Systema Porifera: A Guide to the Classification of Sponges, Edited by John N.A. Hooper and Rob W.M. Van Soest

Family Calthropellidae Lendenfeld, 1907

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Calthropellidae Lendenfeld (Demospongiae, Astrophorida) is a small family of Astrophorida positioned between the major families Ancorinidae and Pachastrellidae. With Ancorinidae (+ Geodiidae) they share the possession of euasters, and with Pachastrellidae they share calthrops-like megascleres. There are no unique features, and it is suspected that the family may turn out to be artificial. All genera have calthrops and euaster microscleres, and some have modified triaenes and tetractines, mesotriaenes (mesocalthrops or mesodichotriaenes) and oxeas. Genera are differentiated by the presence or absence of oxea megascleres, organisation of triaenes in the choanosomal and subectosomal skeletons, and euaster morphology and diversity. Four valid genera are recognised and only about two dozen species worldwide, with records from the North Atlantic, Mediterranean, South Africa, western Indian Ocean, Indonesia and New Zealand, found mainly in warmer waters, moderately deep (about 600 m) but also recorded occasionally from the littoral.
Keywords: Porifera; Demospongiae; Astrophorida; Calthropellidae; *Calthropella*; *Chelotropella*; *Pachastrissa*; *Pachataxa.*

DEFINITION, DIAGNOSIS, SCOPE

Synonymy

Calthropellidae Lendenfeld, 1907: 301.

Definition

Astrophorida with irregularly arranged calthrops or short-rayed mesotriaenes forming the deeper choanosomal skeleton, and radially orientated mesotriaenes or dichocalthrops forming a peripheral skeleton, mostly short-rayed; with or without oxeas; microscleres are euasters, usually spherasters, never sterrasters, sometimes also with microrhabds.

Diagnosis

Encrusting, massive to subspherical globular sponges with a rough surface and hard consistency. The main skeleton tends to be confused, but may be radially arranged if triaenes and/or oxeas are present. Megascleres include calthrops (with rays ranging from two to four, some of which may be bifurcate (dichocalthrops)), or short-shafted triaenes, and sometimes long-shafted triaenes and/or large oxeas; one genus (*Chelotropella*) has radially oriented dichotriaenes and oxeas throughout the skeleton, whereas most species have radial organisation only apparent in the subectosomal region, if at all, with calthrops (and other megascleres if present) irregularly dispersed through the choanosome. Microscleres are euasters, usually spherasters, sometimes modified, and microrhabds or microxeas. Rugose microrhabds occur in one genus (*Pachataxa*).

Remarks

Lendenfeld (1907) originally included three genera, *Calthropella, Pachastrissa*, and one new genus *Chelotropella* in his family Calthropellidae for sponges similar to Pachastrellidae but with euaster microscleres. One additional genus, *Pachataxa* de Laubenfels (1936a) is now included here (Maldonado, 1993). Maldonado (1993) also noted that a few species currently assigned to Calthropellidae (*Pachastrissa pathologica* (Schmidt, 1868) *sensu* Lendenfeld, 1903, and *Pachataxa enigmatica* Lévi & Lévi, 1983b) shared the possession of short-shafted mesotriaenes (mesocalthrops or mesodichotriaenes) with some representatives of Pachastrellidae (*Yodomia* Lebwohl, *Triptolemus* Sollas) and 'Lithistida' (*Brachiaster* Wilson). He concluded that these spicules were non-homologous, and the presence of mesotriaenes in Calthropellidae and Pachastrellidae was a product of convergent evolution (with *Brachiaster* now also included in Pachastrellidae; Maldonado, this volume).

Scope

Seven nominal genera are included in Calthropellidae, four of which are probably valid although two of these are monotypic. Only about two dozen species have been described, distributed in warmer parts of the ocean, in moderately deep water (about 600 m depth) occasionally from the littoral zone, with records from the north Atlantic, Mediterranean, South Africa, East Africa, Indonesia and New Zealand.

Taxonomic history

Although Sollas (1888) described or revised most of the species now considered to belong to Calthropellidae, he still assigned them to Pachastrellidae. Likewise, Lendenfeld (1903) in his revision of the tetraxonid sponges kept them in Pachastrellidae. As late as 1907, the family was erected by Lendenfeld with the above given definition (here modified slightly), and three genera assigned to it. Since then the family was retained in its original format by most authors. De Laubenfels (1936a: 179) erected a genus *Pachataxa* for Schmidt's species *Pachastrella lithistina*, which was later assigned to Calthropellidae by Pulitzer-Finali, 1978. De Laubenfels (1936a) was the only author to reject Lendenfeld's family. He completely mixed up members of Calthropellidae, Pachastrellidae (Astrophorida) and Plakinidae (Homosclerophorida), and distributed these over two families, Halinidae and Plakinastrellidae, whose contents are obviously artificial. Not surprisingly, none of the major authors of the previous century followed this classification.

Although there is an apparently wide acceptance among recent authors of the validity of the family Calthropellidae in its present concept, there is ample reason to reexamine it critically, e.g., by sequencing appropriate genes and including various pachastrellid and ancorinid genera in the analysis. There are no morphological markers for the family, it can only be defined on the unique combination of calthrops and euasters. And even that combination is threatened by the vague separation of genuine calthrops (with four equiangular equal-length rays) and 'short-shafted' triaenes, of which one of the rays is longer and considered homologous to the rhabd of a long-shafted triaene.

