

**Structure and reproduction of *Spongites wildpretii* sp. nov.
(Corallinaceae, Rhodophyta) from the Canary Islands,
with observations and comments on *Spongites absimile* comb. nov.**

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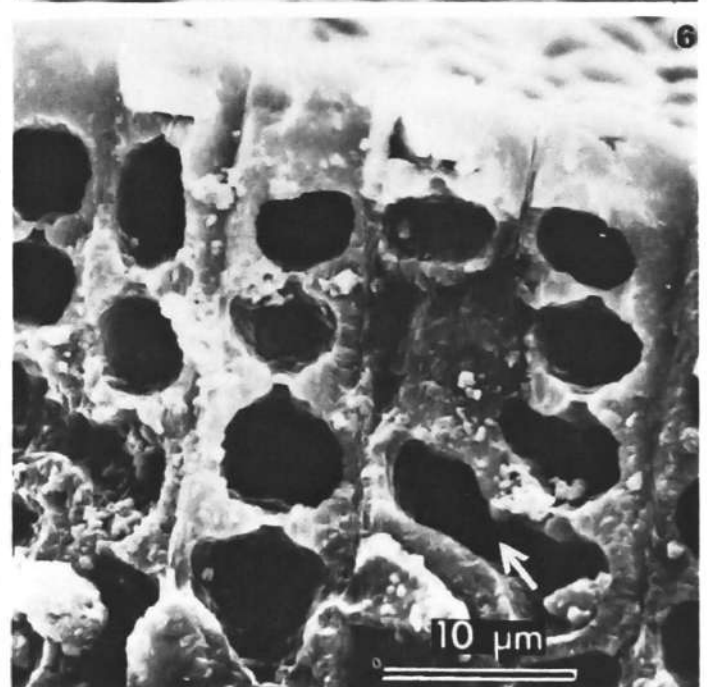
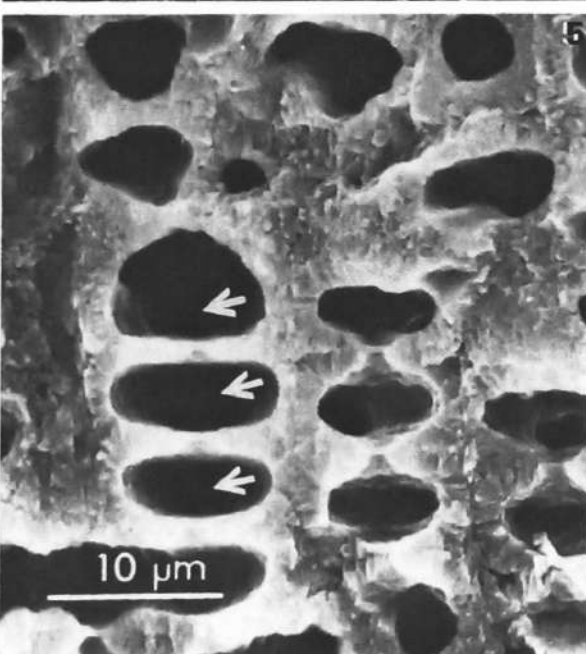
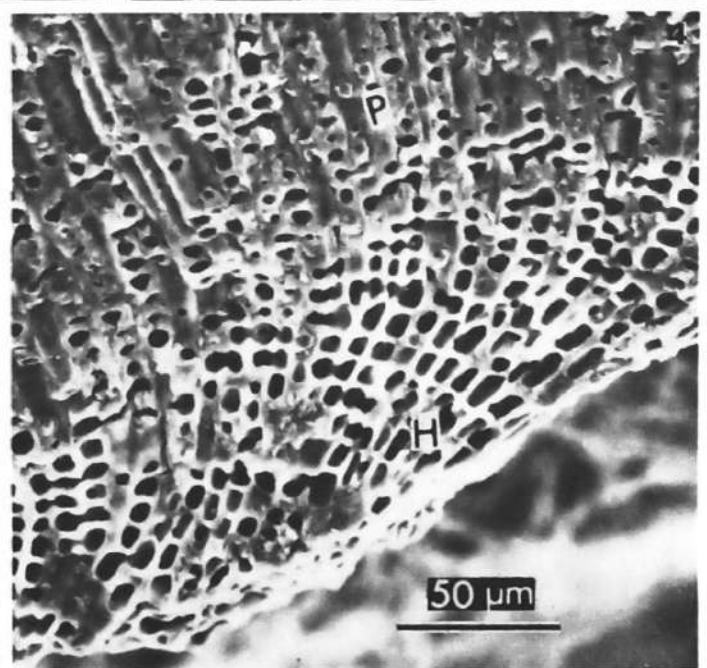
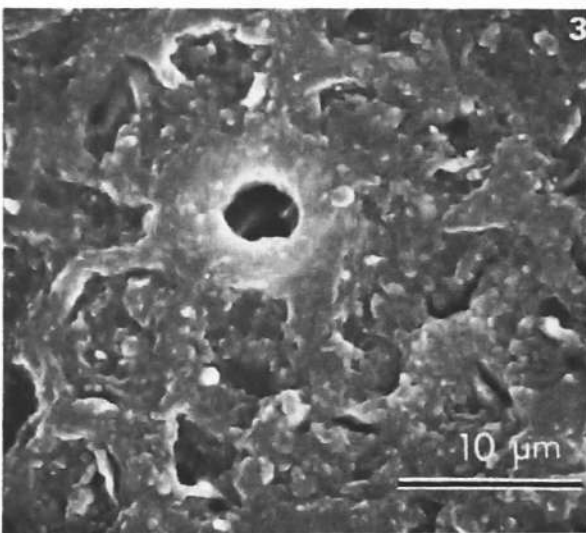
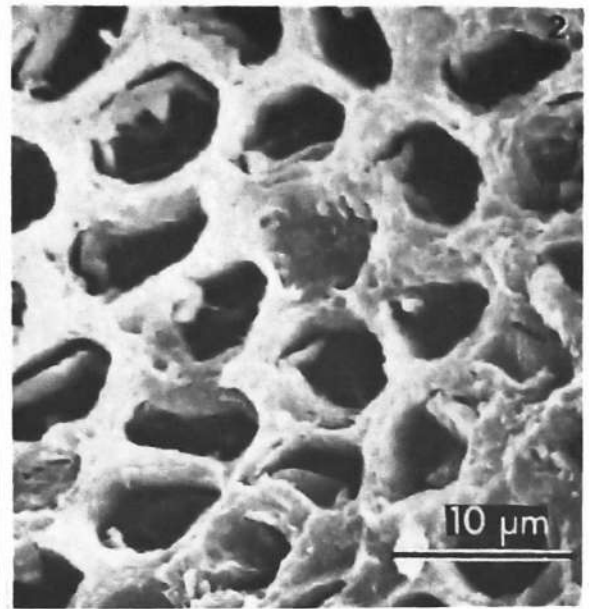
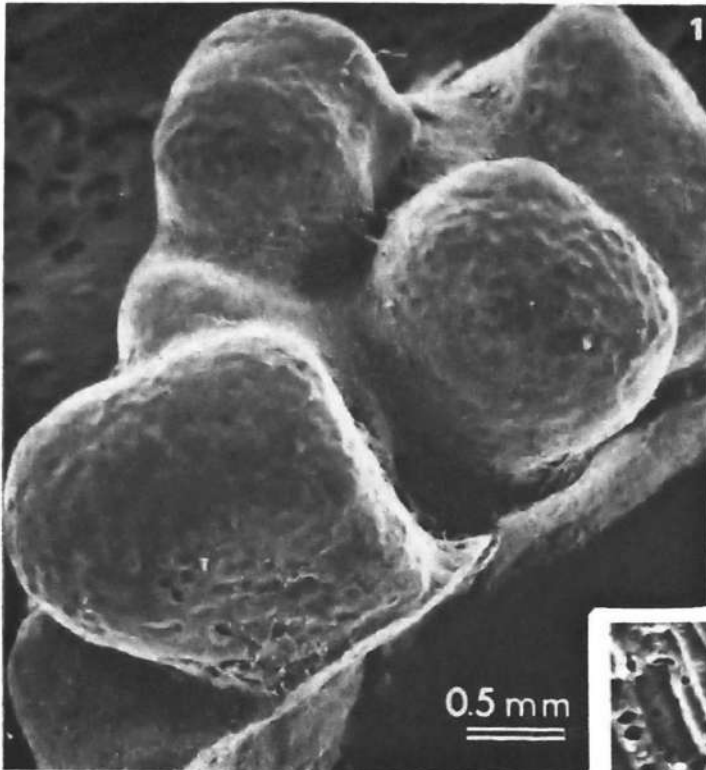
On the basis of a critical study of the holotype specimen, *Lithophyllum absimile* Foslie & Howe is transferred to the genus *Spongites* Kützing, and plants previously reported from the Canary Islands as *Lithophyllum absimile* or *Neogoniolithon absimile* (Foslie & Howe) Cabioch are described as a new species: *Spongites wildpretii* Afonso-Carrillo. The new species is described anatomically and compared with the holotype specimen of *Lithophyllum absimile* and plants from Japan assigned to *L. absimile*. *Spongites wildpretii* is distinguished from the holotype of *L. absimile* by the lack of excrescences, by the less-developed perithallium and by the small size of cells. It is distinguished from the Japanese plants mainly by reproductive attributes (conceptacle dimensions, conceptacle roof structure and occurrence of columella). A detailed reproductive account of *S. wildpretii* is provided with special reference to carposporophyte ontogeny. The diagnostic value of the post-fertilization characters as accessory attributes for segregating *Spongites* from related genera is discussed. Collapse of the conceptacle roof and the regeneration of perithallial tissue of the tetrasporangial and carposporangial conceptacle chambers also are described.

