35, figs. 21–24 (synonymy).

**Diagnosis:** Shell globose, basis shallow to deeply cupped, small membranous slits between parietal junctions. Externally, parietes with variously pronounced longitudinal ribs lined with small, sharp points; internally with prominent longitudinal ribs interlocking with crenate rim of basis. Scutum transversely elongate, with longitudinal ridges crossing growth ridges. Tergum growth ridges crossed with strong longitudinal ridges giving a latticed appearance. Cirrus IV protopod with 14–15 curved teeth, anterior ramus basal segments with 1–4 recurved teeth on anterior margins. Cirrus V with or without 1–3 teeth on medial segments of anterior ramus (after Hosie et al., 2021, p. 35).

**Remarks:** There has never been a fossil record of this species hitherto. The present species is embedded in sponges and is widely distributed in the Indo-West Pacific (Jones and Hosie, 2016).

**Material examined:** MFM143016 (scutum).

Family Balanidae Leach, 1817

Subfamily Amphibalaninae Pitombo, 2004

Genus *Fistulobalanus* Zullo, 1984

***Fistulobalanus amaraquaticus* (Yamaguchi, 1980)**

(Pl. 5, Figs. 1a–9)

*Balanus amaraquaticus* Yamaguchi, 1980, p. 1087, pls. 1–3.

*Fistulobalanus amaraquaticus* (Yamaguchi); Zullo, 1984, p. 1330.

**Diagnosis:** Shell smooth with longitudinal narrow stripes of bright purple to reddish purple in color. Raddii very narrow, summits oblique. Sheath with calcareous vesicles. Parietal tubes subdivided into two or more rows of subsidiary tubes. In horizontal section, moderate subsidiary tubes rectangular, minute tubes variable in shape. Subsidiary tubes and parietal tubes with transverse septa. Adductor ridge of scutum well-developed and sloping toward occludent margin; pit for adductor muscle wide and moderately depressed. Basal margin of both sides of tergal spur straight or slight concave; fascicle moderately wide; spur width approximately 1/5 length of basal margin; distance between basi-scutal angle and anterior side of spur nearly 9/7 of spur width (after Yamaguchi, 1980, p. 1087).

**Remarks:** This species is common in the Toyohashi Formation. *Fistulobalanus amaraquaticus* is confirmed as ranging from middle Pleistocene to upper Pleistocene in age (Yamaguchi, 1980), and recorded from the Shimosa Group, Naganuma, Shimosueyoshi, and Uemachi formations of Honshu, the Hirano Formation of Shikoku, and Kagoshima and Shiroyama formations of Kyushu (Yamaguchi, 1980; Mimoto, 1991).

**Material examined:** MFM143017–MFM143019 (shells), MFM143020 (opercular plates), MFM143021–1–2 (lateral), MFM143022 (shell attached to the pelecypod, *Decatopecten plica*), MFM143023–MFM143024 (shell attached to *Megabalanus rosa*).

***Fistulobalanus kondakovi* (Tarasov and Zevina, 1957)**

(Pl. 5, Figs. 10a–b)

*Balanus amphitrite* var. *niveus* Darwin, 1854, p. 240.

*Balanus amphitrite* var. *kondakovi* Tarasov and Zevina, 1957, p. 179, 191, fig. 76.

*Fistulobalanus kondakovi* (Tarasov and Zevina); Zullo, 1984, p. 1330; Chan et al., 2009, p. 248, figs. 214–217.

**Diagnosis:** Shell with 6 plates, plate surfaces smooth, background dull-red with purple stripes. Scutum triangular, dorsal surface with horizontal striations; tergum arrow-shaped, scutal margin straight, basi-scutal angle very acute, spur long and narrow. Maxilla globular; maxillule not notched; mandible with 4 teeth excluding inferior angle; mandibulatory palp elongated, with long setae on tip; labrum clefted, with 3 large sharp teeth on each side of cutting edge (after Chan et al., 2009, p. 248).

**Remarks:** The present species has been found from the middle Pleistocene Naganuma Formation (Yamaguchi, 1977a) and the middle Pleistocene Nakamura Formation (Mimoto, 1991). *Fistulobalanus kondakovi* is widely distributed in the Indo-West Pacific and attached on rocks in estuarine coastal areas (Chan et al., 2009).

**Material examined:** MFM143025 (shell).

Subfamily Megabalaninae Newman, 1979

Genus *Megabalanus* Hoek, 1913

***Megabalanus rosa* (Pilsbry, 1916)**

(Pl. 5, Figs. 11a–15)

*Balanus tintinnabulum rosa* Pilsbry, 1916, p. 61.



*Megabalanus rosa* (Pilsbry); Newman and Ross, 1976, p. 68; Henry and McLaughlin, 1986, p. 37, figs. 4c, 10a–d. (synonymy).

*Diagnosis:* Shell conic; parietes smooth, usually pinkish red to reddish purple in color; radii moderately wide, summits horizontal; orifice usually greater than 1/2 basal diameter. Scutum with narrow tergal segment acutely inflected; occludent margin toothed; basal margin slightly sinuous; growth ridges strongly developed, rather widely separated; longitudinal striae usually lacking, occasionally faint; articular ridge 2/3 to 3/4 length of tergal margin; adductor ridge blunt or acute, confluent with articular ridge, often extending nearly to basal margin; pit for adductor muscle shallow; pit for lateral depressor muscle moderately deep, sometimes with moderately well-developed crests. Tergum moderately broad with spur furrow closed or nearly so; spur short, moderately broad, separated from basi-scutal angle by own width or more; basal margin straight or slightly sloping on both sides of spur; growth ridges strong, widely separated; longitudinal striae very faint or absent; articular ridge 3/4 to 4/5 length of scutal margin; crests for depressor muscle weakly developed (after Henry and McLaughlin, 1986, p. 37).

*Remarks:* This species is abundant in the Takamatsu Muddy Sand Member. Yamaguchi (1973, 1977b, 1988) reported *Megabalanus rosa* from the Pliocene–Holocene deposits ranging from Hokkaido to the Okinawa-jima Island, Japan. Additional fossil records are known from the lower–middle Pleistocene Onna Formation (Matsuura, 1996), the middle Pleistocene Nakamura Formation (Mimoto, 1991), and the upper Pliocene Kume Formation (Kikuchi, 2004). This species is recorded from Japan, Korea, and Taiwan, and attached to the intertidal rocks, floating substrates, and shells (Chan et al., 2009; Kim, 2011).

*Material examined:* MFM143026 (tergum), MFM143027 (scutum), MFM143028–MFM143029 (cluster of shells), MFM143025 (shells attached to the pelecypod, *Pecten albicans*).

Family Pyrgomatidae Gray, 1825

Subfamily Megatrematinae Holthuis, 1982

Genus *Adna* Sowerby, 1823

*Type and sole included species:* *Pyrgoma anglicum* Sowerby, 1823, by monotypy.

*Diagnosis:* See species.

*Remarks:* Sowerby (1823) first used the genus name *Adna* and treated it as a synonym of *Pyrgoma*. Utinomi (1967) recognized *Megatrema* Sowerby, 1823, as the valid genus and contained three extant species formerly assigned to *Pyrgoma* Leach, 1817, *M. anglicum*, *M. madreporarum* (Bosc, 1801) and *M. oulastrae* (Utinomi, 1962). In the same year, Bałuk and Radwański (1967) erected the new genus *Pyrgomina* with *P. seguenzai* Bałuk and Radwański, 1967 (type) and *P. anglica*. Ross and Newman (1973), in their revision of coral-inhabiting barnacles, found that *Boscia* de Férussac, 1822 (type species, *Balanus madreporarum* Bosc, 1801) was a senior synonym of *Adna*, *Megatrema* (type species, *Megatrema stokesii* Gray, 1825 = *Balanus madreporarum* Bosc, 1801), and *Pyrgomina*. Holthuis (1982) clarified the nomenclature of these genera and concluded that the correct name of *Boscia*, preoccupied by *Boscia* Schweigger, 1820, was *Megatrema*.

Ross and Pitombo (2002), in their taxonomic revision of Megatrematinae, regarded *Adna* and *Pyrgomina* as the valid genera. *Megatrema* differs from *Adna* and *Pyrgomina* by having a narrow tergum with a pronounced beak (Ross and Pitombo, 2002). Prior to their work, Ogawa and Matsuzaki (1995) recognized that the characters of the tergum and labrum readily distinguished *M. madreporarum* from *M. anglicum* and *M. oulastrae*. Therefore, *Megatrema* adapted for *M. madreporarum* is thought to be a valid.

