

Challenging deep-sea cosmopolitanism: taxonomic re-evaluation and biogeography of ‘*Cythere dasyderma* Brady, 1880’ (Ostracoda)

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ABSTRACT – *Cythere dasyderma* Brady, 1880 was described from samples collected from all the world’s oceans during the HMS *Challenger* expedition in the 1870s. Subsequently, *Cythere dasyderma* (or *Echino-cythereis dasyderma*, or *Henryhowella dasyderma*) has been recorded from the Late Eocene to Recent, from Atlantic, Arctic, Indian, Pacific and Southern oceans, and from intertidal to deep abyssal environments. However, even cursory inspection of illustrations from over 50 publications shows that several species have been included in ‘*Cythere dasyderma*’. Here, all syntypes of *Cythere dasyderma* Brady, 1880 archived in the Natural History Museum, London have been re-studied. This species is re-described, re-diagnosed and illustrated with scanning electron microscope images. *Cythere dasyderma* is assigned to *Ayressoleberis* gen. nov., which is described here. The geographical distribution of *Ayressoleberis dasyderma* (Brady, 1880) comb. nov. is no longer cosmopolitan, and includes only the type locality in the abyssal southeastern Pacific. Most of the specimens previously identified as *Cythere dasyderma*, or its synonyms, belong to other trachyleberidid genera (e.g. *Henryhowella*, *Legitimocythere*, *Pennyella*) and not to *Ayressoleberis dasyderma* comb. nov. A new species of *Ayressoleberis*, very similar to *Ayressoleberis dasyderma* comb. nov., is described and illustrated from specimens previously included amongst the syntypes of ‘*Cythere acanthoderma* Brady, 1880’. These latter specimens were collected from the continental slope of the southwestern Indian Ocean. This new species is left in open nomenclature herein because only two left valves are currently available. *J. Micropalaeontol.* 32(2): 109–122, July 2013.

KEYWORDS: *cosmopolitanism, geographical distribution, bathymetric distribution, taxonomy*

SUPPLEMENTARY MATERIAL: *Previous records of Cythere dasyderma sensu lato, and, material included and excluded from the type series of Ayressoleberis dasyderma with corrected identifications are available at <http://www.geolsoc.org.uk/SUP18572>.*

INTRODUCTION

Ostracoda from the HMS *Challenger* expedition from 1873 to 1876

The HMS *Challenger* expedition collected numerous biological samples from hundreds of stations covering the world’s oceans, resulting in the designation of >4000 type specimens. For the class Ostracoda alone, 143 new species and three new genera were first described from the *Challenger* samples (Brady, 1880). Additionally, Brady (1880) formulated the basis of deep-sea ostracod taxonomy; however, he did not designate holotypes for the new taxa. Neither Brady nor any subsequent author provided details (e.g. number, age, sex and size of specimens per sample, availability of soft parts) of the material he studied. Moreover, Brady very often figured, under single specific names, specimens that according to modern ostracod taxonomic practice represent multiple species and even belong not only to different species but also to different genera. The *Challenger* specimens had been collected from a broad geographical range and, consequently, the morphological and biogeographical concept of many of these species has remained very broad and the identities of most of them have, until today, remained unclear. These broad morphological and biogeographical concepts combined with the absence of designated holotypes leave the type localities of the *Challenger* species undefined. Several deep-sea species described from the *Challenger* material were considered to be cosmopolitan not only

by Brady (1880) but also by subsequent authors (e.g. Whatley & Ayress, 1988; Hartmann, 1997).

Bate (1963; 1964) published an inventory of the *Challenger* species archived both in the Natural History Museum (London) and in the Hancock Museum (Newcastle upon Tyne). Subsequently, some lectotypes were designated for six of Brady’s (1880) species, i.e. *Cythere scabrocuneata*, *Cythere squalidentata*, *Cythere arata*, *Cythere dictyon*, *Cythere rastromarginata* and *Cythere radula* (Harding & Sylvester-Bradley, 1953; Benson, 1971; 1972).

In a more extensive study Puri & Hulings (1976) designated lectotypes and provided brief descriptions, line drawings and light microscopy photographs for 131 species first described by Brady (1880) from the *Challenger* material. Although this paper was an important step towards the clarification of the status of the *Challenger* species, the illustrations and light microscope photographs are insufficient for the recognition of key morphological characters. Additionally, the details of the specimens studied were provided almost exclusively for the lectotypes, leaving important questions on the morphology and biogeography of these species unresolved. Maddocks (1990) revised three macrocypridid species described from the *Challenger* material: *Macropyxis similis* (Brady, 1880), *Macropyxis tenuicauda* (Brady, 1880) and *Macropypria canariensis* (Brady, 1880). She concluded that all three species had restricted geographical distributions, and not wide cosmopolitan ranges as previously accepted.

Mazzini (2005) provided the first scanning electron microscopy (SEM) images of lectotypes and paralectotypes of *Challenger* species: *Dutoitella suhmi* (Brady, 1880), *Henryhowella dasyderma* (Brady, 1880), *Legitimocythere acanthoderma* (Brady, 1880), *Pseudobosquetina mucronalata* (Brady, 1880) and *Pennyella dorsoserrata* (Brady, 1880). Her work substantially reduced the taxonomic uncertainties surrounding these key deep-sea ostracod species. Herein and in future publications, we seek to complement Mazzini's work by providing taxonomic reviews (synonymies, new diagnoses, new descriptions, further illustrations) for these and other *Challenger* species. Jellinek *et al.* (2006), while revising *Pseudobosquetina mucronalata* (Brady, 1880) (i.e. Brady's *Cytheropteron mucronalatum*), challenged again the cosmopolitan model for deep-sea ostracods.

The present paper results from efforts to further revise some of the key ostracod (mostly deep-sea) species described by Brady (1880). The *Challenger* specimens, which are housed in the Natural History Museum in London, were studied and catalogued. Over 1500 SEM and 600 light microscopy images were taken. Three previous studies have shown some of the results of this project: they have dealt with *Bairdoppilata simplex* (Brady, 1880) (Brandão, 2008a), *Cytherella serratula* (Brady, 1880) (Brandão, 2008b), *Poseidonamicus viminea* (Brady, 1880) (Brandão & Páplow, 2011). The present paper deals with '*Cythere dasyderma* Brady, 1880', one of the deep-sea species previously recorded as having a cosmopolitan distribution.

Key studies on '*Cythere dasyderma*' Brady, 1880

Here we summarize only the most important publications on *Cythere dasyderma*; a complete list of the >50 studies can be found in the synonymy below and in the Supplementary Material.

Brady (1880) described *Cythere dasyderma* from 20 samples collected from the Pacific, Atlantic, Indian and Southern oceans, from latitudes ranging from 38°N to 52°S, and depths of 274 to 5010 m. However, it is obvious that his *Cythere dasyderma* not only includes different species but also distinct genera, e.g. *Henryhowella*, *Legitimocythere*, *Pennyella* (Brady, 1880, pls 17.4.a–17.4.f; 18.4.a–18.4.f). In 1953, Puri assigned *Cythere dasyderma* to his then new genus *Echinocythereis*. Bate (1963; 1964) reported that material of *C. dasyderma* is housed both in the Natural History Museum (London) and in the Hancock Museum (Newcastle upon Tyne). Puri & Hulings (1976: 273, pl. 11.10–11.11) designated as the lectotype of '*Cythere dasyderma*' one female left valve from the southern Pacific (station 296, 38°6'S, 88°2'W, 1825 m), housed in the NHM, and provided two stereoscopic microscope images of it. They also recorded a right valve as 'topotypic material', which they had picked from the sediment sample from station 185 (Torres' Straits, 11°35'S, 144°3'E, 283 m), not from the sample from the type locality (stations 296). As discussed by Mazzini (2005), Rosenfeld & Bein (1978) were the first to assign *Cythere dasyderma* to the genus *Henryhowella* and, subsequently, most authors have followed this generic assignment (see Supplementary Material). Most of them have almost automatically considered plicate forms to be *Henryhowella asperrima* (Reuss, 1850) and the non-plicate forms to be *Henryhowella dasyderma* (e.g. Dingle *et al.*, 1990; Whatley *et al.*, 1998b; Majoran & Dingle, 2001a, b, 2002; Mazzini, 2005). Mazzini (2005, fig. 26.P–S) discussed the most important publications on '*Cythere dasyderma* Brady [sic] 1869' and provided SEM images of the internal, external

and dorsal views and a detailed view of the frontal and adductor muscle scars of the lectotype. However, because of the relatively small size of the SEM image (Mazzini, 2005, fig. 26.P), the secondary ornamentation cannot be discerned (cf. our Pl. 1, figs a, c, e, f). Another problem is that Mazzini (2005, figs N–O) also figured a specimen that belongs to *Henryhowella* but nevertheless considered it to be a paralectotype of '*Cythere dasyderma*'. This misidentification has added more confusion to the already confused morphological 'concept' of '*Cythere dasyderma*'.

Cythere dasyderma (or *Echinocythereis dasyderma*, *Henryhowella dasyderma* ...) has been recorded (in at least 50 publications) from the Late Eocene to Recent, from Atlantic, Arctic, Indian, Pacific and Southern oceans (northern limit 85°19.4'N; southern limit 70°36'80" S), and from intertidal to deep abyssal environments (from 1 to 5480 m) (e.g. Benson, 1964a; Jones *et al.*, 1999; Majoran & Dingle, 2002) (see details in Supplementary Material). However, these records have resulted from the confusion of at least seven different species belonging to several genera (i.e. *Ayressoleberis* gen. nov., *Echinocythereis*, *Henryhowella*, *Legitimocythere*, *Pennyella*, cf. *Wichmannella*). The overall spatial and temporal ranges of these records have encompassed very distinct ecological conditions, the extremes being the *Challenger* station #192 on the continental shelf in the tropical Indo-Pacific (Brady, 1880) and the subpolar shallow environment off the Marion Island in the Southern Ocean (Dingle, 2003).

The aim of the present publication is to establish a stable morphological concept for '*Cythere dasyderma* Brady, 1880'. Hence, one of us (SNB) re-examined Brady's (1880) material housed in the Natural History Museum in London, and we assign '*Cythere dasyderma* Brady, 1880' to *Ayressoleberis* gen. nov., which is described below. An emended diagnosis of *Ayressoleberis dasyderma* comb. nov. is provided, together with SEM images of the different sexes and instars. We also provide SEM images for other species included by Brady (1880) in his concept of '*Cythere dasyderma* Brady, 1880'. Four of Norman's (Brady & Norman, 1889) '*Cythere dasyderma*' slides were also studied and re-identified. Finally, we compared previously published illustrations of specimens reported as '*Cythere dasyderma*' (or *Henryhowella dasyderma*, *Echinocythereis dasyderma*, *Legitimocythere dasyderma*, *Wichmannella?* *dasyderma*, etc.) with the type material of *Ayressoleberis dasyderma* and hence revise the geographical and stratigraphical distribution for this species.