The coralline algae (Corallinaceae, Rhodophyta) of the Canary Islands were first studied by Foslie (1906) and later by Lemoine (1929); more recently, Afonso-Carrillo, Gil-Rodríguez & Wildpret (1985a) recorded 45 species belonging to 18 genera. Many Canary Island species are in need of taxonomic reinvestigation, however, and Afonso-Carrillo (1984) reassessed seven species in the light of recent taxonomic criteria; a further species, *Spongites wildpretii* Afonso-Carrillo, previously reported as *Lithophyllum absimile* Foslie & Howe (Lemoine, 1929) and *Neogoniolithon absimile* (Foslie & Howe) Cabioch (Afonso-Carrillo, 1985; Afonso-Carrillo, *et al.*, 1985a), is now examined.

Lithophyllum absimile was described by Foslie & Howe (in Foslie, 1907) from a small crust (Printz, 1929, pl. LIV, fig. 4) collected by Howe in Jamaica. This taxon was later recorded from the Danish West

Indies (Lemoine, 1917) and the Canary Islands (Lemoine, 1929). By the absence of perithallial cells aligned in tiers, at that time considered typical of *Lithophyllum*, Lemoine considered the generic status uncertain (as *Lithophyllum absimile*). Nevertheless, this placement was not questioned by Hamel & Lemoine (1953) in their record from the Bay of Biscay (SW of France) and it is included in section III of *Lithophyllum*, which is reserved for thalli with a non-coaxial multistratose hypothallium (cells not aligned in conspicuous layers) and perithallium with cells aligned in tiers or not.

With the exception of the size of the asexual conceptacle, only the vegetative characters of this species have been studied. Presumed sporangial chambers, 120–160 µm in diameter, were examined by Foslie (1907), while sporangial conceptacles, 100–160 µm in diameter, were described by Lemoine (1929) and Hamel & Lemoine (1953).



Masaki (1968) recognized this taxon in Japan and made many observations on the vegetative and reproductive features, giving a complete description of the conceptacles for the first time.

The present investigation was prompted by the collection from the Canary Islands of new material with reproductive features different to those reported by Masaki (1968). A reinvestigation of the type material of *L. absimile* was undertaken with the purpose of adequately evaluating the characters of this taxon in order to elucidate the status of the plants from the Canary Islands and Japan.

MATERIALS AND METHODS

Data were obtained from: (1) plants collected in the Canary Islands and deposited at TFC (Departamento de Botánica, Universidad de La Laguna, Canary Islands) with the numbers 2535, 2541, 2551, 2566 and 2572; (2) the holotype specimen of *Lithophyllum absimile* housed at TRH (Trondheim, Norway); (3) the plants determined by Lemoine (1929) housed at C (The Botanical Museum and Herbarium of Copenhagen, Denmark) with the number 3058 of *Plantae canarienses* of Dr F. Børgesen; and (4) one plant and two microscopic slides with the histological sections of plants from Japan, loaned by Prof. T. Masaki (Hokkaido University, Japan).

Anatomical studies of fresh specimens were carried out on selected fragments fixed in 4% formalin in sea-water, decalcified in Perenyi's solution and embedded in paraffin. Sections, 8 µm thick, were cut and stained in Ehrlich's haematoxylin-eosine (Bressan, 1974). Dried specimens from the herbarium were rehydrated over a long period in 4% formalin in sea-water before decalcification.