Bałuk and Radwański (1967) gave the following diagnosis for *Pyrgomina*: “crown composed of two compartments, carina and rostrum, connected by seams clearly visible on the sheath but invisible on the outer surface of the crown; terga and scuta free of the balanid type”. Their diagnosis of *Pyrgomina* overlaps that of Megatrematinae. The shell and opercular plates of *Pyrgomina seguenzai*, a type species of *Pyrgomina* are quite similar to those of *Adna anglica* and the difference between *P. seguenzai* and *A. anglica* is only seen in the characters of ribs on the external surface of the shell. Ogawa and Matsuzaki (1994; 1995) considered that *Megatrema oulastrae* was a junior synonym of *M. anglicum*. However,

Ross and Pitombo (2002) rejected their work and removed *M. oulastreae* to *Pyrgomina*. Ogawa and Mtsuzaki (1995) showed that the morphology of the shell in *M. anglicum* (= *Adna anglica*) depended on the shape of host corals, based upon the morphometric analyses. As a result of their work, the type attached to ahermatypic corals (like *Adna anglica*) is the shell exerted from the host coral, with a dome-shaped, deep basal cup, whilst that of hermatypic corals (like *Pyrgomina oulastreae*) is the shell completely covered by the coral skeleton, with a low, depressed wall and a shallow basal cup. Kim et al. (2021) showed, using the molecular analysis based on two genes (COI and 12S) sequences, that *Adna anglica* and *Pyrgomina oulastreae* is monophyletic with 0.036%, a quite low value of the K2P distance. *Pyrgomina*, therefore, becomes the junior synonym of *Adna* again. At that time, *Pyrgomina oulastreae* and *P. seguenzai* also become a junior synonym of *Adna anglica*.

Ross and Pitombo (2002) placed *Pyrgoma costatum* Seguenza, 1873, *Pyrgoma elargatum* Seguenza, 1873, *Pyrgoma sulcatum* Philippi, 1836, *Pyrgomina djanae* Ross and Pitombo, 2002, and three unnamed species in *Pyrgomina*. Most recently, Gale et al. (2021) moved *Pyrgoma diploconus* Seguenza, 1873, to *Pyrgomina*. Among these, three unnamed species of *Pyrgomina* are removed to *Adna anglica* and *Pyrgoma sulcatum*, once again, is synonymized with *A. anglica* (see Darwin, 1854). There is no significant difference within shells and opercular plates between *Pyrgomina djanae* and *Adna anglica*, and *P. djanae* is, therefore, regarded as a junior synonym of *A. anglica*. *Pyrgoma costatum* and *P. elargatum* possess the balanid-type scutum and the shell characters like *Adna anglica*. *Pyrgoma elargatum* is regarded as a junior synonym of *Adna anglica* by having a single plated shell and the sheath with a pseudo-alae internally (Gale et al., 2021). *Pyrgoma costatum* may belong to another pyrgomatid genus, *Ceratoconcha* Kramberger-Gorjanovic, 1889 (see Ross and Newman, 1973). A further generic placement of it must await the discovery of better material. The generic status of *P. diploconus* is retained because within the species opercular plates and the internal structure of the shell have not yet known.

### *Adna anglica* (Sowerby, 1823)

(Fig. 1; Pls. 6–7)

- Pyrgoma anglicum* Sowerby, 1823, plate of *Pyrgoma*, fig. 7.
- Adna anglicum* Sowerby, 1823, *Pyrgoma*'s first text page.
- Megatrema* (*Adna*) *anglica* Gray (not Sowerby), 1825, p. 103.
- Pyrgoma elargatum* Seguenza, 1873; p. 317, pl. 2, fig. 5d.
- Pyrgomina oulastreae* Utinomi, 1962, p. 227, figs. 6–8.
- Megatrema anglica* (Sowerby); Utinomi, 1967, p. 232.
- Pyrgomina seguenzai* Bałuk and Radwański, 1967, p. 691, pls. 1–2.
- Pyrgomina anglica* (Sowerby); Bałuk and Radwański, 1967, p. 693.
- Boscia anglicum* (Sowerby); Ross and Newman, 1973, p. 164, figs. 23a–b.
- Megatrema anglicum* (Sowerby); Young, 1988, p. 361; Ogawa and Matsuzaki, 1994, p. 72, figs. 1–16 (synonymy).
- Adna anglica* (Sowerby); Ross and Pitombo, 2002, p. 58, fig. 1; Jones and Hosie, 2016, p. 278 (synonymy).
- Pyrgomina djanae* Ross and Pitombo, 2002, p. 60, fig. 2.
- Pyrgomina oulastreae* (Utinomi); Ross and Pitombo, 2002, p. 61; Chan et al., 2018, line 281 of S1 file, figs. S1E–S1H, S2I–S2L, S11–S13 (synonymy).
- Pyrgomina elargata* (Seguenza); Ross and Pitombo, 2002, p. 60; Gale et al., 2021, p. 30, pl. 13, figs. 2–3 (synonymy).
- Diagnosis:** Shell single-plated, totally fused externally, steeply conical, with radiating ribs, deep purplish red to dark white in color; sheath with pseudo-alae internally. Almost exerted from host corals. Basis cup-shaped or flat, porous. Orifice small, oval, obliquely upward at carinal end. Scutum subtriangular with weak growth ridge. Tergum flat with narrow spur, placed very near to basi-scutal angle (modified from Ogawa and Matsuzaki, 1994, p. 72).
- Remarks:** Eleven specimens (MFM143035–143045) within our collection are attached to the ahermatypic scleractinian corals, *Balanophyllia* sp., *Dendrophyllia* sp., *Heterocyathus japonicus*, *Oulangia stokesiana miltoni*, and *Tubastrea* sp. Among these, three specimens (MFM143039, MFM143044, MFM143045) are

a single host coral carried at least 12 individuals, as Rees (1962) and Tilbrook (1997) illustrated.

The present species is the obligate epibiont of ahermatypic, hermatypic corals from South China Sea, Japan, India, East Atlantic Ocean and the Philippines (Rees, 1962; Ogawa and Matsuzaki, 1994; Ogawa and Matsuzaki, 1995; Asami and Yamaguchi, 1997; Ren, 1986; Chan, 2009). The fossil records of this species are known from the Pleistocene of Japan (Sakakura, 1934; Mimoto, 1991), the Pliocene–Pleistocene of England (Darwin, 1855 [1854]; Tilbrook, 1997; Collins et al., 2014) and Italy (Seguenza, 1873; Gale et al., 2021).

*Material examined:* MFM143031–MFM143034 (shell), MFM143035 (shells attached to the ahermatypic coral, *Tubastrea* sp.), MFM143036 (shells attached to the ahermatypic coral, *Dendrophyllia* sp.), MFM143037 (shells attached to the ahermatypic coral, *Oulangia stokesiana miltoni*, with opercular plates), MFM143038–MFM143040 (shell attached to *Oulangia stokesiana miltoni*), MFM143041 (shell attached to the ahermatypic coral, *Heterocyathus japonicus*), MFM143042 (shells attached to *Oulangia stokesiana miltoni*), MFM143043 (shell attached to *Dendrophyllia* sp.), MFM143044 (shells attached to the ahermatypic coral, *Balanophyllia* sp.), MFM143045 (shells attached to *Balanophyllia* sp.).

*Referred specimens:* MFM129151 (extant shell attached to *Tubastrea* sp.) from Kushimoto of Wakayama Prefecture. MFM129152 (extant shells attached to *Dendrophyllia* sp.) from Minabe of Wakayama Prefecture. MFM143046–MFM143049 (shells attached to *Heterocyathus japonicus*) from Sakurai (=Loc. Ko-1 of Kato and Karasawa, 1998, p. 2), Kisarazu City, Chiba Prefecture; sand of the Kioroshi Formation of the Shimosa Group; Late Pleistocene, Marine Isotope Stage 5 (5e) by Okazaki et al. (2018).

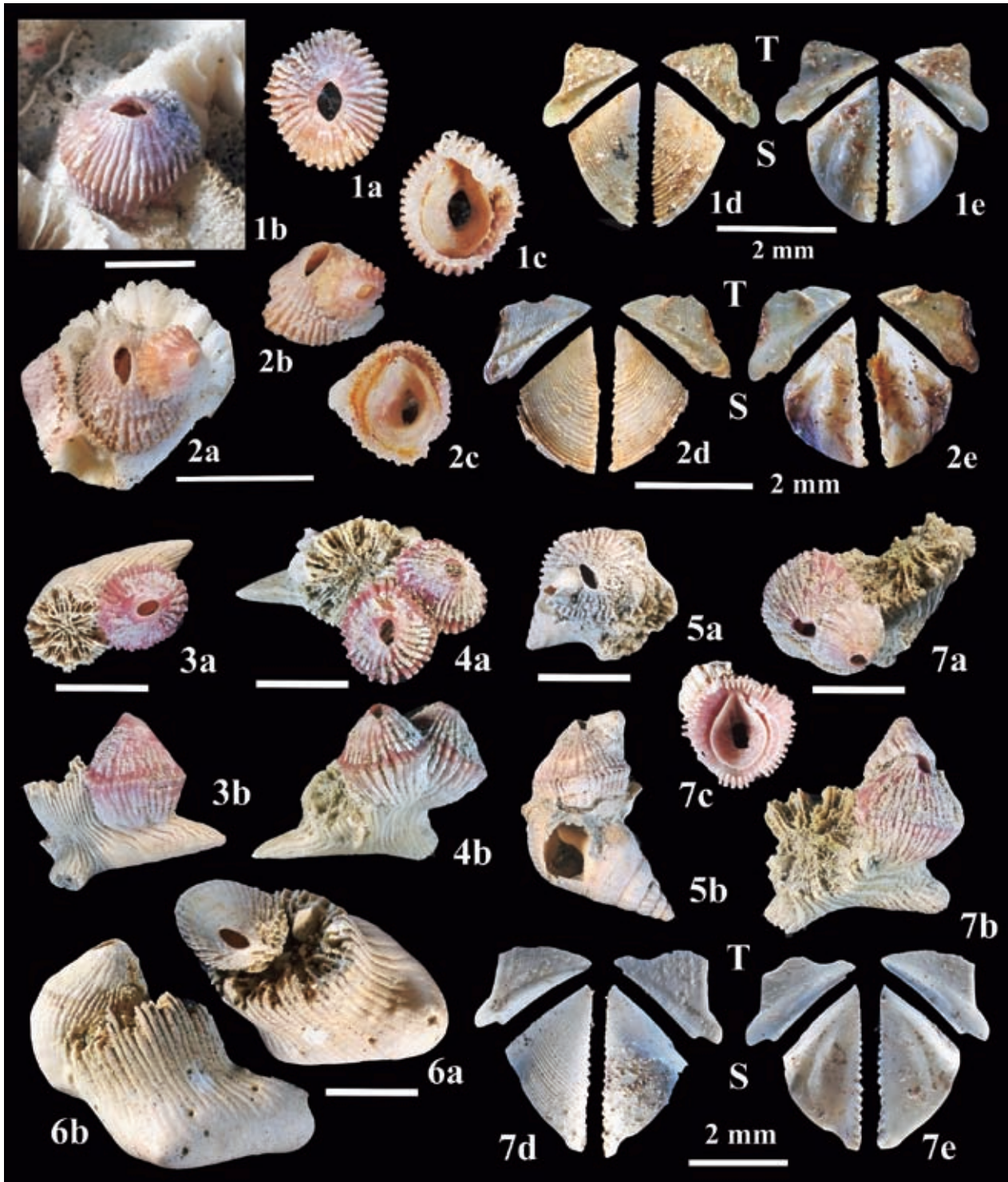
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### 4. References