One of us (SNB) tried without success to study the Brady material housed in the Hancock Museum (Newcastle upon Tyne), but this collection is currently unavailable because it is being moved and reorganized. However, since the lectotype and paralectotypes of '*Cythere dasyderma*' are studied herein, the information on further specimens might add detail to the present study, but would not change its conclusions.

MATERIAL AND METHODS

All specimens studied are housed in the collection of the Zoology Department of the Natural History Museum, London (NHM) (see Supplementary Material). When there was more than one slide with the same collection number (e.g. NHM 1961.12.4.39), one of us (SNB) has added a distinct capital letter after the number (e.g. NHM 1961.12.4.39.A, NHM 1961.12.4.39.B, NHM 1961.12.4.39.C). Several of the slides cited below were found to contain the valves of more than one species. In such cases, SNB

has left the valves of one of the species on the original slide and transferred the valves of other species to distinct slides (one species per slide). The collection number for the old slide has been retained but supplemented with a letter (mostly A). The new slides with the different species have been assigned the same collection number but supplemented with a distinct letter as a suffix (i.e. B, C, D ...). For example, there were three slides with the collection number NHM 1961.12.4.39; each of these slides was assigned a distinct capital letter after the collection number: (1) Puri's slide with the lectotype of '*Cythere dasyderma*' (NHM 1961.12.4.39.A); (2) another Puri slide labelled paralectotypes (NHM 1961.12.4.39.B); and (3) Brady's original slide (NHM 1961.12.4.39.C). On the slide NHM 1961.12.4.39.B there were three valves of three distinct species: (a) the coated left valve (LV) of *A. dasyderma* comb. nov. retained in the slide NHM 1961.12.4.39.B; (b) while the coated right valve (RV) of *Legitimocythere* sp. was transferred to a new slide with the numbers NHM 1961.12.4.39.F and SNB-1 056a (this last number gives SNB's initials and refers to a list of all new slides that SNB added to the *Challenger* ostracod collection in the NHM); and finally (c) the coated LV of *Henryhowella* sp. was transferred to a third slide numbered 1961.12.4.39.G (SNB-1 058). Some slides previously in the NHM collection also received a SNB number. Uncoated valves were digitally imaged with Zeiss environmental SEM LEO 1455VP in the Natural History Museum, London.

Abbreviations

(A-1), last juvenile instar; LV, left valve; RV, right valve; L, length; H, height; MP, micropalaeontological slide; ICZN, International Code of Zoological Nomenclature; NHM, Zoology collection of the Natural History Museum, London; SEM, scanning electron microscope.

General results on '*Cythere dasyderma* Brady, 1880'

Before SNB began her series of five visits (from November 2008 to February 2011) to the NHM, London, the Museum's collection included 17 card micropalaeontological slides labelled '*Cythere dasyderma*' (see Supplementary Material):

- (1) nine are Brady's original, light brown card slides with a black cavity.
- (2) two are white card slides with a black cavity labelled by Puri prior to the publication of Puri & Hulings (1976).
- (3) one is a white plastic slide with a black cavity, which was used for valves picked in the 1970s from dried sediment from the *Challenger* samples deposited in the NHM. This material was included in Puri & Hulings' (1976) paper.
- (4) one white card slide with a rectangular cavity that was used and labelled by Mazzini (I. Mazzini, personal communication).
- (5) four are Norman's original, brown card slides with black holes.

All the valves included in '*Cythere dasyderma*' by Brady (1880) are now on 28 micropalaeontological slides (details in Supplementary Material): the ones described above plus 11 new slides, which are white with a black, rounded cavity that have been used to separate specimens from distinct species.

Finally, one slide labelled by Brady as *Cythere acanthoderma* contained one new species, i.e. *Ayressoleberis* sp. nov., which is described but not named herein.

GENERIC ASSIGNMENT OF '*CY THERE DASYDERMA*

BRADY, 1880'

The assignment of '*Cythere dasyderma*' to the genus *Henryhowella* Puri, 1957 has been almost universal (see Supplementary Material). However, the present morphological study of '*Cythere dasyderma*' shows that it should be assigned to a new genus, i.e. *Ayressoleberis* gen. nov., described below, which is more similar to *Taracythere* Ayress, 1995 than to *Henryhowella*. Features shown by *Ayressoleberis dasyderma* (Brady, 1880) comb. nov. that are contrary to Puri's (1956, pp. 274–275) description of *Howella* (name subsequently replaced by *Henryhowella*), are: (a) Absence of marginal frill; (b) surface of the carapace ornamented with multifurcate spines (instead of small and rounded spines); (c) these spines are not arranged concentrically in the anterior half, and (d) they are not arranged in 'three well-developed rows' in the posterior half. Therefore, we conclude that *Ayressoleberis dasyderma* comb. nov. does not belong to *Henryhowella*, contrary to previous assignments.

Mazzini (2005) was uncertain about the correct assignment of *Henryhowella* or *Fallacihowella* Jellinek & Swanson, 2003 for '*Cythere dasyderma*', because, in her opinion, only poorly preserved specimens were available in its syntype series. Despite Jellinek & Swanson's (2003, p. 40) comparisons of *Henryhowella* or *Fallacihowella*, we think that *Henryhowella* still requires revision, so that the two genera can be unambiguously differentiated. However, as mentioned above, we are convinced that *Ayressoleberis dasyderma* does not belong to either of these two genera because: (a) it has a more sinuous lateral outline; (b) it has secondary reticulation; (c) it has multifurcate spines; and (d) it has larger, more robust and more widely spaced spines.

TAXONOMY

- Class **Ostracoda** Latreille, 1802
- Subclass **Podocopa** Sars, 1866
- Order **Podocopida** Sars, 1866
- Suborder **Cytherocopina** Baird, 1850
- Superfamily **Cytheroidea** Baird, 1850
- Family **Trachyleberididae** Sylvester-Bradley, 1948

Remarks. The higher classification is based on Horne *et al.* (2002). In order to clarify the biogeography of *Ayressoleberis dasyderma*, we include in the taxonomic sections below all specimens previously contained in the syntype series of '*Cythere dasyderma*', i.e. the following taxa *Ayressoleberis dasyderma* (Brady, 1880) comb. nov., *Henryhowella* spp., *Legitimocythere* spp., *Pennnyella* sp., *Trachyleberididae* indet. and *Bythocytheridae* indet. Also included below is *Ayressoleberis* sp. nov., which is very similar to *Ayressoleberis dasyderma* but was previously included in the syntype series of '*Cythere acanthoderma*'. Finally, the specimens identified by Brady & Norman (1889) as *Cythere dasyderma*, but which actually belong to *Henryhowella*, are also listed below.

Genus *Ayressoleberis* gen. nov.

Type species. *Trachyleberis bathymarina* Ayress, 1993.

Additional species. *Cythere dasyderma* Brady, 1880; *Trachyleberis brevicosta* Hornibrook, 1952; *Actinocythereis microagrenon* Ayress, 1995.

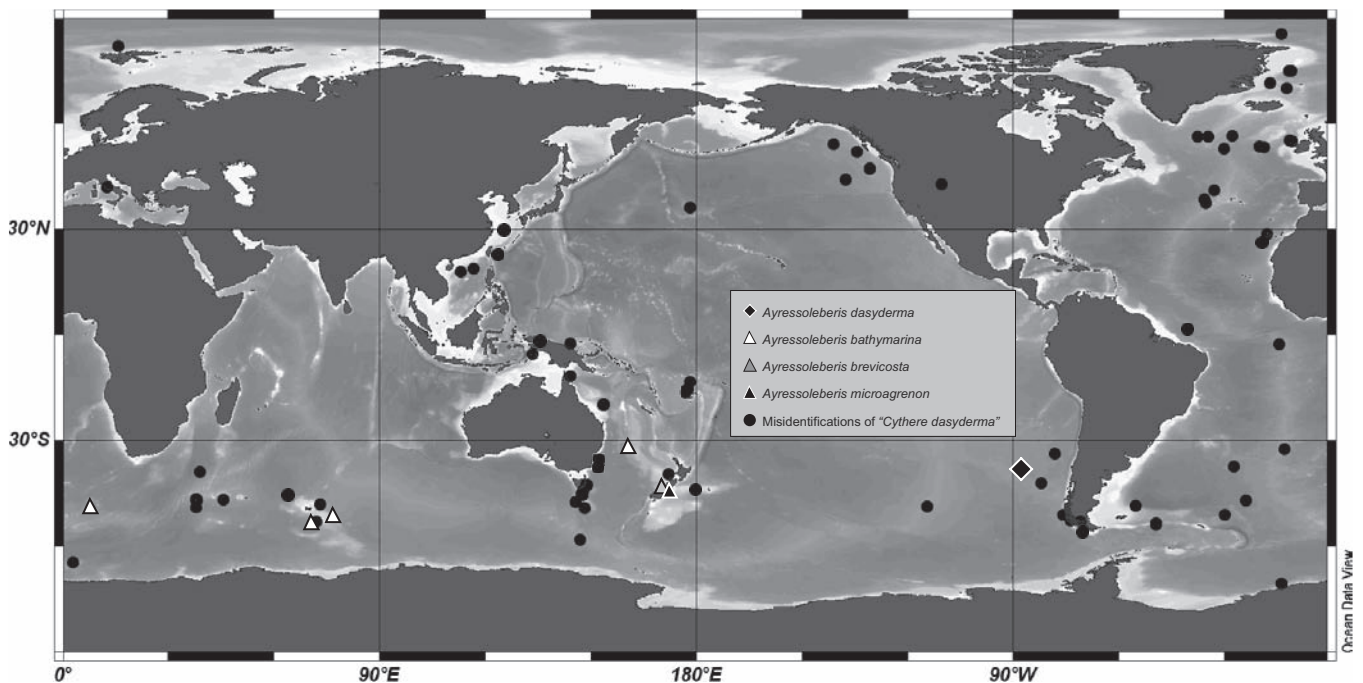


Fig. 1. Geographical distribution of *Ayressoleberis* gen. nov. (Hornibrook, 1952; Puri & Hulings, 1976; Ayress, 1993; 1995; Ayress *et al.*, 2004; Yasuhara *et al.*, 2009), and previous misidentifications of '*Cythere dasyderma*' (see Supplementary Material). Map prepared with Ocean Data View 4 (Schlitzer, 2012).

Derivation of name. In honour of Dr Michael A. Ayress, Ichron Limited, UK, for his work on Recent and fossil ostracods.

Diagnosis. A trachyleberidid with elongate lateral outline. Lateral surface of carapace spinous; spines nodose and often multifurcate; ventrolateral ridge and subcentral tubercle absent. Four adductor scars in a vertical row, frontal scar v-shaped. Hinge holamphidont. In internal view, marginal frill absent. Sexual dimorphism conspicuous, males more elongate, lower in relation to length than females.

Comparisons with similar genera. *Henryhowella* Puri, 1957 is similar to the new genus, but the right valve of the former genus has a conspicuous and broad marginal frill in internal valve margin. *Ayressoleberis* gen. nov. can be distinguished from *Cythereis* Jones, 1849 because the former lacks a ventrolateral ridge and a subcentral tubercle. *Taracythere* Ayress, 1995 is the most similar to *Ayressoleberis* gen. nov., but the former tends to have a more upturned posterior margin and less spinous lateral carapace surface. Furthermore, *Taracythere* has a divided frontal muscle scar, which is composed of an elongate scar and a small rounded scar (M. Yasuhara, unpublished data). In contrast, *Ayressoleberis* gen. nov. has a v-shaped frontal scar.