Reviews

Lendenfeld (1907), Maldonado (1993).

KEY TO GENERA

(1) Microscleres include rugose microrhabds (ataxasters) in addition to regular euasters; calthrops are irregularly arranged throughout the skeleton; short-shafted mesotriaenes occur in some species ..... ***Pachataxa***
No rugose microrhabds 2
(2) Megascleres include oxeas 3
No oxea megascleres; with calthrops irregularly arranged throughout skeleton; microscleres regular euasters ..... ***Calthropella***
(3) Skeleton radial throughout; calthrops (dichotriaenes) and oxeas radially orientated in the peripheral skeleton and form two distinct subectosomal layers; long-shafted triaenes present; microscleres diverse euasters (strongylasters, acanthotylasters, spherasters, oxyspherasters) ..... ***Chelotropella***
Skeleton irregular except at surface; microscleres regular euasters (spherasters to spheroxyasters); short-shafted (dicho-) triaenes may be present ..... ***Pachastrissa***

CALTHROPELLA SOLLAS, 1888

Synonymy

Calthropella Sollas, 1888: 107. [*Corticella*] Sollas, 1888: 281 (preocc. by *Corticella* Ehrenberg, 1872, Protoctista). *Corticellopsis* Bergquist, 1968: 62.

Type species

Calthropella simplex Sollas, 1888: cxxxiii, 107 (by original designation).

Definition

Calthropellidae with megascleres only calthrops irregularly arranged throughout the skeleton; without long-shafted triaenes or oxeas; and microscleres are only regular euasters.

Diagnosis

Massive to thickly encrusting or globular sponges of hard consistency, with irregular conulose, tuberculate and microhispid surface. Ectosomal region with a dense organic cortex and a layer of predominantly smaller euasters. Choanosomal skeleton with a confused mass of irregularly dispersed calthrops or short-shafted triaenes, typically simple, with sharply pointed single rays, or bifurcate (dichocalthrops, dichotriaenes) in some species, and larger euasters intermingled.

Remarks

The characters on which *Calthropella* is distinguished from the other genera of the family are particularly negative. On the one hand, if we assume that Pachastrellidae and Ancorinidae are closely related families, the absence of oxeas and long-shafted triaenes may be interpreted as losses, and thus as synapomorphies. Alternatively, long-shafted triaenes are not only a synapomorphy of Ancorinidae and Pachastrellidae, but are also shared with Geodiidae, Theneidae and Spirophorida, together forming the nominal order Tetractinellida (i.e., Astrophorida + Spirophorida) (e.g., Chombard *et al*., 1998). In some genera in each of these families long-shafted triaenes are independently lost, including most Calthropellidae except some species of *Chelotropella*, with the consequence that this feature may not be diagnostic above the species or genus level.

[*Corticella*] Sollas, 1888: 281 was erected for type species *Corticium stelligerum* Schmidt, 1868: 25, pl. III fig. 6. This is a white encrusting Mediterranean sponge, represented by type specimens in LMJG 15351, 15352 and 15507 (Desqueyroux-Faúndez & Stone, 1992), of which the characters overlap entirely with those of *Calthropella*. Sollas (1888: 281) defines the genus as having 'polyactinose as well as tetractinose asters', but the sizes quoted for the 'tetractinose' aster (rays of 330 μm) make it clear that these are nothing but calthrops. The true 'polyactinose' asters have 6–12 rays and measure 20 μm in diameter. Topsent (1904b) employed *Corticella* (*sensu* Sollas) for what he considered a combined species *Calthropella geodioides* (Carter, 1876) and *Calthropella simplex*. However, *C. geodioides* in Carter's sense has oxeas, and is here considered the type of a genus *Pachastrissa* (see below).

[*Corticella*] is a synonym of *Calthropella*, and because the latter has page priority, it is considered the senior name. Moreover, Bergquist (1968: 62) discovered that [*Corticella*] Sollas, 1888 is preoccupied by the protoctist genus *Corticella* Ehrenberg, 1872. For that reason, she erected *Corticellopsis* (type species not fixed, here designated as *Corticium stelligerum* Schmidt, 1868). The difference she brought up to differentiate *Corticellopsis* from *Calthropella*, viz., the occurrence in the latter of triactines and bent diactines, are generally considered of minor significance, and does not justify maintaining two genera. Accordingly, *Corticellopsis*, like *Corticella sensu* Sollas, is considered a junior synonym of *Calthropella*.