Scanning electron microscopy procedures are outlined in Afonso-Carrillo, Gil-Rodríguez, Haroun-Tabraue & Wildpret (1985b). Selected dried fragments were sectioned with a scalpel and rinsed under distilled water. After air drying, fragments were coated with gold and viewed in a Hitachi S-450 Stereoscan Microscope.

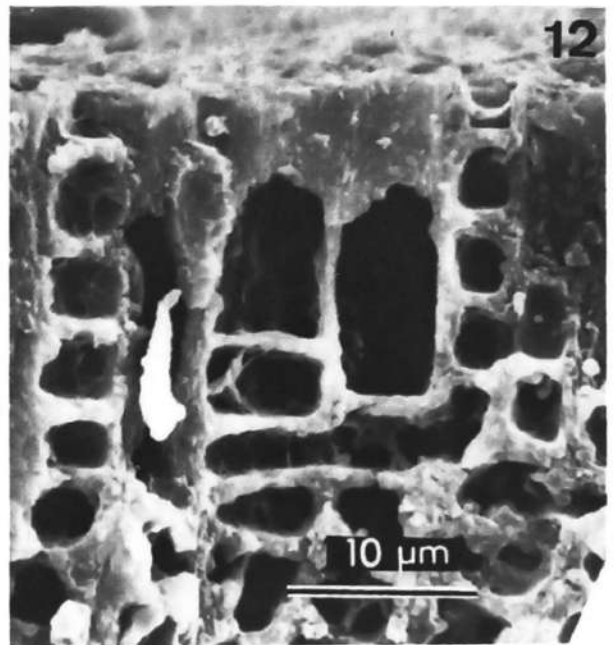
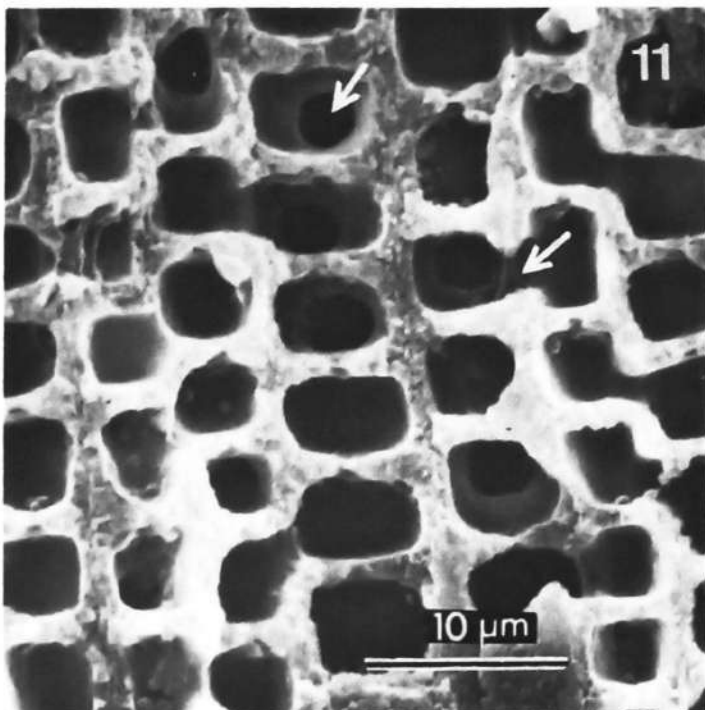
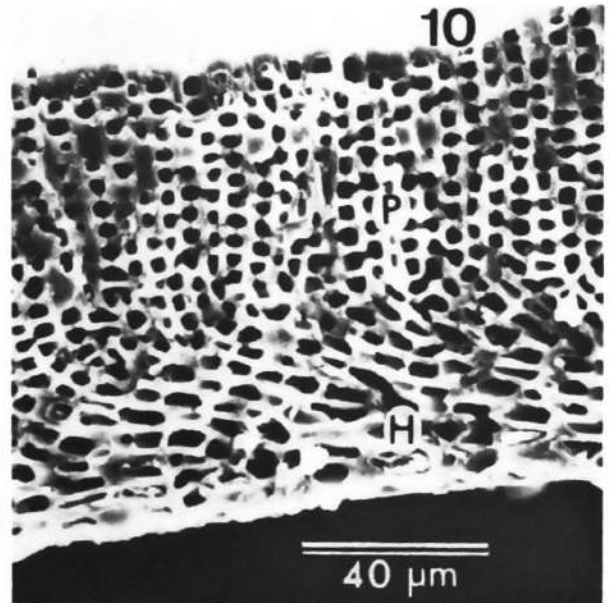
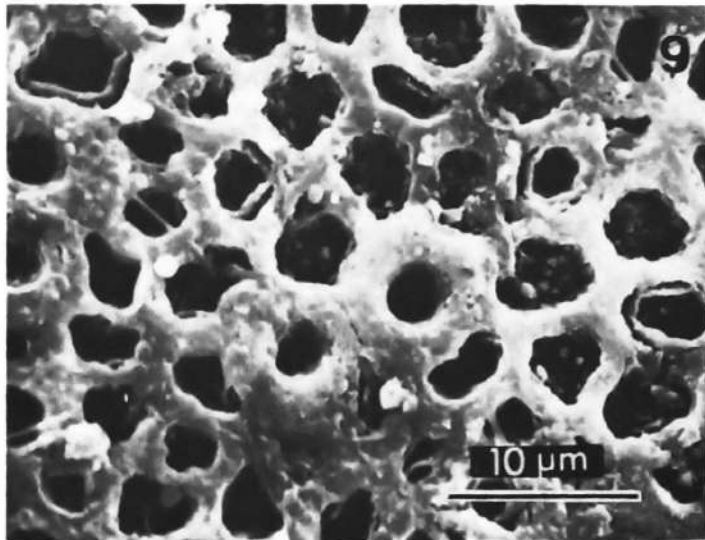
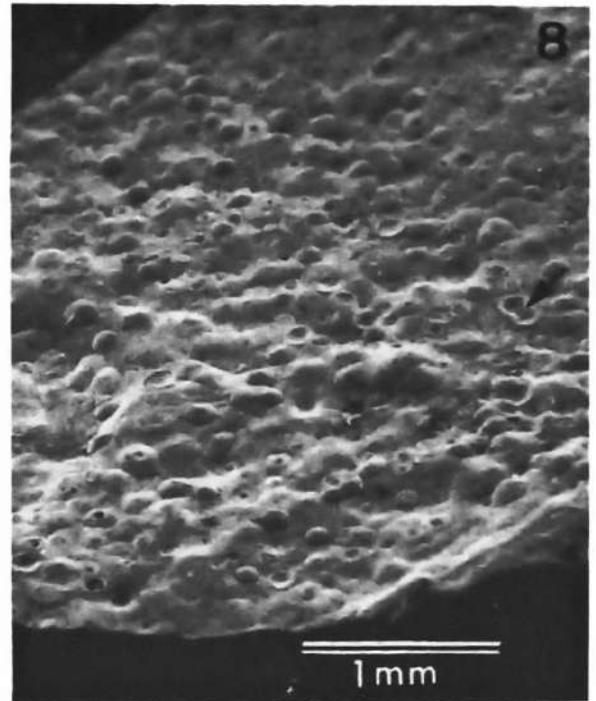
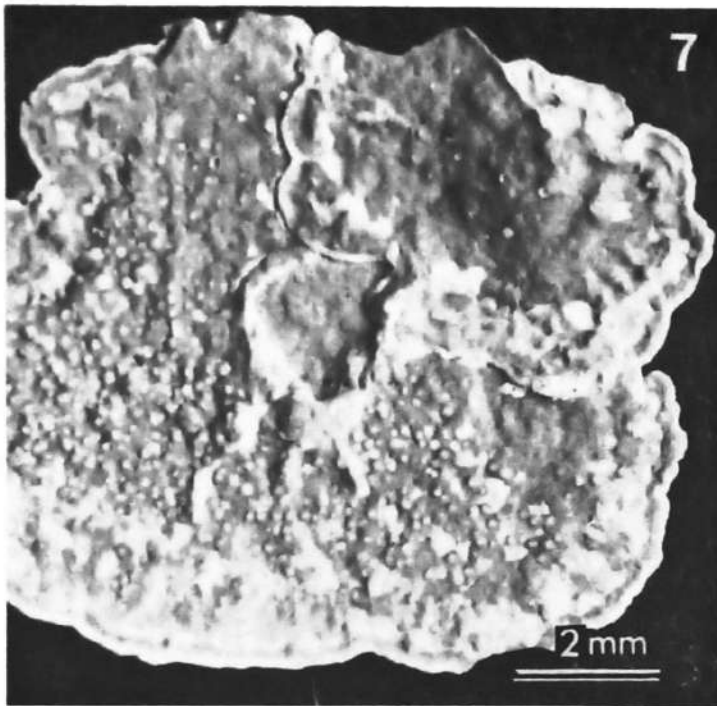
RESULTS