- Annandale, N. 1909. An account of the Indian Cirripedia Pedunculata. Pt. I. Family Lepadidae (sensus stricto). *Memoirs of the Indian Museum* 2: 60–138.
- Asami, K., and T. Yamaguchi. 1997. Distribution of living and fossil coral barnacles (Cirripedia; Pyrgomatidae) in Japan. *Sessile Organisms* 14: 9–16. DOI: 10.4282/sosj.14.9
- Aurivillius, C. W. S. 1892. Neue Cirripeden aus dem Atlantischen, Indischen und Stillen Ocean. *Kongliga Vetenskaps-akademiens Förhandlingar Stockholm* 3: 123–134.
- Bałuk, W., and A. Radwański. 1967. *Pyrgomina* gen. n., an aberrant cirriped and its Pliocene and Recent representatives. *Bulletin de L'Academie Polonaise des Sciences* 15(11): 691–695.
- Bosc, C. 1801. Observation et description d'une espèce de Balanite qui se fixe dans les madrépores. *Bulletin des Sciences, par le Societe Philomatique de Paris* 3: 66, pl. 3, fig. 2.
- Buckeridge, J. S., and W. A. Newman. 2006. A revision of the Iblidae and the pedunculate barnacles (Crustacea: Cirripedia: Thoracica), including new ordinal, familial and generic taxa, and two new species from New Zealand and Tasmanian waters. *Zootaxa* 1136: 1–38. DOI: 10.11646/zootaxa.1136.1.1.
- Chan, B. K. K. 2009. Shallow water and deep sea barnacles (Crustacea, Cirripedia Thoracica) collected during the Philippine Panglao 2005 Expedition, with description of two new species. *Raffles Bulletin of Zoology Supplement* 20: 47–82.
- Chan, B. K. K., N. Dreyer, A. S. Gale, H. Glenner, C. Ewers-Saucedo, M. Perez-Losada, G. A. Kolbasov, K. A. Crandall, and J. T. Hoeg. 2021. The evolutionary diversity of barnacles, with an updated classification of fossil and living forms. *Zoological Journal of the Linnean Society* 193: 789–846. DOI: 10.1093/zoolinnean/zlaa160.
- Chan, B. K. K., R. E. Prabowo, and L. Kwen-Shen. 2009. Crustacean fauna of Taiwan: Barnacles, volume 1—Cirripedia: Thoracica, excluding Pyrgomatidae and Acastinae. National Taiwan Ocean University, Taiwan. 297 p.





**Fig. 1.** *Adna anglica* (Sowerby, 1823). **1a–1e**, MFM129151, shell and opercular plates attached to *Tubastrea* sp. from Kushimoto of Wakayama Prefecture. **2a–2e**, MFM129152, shells and opercular plates attached to *Dendrophyllia* sp. from Minabe of Wakayama Prefecture. **3a–7e**, shells and opercular plates attached to *Heterocyathus japonicus* from the Pleistocene Kioroshi Formation, Chiba Prefecture. **3a–b**, MFM143046; **4a–b**, MFM143047; **5a–b**, MFM143048; **6a–b**, MFM143049; **7a–e**, MFM143049. **1a**, **2a**, **3a**, **4a**, **5a**, **6a**, **7a**, dorsal; **1b**, **2b**, **3b**, **4b**, **5b**, **6b**, **7b**, lateral; **1c**, **1e**, **2c**, **2e**, **5c**, **5e**, internal; **1d**, **2d**, **5d**, external view. Scale bar = 5 mm; otherwise stated. **Abbreviations:** S, scutum; T, tergum.

- Chan, B. K. K., G. Xu, H. K. Kim, J.-H. Park, and W. Kim. 2018. Living with marginal coral communities: Diversity and host-specificity in coral-associated barnacles in the northern coral distribution limit of the East China Sea. *PLoS ONE* 13: e0196309.  
DOI: 10.1371/journal.pone.0196309.
- Collins, J. S. H., S. K. Donovan, and C. Mellish. 2014. An illustrated guide to the fossil barnacles (Cirripedia) from the Craggs (Plio-Pleistocene) of East Anglia, *Proceedings of the Geologists' Association* 125: 215–226.  
DOI: 10.1016/j.pgeola.2014.01.004.
- Darwin, C. 1852 [1851]. A monograph on the subclass Cirripedia, with figures of all species. The Lepadidæ; or, pedunculated cirripedes. The Ray Society. London. 400 p. + 10 pls. (date of publication by Newman, W. A. (1993, Darwin and cirripedology. In J. Truesdale, ed., *The History of Carcinology. Crustacean Issues* 8: p. 363).
- Darwin, C. 1854. A Monograph on the Subclass Cirripedia with Figures of all the Species. The Balanidae, the Verrucidae, etc. Ray Society. London. 684 p. 30 pls.
- Darwin, C. 1855 [1854]. A monograph on the fossil Balanidae and Verrucidae of Great Britain. *Monographs of the Palaeontographical Society* 8(30): 1–44.
- de Férussac, D. 1822. Balane et Balanes. In, M. Bory de Saint-Vincent, ed., *Dictionnaire Classique d'histoire naturelle. Tome II. Rey et Gravier, Libraries-Editeurs. Paris.* p. 142–151.
- Ellis, J., and D. Solander. 1876. *The Natural History of Many Curious and Uncommon Zoophytes, Collected from Various Parts of the Globe.* Benjamin White and Son. London. Xii+206 p.
- Fabricius, O. 1798. Tillaeg-til Conchylie-Slaegterne. Lepas, Pholas, Mya og Solen. *Skrivter af Naturhistorie-Selskabet* 4: 34–51.
- Gale, A. S., A. Ross., and A. Vertino. 2021. Cirripedes (Crustacea, Thoracica) from the Plio-Pleistocene of Sicily (Italy) and a review of the history of Mediterranean Cainozoic cirripedes. *Cainozoic Research* 21: 3–73.
- Gray, J. E. 1825. A synopsis of the genera of Cirripedes arranged in natural families, with a description of some new species. *Annals of Philosophy, new series* 10: 97–107.
- Gruvel, A. 1903. Révision des cirripèdes appartenant à la collection du Muséum national d'Histoire naturelle (Operculés), I. Partie systématique. *Nouvelles Archives du Muséum National d'Histoire Naturelle, sér. 4* 5: 95–170.
- Gruvel, A. 1905. *Monographie des Cirripèdes or Thécostracés.* Masson et Cie, Éditeurs. Paris. 472 p.
- Hayashi, R. 2012. Atlas of the barnacles on marine vertebrates in Japanese waters including taxonomic review of superfamily Coronuloidea (Cirripedia: Thoracica). *Journal of the Marine Biological Association of the United Kingdom* 92: 107–127.  
DOI: 10.1017/S0025315411000737
- Hayashi, R. 2013. A checklist of turtle and whale barnacles (Cirripedia: Thoracica: Coronuloidea). *Journal of the Marine Biological Association of the United Kingdom* 93: 143–182.  
DOI: 10.1017/S0025315412000847
- Henry, D. P., and P. A. McLaughlin. 1986. The recent species of *Megabalanus* (Cirripedia: Balanomorph) with special emphasis on *Balanus tintinnabulum* (Linnaeus) sensu lato. *Zoologische Verhandlungen* 235: 1–60.
- Hiro, F. 1939. Studies on the cirripedian fauna of Japan IV. Cirripeds of Formosa (Taiwan), with some geographical and ecological remarks on the littoral forms. *Memoirs of the College of Science, Kyoto Imperial University, Series B* 15: 245–284.
- Hoek, P. P. C. 1883. Report on the Cirripedia collected by H.M.S. Challenger during the years 1873–76. Report of the Scientific Results from the Exploratory Voyages of H.M.S. Challenger, *Zoology* 8: 1–169.
- Hoek, P. P. C. 1913. The Cirripedia of the Siboga Expedition. B. Cirripedia sessilia. *Siboga-Expeditie, Monograph* 31b: 129–275.
- Holthuis, L. B. 1982. The nomenclature of some coral-inhabiting barnacles of the family Pyrgomatidae (Cirripedia, Balanomorph). *Crustaceana* 43: 316–320.  
DOI: 10.1163/156854082X00272
- Hosie, A. M., J. Fromont, K. Munyard, and D. S. Jones. 2021. New species and new records of sponge-inhabiting barnacles (Cirripedia, Balanidae, Acastinae) from Australia. *Diversity* 13: 290.