Sollas (1888) suggested *Calthropella* was similar to Pachastrellidae (at that time included in suborder Astrophorida, *demus* Streptastrosa), and intermediate between 'typical' pachastrellids, like *Pachastrella*, and Theneidae (both the latter now included in a single family Pachastrellidae; see Maldonado, this

volume). In the same monograph Sollas (1888) included [*Corticella*] Sollas based on its possession of polyactinal as well as tetractinal aster morphologies and in this regard differing from its alleged sibling taxa *Corticium* and *Plakortis*. All three were allocated to a family Corticidae Vosmaer. Sollas (1888) gave no indication that he considered either *Calthropella* or [*Corticella*] Sollas were remotely closely related. Lendenfeld (1903) subsequently synonymised the two taxa, referring *C. stelligera* to *Calthropella*, noting that the possession of modified (polyactinal) asters in the former was not significantly different from the uniform (regular) euasters in *Calthropella*. Pulitzer-Finali (1970) followed this action. Conversely, de Laubenfels (1936a) rejected this interpretation and stated that *Calthropella* had calthrops, triads and bent diacts whereas [*Corticella*] Sollas had only calthrops and spiny euasters. Bergquist (1968) followed de Laubenfels' (1936a) system, adopting the name Halinidae de Laubenfels (1934), over Pachastrellidae (which they erroneously attributed to Hentschel, 1923), arguing for recognition of seniority of their respective type genera, with *Halina* Bowerbank having priority over *Pachastrella* Schmidt. This action is now recognised as both contrary to the Rule of Priority (ICZN, Anon., 1999), and erroneous (i.e., Pachastrellidae was erected by Carter, 1875c and has clear seniority over Halinidae). Bergquist (1968) assigned the family to the order Homosclerophorida and also including in it the genus *Pachastrella*.

Description of type species

Calthropella simplex Sollas, 1888 (Figs 1A–C).

Synonymy. *Calthropella simplex* Sollas, 1888: 107–108, pl. 10, figs 13–14, 21–29.