Stratigraphic and geographical occurrence. Eocene to Recent. Southern Pacific and Southern Ocean, continental shelf to abyssal depths (Fig. 1).

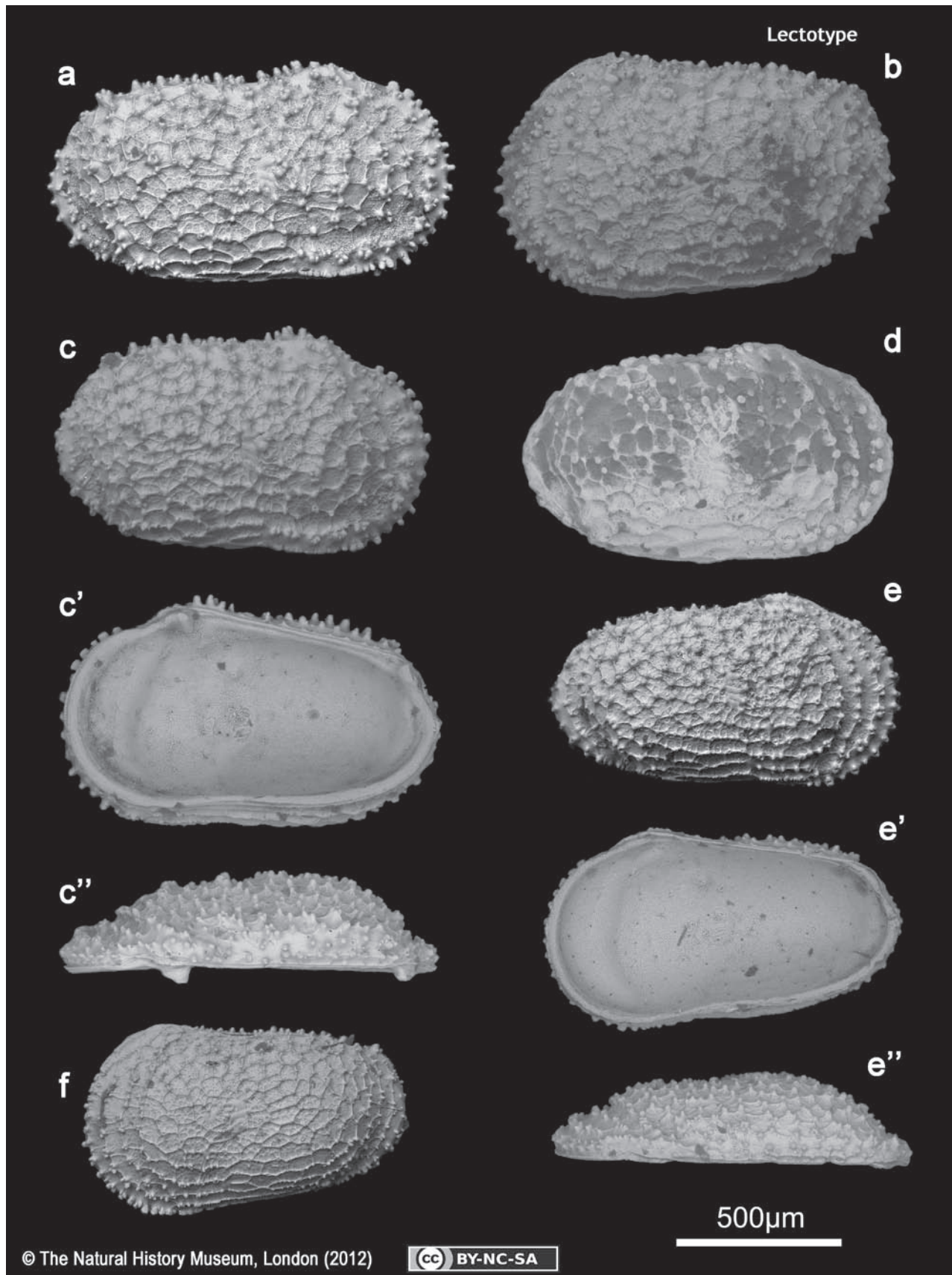
Evolution. Since the highest diversity (i.e. three species) and the oldest record of *Ayressoleberis* gen. nov. are from the southwestern Pacific Ocean, we suggest that the new genus originated in this region at some time during or before the Late Eocene (Ayress, 1995). Additionally, the morphological resemblance of the new genus to *Taracythere* suggests that both genera are phylogenetically close to each other. However, a more precise model of the evolution of trachyleberidid genera will be possible only after several of these genera have been revised. Finally, molecular data would be useful to test a morphologically based, phylogenetic theory.

Taxonomic revision of *Ayressoleberis dasyderma* (Brady, 1880) comb. nov.

Ayressoleberis dasyderma (Brady, 1880) comb. nov.
(Pl. 1, figs a–f, Pl. 2, figs c–e)

1880 in part *Cythere dasyderma* n. sp. Brady: 105–106; non pl. 17, figs 4.a–4.f, pl. 18, figs 4.e–4.f.
?1884 *C. dasyderma* Brady; Seguenza: 309

Explanation of Plate 1. Valves of *Ayressoleberis dasyderma* (Brady, 1880), *Challenger* station 296, off Chile, southeastern Pacific, 38°6'S, 88°2'W, 3338m, 09.11.1875. **figs a, c, c', c'', e, e', e'', f.** Paralectotypes: **(a)** (NHM 1961.12.4.39.D), male RV, external view; **(c, c', c'')** (NHM 1961.12.4.42.A), male RV – (c) external view, (c') internal view, (c'') dorsal view; **(e, e', e'')** (NHM 1961.12.4.41.A), (A-1) RV – (e) external view, (e') internal view, (e'') dorsal view; **(f)** (NHM 1961.12.4.42.A), (A-1) LV, external view. **fig. b.** Lectotype (NHM 1961.12.4.39.A), LV, external view. **fig. d.** Not type, material re-sorted from dry sediment of *Challenger* station 296 (NHM 2012.1473, SNB-1 054), female RV, external view. Photos: SNB, © Natural History Museum, London.



- ?1885 *Cythere dasyderma* Brady; Carus: 300.
 ?1887 *Cythere dasyderma* Brady; Brady: 165.
 non 1889 *Cythere dasyderma*, Brady; Brady and Norman: 153–154 (surely not the species housed in the Norman collection of the NHM: ‘Porcupine’ expedition, 1869, station 19 and ‘Valorous’ expedition, 1875, station 12).
 ?1889 *Cythere dasyderma*, Brady; Brady and Norman: 154–155, ?pl. 15, figs 28–29. (the material from the ‘Côtes de Landes, Bay of Biscay, Marquis de Folin’ (G.S.B.) was not found in the NHM (Zoology) Ostracoda collection).
 non 1900 *Cythere dasyderma circumdentata* (Brady, 1880); Namias: 102, non pl. 15.8.
 ?1910 *Cythere dasyderma* G. S. Brady, Chapman: 432.
 1912 in part *Cythereis dasyderma* (Brady, 1880); Müller: 362.
 non 1914 *Cythere dasyderma* G. S. Brady; Chapman: 34, non pl. 6.10.
 ?1919 *Cythere dasyderma* G. S. Brady, 1880, Chapman: 24.
 1954 *Echinocythereis dasyderma* (Brady, 1880); Puri: 260.
 1963 *Cythere dasyderma* Brady; Bate: 80, tab. 1.
 non 1964 *Echinocythereis dasyderma* (Brady)? 1880; Benson (1964a): 34–35, non text-fig. 25; Benson (1964b): 416.
 1976 in part *Cythere dasyderma* Brady; Puri & Hulings: 273, pl. 11, figs 10–11.
 non 1977 *Echinocythereis dasyderma* (Brady); Joy & Clark: 142, non pl. 2, figs 14–17, non text-fig. 5.
 non 1978 *Henryhowella dasyderma*; Rosenfeld & Bein: 18, non pl. 1, fig. 24.
 non 1982 *Echinocythereis* cf. *E. dasyderma* (Brady, 1880); Brouwers: 32–33.
 ?1982 *Wichmannella?* *dasyderma* (Brady, 1880); Yajima: 200.
 non 1987 *Henryhowella dasyderma* (Brady); Whatley & Coles: 36.
 non 1987 *Henryhowella* sp. cf. *H. dasyderma*; Whatley & Coles: 38, non pl. 5, figs 12–13.
 non 1988 *Wichmannella?* *dasyderma* (Brady); Ruan and Hao: 365, pl. 66, figs 6–11.
 ?1988 *Wichmannella dasyderma* (Brady); Ruan & Hao, tab. 2.
 non 1988 ‘*Echinocythereis*’ *dasyderma* (Brady); Wang *et al.*: 252, pl. 46, fig. 6.
 1988 in part *Henryhowella dasyderma* (Brady, 1880); Whatley & Ayress: in part text-fig. 2, tab. 3.
 non 1989 *Wichmannella dasyderma* (Brady); Hao: 128, pl. 24, figs 6–8.
 non 1989 *Echinocythereis* spec. Ant. 6817; Hartmann: 214, non pl. 1, figs 5–8.
 1990 in part *Henryhowella dasyderma* (Brady, 1880); Dingle & Lord: in part tab. 2–3.
 1990 in part *Henryhowella dasyderma* (Brady, [sic] 1886); Coles, Ayress & Whatley: in part tab. 2.
 1991 in part *Henryhowella dasyderma* (Brady, 1880); Whatley & Coles: in part fig. 4.
 non 1996 *Henryhowella dasyderma* (Brady, 1880); Whatley, Staunton, Kaesler & Mognilevsky: 67, non pl. 3, figs 8–9.
 non 1997 *Echinocythereis dasyderma* (Brady, 1880); Hartmann: 91–92, non fig. 31.
 1997? in part *Henryhowella dasyderma*; Ayress, Neil, Passlow, & Swanson: 292.
 ?1997 *Henryhowella dasyderma*; Passlow: ?figs 1–2.
 non 1997 *Henryhowella dasyderma* (Brady, 1880); Whatley, Staunton & Kaesler: non fig. 5–6, non tab. 2.
 ?1998 *Henryhowella dasyderma*; Jones, Whatley & Cronin: tab. 4.
 non 1998a *Henryhowella dasyderma* (Brady, 1880); Whatley, Eynon & Mognilevsky: non pl. 3, figs 20–21.
 non 1998b *Henryhowella dasyderma* (Brady, 1880); Whatley, Mognilevsky, Ramos & Coxill, 1998b: 129, non fig. 3, non pl. 4, figs 24–27.
 ?1999 *Henryhowella dasyderma* (Brady, 1880); Jones, Whatley, Cronin & Dowsett: ?tabs 1–5.
 ?1999 *Henryhowella dasyderma* (Brady, 1880); Whatley & Roberts: 13.
 non 2000 *Henryhowella* sp. cf. *H. dasyderma* (Brady); Didié & Bauch: non tab. 2, non pl. 1, figs 1–2.
 non 2001 *Henryhowella* sp. cf. *H. dasyderma* (Brady); Didié: 107, non tab. 2, non pl. 1, figs 1–2.
 non 2001b *Henryhowella dasyderma* (Brady, 1880); Majoran & Dingle: 214, pl. 1, figs 8–10.
 non 2002 *Henryhowella dasyderma* (Brady, 1880); Dingle: non tab. 1.
 non 2002 *Henryhowella dasyderma* (Brady, 1880); Majoran & Dingle: 144, non fig. 4.3, non tab. 2.
 non 2003 *Henryhowella dasyderma* (Brady) 1880 *sensu* Whatley *et al.*, 1998b; Dingle: 148, non pl. 5, fig. 3.
 non 2004 *Henryhowella* cf. *dasyderma* (Brady); Ayress, DeDecker & Coles: 18, non fig. 4, non pl. 1, fig. 13, non tab. 3.
 non 2005 *Henryhowella dasyderma* (Brady); Zhao: non pl. 3, fig. 19., non tab. 1.
 2005 in part ‘*Cythere dasyderma* Brady [sic] 1869’; Mazzini: 50–52, fig. 26.P–26.S, non fig. 26.M–26.O.
 non 2007 *Legitimocythere?* *dasyderma* (Brady, 1880); Hou and Gou: 458, pl. 179, fig. 16, pl. 180, fig. 9, pl. 181, figs 6–8.
 non 2009 *Henryhowella dasyderma* (Brady); Alvarez Zarikian: 6, pl. 9, figs 6–8.
 non 2009 *Henryhowella dasyderma* (Brady); Alvarez Zarikian *et al.*: 80.
- Diagnosis.** Valves ovate in lateral outline; anterior and posterior margins evenly rounded; ventral margin slightly convex; RV dorsal margin conspicuously sinuous, LV dorsal margin slightly sinuous. Lateral surface covered by fairly homogeneously distributed, multifurcated spines. Spines form irregular, sub-parallel, slight ridges on ventral area. Spines longest and mostly conical on dorsal margin. Spines laterally flattened on dorsal part of anterior margin. Conspicuous, honeycomb-like secondary reticulation. Inner marginal area fairly broad. Hinge holamphidont; RV with a large anterior tooth, followed by a large socket, a thin and long groove, one smaller socket, and one smaller tooth. Four adductor muscle scars in a row; three ventral adductor muscle scars on an inclined row, dorsal adductor scar forming an angle of approximately 45° with the next dorsal scar; frontal scar v-shaped.
- Material.** 7 RV and 5 LV on 8 micropalaeontological slides (see Supplementary Material).
- I: Type material.** Housed in the NHM, London: 6 RV and 5 LV on 8 micropalaeontological slides.
- Lectotype.** (1) 1 coated LV on one micropalaeontological slide labelled ‘173, *Cythere dasyderma* Brady, H. S. Puri 7/67, Lecto-holotype, Challenger, No. 296, D. 1825, wash of trawl,