- DOI: 10.3390/d13070290
- Jones, D. S. 2004. Barnacles (Cirripedia: Thoracica) of the Dampier Archipelago, Western Australia. In D. S. Jones, ed., Report on the results of the Western Australia Museum/Woodside Energy Limited Partnership to explore the Marine Biodiversity of the Dampier Archipelago, Western Australia 1998–2002. Records of the Western Australian Museum, Supplement 66: 121–157.  
DOI: 10.18195/issn.0313-122x.66.2004.121-157
- Jones, D. S., and A. M. Hosie. 2016. A checklist of the barnacles (Cirripedia: Thoracica) of Singapore and neighbouring waters. Raffles Bulletin of Zoology Supplement 34: 241–311.
- Karasawa, H. 2020. Cenozoic pedunculate barnacles (Cirripedia: Thoracica) deposited in the Mizunami Fossil Museum, Japan, Bulletin of the Mizunami Fossil Museum 47: 21–40.  
DOI: 10.50897/bmfm.47.0\_21
- Karasawa, H., N. Kobayashi, T. Goda, N. Ohira, and Y. Ando. 2014. A diversity for crabs (Decapoda) from the middle Pleistocene Atsumi Group, Japan. Bulletin of the Mizunami Fossil Museum 40: 55–73.
- Kato, H., and H. Karasawa. 1998. Pleistocene fossil decapod Crustacea from the Boso Peninsula, Japan. Natural History Research, Special issue 5: 1–31.
- Kikuchi, Y. 2004. Barnacle fossil from the Pliocene Kume Formation in Kanasago-machi, Kuji-gun, Ibaraki Prefecture, Northern Kanto, Japan. Monograph of Ibaraki Nature Museum 1: 126–128.
- Kim, H. K., B. K. K. Chan, G. Xu, and W. Kim. 2019. The formation of lunule-like hollows in shells of the acorn barnacle *Tetraclitella chinensis* (Nilsson-Cantell, 1921), with a reappraisal of the taxonomic status of *T. multcostata* (Nilsson-Cantell, 1930) (Cirripedia: Tetraclitidae). Journal of Crustacean Biology 39: 136–149.  
DOI: 10.1093/jcabiol/ruy103
- Kim H. K., B. K. K. Chan, S. J. Song, and J. S. Khim. 2021. DNA-based diversity assessment reveals a new coral barnacle, *Cantellius alveopora* sp. nov. (Balanomorpha: Pyrgomatidae) exclusively associated with the high latitude coral *Alveopora japonica* in the waters of southern Korea. PeerJ 9: e11284.  
DOI: 10.7717/peerj.11284
- Kim, I.-H. 2011. Barnacles. Invertebrate Fauna of Korea. Volume 21, Number 6 Arthropoda: Crustacea: Cirripedia. National Institute of Biological Resources Environmental Research Complex. Republic of Korea. 144 p.
- Kobayashi, N., T. Goda, N. Ohira, and H. Karasawa. 2008. New records of crabs and barnacles (Crustacea: Decapoda and Cirripedia) from the middle Pleistocene Atsumi Group of Aichi Prefecture, Japan. Bulletin of the Mizunami Fossil Museum 34: 111–115.
- Kolbasov, G. A. 1993. Revision of the genus *Acasta* Leach (Cirripedia: Balanoidea). Zoological Journal of the Linnean Society 109: 395–427.  
DOI: 10.1111/j.1096-3642.1993.tb00307.x
- Kramberger-Gorjanovic, D. M. 1889. Über einer tertiären Rudisten aus Podused bei Agram. Glasnik Hrvatskoga Prirodoslovnoga Društva 4(1): 48–55.
- Krüger, D. P. 1911. Beiträge zur Cirripedenfauna Ostasien. Beiträge zur Naturgeschichte Ostasiens herausgegeben von F. Doflein. Kongl. Bayerische Akademie der Wissenschaften, Munich Mathematische–physikalische Klasse. Abhandlungen Supplement Band 2: 1–72.
- Lamarck, J. B. P. A. 1802. Mémoire sur la Tubicinelle. Annales du Muséum National d’Histoire Naturelle 1: 461–464.
- Lamarck, J. B. P. A. 1818. Histoire naturelle des animaux sans vertébrés, présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s’y rapportent; précédée d’une introduction offrant la détermination des caractères essentiels de l’animal, sa distinction du végétal et des autres corps naturels, en n, l’exposition des principes fondamentaux de la zoologie, vol. 5. Verdrière. Paris. p. 1–612.
- Leach, W. E. 1817. Distribution, systematique de la class Cirripedes. Journal de Physique de Chimie et d’Histoire Naturelle, Paris 85: 67–69.
- Linnaeus, C. von. 1758. Systema Naturae per Regna tria Naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis (ed. 10), vol. 1. Laurentii Salvii. Holmiae [= Stockholm]. p. 1–824.



- Linnaeus, C. von. 1767. *Systema Naturae* (ed. 12), vol. 1 (2). Laurentii Salvii. Holmiae [= Stockholm]. p. 533–1372.
- Liu, R. Y., and X. Q. Ren. 2007. *Fauna Sinica. Invertebrata. Volume 42 Crustacea Cirripedia Thoracica*. Science Press, Beijing, China. 633 p.
- Matsuura, N. 1996. Taxonomic list of invertebrate macrofossils from the Omma Formation of Kanazawa area, Ishikawa Prefecture, Japan—Molluscs, echinoids, brachiopods and barnacles. *HGI Report* 5: 41–53.
- Mimoto, K. 1991. Cirripedian fossils from the Pleistocene deposits of the southwestern part of Kochi Prefecture Shikoku. *Fossils* 51: 15–23.  
DOI: 10.14825/kaseki.51.0\_15
- Newman, W. A. 1979. On the biogeography of Balanomorph barnacles of the southern ocean including new balanid taxa. *Proceedings of the International Symposium on Marine Biogeography and Evolution in the Southern Hemisphere, Auckland, New Zealand, July 1978. New Zealand DSIR Information Series 137*: 279–306.
- Newman, W. A., and A. Ross. 1976. Revision of the balanomorph barnacles; including a catalog of the species. *Memoirs of the San Diego Society of Natural History* 9: 1–108.
- Nilsson-Cantell, C. A. 1921. Cirripeden-studien. Zur Kenntnis der Biologie, Anatomie und Systematic dieser Gruppe. *Zoologiska Bidrag från Uppsala* 7: 75–404.  
DOI: 10.5962/bhl.title.10682
- Ogawa, K., and K. Matsuzaki. 1994. First record of *Megatrema anglicum* (Balanomorpha, Pyrgomatidae) from Japan, with some ecological notes. *Bulletin of the Biogeographical Society of Japan* 49: 71–86.
- Ogawa, K., and K. Matsuzaki. 1995. Host influence on the morphology of coral-inhabiting barnacles revealed by morphometric analyses of *Megatrema* with the revision of the genus. *Bulletin of the Biogeographical Society of Japan* 50: 21–37.
- Okazaki, H., A. Ishii, M. Kaneko, T. Tamura, Chigaku Club of Gunma Prefectural Ota Girls' High School, H. Kato, S. Isaji, and G. Tanaka. 2018. An excavation report of a baleen whale, from the Pleistocene Kioroshi Formation, Shimosa Group—Sedimentary facies, microfossils, ground penetrating radar analysis. *Journal of the Natural History Museum and Institute, Chiba* 14: 19–28.
- Philippi, R. A. 1836. *Enumeratio molluscorum Siciliae, cum viventium tum in tellure tertiaria fossilium quae in itinere suo observavit. S. Schroppii. Berolini*. 303 p., 28 pls.
- Pilsbry, H. A. 1912. Scientific results of the Philippine cruise of the Fisheries steamer Albatross, 1907–1910—No. 19. Diagnoses of new barnacles from the Philippine Archipelago and China Sea. *Proceedings of the United States National Museum* 42(1904): 291–294.  
DOI: 10.5479/si.00963801.1904.291
- Pilsbry, H. A. 1916. The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum; including a monograph of the American species. *Bulletin of the United States National Museum* 93: 1–366.  
DOI: 10.5479/si.03629236.93.1
- Pitombo, F. B. 2004. Phylogenetic analysis of the Balanidae (Cirripedia, Balanomorpha). *Zoological Scripta* 33: 261–276.  
DOI: 10.1111/j.0300-3256.2004.00145.x
- Pitriana, P., D. S. Jones, L. Corbari, and K. von Rintelen. 2020. New insights gained from museum collections: Deep-sea barnacles (Crustacea, Cirripedia, Thoracica) in the Museum National d'Histoire Naturelle, Paris, collected during the Karubar expedition in 1991. *Zoosystematics and Evolution* 96: 649–698.  
DOI: 10.3897/zse.96.55733
- Rees, W. J. 1962. The distribution of the coral, *Caryophyllia smithii* and the barnacle *Pyrgoma anglicum* in British waters. *Bulletin of the British Museum (Natural History), Zoology* 8: 401–418.
- Ren, X. 1986. *Studies on Chinese Cirripedia (Crustacea). VII. Family Pyrgomatidae. Studia Marina Sinica* 7: 129–158.
- Ross, A., and W. A. Newman. 1973. Revision of the coral-inhabiting barnacles (Cirripedia: Balanidae). *Transactions of the San Diego Natural History Society* 17: 136–173.
- Ross, A., and F. B. Pitombo. 2002. Notes on the coral-inhabiting Megatrematinae and the description of a new tribe, new genus and three new species