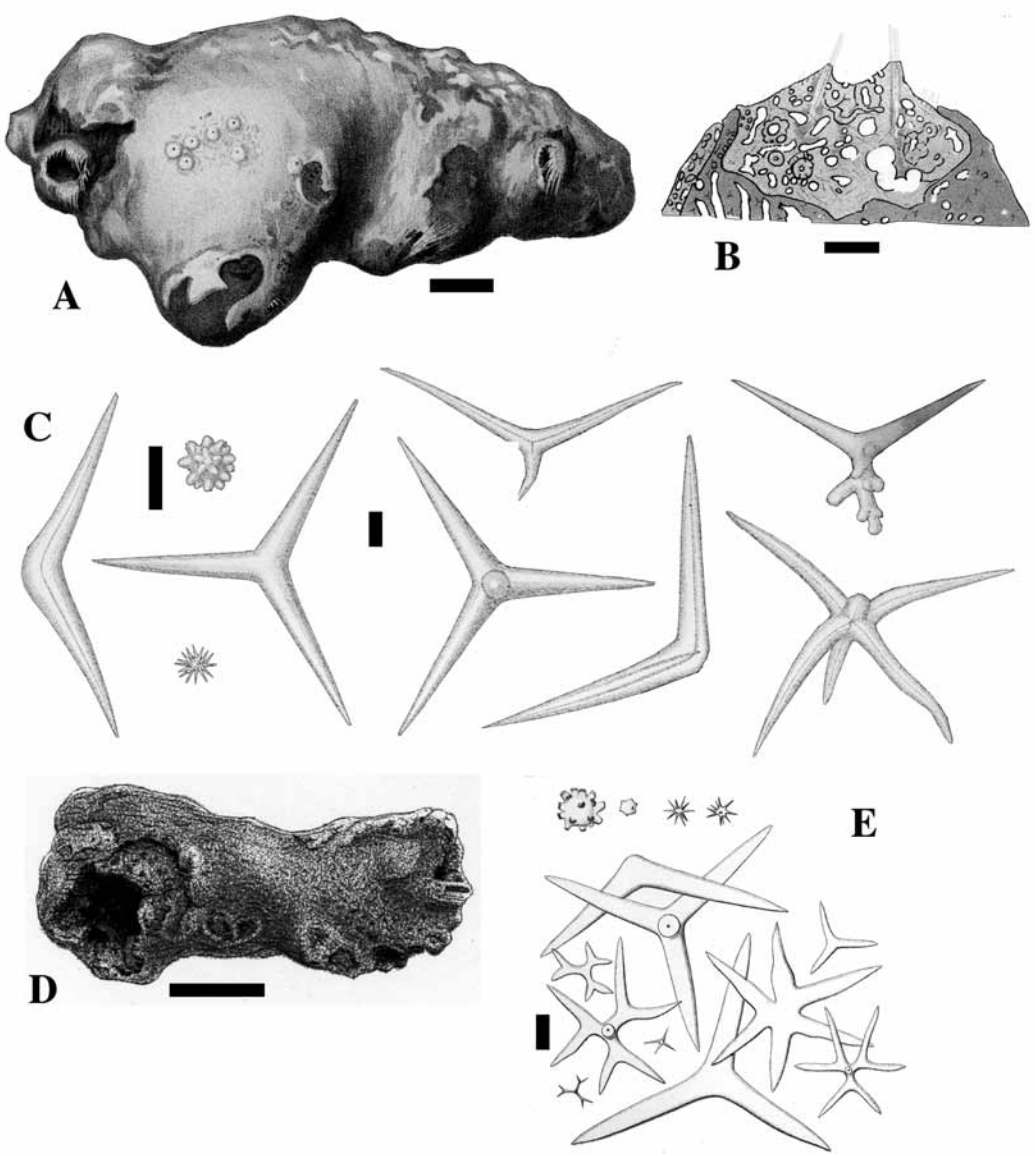

Fig. 1. *Calthropella* Sollas, 1888. A–C, *Calthropella simplex* Sollas, 1888. A–B, habit and cross section (from Sollas, 1888: pl. 10, figs 13–14). C, calthrops and spherasters (from ditto pl. 10, figs 21–29) (scales: A–B, 1 cm; C, 100 μm (megascleres), 25 μm (microscleres)). D–E, '*Corticella' geodioides sensu* Topsent, 1892a, 1904b (= ? *Calthropella* spec.). D, habit (scale 1 cm) (from Sollas, 1888 pl. 4, fig. 14). E, calthrops and spherasters (scales: 100 μm (megascleres), 10 μm (microscleres)) (from Sollas, 1888: pl.10 fig. 12).

Material examined. None. Holotype: BMNH (not seen) – Praia, São Tiago, Cape Verde Islands. The type species was recorded subsequently from the Azores, at depths of 400–800 m, 'Challenger' Expedition.

Description (from Sollas, 1888). Massive, irregular ridges with flattened base and rounded sides, overgrowing a species of *Vulcanella* (as *Sphinctrella*) (Figs 1A–B), together they are 9×3.5×3.8 cm. Surface smooth, raised in places to form small rounded tubercles, each with a crater-like depression at the summit, 0.15–0.5 mm diameter and a centrally perforated floor (a sieve). Both oscules and inhalant pores are similar in having a sieve covering them. This central sieve on the tubercles leads into comparatively large subdermal cavities. Cortex collagenous, about 0.2 mm thick, containing numerous granular, elongated fusiform cells, with a subectosomal layer of spheraster euasters immediately below, mostly small with occasional larger ones dispersed in between. Choanosomal skeleton highly collagenous mesohyl with granular cells scattered throughout, a well-developed canal system traversed by numerous prosopyles surrounded by concentrically arranged myocytes and fusiform collencytes radiating inwards from the margin; choanocyte chambers about 20 × 16 μm. Spicule skeleton is a confused mass of calthrops (Fig. 1C) divisible into two size categories, both with 1–4, mostly 3 conical actines, smooth, simple, oxeote, tornote or strongylote, the larger with rays 800×90 μm and the smaller with rays 150 × 20 μm long. Microscleres (Fig. 1C) are spherasters, more-or-less in 2 sizes, the larger with a relatively large centrum, numerous actines reduced to rounded tubercles, 24 μm in diameter, and the smaller with fewer tubercles, 12 μm in diameter, with actines more slender, conical and oxeote, and most commonly found in the subectosomal region.

Remarks. Sollas (1888) originally included two species in the genus, *C. simplex* and *C. (Pachastrella) geodioides* (Carter) (the latter with dichocladose actines on calthrops). Following the revisions of various calthropellid genera by Lendenfeld (1903, 1907) and others, five species are currently included in this genus, three from the Atlantic-Mediterranean region (*C. recondita* Pulitzer-Finali, 1970 *C. simplex* Sollas, 1888, and *C. stelligera* (Schmidt, 1868)), and two from the Indo-Pacific (*C. novaezealandiae* (Bergquist, 1961c), *C. digitata* Pulitzer-Finali, 1993). A possible further species is the sponge described by Topsent (1904b) as *Corticella geodioides*, (see Figs 1D–E), which does not appear to belong to *Pachastrissa geodioides* (cf. below) as Topsent did not describe the presence of oxeas. Other species included in *Calthropella* at one time or another, *C. inopinata* Pulitzer-Finali, 1993, *Stelletta pathologica* Schmidt, 1868, and *Pachastrella geodioides* Carter, 1876 were subsequently referred to *Pachastrissa*. Sollas (1888: 111) also referred *Pachastrella exostitus* Schmidt, 1868 to *Calthropella* (with question mark), based on its supposed similarities in spherasters with those of *C. geodioides* and *C. simplex*, but he also noted that the former had tuberculated microrhabds, and in this respect he indicated that it might have closer affinities to *Dercitus* (Pachastrellidae). Pulitzer-Finali (1983) suggested further that *C. pathologica, C. geodioides* and *C. simplex* may constitute a single, variable species given similarities in their spiculation and apparently only minor differences in other morphometric characters, but no decision is possible to confirm or refute this hypothesis, which requires a far more detailed study of the respective type material than is possible here.

Distribution

Mediterranean, NE Atlantic, SW Pacific.

CHELOTROPELLA LENDENFELD, 1907

Synonymy

Chelotropella Lendenfeld, 1907: 302.

Type species

Chelotropella sphaerica Lendenfeld, 1907 (by original designation).

Definition

Calthropellidae with calthrops, oxeas and peripheral dichotriaenes forming a radial skeleton throughout, and in the peripheral region forming two subdermal layers, and with the addition of long-shafted triaenes; microscleres diverse forms of euasters (strongylasters, acanthotylasters, spherasters, oxyspherasters).