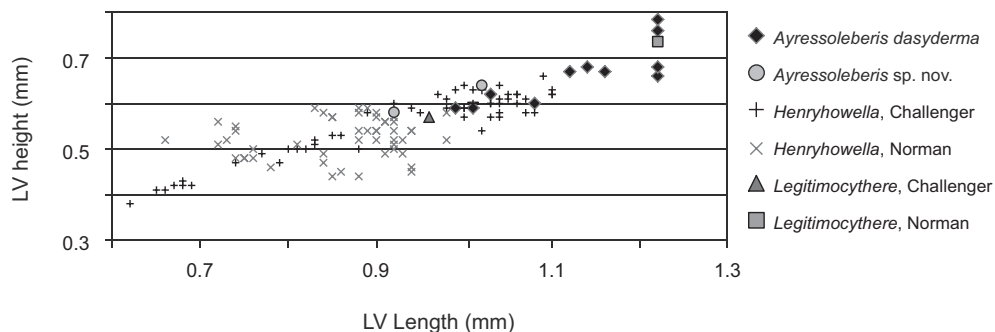


Fig. 2. Size of valves of *Ayressoleberis dasyderma* (Brady, 1880), *Ayressoleberis* sp. nov., *Legitimocythere* and *Henryhowella*, all specimens previously identified as '*Cythere/Henryhowella dasyderma*'.

1961.12.4.39.A'. This valve was SEM imaged by J.E. Whittaker and published by Mazzini (2005, fig. 28.P–S). This specimen was photographed again and is herein illustrated in Plate 1, fig. b.

Paralectotypes. (2) 1 broken RV, which was on a micropalaeontological slide originally used by Brady (now labelled 80.38.70.A), now on a new white card micropalaeontological slide labelled '*dasyderma sensu stricto*, Challenger #296, depth 1825 fathoms, wash of trawl, (SNB-1 049), 80.38.70.C'. Another 12 valves of *Henryhowella* sp. were left on the original micropalaeontological slide NHM 80.38.70.A.

(3) 1 coated LV on one white card micropalaeontological slide used by Puri and labelled '173, *Cythere dasyderma* Brady, H. S. Puri 7/67, [sic] lectoparatype, 56, Challenger, No. 296, D. 1825, wash of trawl, 1961.12.4.39.B'. The following valves were transferred from this slide to new slides: (a) 1 coated LV of *Henryhowella* now on one micropalaeontological slide NHM 1961.12.4.39.G; and (b) 1 coated RV of *Legitimocythere* now on one micropalaeontological slide NHM 1961.12.4.39.F.

(4) 1 RV was on a micropalaeontological slide originally used by Brady (now labelled 1961.12.4.39.C), but now on a new white card micropalaeontological slide labelled '*dasyderma sensu stricto*, Challenger wash of trawl, (SNB-1 050), 1961.12.4.39.D'. This RV is herein illustrated in Plate 1, fig. a. The following valves were also on the slide NHM 1961.12.4.39.C: (a) four valves of *Henryhowella* sp. were left on the micropalaeontological slide NHM 1961.12.4.39.C; and (b) 1 broken *Legitimocythere* RV was transferred to a new micropalaeontological slide numbered NHM 1961.12.4.39.E (SNB-1 057).

(5) 1 RV, 1 LV were on a micropalaeontological slide originally used by Brady (now labelled 1961.12.4.40.A), and are now on a new white card micropalaeontological slide labelled '*dasyderma* s.s., Challenger # 296, depth 1825 fathoms, wash of trawl, (SNB-1 053), 1961.12.4.40.B'. The RV specimen is herein illustrated in Plate 2, fig. c. The following valves were also on the slide NHM 1961.12.4.40.A: (a) 1 broken LV and 1 broken RV of *Legitimocythere* kept on one micropalaeontological slide NHM 1961.12.4.40.A; (b) 1 V *Bradleya* transferred to a new slide.

(6) 1 RV on a micropalaeontological slide originally used by Brady and labelled '*Cythere dasyderma* n. sp., 1961.12.4.41.A,

'CHALLENGER', No. 296, 173, depth 1825 faths., wash of trawl, G. S. Brady, 9/11/75'. This RV is herein illustrated in Plate 2, fig. e. The following valves were originally on one micropalaeontological slide NHM 1961.12.4.41.A: (a) 1 LV, 9 RV of *Henryhowella* sp., which were transferred to micropalaeontological slide NHM 1961.12.4.41.B.

(7) 2 LV, 2 RV on a micropalaeontological slide originally used by Brady labelled '*Cythere dasyderma* n. sp., 1961.12.4.42.A, "CHALLENGER", No. 296, 173, depth 1825 faths., wash of trawl, G. S. Brady, 9/11/75'. One RV is herein illustrated in Plate 1, fig. c and Plate 2, fig. d. The following valves were initially in the *Challenger* original slide NHM 1961.12.4.42.A: (a) 9 LV and 7 RV of *Henryhowella* sp. now on one micropalaeontological slide NHM 1961.12.4.42.B, SNB-1 047; and (b) 1 broken LV and 1 RV of *Legitimocythere* now on one micropalaeontological slide NHM 1961.12.4.42.D, SNB-1 059.

II. Non Type, material re-sorted by I. Mazzini (personal communication) from dry sediment of Challenger station 296: 1 right valve.

(8) 1 coated RV on one squared micropalaeontological slide labelled '*Cythere dasyderma* Brady, Challenger, n. 296, D. 1825', now numbered NHM 2012.1473 (SNB-1 054).

Dimensions (in mm). *Challenger* station 296: Lectotype – (NHM 1961.12.4.39.A) LV L 1.22, H 0.76. Paralectotypes – (NHM 1961.12.4.39.B) LV L 1.22, H 0.78; (NHM 1961.12.4.39.D) RV L 1.22, H 0.66; (NHM 1961.12.4.40.B) RV L 1.22, H 0.68, LV L 1.03, H 0.62; (NHM 1961.12.4.41.A) RV L 1.08, H 0.60; (NHM 1961.12.4.42.A) RV L 1.16, H 0.67, RV L 1.14, H 0.68, LV 1.01, H 0.59, LV L 0.99, H 0.59; (SNB-1 054) RV L 1.12, H 0.67 (Fig. 2).

Stratigraphic and geographical occurrence. Recent. Excluding the mistaken and dubious records, *A. dasyderma* s.s. is known only from the type locality, *Challenger* station 296, off Chile, southeastern Pacific, 38°6'S, 88°2'W, 3338 m (Fig. 1).

Remarks. As mentioned above, *Cythere dasyderma* (or *Echinocythereis dasyderma*, *Henryhowella dasyderma* ...) has been recorded from the Late Eocene to Recent, from all oceans, and bathymetrically from the intertidal zone to the deep abyss at 5480 m. Overall this extensive biogeographical range encompasses widely

differing environmental and ecological conditions, ranging from the continental shelf in the tropical Indo-Pacific (Brady, 1880) to the very cold shallow environment off Marion Island in the Southern Ocean (Dingle, 2003).

Brady (1880, p. 105) recorded *Cythere dasyderma* from all the world's oceans (19 *Challenger* stations: 5, 70, 85, 122, 146, 164a, 167, 185, 191a, 218, 246, 296, 300, 302, 305, 311, 317, 335, and 346) (see Supplementary Material). Only material from stations 146 (southwestern Indian Ocean), 185 (southwestern Pacific), 192 (Indo-Pacific), 296 (southeastern Pacific), 302 (southeastern Pacific), 332 (southwestern Atlantic) are archived in the NHM. According to Bate (1963), specimens of '*Cythere dasyderma* Brady' are housed in the Hancock Museum (Newcastle) but have not been available for study.