- (Cirripedia: Sessilia: Pyrgomatidae), Sessile Organisms 19: 57–68.  
DOI: 10.4282/sosj.19.57
- Sakakura, K. 1934. Pleistocene *Pyrgoma* from Tiba Prefecture. The Journal of the Geological Society of Japan 41: 575–581.
- Schweigger, A. F. 1820. Handbuch der Naturgeschichte der skelettlosen ungliederten Thiere. Im Verlag der Dyk'schen Buchhandlung. Leipzig. 776 p.
- Seguenza, G. 1873. Recherche paleontologique intorno ai Cirripedi Terziarii della provincia di Messina. Conappendice intorno ai Cirripedi viventi nel Mediterraneo, e sui fossili Terziarii fossili dell'Italia meridionale. Pt. I, Fam. Balanidi e Verrucidi. Atti dell'Accademia Pontaniana, Napoli 10: 266–366.
- Sowerby, G. B. 1823. The number XVIII (Price 4s. Plain, or 6s. highly finished in Colours,) of the Genera of Recent and Fossil Shells, for the Use of Students in Conchology and Geology. G. B Sowerby. London. No pagination with 6 pls. (date of publication by Sherborn, C. D. (1894), On the dates of Sowerby's 'Genera of recent and fossil shells'. The Annals and Magazine of Natural History, series 6 13: 370–371.
- Spengler, L. 1793. Beskrivelse over tvende nye arter af *Lepas*. Skrivter af Naturhistorie-Selskabet 2: 103–110, pl. X.
- Tarasov, N. E., and Z. B. Zevina. 1957. Cirripedia Thoracica of the Seas of USSR. Fauna Russian Natural Science 6: 1–267. (in Russian).
- Tilbrook, K. J. 1997. Barnacle and bivalve associates of a bryozoan-coral symbiosis from the Coralline Crag (Pliocene) of England. Tertiary Research 18: 7–22.
- Utinomi, H. 1962. Studies on the cirripedian fauna of Japan. VIII. Thoracic cirripeds from western Kyusyu. Publications of the Seto Marine Biological Laboratory 10: 211–239.
- Utinomi, H. 1967. Comments on some new and already known cirripeds with emended taxa, with special reference to the parietal structure. Publications of the Seto Marine Biological Laboratory 15: 199–237.
- Utinomi, H. 1970. Studies on the cirripedian fauna of Japan. IX.--Distributional survey of thoracic cirripeds in the southeastern part of the Japan Sea. Publications of the Seto Marine Biological Laboratory 17: 339–372.
- Yamaguchi, T. 1973. On *Megabalanus* (Cirripedia, Thoracica) of Japan. Publications of the Seto Marine Biological Laboratory 21: 115–140.
- Yamaguchi, T. 1977a. Taxonomic Studies on Some Fossil and Recent Japanese Balanoidea (Part 1). Transactions and Proceedings of the Palaeontological Society of Japan, New Series 107: 135–160.  
DOI: 10.14825/prpsj1951.1977.107\_135
- Yamaguchi, T. 1977b. Taxonomic Studies on Some Fossil and Recent Japanese Balanoidea (Part 2). Transactions and Proceedings of the Palaeontological Society of Japan, New Series 108: 161–201.  
DOI: 10.14825/prpsj1951.1977.108\_161
- Yamaguchi, T. 1980. A new species belonging to the *Balanus amphitrite* Darwin group (Cirripedia, Balanomorpha) from the late Pleistocene of Japan; an example of peripheral speciation. Journal of Paleontology 54: 1084–1101.
- Yamaguchi, T. 1988. Distribution in time and space of Japanese barnacles. Fossils 44: 1–11.  
DOI: 10.14825/kaseki.44.0\_1
- Young, P. S. 1988. Recent cnidarian-associated barnacles (Cirripedia, Balanomorpha) from the Brazilian coast. Revista Brasileira de Zoologia 5: 353–369.
- Yu, M.-C., G. A. Kolbasov, A. M. Hosie, T.-M. Lee, and B. K. K. Chan. 2017. Descriptions of four new sponge-inhabiting barnacles (Thoracica: Archaeobalanidae: Acastinae). Zootaxa 4277: 151–198.  
DOI: 10.11646/zootaxa.4277.2.1
- Zevina, G. B. 1978. A new system of the family Scalpellidae Pilsbry (Cirripedia, Thoracica). 1. Subfamilies Lithotryinae, Calanticinae, Pollicipinae, Scalpellinae, Brochiinae and Scalpellipsinae. Zoologicheskii Zhurnal 57: 998–1007. (in Russian).
- Zullo, V. 1984. New genera and species of balanoid barnacles from the Oligocene and Miocene of North America. Journal of Paleontology 58: 1312–1338.



**Explanation of Plates****Plate 1****Figs. 1–3b. *Smilium scorpio* (Aurivillius, 1892) トゲヒメミョウガ**

1, MFM142685, tergum; 2, MFM142685-2, scutum; 3a–b, MFM142685-3, carina. 1, 2, 3b, lateral; 3a, carinal view.

**Figs. 4a–8. *Lepas anatifera* Linnaeus, 1758 エボシガイ**

4a–b, MFM142473-5, carina; 5a–b, MFM142473, scutum; 6, MFM142473-2, scutum; 7, MFM142473-4, tergum; 8, MFM142473-3, tergum. 4a, 5a, 6–8, lateral; 4b, 5b, ventral view.

**Figs. 9a–15. *Lepas pectinata* Spengler, 1793 ルリエボシ**

9a–b, MFM142687-7, carina; 10, MFM142687, scutum; 11, MFM142687-2, scutum; 12, MFM142687-3, scutum; 13, MFM142687-4, scutum; 14, MFM142687-5, scutum; 15, MFM142687-6, tergum. 9a, 10–15, lateral; 9b, carinal view.

**Figs. 16a–17. *Oxynaspis* sp. トゲエボシ属の未定種**

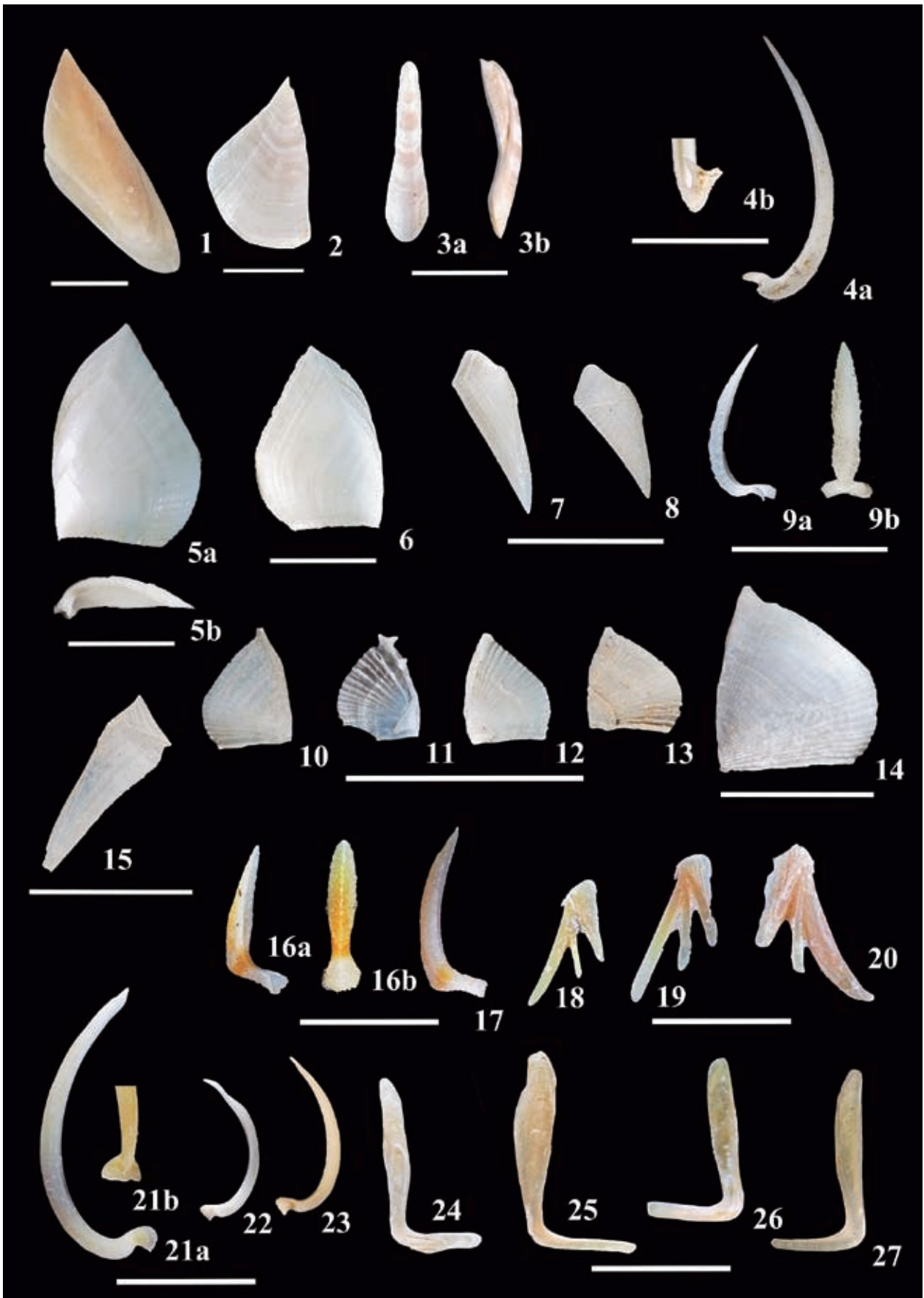
16a–b, MFM142688, carina; 17, MFM142688-2, carina. 16a, 17, lateral; 16b, carinal view.