Diagnosis

Irregular spherical globular growth form with granular surface. Subectosomal skeleton characterized by large subdermal cavities with long-rayed dichotriaenes radially oriented in the upper part of the sponge, their cladomes forming two layers parallel to the surface. Skeleton composed of radial bundles of oxeas and dichotriaenes extending from the proximal part of the choanosomal skeleton to the periphery, with a more disorganized skeleton of calthrops in deeper parts of the skeleton. Megascleres consist of oxeas, dichotriaenes, calthrops of two sizes. Microscleres consist of diverse euaster morphologies including strongylasters, acanthotylasters, spherasters and oxyasters.

Remarks

This genus was erected by Lendenfeld (1907) for a single species which he considered was intermediate between other calthropellids and members of the Stellettidae. It differs from other nominal calthropellids in possessing two distinct layers of dichotriaene cladomes, parallel to the surface, one in the peripheral part of the subectosome and the other at the junction of the cavernous subectosome and choanosome, and possibly also by its diverse euaster morphologies not seen in other species. The genus remains monotypic.

Description of type species

Chelotropella sphaerica Lendenfeld (Figs 2A–C).

Synonymy. *Chelotropella sphaerica* Lendenfeld, 1907: 302–304, pl. 34, figs 1–7; Pulitzer-Finali, 1993: 254; Lévi, 1969: 954; Lévi & Lévi, 1983b: 150.

Material examined. None. Holotype (not seen): ZMB – Agulhas Banks, South Africa coast, 'Valdivia' Expedition.

Description (from Lendenfeld, 1907). Growth form is irregular, globular spherical with a granular surface. Small oscules 1–2 mm diameter arranged in groups. Ectosomal cortex about 700 μm thick covered by a thin dermal membrane and overlying a cavernous subectosome free of choanocyte chambers. Choanosomal region with spherical choanocyte chambers, 15–20 μm diameter. Choanosomal skeleton (Fig. 2C) composed of radial bundles of longitudinal long-rayed dichotriaenes with calthrops ('chelotrope') and euasters. Radial bundles of slender oxeas and dichotriaenes