On the available slides, *Ayressoleberis dasyderma* (Brady, 1880) comb. nov. was found only in the material from the type locality (station 296 in the southeastern Pacific). Examination of all the published illustrations (mostly SEM photos) previously identified as *Cythere dasyderma* (or *Echinocythereis dasyderma*, or *Henryhowella dasyderma*) has shown that none is conspecific with *Ayressoleberis dasyderma* (Brady, 1880) comb. nov. Only one author has previously provided SEM images of *Ayressoleberis dasyderma* (Brady, 1880) comb. nov. Mazzini (2005) illustrated two LV under the name '*Cythere dasyderma* (Brady, 1880)': (a) the lectotype (her figs 26.P–26.R) (current collection number NHM 1961.12.4.39.A); and (b) a putative paralectotype of her '*Cythere dasyderma*' (current collection number NHM 1961.12.4.39.G), but which actually belongs to the genus *Henryhowella* (her figs 26.M–26.O). Here we provide further illustrations of the lectotype and paralectotypes of *A. dasyderma* comb. nov. (Pl. 2, figs c–e). This last species is most similar to *A. bathymarina* (Ayress, 1993) comb. nov., but *A. bathymarina* has a more elongated shape, tapering posterior, and has less developed spines on the lateral surface especially around the anteromarginal sulcus. *Ayressoleberis dasyderma* has more strongly developed, more nodose and multifurcate spines on its lateral surface. *Ayressoleberis bathymarina* is widely distributed in South Pacific and Southern oceans (Ayress, 1993; Ayress *et al.*, 2004; Yasuhara *et al.*, 2009). In contrast, the present evidence indicates that *Ayressoleberis dasyderma* is probably restricted to the southeastern Pacific.

Paralectotypes of *Ayressoleberis dasyderma* herein re-identified as *Henryhowella*, *Legitimocythere acanthoderma*, *Legitimocythere* and *Pennyella* (see Supplementary Material for details): 42 valves. (1) 12 V of *Henryhowella* now on one micropalaeontological slide NHM 80.38.70.A; (2) 1 broken LV of *Henryhowella* and 1 broken LV of *Legitimocythere* now on one micropalaeontological slide NHM 80.38.70.B.74.A; (3) 1 RV of *Henryhowella* now on one micropalaeontological slide NHM 80.38.71.A.48A.75 (SNB-1 021); (4) 1 LV of *Pennyella* now on one micropalaeontological slide NHM 80.38.71.A.48A.75 (SNB-1 051); (5) 1 RV of

Legitimocythere now on one micropalaeontological slide NHM 2012.1472 (SNB-1 022); (6) 1 coated RV of *Legitimocythere acanthoderma* now on one micropalaeontological slide NHM 1961.12.4.39.F (SNB-1 056a); (7) 1 coated LV of *Henryhowella* now on one micropalaeontological slide NHM 1961.12.4.39.F (SNB-1 056a); (8) 2 LV, 2 RV of *Henryhowella* now on one micropalaeontological slide NHM 1961.12.4.39.C; (9) 1 broken LV, 1 broken RV of *Legitimocythere* now on one micropalaeontological slide NHM 1961.12.4.40.A; (10) 1 RV of *Henryhowella* now on one micropalaeontological slide NHM 1961.12.4.41.B (SNB-1 055); (11) 1 RV of *Henryhowella* now on one micropalaeontological slide NHM 1961.12.4.42.B (SNB-1 047); (12) 1 LV, 1 RV of *Legitimocythere* now on one micropalaeontological slide NHM 1961.12.4.42.D (SNB-1 059); (13) 6 LV, 5 RV *Henryhowella* now on one micropalaeontological slide NHM 1961.12.4.43.A; (14) 1 LV of Trachyleberididae now on one micropalaeontological slide NHM 1961.12.4.43.B (SNB-1 052); (15) 1 coated RV of Bythocytheridae now on one micropalaeontological slide NHM 1974.275.

The following 66 valves identified as *Cythere dasyderma* by Norman are in the ostracod collection of the Zoology Department, NHM, London, but are not *Ayressoleberis dasyderma*: (16) 3 LV, 5 RV of *Henryhowella* on one micropalaeontological slide NHM 1900-3-6-235; (17) 16 LV, 18 RV, 1 RLV of *Henryhowella* and indet. Trachyleberididae on one micropalaeontological slide NHM 2012.1474 (SNB-1 041); (18) 7 LV, 5 RV of *Henryhowella* on one micropalaeontological slide NHM 1900-3-6-236; (19) 7 LV, 2 RV of *Henryhowella* and 1 LV of *Legitimocythere* on one micropalaeontological slide NHM 1911.11.8, M. 3306.

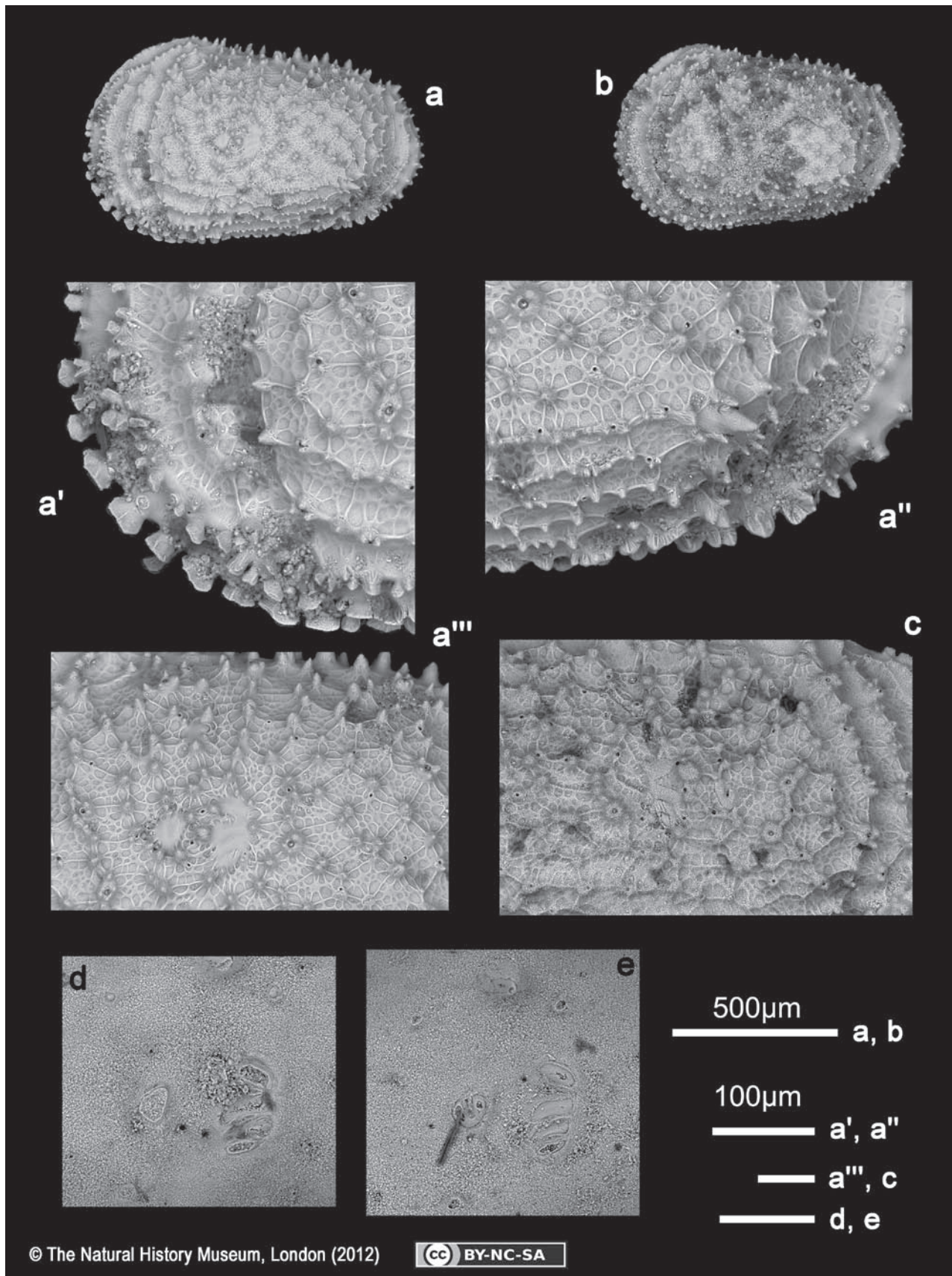
Ayressoleberis sp. nov.
(Pl. 2, figs a–b)

1880 in part *Cythere acanthoderma* n. sp. Brady: 104–105.

Material examined. 2 LV (paralectotypes of *Cythere acanthoderma* Brady, 1880) on one micropalaeontological slide (see Supplementary Material for details). 2 (possibly juvenile) LV on one micropalaeontological slide originally used by Brady and labelled '*Cythere dasy acanthoderma* Brady, 80.38.49, Type, "CHALLENGER", No. 146, depth 1375 fathoms, from trawl, G. S. Brady, 173'. These valves are herein illustrated in Plate 2, figs a–b.

Description. Valves lateral outline ovate to sub-trapezoidal; anterior margin more broadly rounded than posterior margin; anterior margin evenly rounded; posterior margin slightly angulate; ventral margin fairly straight; dorsal margin slightly sinuous. Lateral surface covered by spirally arranged, mostly conical spines; a few spines multifurcated. Spines form irregular, sub-parallel, slight ridges on ventral area. Spines longest and mostly conical on dorsal margin. Spines laterally flattened on dorsal part of anterior

Explanation of Plate 2. figs a, a', a'', a''', b. Type of *Ayressoleberis* sp. nov. from *Challenger* station 146, southwestern Indian Ocean, 46°46'S, 45°31'E, 2515 m, 29.12.1873, (NHM 80.38.49.A) juvenile? LV, external view – (a, b) entire valves, (a') anteroventral area, (a'') posteroventral area, (a''') detail of external ornamentation. **figs c–e.** Types of *Ayressoleberis dasyderma* (Brady, 1880) from *Challenger* station 296, off Chile, southeastern Pacific, 38°6'S, 88°2'W, 3338 m, 09.11.1875, (c) (NHM 1961.12.4.40.B), male RV, detail of external ornamentation; (d) (NHM 1961.12.4.42.A), male RV, adductor muscle scar pattern; (e) (NHM 1961.12.4.41.A), (A-1) RV, adductor muscle scar pattern. Photos: SNB, © Natural History Museum, London.



margin, spines on ventral margin mostly flattened. One conspicuous, large, conical spine on posteroventral area of lateral surface. Conspicuous, honeycomb-like secondary reticulation.

Dimensions (in mm). *Challenger* station 146: (NHM 80.38.49) LV L 1.02, H 0.64, LV L 0.92, H 0.58 (Fig. 2).

Stratigraphical and geographical occurrence. Known only from *Challenger* station 146, Recent, southwestern Indian Ocean, 46°46'S, 45°31'E, 1375 m, sampled on 29 December, 1873.