Holotype collection of *Lithophyllum absimile*

The original collection of *L. absimile* consists of a single irregularly shaped calcareous mass up to 40 mm long (Printz, 1929, pl. LIV, fig. 4), consisting of a crustose portion up to 1 mm thick and numerous excrescences 1–3 mm in diameter which protrude from the basal crust and give the thallus a verrucose appearance (Fig. 1). The plants cover a heterogeneous conglomerate of corals and crustose corallines. Mature conceptacles are not apparent, although cavities of senescent conceptacles occur. The thallus surface shows a series of orbicular or irregular epithallial concavities separated by calcified regions (Fig. 2); trichocyte pores are frequent (Fig. 3).

Anatomically, the holotype material of *L. absimile* consists of numerous contiguous filaments in which three regions of filaments are recognizable. The hypothallium is multi-stratose and non-coaxial, poorly developed (Fig. 4) and consists of four to eight layers of subcylindric cells, 10–22 µm long by 7–11 µm in diameter. Adjacent hypothallial filaments are interconnected with cell fusions (Fig. 4). The perithallium is highly developed, heavy calcification of the lateral cell walls making the erect filaments very distinctive. Perithallial cells are subspherical or subcubical, 5–7(10) µm in diameter, and are not arranged in horizontal tiers. Fusions occur commonly between cells of contiguous filaments (Fig. 5). Trichocytes occur in vertical series (Fig. 5). The unistratose epithallium originates from the perithallial meristem. Meristematic cells are not morphologically different from other cells of the perithallium (Fig. 6). No conceptacle-like structures occur in the material examined. However, in Foslie's slides of the

FIGS 1–6. Scanning electron micrographs of the holotype of *Lithophyllum absimile* Foslie & Howe. Fig. 1. Thallus surface showing the excrescences. Fig. 2. Surface with epithallial concavities and cell walls. Fig. 3. Detail of surface with trichocyte pore. Fig. 4. General view of structure with the hypothallium (H) and perithallium (P). Fig. 5. Detail of perithallium structure with a vertical series of trichocytes (arrows). Fig. 6. Detail of upper perithallium with cell fusion (arrows) between adjacent filaments.



original collection, three conceptacle chambers, 120–160 μm in diameter, are present but are empty and lack an ostiole.

Canary Island plants

The plants collected recently and that collected by F. Børgesen from Tenerife (Lemoine, 1929) and housed at C, are small. They have no excrescences (Figs 7–8) but have an irregular surface. Individual plants are 20–30 mm in diameter and up to 0.6 mm thick. They adhere tightly to the substratum and are pink in colour, with somewhat attenuated white margins, sometimes lobed, with folds and grooves. The young (primary) plants are suborbicular and fuse between themselves to compose the collective thallus. Epithallial concavities, calcified cell walls and trichocyte pores are apparent on the thallus surface (Fig. 9).