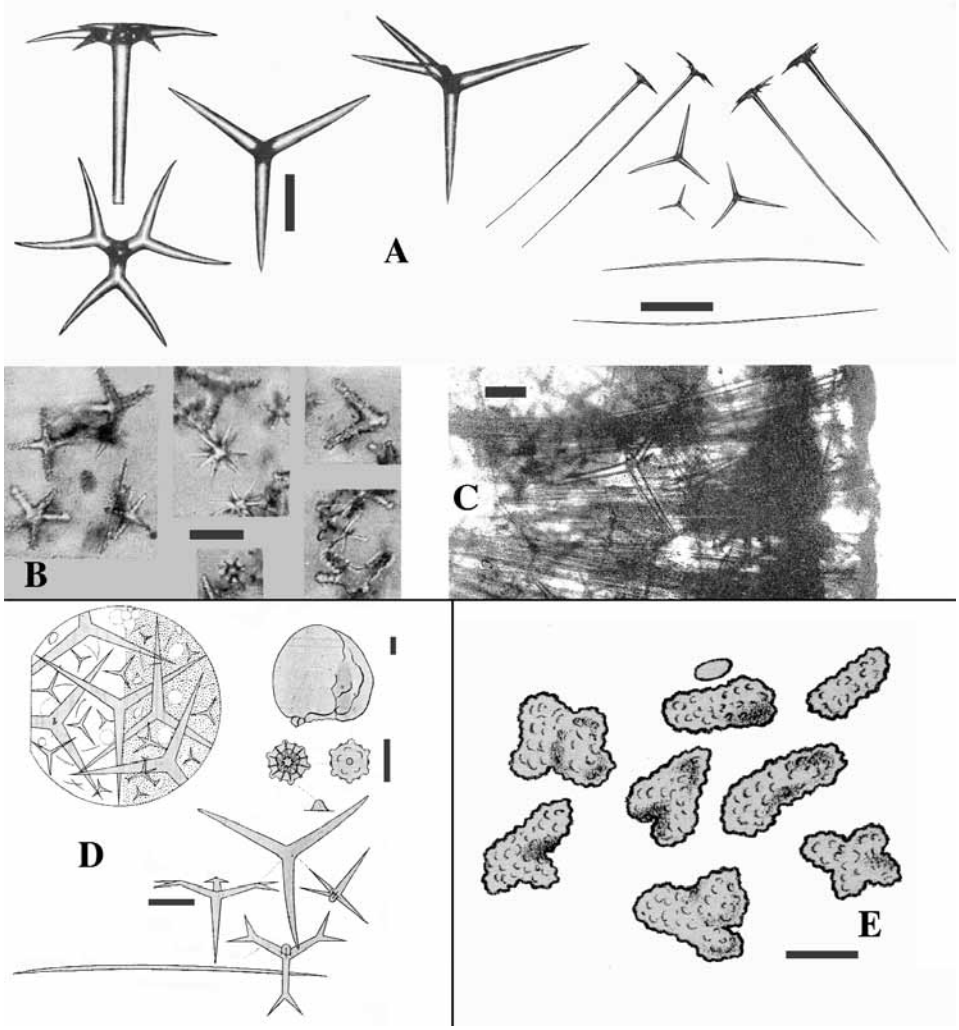

Fig. 2. *Chelotropella, Pachastrissa, Pachataxa*. A–C, *Chelotropella sphaerica* Lendenfeld, 1907. A, dichotriaenes, calthrops, oxeas (scales: left 500 μm, right 1000 μm). B, strongylasters, acnthotylasters, spheraster and oxyaster euasters (scale 25 μm). C, cross section of peripheral skeleton (scale 1000 μm) (from Lendenfeld, 1907, pl. 34 figs 1–7). D, *Pachastrissa geodioides* (Carter, 1876 as *Pachastrella*), habit (scale 1 cm), oxeas, calthrops, short-shafted triaenes and dichotriaenes (scale 500 μm) and microscleres (scale 25 μm) (from Carter, 1876: pl. 14 fig. 23). E, *Pachataxa lithistina* (Schmidt, 1880b as *Pachastrella*), microrhabds (scale 10 μm) (from Schmidt, 1880b: pl. 9 fig. 3).

extend from the proximal portion of the centre of the sponge to the distal portion of the choanosome, just below the cortex. Cladomes of dichotriaenes are arranged in two layers above each other, one at the external surface carrying a crust of euasters and the other marking the boundary between the subectosomal and choanosomal regions. Dichotriaene cladomes are more numerous in the upper layer than in the deeper subectosomal cavernous layer. Calthrops are very abundant and irregularly dispersed throughout the choanosome, including smaller, possibly juvenile forms, forming a confused mass. Microscleres are variable in morphology. In the subectosomal region are numerous, mostly large, thick-rayed strongylasters, whereas in the deeper parts of the choanosome there are oxyasters, acanthotylasters and very small spheraster with acanthose actines (and many transitional forms). Megascleres (Fig. 2A) are oxeas, mostly symmetrical, slightly curved, 3600–5600 × 50–80 μm. Triaenes are exclusively dichotriaenes, conically pointed rays, straight or slightly bent and constricted at the acladome end, rhabdome 2800–4400×100–440 μm, cladome 650–1300 μm in diameter, clades 130–170 μm long and the paired clades 300–550 μm long. There are apparently intermediate forms between calthrops and triaenes. Calthrops are mostly regular in shape but differentiated into two size classes, the large ones are regular but less numerous and have four congruent straight conical pointed rays 700–1050 × 85–120 μm. More numerous smaller calthrops have rays 170–700 × 20–85 μm, and all their rays have a similar conical shape. Euasters (Fig. 2C) include diverse morphologies: large thick-rayed stongylasters with 6–7 tapering rays, smooth towards the centrum and spined elsewhere, and with hook-like spines, 21–27 μm diameter; 2–5 rayed euasters 26–45 μm diameter. Acanthotylasters with 8–12 rays tapering only slightly towards the end, cylindrical conically pointed, with only few spines except for larger spines at the end of actines, 8–16 μm diameter. Spheraster divisible into smaller sphere-like asters with 14–20 conical rays each bearing a crown of spines at its end and appearing acanthose, 5–9 μm diameter, and oxyspheraster with 10–14 rays, conically pointed, with the proximal half and tip smooth and the remainder covered with spines, 20–32 μm diameter.

Remarks. Monotypic. The species has been recorded from East Africa, South Africa and South West Africa. Pulitzer-Finali, 1993: 254 mentions the presence of anatriaenes in his material from Kenya

assigned to this species; possibly this pertains then to a second species separate from *C. sphaerica*. Anatriaenes were also reported in a further record of *Chelotropella* from New Caledonia, viz., *Chelotropella neocaledonica* Lévi & Lévi, 1983b: 148, fig. 27. This species has oxeas, long-shafted dichotriaenes, anatriaenes and calthrops as megascleres and the combination of strongylasters, spherasters and centrotylote microrhabds. It is possible that this species belongs to Ancorinidae, close to *Ecionemia*, rather than to *Chelotropella*. The difference of *Chelotropella* and *Calthropella* is the presence of long-shafted triaenes and oxeas, features which may be interpreted as ancestral. The presence of these spicules have a profound influence on the structure of the skeleton, which becomes radiate because of parallel arrangement of the long shafts. This genus also marks the thin dividing line between Calthropellidae and Ancorinidae. But for the presence of the calthrops, this genus could easily fit in *Stelletta*.

Distribution

Known only from South Africa, SW Africa and Kenya.

PACHASTRISSA LENDENFELD, 1903

Synonymy

Pachastrissa Lendenfeld, 1903: 80. *Jasplakina* de Laubenfels, 1954: 228.

Type species

Pachastrella geodioides Carter, 1876 (by original designation).

Definition

Calthropellidae with oxeas and calthrops irregularly arranged except at surface, lacking long-shafted triaenes, with short-shafted (dicho-)triaenes present in some species; microscleres only regular euasters.

Diagnosis

Massive, globular to thickly encrusting sponges with rough surface. Few small oscules. Ectosomal skeleton with a layer of confused euasters covering the clades of larger calthrops lying parallel to the surface. Choanosomal skeleton largely confused, with oxeas, calthrops and/or short-shafted triaenes and dichotriaenes, and sometimes mesotriaenes dispersed without apparent order. Microscleres are euasters ranging from spherasters to spheroxyasters.