**Figs. 18–27. *Octolasmis orthogonia* (Darwin, 1852) ウスエボシ**

18, MFM142680-2, tectum; 19, MFM142680, tectum; 20, MFM142680-3, tectum; 21a–b, MFM142680-6, carina; 22, MFM142680-4, carina; 23, MFM142680-5, carina; 24, MFM142680-8, scutum; 25, MFM142680-7, scutum; 26, MFM142680-9, scutum; 27, MFM142680-10, scutum;. 18–21a, 22–25, lateral; 26–27, internal; 21b, ventral view.

Scale bar = 5 mm.

Plate 1



**Plate 2****Figs. 1a–2c. *Coronula* sp. オニフジツボ属の未定種**

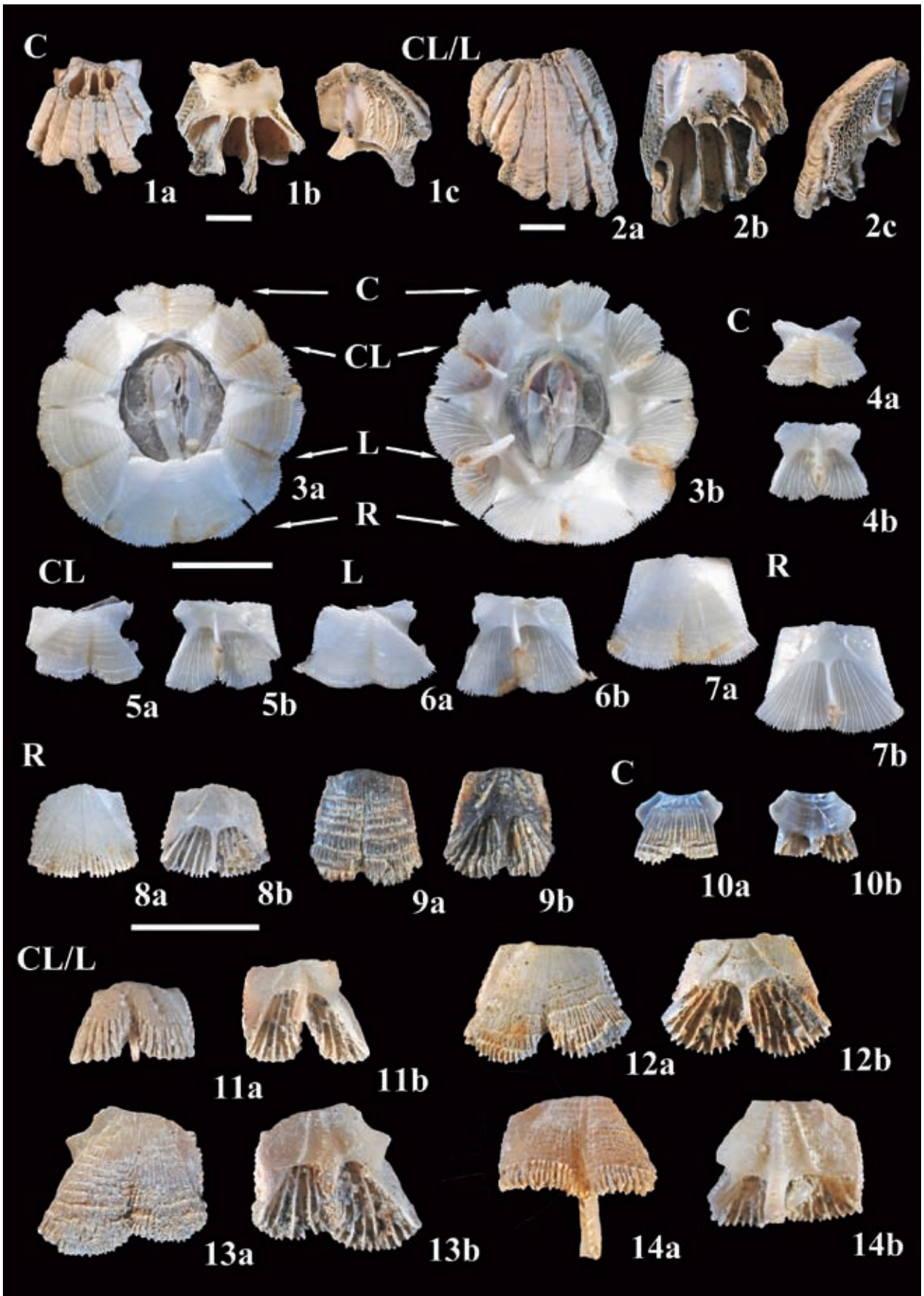
1a–c, MFM142999, carina; 2a–c, MFM142475, carinolateral/lateral.  
1a, 2a, external; 1b, 2b, internal; 1c, 2c, lateral view.

**Figs. 3a–14b. *Platylepas hexastylus* (Fabricius, 1798) サラフジツボ**

3a–7b, MFM129150, shell from Atsumi (extant); 3a–b, shells; 4a–b, carina; 5a–b, carinolateral; 6a–b, lateral; 7a–b, rostrum. 8a–b, MFM143000-1, rostrum; 9a–b, MFM143000-2, rostrum; 10a–b, MFM143000-3, carina; 11a–b, MFM143000-4, carinolateral/lateral; 12a–b, MFM143000-5, carinolateral/lateral; 13a–b, MFM143000-6, carinolateral/lateral; 14a–b, MFM143000-7, carinolateral/lateral. 3a, dorsal; 3b, basal; 5a, 6a, 7a, 8a, 9a, 10a, 11a, 12a, 13a, 14a, external; 4b, 5b, 6b, 7b, 8b, 9b, 10b, 11b, 12b, 13b, 14b, internal view.

Scale bar = 5 mm.

**Abbreviations:** C, carina; CL, carinolateral; L, lateral; R, rostrum.



**Plate 3****Figs. 1a–b. *Tetraclitella chinensis* (Nilsson-Cantell, 1921)**

ムツアナヒラフジツボ

1a–b, MFM143002, tergum. 1a, external; 1b, internal view.

**Figs. 2a–5d. *Solidobalanus socialis* (Hoek, 1883) ムレフジツボ**

2a–b, MFM143003, opercular plates. 3–4, MFM143004-1–MFM143004-2, shell attached to *Hemicentrotus* sp.; 5a–d, MFM143005, shells attached to *Pecten albicans*; 5c–d, close-up images of shells. 2a, external; 2b, internal view.