Remarks. *Ayressoleberis* sp. nov. is close to but differs from *A. dasyderma* on the characters below; however, as both studied valves of *A.* sp. nov. are possibly juveniles we have not formally named this new species. *Ayressoleberis* sp. nov. shows: (1) relatively long, robust and pointed spines on the lateral surface, while *A. dasyderma* shows short, verrucose spines; (2) the spines on the lateral surface form a spiral pattern around the adductor muscle scars whereas in *A. dasyderma* the spines are irregularly arranged. The unnamed species shows (3) a conspicuously longer and pointed postero-ventral spine on the lateral surface, while *A. dasyderma* lacks this spine; however, the lack of such a spine in *A. dasyderma* may be a preservation artefact; (4) the new species shows numerous flattened spines on the ventral surface of the valve and on the antero-ventral, ventral and postero-ventral margins, while *A. dasyderma* shows fewer and mostly pointed or verrucose spines on the lateral surface and on the margins; and (5) the secondary ornamentation on the new species shows more numerous and smaller pits than *A. dasyderma*.

Taxa of specimens previously included in the syntype series of ‘*Cythere dasyderma*’

Henryhowella spp.
(Pl. 3, figs a–e)

1880 in part *Cythere dasyderma* n. sp. Brady: 105–106.

1889 *Cythere dasyderma*, Brady; Brady and Norman: 153–154.

Material examined. 57 LV, 61 RC, 1 subfossil carapace on 11 micropalaeontological slides.

I. Paralectotypes of *Ayressoleberis dasyderma*. 27 LV and 28 RV on 7 slides:

(1) 5 RV, 7 LV on one original micropalaeontological slide used by Brady and labelled ‘*Cythere dasyderma* n. sp., 80.38.70.A [.A added by SNB], “CHALLENGER”, No. 296, depth 1825 fathoms, wash of trawl, 173, G. S. Brady 9/11/75’. Previously, another broken RV was on this slide (now it is on the slide NHM 80.38.70.C (SNB-1 049).

(2) 1 broken *Henryhowella* LV on one original micropalaeontological slide used by Brady and labelled ‘1. *Cythere dictyon* n. sp., 2. *C. acantho dasyderma*, 80.38.70.74, “CHALLENGER” No. 332, depth 2200 faths., tow-net at trawl, 173, G. S. Brady 10/3/76’, now this slide is numbered NHM 80.38.70.B.74.A. Previously, one posteriorly broken RV and one antero-dorsally broken LV of *Poseidonamicus* were on this slide. They were transferred to a new slide labelled ‘SNB-1 008’ – NHM 80.38.70.B.74.A.

(3) 2 LV, 2 RV on one original micropalaeontological slide used by Brady and labelled ‘173, *Henryhowella* [added by SNB], *Cythere dasyderma* Brady, 1961.12.4.39.C [.C added by SNB], “CHALLENGER”, No. 296, depth 1825 faths., wash of trawl, G. S. Brady, 173’. Previously, 2 other valves were on this slide: 1 RV of *Ayressoleberis dasyderma* (transferred to the slide NHM 1961.12.4.39.D), and 1 broken RV of *Legitimocythere* transferred to the slide labelled NHM 1961.12.4.39.E.

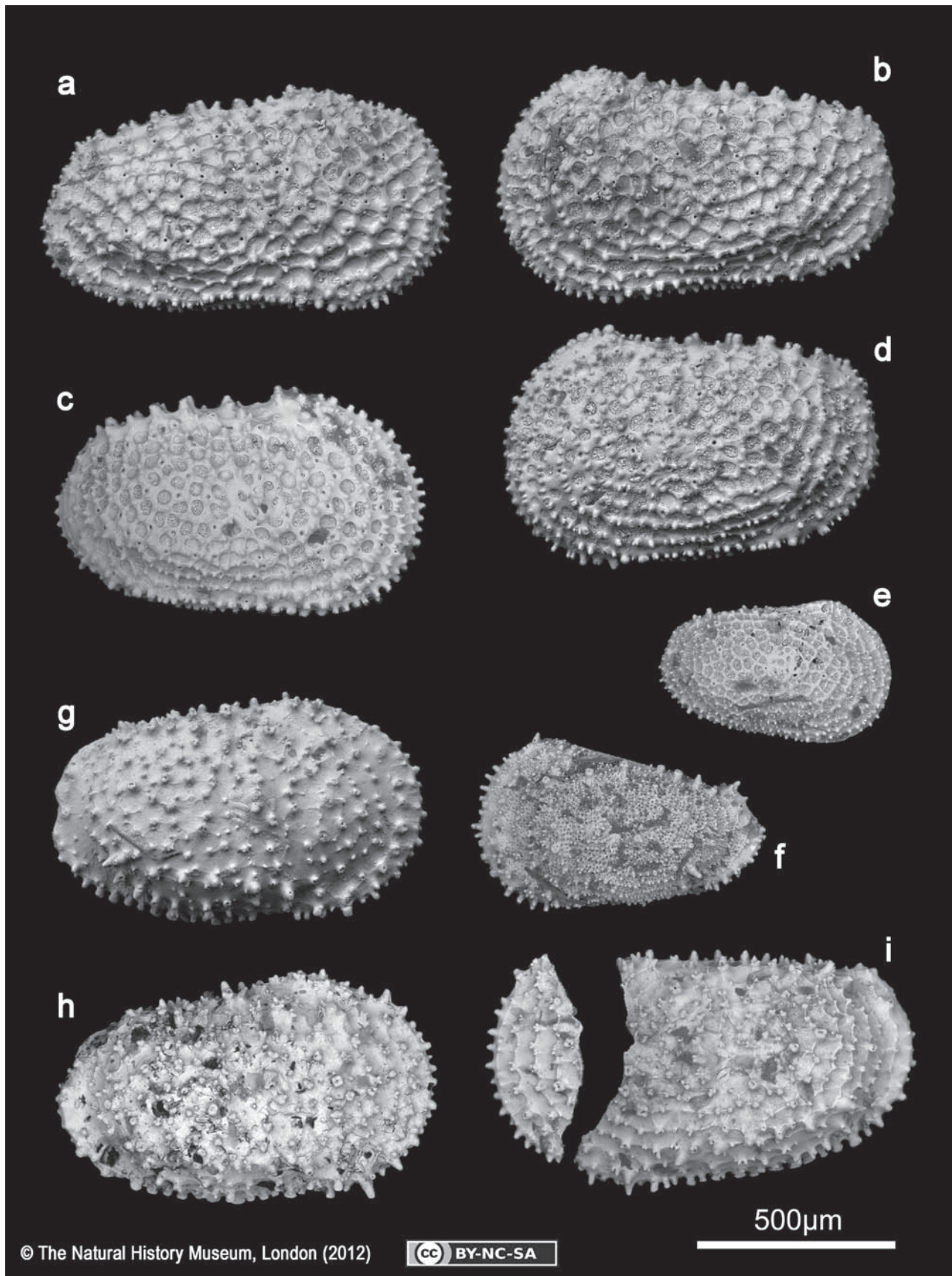
(4) 1 coated LV on a new white card micropalaeontological slide labelled ‘*Henryhowella* sp., Challenger #296, depth 1825 fathoms, wash of trawl, (SNB-1 058), 1961.12.4.39.G’. This valve was illustrated as the [sic] paralectotype of ‘*Cythere dasyderma*’ by Mazzini (2005, figs 23.N–23.O). Previously, this LV was on a white card micropalaeontological slide used by Puri (now labelled as NHM 1961.12.4.39.B) together with 1 coated LV of *Ayressoleberis dasyderma* (left on original slide) and 1 coated *Legitimocythere* RV (transferred to a new slide labelled NHM 1961.12.4.39.F).

(5) 1 LV, 9 RV on one micropalaeontological slide labelled ‘*Henryhowella* sp., Challenger #296, depth 1825 fathoms, wash of trawl, (SNB-1 055), 1961.12.4.41.B’. Previously, these ten valves were on the slide NHM 1961.12.4.41.A, together with 1 RV of *Ayressoleberis dasyderma*. One LV and one RV herein illustrated in Plate 3, figs a–b.

(6) 9 LV and 7 RV on one micropalaeontological slide labelled ‘*Henryhowella* sp., Challenger #296, 1825 fathoms, wash of trawl, (SNB-1 047), 1961.12.4.42.B’. One female LV is herein illustrated in Plate 3, fig. d. Previously, these 16 valves were on the slide NHM 1961.12.4.42.A, together with 2 LV, 2 RV of *Ayressoleberis dasyderma* (left on the original slide), and 1 broken LV and 1 RV of *Legitimocythere* (transferred to the new slide NHM 1961.12.4.42.D, SNB-1 059).

(7) 6 LV, 5 RV on one original micropalaeontological slide used by Brady and labelled ‘*Cythere acanthoderma dasy* n. sp., 1961.12.4.43.A [.A added by SNB], “CHALLENGER”, No. 302, 173, depth 1450 faths., 173, G. S. Brady, 28/12/75’. One female RV is herein illustrated in Plate 3, fig. c. Previously, 1 LV of

Explanation of Plate 3. External views of *Henryhowella*, *Legitimocythere* and *Pennyella* (paralectotypes of *Ayressoleberis dasyderma* comb. nov.) **figs a, b, d.** *Henryhowella* sp., *Challenger* station 296, off Chile, southeastern Pacific, 38°6'S, 88°2'W, 3338 m, 09.11.1875: **(a)** (NHM 1961.12.4.41.B) male RV; **(b)** (NHM 1961.12.4.41.B) male LV; **(d)** (NHM 1961.12.4.42.B) female LV. **fig. c.** *Henryhowella* sp., *Challenger* station 302, off Chile, southeastern Pacific, 42°3'S, 82°11'W, 2652 m, 28.12.1875 (NHM 1961.12.4.43.A) female RV. **fig. e.** *Henryhowella* sp., *Challenger* station 192, off Ki Islands, Indo-Pacific, 236 m, 26.09.1874 (NHM 80.38.71A.48A.75, SNB-1 021) juvenile RV. **fig. f.** *Pennyella* sp., *Challenger* station 192, off Ki Islands, Indo-Pacific, 236 m, 26.09.1874 (NHM 80.38.71A.48A.75, SNB-1 051) juvenile LV. **figs g–i.** *Legitimocythere* sp., *Challenger* station 296, off Chile, southeastern Pacific, 38°6'S, 88°2'W, 3338 m, 09.11.1875: **(g)** (NHM 1961.12.4.42.D) RV; **(h)** (NHM 1961.12.4.39.F) RV; **(i)** (NHM 1961.12.4.42.D) LV. Photos: SNB, © Natural History Museum, London.



Trachyleberididae gen. indet. was also on this slide (now transferred to slide NHM 1961.12.4.43.B).

II. Material from the Norman collection. 30 LV, 33 RV, 1 closed carapace on 4 slides:

(8) 3 LV, 5 RV on one micropalaeontological slide labelled '*Cythere dasyderma* G. S. Brady, 1900-3-6-235, "Porcupine" 1869, Stat. 19, Lat 54°53'N, Long 10°56' W, 1366 fath.'

(9) 16 LV, 18 RV, 1 carapace on one micropalaeontological slide labelled '*Cythere dasyderma* G. S. Brady, "Porcupine" 1869, Stat. 20, Lat 55°11'N, Long 11°31'W, 1443 fath.'. This slide is now labelled 'SNB-1 041' –NHM 2012.1474.