Remarks

Short-shafted mesotriaenes are known for several species, e.g., *P. pathologica* (Schmidt, 1868) and *P. inopinata* (Pulitzer-Finali, 1983), but are considered convergent and non-homologous with those of Pachastrellidae, such as *Triptolemus* (Maldonado, 1993). Mesotriaenes are reportedly not present in the type species of *Pachastrissa*.

Description of type species

Pachastrissa geodioides (Carter) (Fig. 2D).

Synonymy. *Pachastrella geodioides* Carter, 1876: 407, pl. 14, fig. 23. *Calthropella geodioides*; Sollas, 1888: 111. *Calthropella geodioides* var. Topsent, 1897a: 434. *Pachastrissa geodioides*; Lendenfeld, 1903: 81. ? *Corticella geodioides*; Topsent, 1892a: 42; 1904b: 77, pl. 4, fig. 14, pl. 10, fig. 12. ? *Calthropella geodioides*; Desqueyroux-Faundez, 1981: 730–732, figs 13,15, 106.

Material examined. None. Holotype (not seen): BMNH – Cape St Vincent, off the Portugese south coast, North Atlantic, 525 m depth.

Description (from Carter, 1876). Growth form globular (Fig. 2D) to thickly encrusting. Surface even or slightly undulating, correlated with size of specimen, slightly hispid, with oscules scattered over surface. Ectosomal region without cortex but with foreign detritus and euasters interdispersed and forming a confused mass, although not markedly offset from choanosomal skeleton. Choanosomal skeleton with heavy mesohyl containing foreign detritus and two size classes of calthrops and oxeas dispersed without apparent order. Larger calthrops (Fig. 2D) have clads lying parallel to the surface, intermingled with and largely covered by spherasters. Calthrops morphology is variable, with the most numerous forms with simple actines commonly four in number, sometimes three and occasionally reduced to two. Less common are dichocalthrops, with three rays bifurcated and extended in a plane tangential to the surface and with the fourth ray perpendicular to the others, consisting only of a short extension of the central shaft, and producing a dichotriaene-like spicule with short rhabdome. Smaller calthrops ('subquadriradiates' of Carter) have the fourth ray more-or-less atrophied which is extended into a short round prominence more or less prolonged, arms of equal length, smooth, round, sharply pointed, and slightly curved. Dichotriaenes (Fig. 2D) are equally numerous and have the rhabdome much shorter than the rays (rays 700×85 μm). Oxeas (Fig. 2D) fusiform, smooth, sharply pointed and slightly curved, 736×9.3 μm. Microscleres (Fig. 2D) vary from spherasters to spheroxyasters. The former are most abundant at the surface, consisting of a thick centrum and numerous cylindrical, short round tubercles (rays), smooth or crowned with very fine spines, 7–25 μm diameter. The latter are more sparsely dispersed, with a poorly developed centrum and numerous rays, possibly representing younger forms of the former, with blunt or sharply pointed rays, 12–15 μm diameter.

Remarks. Topsent's (1892a, 1904b) records of this species (as *Corticella*) are uncertain because he fails to mention the presence of oxeas in these specimens (see Figs 1D–E). He also expressed his opinion that *geodioides* and *Calthropella simplex* comprise a single species. It is possible that his material concerns a species of *Calthropella*. A second species assigned to *Pachastrissa* by Lendenfeld is *Stelletta pathologica* Schmidt, 1868. 19, pl. III figs 3–4 (see redescription in Sollas, 1888: 202). This is not a straightforward *Pachastrissa* because true calthrops are apparently lacking, instead of which there are mesotriaenes. Still, it is conceivable that the mesotriaenes represent modified calthrops. Lendenfeld also assigned *Pachastrella connectens* Schmidt, 1870: 65, pl. VI fig. 5 to *Pachastrissa*, but the affinities of that sponge remain uncertain. Sollas (1888: 111) apparently had a slide of Schmidt's material and from this it may be concluded that it could perhaps be a *Penares*. The apparent possession of both microxeas and centrotylote strongyles make membership of Calthropellidae less likely. In any case, Sollas (1888: 112) synonymised *P. connectens* with *Characella agassizi*, but this action was apparently not accepted by Lendenfeld (1903). Uliczka (1929: 50, figs 41–45) described *Pachastrissa hartmeyeri* from deep water off Barbados.

Subsequently, Pulitzer-Finali (1986: 73) reported this species from shallow water off the Dominican Republic. It has much smaller oxeas and calthrops than *P. geodioides. Pachastrella connectens* was previously synonymised with *Characella agassizi* by Sollas (1888: 112), but this action was apparently not accepted by Lendenfeld (1903). Pulitzer-Finali (1983) described a fourth species, *P. inopinata*, as *Calthropella*, from the Mediterranean which was subsequently referred to *Pachastrissa* by Maldonado (1993). Finally, Topsent's (1897a) record of a variety of the type species from Ambon, Indonesia, is also questionable as to its conspecificity with the North Atlantic population, and it too possibly represents a distinct species. Redescription of this material by Desqueyroux-Faundez (1981) suggests that there are several slight morphometric differences between Indonesian and North Atlantic populations. In fact Topsent himself (1904b: 79) commented on several differences between these populations, although this alleged 'cosmopolitanism' still remains unresolved.