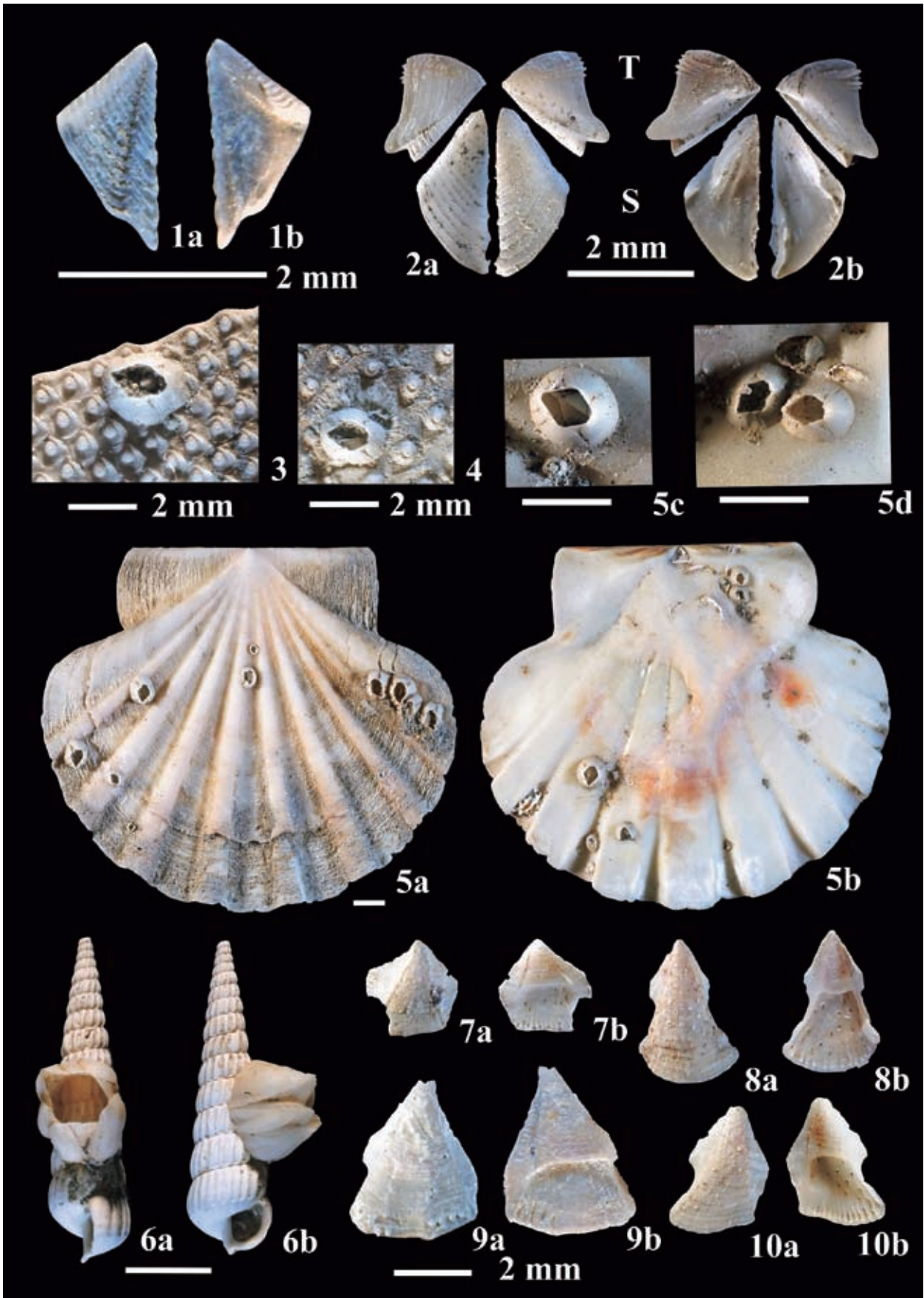
**Figs. 6a–b. *Striatobalanus tenuis* (Hoek, 1883) シロフジツボ**6a–b, MFM143006 (shell attached to *Punctoterebra japonica*).**Figs. 7a–10b. *Acasta* s.l. sp. カイメンフジツボ属(広義)の未定種**

7a–b, MFM143007, rostrum; 8a–b, MFM143008, carina; 9a–b, MFM143009, carinolateral; 10a–b, MFM143010, carinolateral. 7a, 8a, 9a, 10a, external; 7b, 8b, 9b, 10b, internal view.

Scale bar = 5 mm; otherwise stated.

**Abbreviations:** S, scutum; T, tergum.





**Plate 4****Figs. 1a–8b. *Acasta sulcata* Lamarck, 1818 ナミカイメンフジツボ**

1a–b, MFM143011-1, rostrum; 2a–b, MFM143011-2, lateral; 3a–b, MFM143011-3, carina; 4, MFM143011-4, carinolateral; 5, MFM143011-5, basis; 6, MFM143011-6, basis; 7a–b, MFM143011-7, tergum; 8a–b, MFM143011-8, scutum. 1a, 2a, 3a, 4, 7a, 8a, external; 1b, 2b, 3b, 7b, 8b, internal; 5, 6, basal view.

**Figs. 9a–18. *Euacasta dofleini* (Krüger, 1911) ケハダカイメンフジツボ**

9a–e, MFM143012, shell; 10a–e, MFM143013, shell; 11a–b, MFM143014-1, rostrum; 12a–b, MFM143014-2, lateral; 13a–b, MFM143014-3, carina; 14a–b, MFM143014-4, tergum; 14a–b, MFM143014-5, scutum; 16, MFM143014-6, basis; 17, MFM143014-7, basis; 18, MFM143014-8, carinolateral. 9a–d, 10a–d, lateral; 9e, 10e, 16, 17, basal; 11a, 12a, 13a, 14a, 18, external; 11b, 12b, 13b, 14b, internal view.

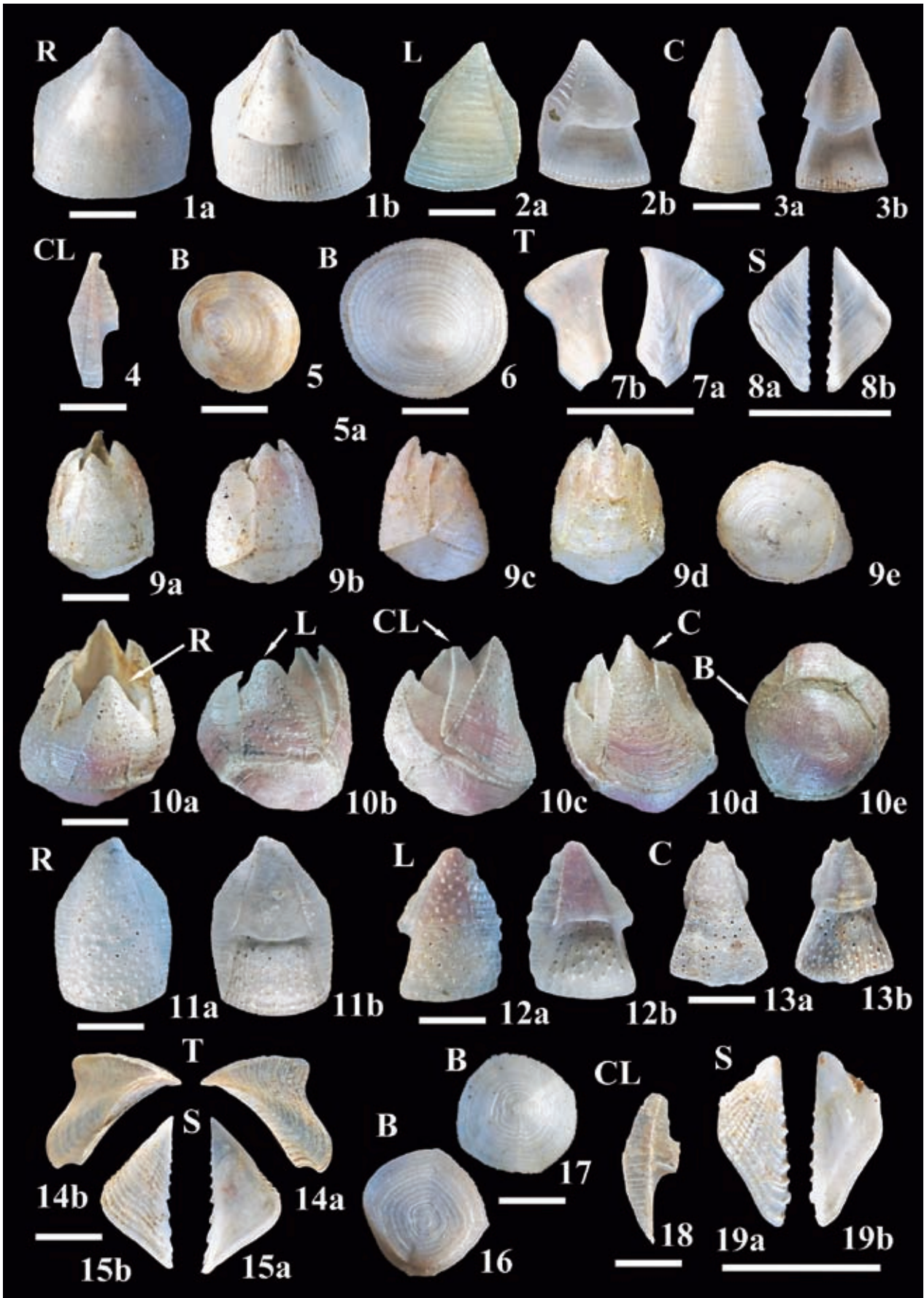
**Figs. 19a–b. *Pectinoacasta pectinipes* (Pilsbry, 1912)**

ドングリカイメンフジツボ

MFM143016, scutum. 19a, external; 19b, internal view.

Scale bar = 2 mm.

**Abbreviations:** B, basis; C, carina; CL, carinolateral; L, lateral; R, rostrum; S, scutum; T, tergum.





**Plate 5****Figs. 1a–9. *Fistulobalanus amaraquaticus* (Yamaguchi, 1980)**

ニセタテスジフジツボ (新和名)

1a–b, MFM143017, shell; 2a–b, MFM143018, shell; 3a–b, MFM143019, shell; 4a–b, MFM143020, opercular plates; 5, MFM143021-1, lateral; 6, MFM143021-2, lateral; 7, MFM143022, shells attached to *Decatopecten plica*; 8, MFM143023, shell attached to *Megabalanus rosa*; 9, MFM143024, shell attached to *Megabalanus rosa*. 1a, 2a, 3a, dorsal; 1b, 2b, 3b, lateral; 4a, external; 4b, internal; 6, 7, oblique internal view.