(10) 7 LV, 2 RV valves (plus 1 LV of ?*Legitimocythere* sp., see below) on one micropalaeontological slide labelled '*Cythere dasyderma* G. S. Brady, NORMAN COLLECTION, 1911.11.8, M. 3306, *Valorous* 1875, Stat 12, Lat 36°11'N, Long 37°41' W, 1450 fath.'

(11) 7 LV, 5 RV valves on one micropalaeontological slide labelled '*Cythere dasyderma* [sic] G. O. Sars, 1900-3-6-236, *Valorous* 1875, Stat 13, Lat 56°1'N, Long 34.42' W, 690 fath.'

Legitimocythere spp.
(Pl. 3, figs g-i)

1880 in part *Cythere dasyderma* n. sp. Brady: 105–106.

I. Paralectotypes of *Ayressoleberis dasyderma*. 2 LV and 4 RV on 4 micropalaeontological slides:

(1) 1 coated RV on a new white card micropalaeontological slide labelled '*Legitimocythere* sp., Challenger #296, depth 1825 fathoms, wash of trawl, (SNB-1 056), 1961.12.4.39.F'. This RV is herein illustrated in Plate 3, fig. h. Previously, this coated RV was on a white paper micropalaeontological slide used by Puri (now labelled as NHM 1961.12.4.39.B) together with 1 coated LV of *Ayressoleberis dasyderma* (left on original slide) and 1 coated *Henryhowella* LV (transferred to a new slide labelled NHM 1961.12.4.39.G, SNB-1 058).

(2) 1 broken RV on a new white card micropalaeontological slide labelled '*Legitimocythere* sp., Challenger #296, depth 1825 fathoms, wash of trawl, (SNB-1 057), 1961.12.4.39.E'. Previously, this RV was on the original slide used by Brady (now labelled as NHM 1961.12.4.39.C), together with 2 LV, 2 RV of *Henryhowella* (left on the original slide) and 1 RV of *Ayressoleberis dasyderma* (transferred to new slide NHM 1961.12.4.39.D).

(3) 1 broken LV and 1 broken RV on an original micropalaeontological slide used by Brady and labelled '*Cythere n. sp. dasyderma*, 1961.12.4.40.A [A added by SNB], "CHALLENGER", 173, No. 296, depth 1825 faths., wash of trawl, G. S. Brady'. Previously, another RV and one LV of *Ayressoleberis dasyderma* were on this slide (NHM 1961.12.4.40.A), now transferred to slide NHM 1961.12.4.40.B.

(4) 1 broken LV and 1 RV on a micropalaeontological slide labelled '*Legitimocythere* sp, Challenger #296, depth 1825 fathoms, wash of trawl, (SNB-1 059), 1961.12.4.42.D'. The LV is herein illustrated in

Plate 3, fig. i. These valves were previously on slide NHM 1961.12.4.42.A, together with 2 LV, 2 RV of *Ayressoleberis dasyderma* (left on the original slide) and 9 LV and 7 RV of *Henryhowella* (transferred to slide NHM 1961.12.4.42.B, SNB-1 047).

(5) 1 RV of *Legitimocythere* now on one micropalaeontological slide labelled '*Henryhowella* cf. *acanthoderma*, Challenger # 192, Depth 129 fathoms, off Ki Islands, G.S. Brady 26/9/74'. This valve was on slide with original Nr. = 80,38,71A.48A.75 (which is now labelled SNB-1 021, SNB-1 022). This slide has the new number NHM 2012.1472 (SNB-1 022).

II. Material from the Norman collection. 1 LV on one slide. 1 LV (plus 10 V of *Henryhowella* spp., see above) on 1 micropalaeontological slide labelled '*Cythere dasyderma* G. S. Brady, NORMAN COLLECTION, 1911.11.8, M. 3306, *Valorous* 1875, Stat 12, Lat 36°11'N, Long 37°41' W, 1450 fath.'

Pennyella sp.
(Pl. 3, fig. f)

1880 in part *Cythere dasyderma* n. sp. Brady: 105–106.

I. Paralectotypes of *Ayressoleberis dasyderma*. 1 left valve on one micropalaeontological slide: 1 LV on a new black, plastic micropalaeontological slide labelled NHM 80.38.71.A.48.A.75 (SNB-1 051) 'Challenger # 192, Depth 129 fathoms, off Ki Islands, (SNB-1 051)'. Previously this LV plus three other valves were on Brady's original slide NHM 80.38.71.A.48.A.75 (SNB-1 021). These three additional valves belong to: [sic] *Cythere dictyon*, *Henryhowella*, cf. *Legitimocythere*.

Trachyleberididae indet.

1880 in part *Cythere dasyderma* n. sp. Brady: 105–106.

I. Paralectotypes of *Ayressoleberis dasyderma*. 1 LV on one slide: 1 LV on one micropalaeontological slide labelled 'Challenger #302, depth 1450 fathoms, (SNB-1 052), 1961.12.4.43.B'. This valve was previously on slide NHM 1961.12.4.43.A, together with 6 LV, 5 RV of *Henryhowella*.

Bythocytheridae indet.

1880 ?in part *Cythere dasyderma* n. sp. Brady: 105–106.

I. Paralectotypes of *Ayressoleberis dasyderma*. 1 LV on one slide: 1 gold coated RV on 1 white plastic micropalaeontological slide labelled '*Cythere dasyderma*, 1974.275, Topotype, Sediment sample M-237 (Stat. 185, 155 fms., Torres Straits), Challenger 31.8.1874'. Mazzini (2005, p. 52) also recorded this misplaced or misidentified specimen.

ACKNOWLEDGEMENTS

Miranda Lowe (NHM, London) carefully assisted the first author during five visits to the NHM and also kindly provided access to the *Challenger* and other ostracod specimens housed in the NHM. William Briggs, Elisabeth Brouwers, Richard Dingle, Stephen Eagar, Ilaria Mazzini and Eugen Kempf provided valuable

information and papers. Martin Angel suggested revisions to the English. We are grateful for the constructive criticism of both reviewers, Kerry Swanson and Tom Cronin, and the editors Elisabeth Brouwers and Alan Lord. This research received support from the SYNTHESYS Project <http://www.synthesys.info/> which is financed by the European Community Research Infrastructure Action under the FP7 Integrating Activities Programme. S.N.B. thanks the Alexander von Humboldt Foundation for a Post-Doctoral Fellowship. This study was also financially supported by the *Encyclopedia of Life* and the Hansische Universitäts-Stiftung. M.Y. was supported by Seed Funding from the Programme for Basic Research of the University of Hong Kong (project code: 201105159002), Smithsonian Postdoctoral Fellowship, and Smithsonian Marine Science Network Postdoctoral Fellowship.

Manuscript received 13 April 2012

Manuscript accepted 2 July 2012

Scientific editing by Elisabeth Brouwers

REFERENCES

- Alvarez Zarikian, C.A. 2009. Data report: Late Quaternary ostracodes at IODP Site U1314 (North Atlantic Ocean). In: Channell, J.E.T., Kanamatsu, T., Sato, T., Stein, R., Alvarez Zarikian, C.A. & Malone, M.J. and the Expedition 303/306 Scientists (Eds), *Proceedings of the IODP, 303/306*. Integrated Ocean Drilling Program Management International Inc., College Station, TX, 1–13.
- Alvarez Zarikian, C.A., Stepanova, A.Y. & Grützner, J. 2009. Glacial–interglacial variability in deep sea ostracod assemblage composition at IODP Site U1314 in the subpolar North Atlantic. *Marine Geology*, **258**: 69–87.
- Ayress, M.A. 1993. On *Trachyleberis bathymarina* Ayress sp. nov. *Stereo-Atlas of Ostracod Shells*, **20**: 105–108.
- Ayress, M.A. 1995. Late Eocene Ostracoda (Crustacea) from the Waihao District, South Canterbury, New Zealand. *Journal of Paleontology*, **69**: 897–921.
- Ayress, M.A., Neil, H., Passlow, V. & Swanson, K.M. 1997. Benthonic ostracods and deep watermasses: a qualitative comparison of south-west Pacific, southern and Atlantic Oceans. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **131**: 287–302.
- Ayress, M.A., De Deckker, P. & Coles, G.P. 2004. A taxonomic and distributional survey of marine benthonic Ostracoda off Kerguelen and Heard Islands, South Indian Ocean. *Journal of Micropalaeontology*, **23**: 15–38.
- Bate, R.H. 1963. The Ostracoda collected during the Voyage of H.M.S. *Challenger*. *Micropalaeontology*, **9**: 79–84.
- Bate, R.H. 1964. The Ostracoda collected during the voyage of H.M.S. *Challenger* – addendum. *Micropalaeontology*, **10**: 395–395.
- Benson, R.H. 1964a. Recent Cytheracean Ostracodes from McMurdo Sound and the Ross Sea, Antarctica. *University of Kansas Paleontological Contributions*, **6**: 1–36.
- Benson, R.H. 1964b. Recent marine podocopid and Platycopid Ostracodes of the Pacific. *Pubblicazioni Della Stazione Zoologica Di Napoli*, **33**: 387–420.
- Benson, R.H. 1971. A new Cenozoic deep-sea genus *Abyssocythere* (Crustacea, Ostracoda, Trachyleberididae) with descriptions of five new species. *Smithsonian Contributions to Paleobiology*, **7**: 1–25.
- Benson, R.H. 1972. The *Bradleya* problem, with description of two new psychrospheric ostracode genera, *Agrenocythere* and *Poseidonamicus* (Ostracoda: crustacea). *Smithsonian Contributions to Paleobiology*, **12**: 1–138.
- Brady, G.S. 1880. Report on the Ostracoda dredged by H.M.S. *Challenger* during the Years 1873–1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger*. *Zoology*, **1**: 1–184.
- Brady, G.S. 1887. Chapitre 4: Les Crustacés–Ostracodes des expéditions du travailleur et du Talisman de 1881 A 1883. In: Folin, L., Périer, J.P.L. (Ed.), *Les Fonds de la Mer, Etude Internationale sur les particularités nouvelles des régions sous-marines*, 164–166.
- Brady, G.S. & Norman, A.M. 1889. A monograph of the marine and fresh-water Ostracoda of the North Atlantic and of north-western Europe. Section I: podocopa. *Scientific Transactions of the Royal Dublin Society*, **4**: 63–270.
- Brandão, S.N. 2008a. New species of Bairdioidea (Crustacea, Ostracoda) from the Southern Ocean and discussions on *Bairdoppilata simplex* (Brady, 1880), *Bairdoppilata labiata* (Müller, 1908) and *Bythopussella aculeata* (Müller, 1908). *Zootaxa*, **1866**: 373–452.
- Brandão, S.N. 2008b. First record of a living Platycopida (Crustacea, Ostracoda) from Antarctic waters and a discussion on *Cytherella ser-ratula* (Brady, 1880). *Zootaxa*, **1866**: 349–372.
- Brandão, S.N. & Păpłow, O. 2011. New species and occurrences of *Bradleya* Benson, 1972, *Harleya* Jellinek & Swanson, 2003 and *Poseidonamicus* Benson, 1972 (Ostracoda: cytheroidea) from the Atlantic Sector of the Southern Ocean. *Journal of Micropalaeontology*, **30**: 1–27.
- Brouwers, E.M. 1982. Reevaluation of Cytheracean ostracode species identified by Painter, 1965 from localities in the northeastern Pacific Ocean and Chukchi Sea. *United States Geological Survey Open-file Report*, **82-736**: 1–35.
- Carus, J.V. 1885. *Prodromus Faunae Mediterraneae*. E. Schweizerbart'sche Verlagshandlung (E. Koch) Stuttgart, 1–524.
- Chapman, F. 1910. On the Foraminifera and Ostracoda from soundings (chiefly deep-water) collected round Funafuti by H.M.S. Penguin. *Journal of the Linnean Society of London*, **30**: 388–444.
- Chapman, F. 1914. Descriptions of new and rare fossils obtained by deep boring in the Malle. Part III, Ostracoda to Fishes. *Proceedings of the Royal Society of Victoria, New Series*, **27**: 28–71.
- Chapman, F. 1919. Ostracoda. *Australasian Antarctic Expedition, 1911–1914, Scientific Reports, Series C., Zoology and Botany*, **5**: 5–45.
- Coles, G., Ayress, M.A. & Whatley, R.C. 1990. A comparison of North Atlantic and Pacific Cainozoic deep-sea Ostracoda. In: Whatley, R.C. & Maybury, C. (Eds), *Ostracoda and Global Events*. Chapman & Hall, Cambridge, 287–301.
- Didić, C. 2001. Late Quaternary climate variations recorded in North Atlantic deep-sea benthic ostracodes. *Berichte zur Polar- und Meeresforschung*, **390**: 1–121.
- Didić, C. & Bauch, H.A. 2000. Species composition and glacial–interglacial variations in the ostracode fauna of the northeast Atlantic during the past 200,000 years. *Marine Micropalaeontology*, **40**: 105–129.
- Dingle, R.V. 2002. Insular endemism in Recent Southern Ocean benthic Ostracoda from Marion Island: Palaeozoogeographical and evolutionary implications. *Revista Española de Micropalaeontología*, **34**: 215–233.
- Dingle, R.V. 2003. Recent subantarctic benthic ostracod faunas from the Marion and Price Edward Islands Archipelago, Southern Ocean. *Revista Española de Micropalaeontología*, **35**: 119–155.
- Dingle, R.V. & Lord, A.R. 1990. Benthic ostracods and deep watermasses in the Atlantic Ocean. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **80**: 213–235.
- Dingle, R.V., Lord, A.R. & Boomer, I.D. 1990. Deep-water Quaternary Ostracoda from the continental margin of south-western Africa (SE Atlantic Ocean). *Annals of the South African Museum*, **99**: 245–366.
- Hao, Y. 1989. *Quaternary Microbiotas and their Geological Significance from Northern Xisha Trench of South China Sea*. China University of Geosciences Press, Wuhan, 1–223.
- Harding, J.P. & Sylvester-Bradley, P.C. 1953. The ostracod genus *Trachyleberis*. *Bulletin of the British Museum (Natural History)*. *Zoology*, **2**: 1–15.
- Hartmann, G. 1989. Antarktische benthische Ostracoden. 4. Auswertung der während der Reise von FFS ‘Walther Herwig’ (68/1) bei Sud-Georgien gesammelten Ostracoden. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, **86**: 209–230.
- Hartmann, G. 1997. Antarctic and subantarctic Podocopa (Ostracoda). *Theses Zoologicae*, **26**: 1–355.
- Horne, D.J., Cohen, A. & Martens, K. 2002. Taxonomy, morphology and biology of Quaternary and living Ostracoda. In: Holmes, J.A. & Chivas, A.R.