The genus *Jasplakina* de Laubenfels, 1954: 228 was erected for type species *Jasplakina nux* de Laubenfels, 1954: 228, fig. 157 (by original designation). The holotype USNM 23120 (not examined) is described as a jet black rounded mass of $6 \times 8 \times 5$ cm (internally much lighter coloured), with undulate surface showing a few oscules of 6mm diameter. The ectosome is packed with microxeas of 25–100 $\times$ 0.5–2 μm and euasters with reduced number of rays (four or more) up to 36 μm in diameter. Megascleres arranged vaguely radiate, comprised of oxeas of up to 830×12 μm and relatively rare reduced triactine calthrops, rays up to 250×10 μm. The microxeas are unique in the family, and indicate a possible relationship with *Penares* in the Ancorinidae. The combined characters conform closely to *Pachastrissa* and accordingly *Jasplakina* is here considered a junior synonym of this genus.

Distribution

Three species are currently described from the Atlantic, a possible valid fourth species from Indonesia, and a tentatively fifth member occurs in the Central Pacific.

PACHATAXA DE LAUBENFELS, 1936

Synonymy

Pachataxa de Laubenfels, 1936a: 179.

Type species

Pachastrella lithistina Schmidt, 1880b (by original designation)

Definition

Calthropellidae with calthrops irregularly arranged throughout the skeleton; short-shafted mesotriaenes occur in some species although true triaenes absent; microscleres are regular euasters (spherasters) and characteristic rugose microrhabs (ataxasters).

Diagnosis

Massively encrusting, hard sponges. Ectosomal crust of euaster microscleres. Choanosomal skeleton a dense mass of calthrops. Microscleres irregularly shaped rugose microrhabds (called ataxasters) and spherasters. Long-shafted triaenes and oxeas are absent, although mesotriaenes occur in some species.

Remarks. Short-shafted mesotriaenes are not considered to be typical of this genus, found in some species (e.g., *P. enigmatica* Lévi & Lévi, 1983b) but not in others (including the type species, *P. lithistina* (Schmidt, 1880b) and *P. lutea* Pulitzer-Finali, 1987). Calthrops and derivatives display interspecific variation in *Pachataxa*, absent from *P. enigmatica* and present in *P. lithistina* and *P. lutea*.

Description of type species

Pachataxa lithistina (Schmidt, 1880b) (Fig. 2E).

Synonymy. *Pachastrella lithistina* Schmidt, 1880b: 68, pl. 9, fig. 3; Topsent, 1923: 6, fig. 1. Pachastrellidae *incertae sedis*, Sollas, 1888: 112 *Dercitus lithistina*; Lendenfeld, 1903: 82. *Pachataxa lithistina*; de Laubenfels, 1936a: 179.

Material examined. None. Lectotype (here designated): MZUS – dry specimen without locality data other than "Mexic.busen" (redescribed by Topsent, 1923: 6) Caribbean. The MZUS specimen conforms closely to Schmidt's description and is here indicated as the lectotype (following information from Desqueyroux-Faúndez & Stone, 1992: 52). Schmidt's original description gives no locality data. Paralectotypes: MCZ – an assumed 'holotype' from Grenada. ZMB 6870 – 2 slides without locality data.

Description (from Schmidt, 1880b, and Topsent, 1923). Thickly encrusting to cushion-shaped 10–20 mm thick. Upper surface with numerous low conules each with a terminal osculum 0.5 mm diameter. Under surface is even but with similar oscules and pores dispersed. Subectosomal skeleton with large cavities forming a labyrinthine network under the thin ectosomal cortex and permeating the whole sponge. Skeleton a dense mass of calthrops underneath a surface layer of euasters; the latter are also frequent in the interior. Spicules. Calthrops in a large size range (no sizes given). Microscleres spherasters to oxyspherasters with numerous rays, 10–16 μm diameter, and irregularly shaped rugose microrhabds (Fig. 2E), often somewhat ellipsoid, but some appear to have short rounded lobes and these are possibly derived from asters.

Remarks. De Laubenfels (1936a) erected this genus on the basis that its megasclere spiculation apparently consisted almost exclusively of calthrops and that microscleres were ataxasters, whereas Topsent (1923) regarded these features as merely modifications to characters typical of *Pachastrella monilifera*. Lendenfeld (1903: 82) transferred the type species to *Dercitus*, but de Laubenfels suggested that it was so "radically different from other forms" as to warrant a new genus. Two other species have been described, one *Pachataxa lutea* Pulitzer-Finali, 1987, also from the Caribbean (Jamaica). It differs a.o. in having some of the calthrops with two rays reduced resulting in diactines. Lévi & Lévi (1983b) recorded *Pachataxa enigmatica* from deep water off New Caledonia. This is closely similar in spiculation to *P. lithistina*, but the asters are only 4–5 μm in diameter. The microrhabds of *Pachataxa* are peculiar and constitute an easy character for the genus. In other aspects, *Pachataxa* is closely similar to *Calthropella*.

Distribution

Caribbean and New Caledonia.