**Figs. 10a–b. *Fistulobalanus kondakovi* (Tarasov and Zevina, 1957)**

ドロフジツボ

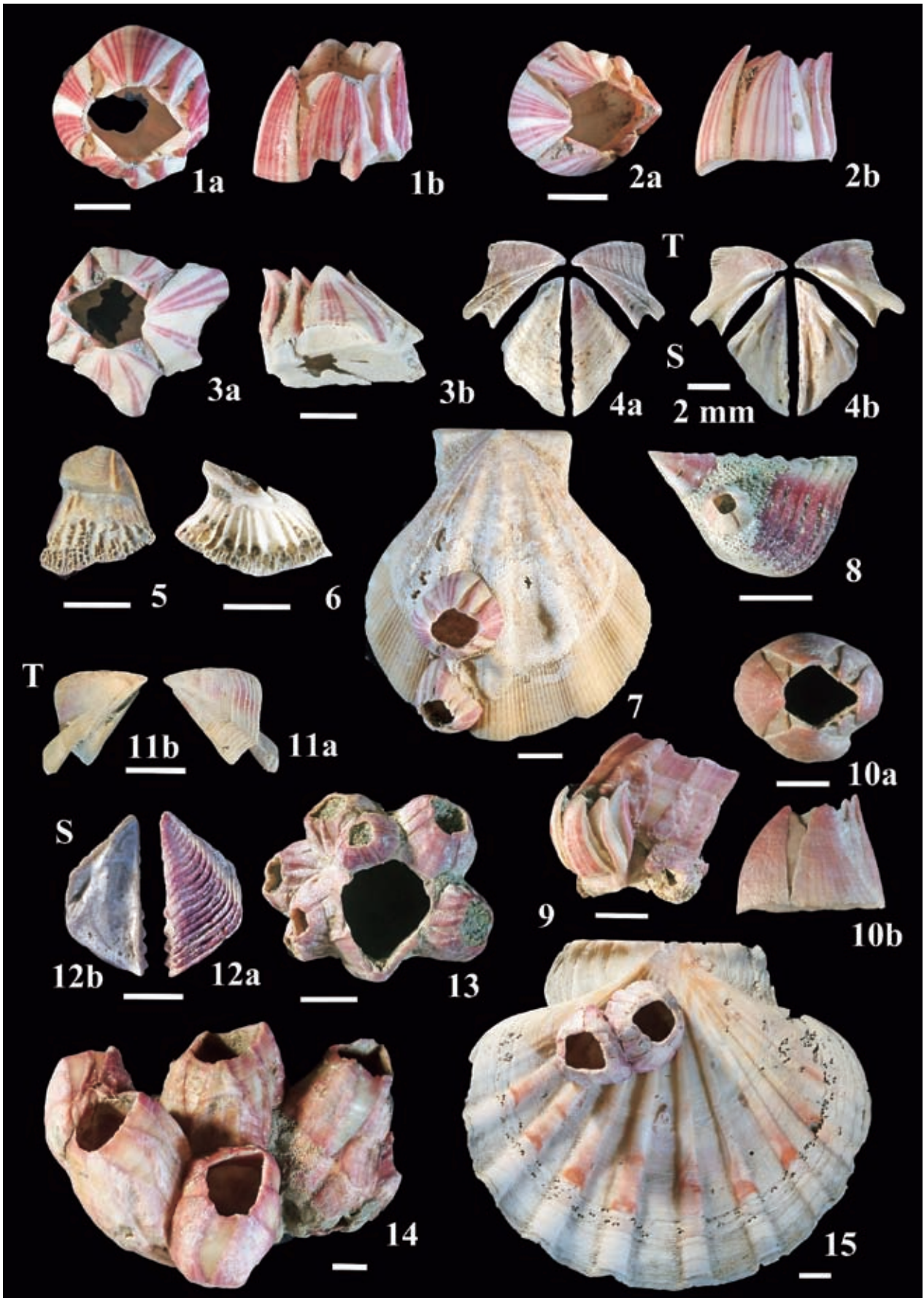
MFM143025, shell. 10a, dorsal; 10b, lateral view.

**Figs. 11a–15. *Megabalanus rosa* (Pilsbry, 1916) アカフジツボ**

11a–b, MFM143026, tergum; 12a–b, MFM143027, scutum; 13, MFM143028, cluster of shells; 14, MFM143029, cluster of shells; 15, MFM143030, shells attached to *Pecten albicans*. 11a, 12a, external; 11b, 12b, internal view.

Scale bar = 5 mm; otherwise stated.

**Abbreviations:** S, scutum; T, tergum.



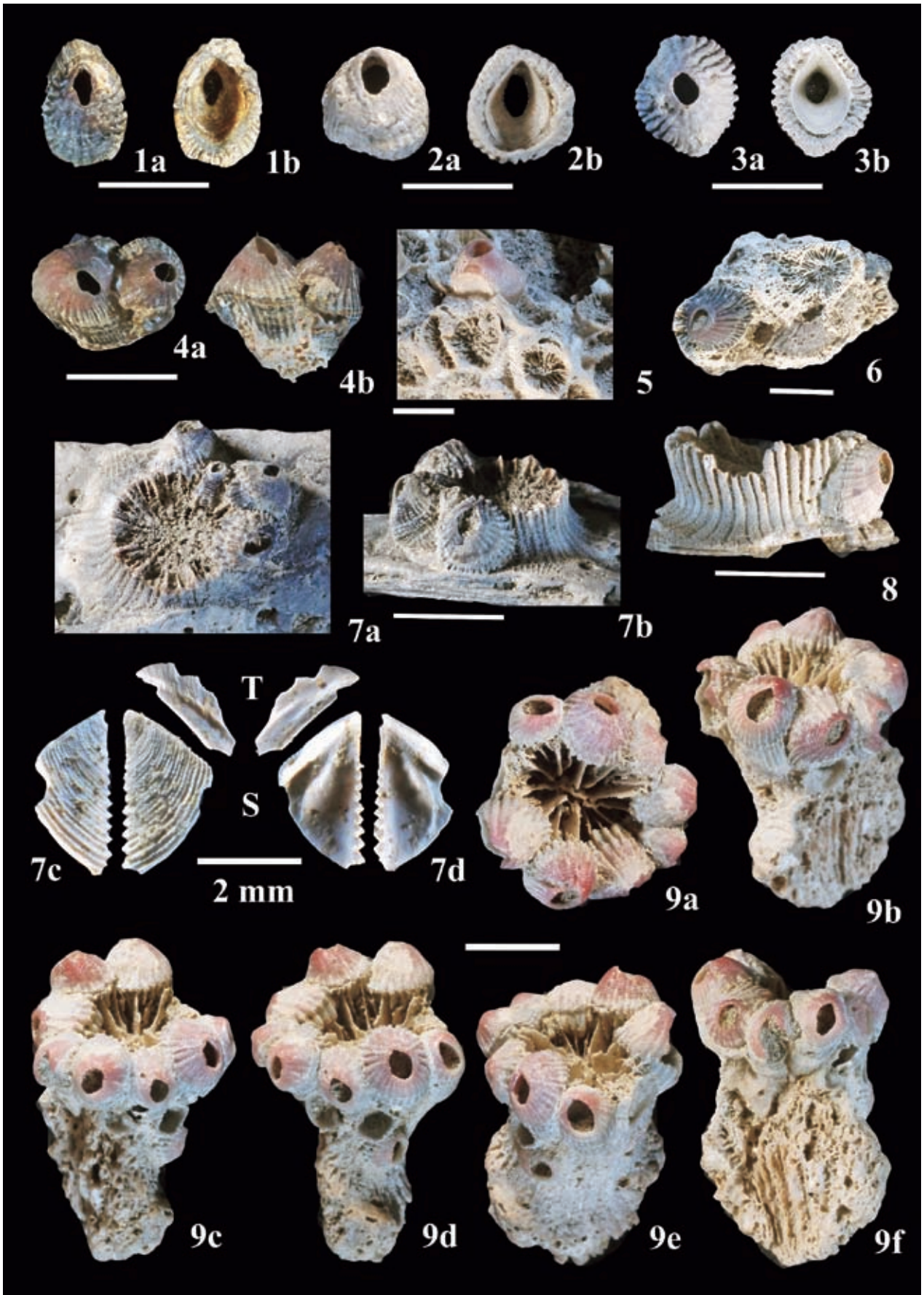


**Plate 6****Figs. 1a–9f. *Adna anglica* (Sowerby, 1823) トンガリサンゴフジツボ**

1a–b, MFM143031, shell; 2a–b, MFM143032, shell; 3a–b, MFM143033, shell; 4a–b, MFM143034, shells; 5, MFM143035, shell attached to *Tubastrea* sp.; 6, MFM143036 (shells attached to *Dendrophyllia* sp.); 7a–b, MFM143037, shells attached to *Oulangia stokesiana miltoni*; 7c–d, MFM143037, opercular plates; 8, MFM143038, shell attached to *Oulangia stokesiana miltoni*; 9a–f, MFM143039, shells attached to *Balanophyllia* sp. 1a, 2b, 3b, dorsal; 1b, 2b, 3b, 7d, internal; 7a, external view.

Scale bar = 5 mm; otherwise stated.

**Abbreviations:** S, scutum; T, tergum.



**Plate 7****Figs. 1a–5c. *Adna anglica* (Sowerby, 1823) トンガリサンゴフジツボ**

1a–c, MFM143041, shell attached to *Heterocyathus japonicus*; 2a–b, MFM143042, shells attached to *Oulangia stokesiana miltoni*; 3a–e, MFM143043, shell attached to *Dendrophyllia* sp.; 4, MFM143044, shells attached to *Balanophyllia* sp.; 5a–c, MFM143045, shells attached to *Balanophyllia* sp.

Scale bar = 5 mm.



Plate 7