- (Eds), *The Ostracoda. Applications in Quaternary*. Research & American Geophysical Union, Washington, DC, 5–35.
- Hornibrook, N. de B. 1952. Tertiary and recent marine Ostracoda of New Zealand, their origin affinities and distribution. *New Zealand Geological Survey, Paleontological Bulletin*, **18**: 1–82.
- Hou, Y. & Gou, Y. 2007. *Fossil Ostracoda of China*. Volume 2: *Cytheracea and Cytherellidae*. Science Publishing House, Beijing, 1–798.
- Jellinek, T. & Swanson, K.M. 2003. Report on the taxonomy, biogeography and phylogeny of mostly living benthic Ostracoda (Crustacea) from deep-sea samples (Intermediate Water depths) from the Challenger Plateau (Tasman Sea) and Campbell Plateau (Southern Ocean), New Zealand. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, **558**: 1–329.
- Jellinek, T., Swanson, K.M. & Mazzini, I. 2006. Is the cosmopolitan model still valid for deep-sea podocopid ostracods? *Senckenbergiana maitima*, **36**: 29–50.
- Jones, R., Whatley, R.C. & Cronin, T.M. 1998. The zoogeographical distribution of deep water Ostracoda in the Arctic Ocean. *Bulletin du Centre de Recherches Elf Exploration Production, Mémorie*, **20**: 83–90.
- Jones, R., Whatley, R.C., Cronin, T.M. & Dowsett, H.J. 1999. Reconstructing late Quaternary deep-water masses in the eastern Arctic Ocean using benthic Ostracoda. *Marine Micropaleontology*, **37**: 251–272.
- Joy, J.A. & Clark, D.L. 1977. The distribution ecology and systematics of the benthic Ostracoda of the central Arctic Ocean. *Micropaleontology*, **23**: 129–154.
- Maddocks, R.F. 1990. Living and fossil Macrocypridae (Ostracoda). *University of Kansas Paleontological Contributions Monograph*, **2**: 1–285.
- Majoran, S. & Dingle, R.V. 2001a. Palaeoceanographical changes recorded by Cenozoic deep-sea ostracod assemblages from the South Atlantic and the Southern Ocean (ODP Sites 1087 and 1088). *Lethaia*, **34**: 63–83.
- Majoran, S. & Dingle, R.V. 2001b. Cenozoic deep-sea ostracods from southwestern South Atlantic (DSDP/ODP Sites 329, 513 and 699). *Revista Española de Micropaleontología*, **33**: 205–215.
- Majoran, S. & Dingle, R.V. 2002. Cenozoic deep-sea ostracods from Maud Rise, Weddell Sea, Antarctica (ODP Site 689): A palaeoceanographical perspective. *Geobios*, **35**: 137–152.
- Mazzini, I. 2005. Taxonomy, biogeography and ecology of Quaternary benthic Ostracoda (Crustacea) from circumpolar deep water of the Emerald Basin (Southern Ocean) and the S Tasman Rise (Tasman Sea). *Senckenbergiana maritima*, **35**: 1–119.
- Müller, G.W. 1912. Crustacea: Ostracoda. In: *Das Tierreich. Königlich Preussische Akademie der Wissenschaften zu Berlin*. Berlin, 1–434.
- Namias, I. 1900. Ostracodi fossili della Farnesina e Monte Mario presso Roma. *Palaeontographia Italica*, **6**: 79–114.
- Passlow, V. 1997. Quaternary ostracods as palaeoceanographic indicators: A case study off southern Australia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **131**: 315–325.
- Puri, H.S. 1953. The ostracode genus *Trachyleberis* and its ally *Actinocythereis*. *American Midland Naturalist*, **49**: 171–187.
- Puri, H.S. 1954. Contribution to the study of the Miocene of the Florida Panhandle. Part 3: Ostracoda. *Florida Geological Survey, Bulletin*, **36**: 215–345.
- Puri, H.S. 1956. Two new Tertiary ostracode genera from Florida. *Journal of Paleontology*, **30**: 274–277.
- Puri, H.S. & Hulings, N.C. 1976. Designation of lectotypes of some ostracods from the Challenger expedition. *Bulletin of the British Museum (Natural History). Zoology*, **29**: 251–315.
- Rosenfeld, A. & Bein, A. 1978. A preliminary note on recent ostracodes from shelf to rise sediments off northwest Africa. *Meteor Forschungsergebnisse, Reihe C Geologie und Geophysisch*, **29**: 14–20.
- Ruan, P. & Hao, Y. 1988. *Systematic description of microfossils. 2. Ostracoda. Quaternary Microbiotas in the Okinawa Trough and Their Geological Significance*. Geological Publishing House, Beijing, 227–395.
- Schlitzer, R. 2012. *Ocean Data View 4*. <http://odv.awi.de> (accessed May 2012).
- Seguenza, G. 1884. Il Quaternario di Rizzolo. II: Gli Ostracodi. *Il Naturalista Siciliano*, **3**: 308–311.
- Wang, P., Zhang, J., Zhao, Q. et al. 1988. *Foraminifera and Ostracoda in Bottom Sediments of the East China Sea*. Ocean Press, Beijing, 1–438.
- Whatley, R.C. & Ayress, M. 1988. Pandemic and endemic distribution patterns in Quaternary deep-sea Ostracoda. *Developments in Palaeontology and Stratigraphy*, **11**: 739–755.
- Whatley, R.C. & Coles, G.P. 1987. The Late Miocene to Quaternary Ostracoda of Leg 94, Deep Sea Drilling Project. *Revista Española de Micropaleontología*, **19**: 33–98.
- Whatley, R.C. & Coles, G.P. 1991. Global change and the biostratigraphy of North Atlantic Cainozoic deep water Ostracoda. *Journal of Micropalaeontology*, **9**: 119–132.
- Whatley, R.C., Eynon, M. & Moguilevsky, A. 1998a. The depth distribution of Ostracoda from the Greenland Sea. *Journal of Micropalaeontology*, **17**: 15–32.
- Whatley, R.C., Moguilevsky, A., Ramos, M.I.F. & Coxill, D.J. 1998b. Recent deep and shallow water Ostracoda from the Antarctic Peninsula and the Scotia Sea. *Revista Española de Micropaleontología*, **30**: 111–135.
- Whatley, R.C. & Roberts, R. 1999. Late Quaternary Ostracoda from a core in the Weddell Sea, Antarctica. *Universidade Federal do Rio Grande do Sul Instituto de Geociencias Pesquisas*, **26**: 11–19.
- Whatley, R.C., Staunton, M. & Kaesler, R.L. 1997. The depth distribution of recent marine Ostracoda from the southern Strait of Magellan. *Journal of Micropalaeontology*, **16**: 121–130.
- Whatley, R.C., Staunton, M., Kaesler, R.L. & Moguilevsky, A. 1996. The taxonomy of Recent Ostracoda from the southern part of the Strait of Magellan. *Revista Española de Micropaleontología*, **28**: 51–76.
- Yajima, M. 1982. Late Pleistocene Ostracoda from the Boso Peninsula, central Japan. *Bulletin University Museum University of Tokyo*, **20**: 141–227.
- Yasuhara, M., Cronin, T.M., Hunt, G. & Hodell, D.A. 2009. Deep-sea ostracods from the South Atlantic sector of the Southern Ocean during the last 370,000 years. *Journal of Paleontology*, **83**: 914–930.
- Zhao, Q.H. 2005. Late Cainozoic Ostracod faunas and paleoenvironmental changes at ODP Site 1148 South China Sea. *Marine Micropaleontology*, **54**: 27–47.