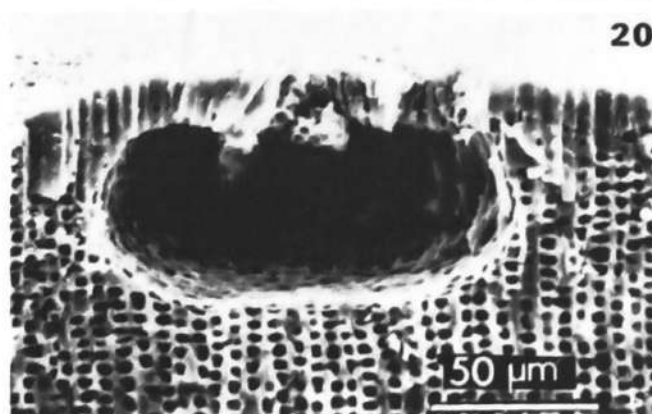
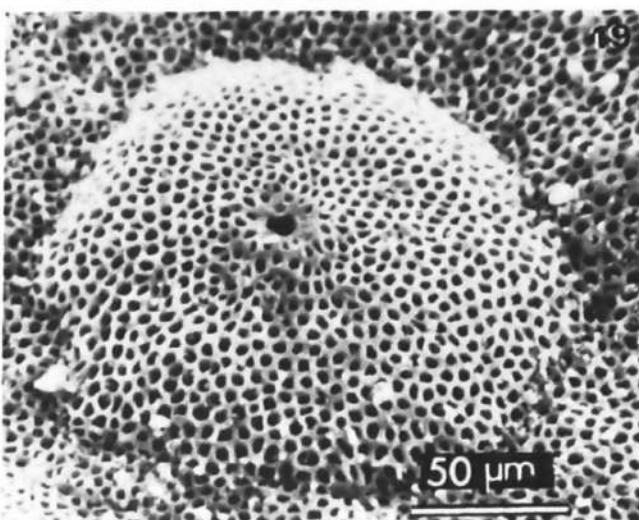
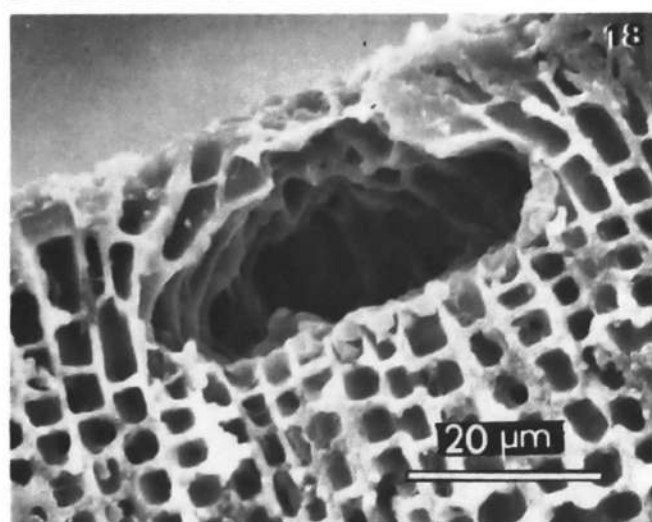
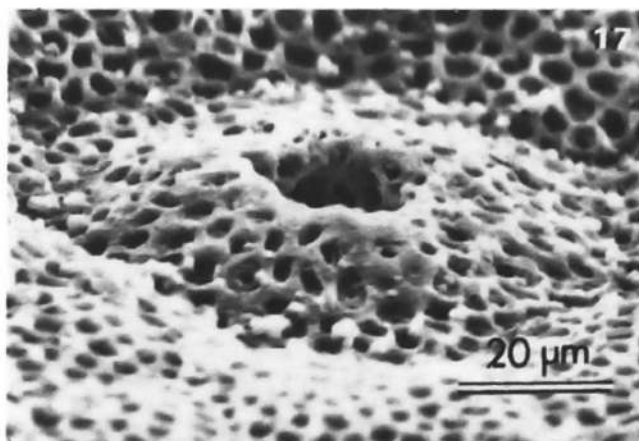
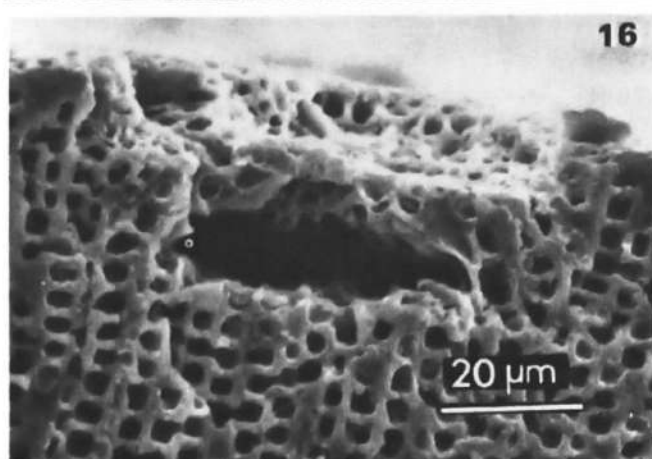
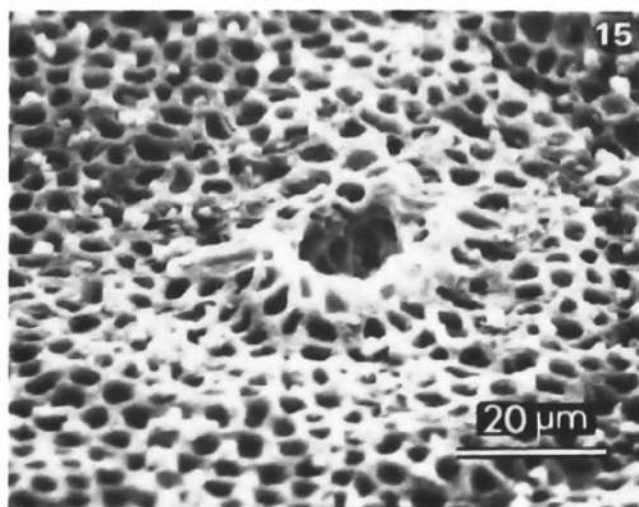
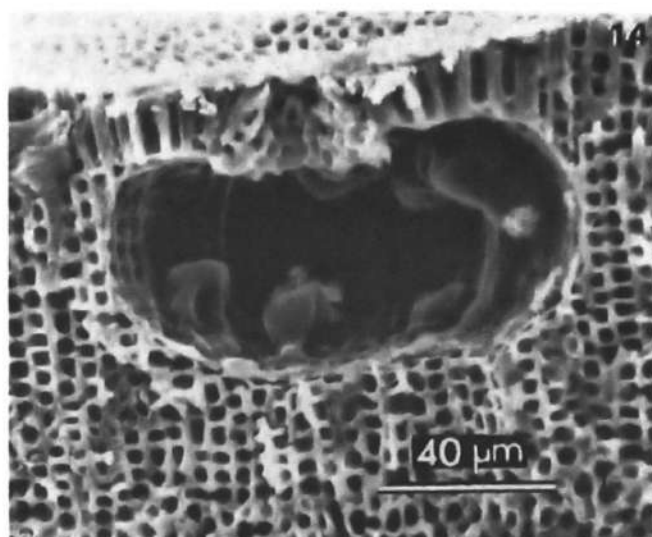
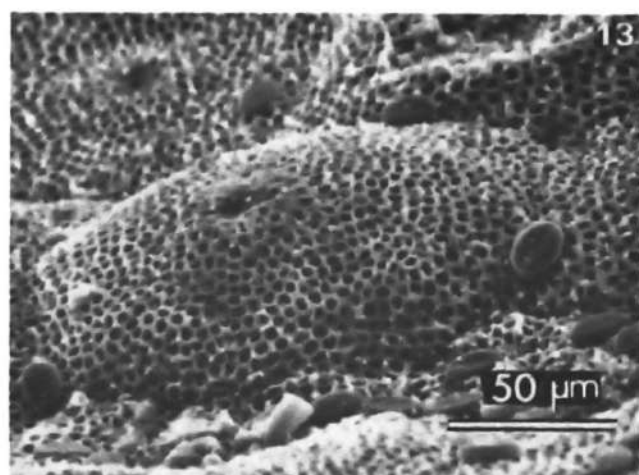
The internal structure and organization of the thallus (Fig. 10) is 'lithothamnioide' (Cabioch, 1972). The multistratose, non-coaxial hypothallium contains six to 10 layers of hypothallial filaments composed of subcylindrical cells 8–17 μm long by 4–8 μm in diameter. Cell fusions are common. Growth in area occurs via marginal initials. The perithallium is up to 400 μm thick, with erect vertical filaments, composed of spherical, subcubical, transversely or vertically compressed cells, 4–7 μm in diameter, interconnected by cell fusions (Fig. 11). The epithallium is unistratose and composed of domed cells, 3–4 μm in diameter. Bicellular trichocytes (Fig. 12), 6–10 μm in diameter, 4–6 μm high (upper cells) and 6–10 μm (lower cell) are very frequent. A single calcified envelope encloses both cells (Fig. 12). These trichocytes become transformed within the perithallium into a vertical series of megacells.

Uniporate tetrasporangial conceptacles are very common on the central portion of the thallus. Conceptacles vary in outline from circular to ellipsoidal with the convex roof protruding only slightly above the surrounding thallus surface (Fig. 13). In section, tetrasporangial conceptacles are slightly convex and measure 100–160 μm in diameter by 60–85 μm high; the chamber is more or less ovoid with a pronounced ostiole (Fig. 14). Three layers of cells are present in the weakly protuberant conceptacle roof. Ostioles are 10–20 μm in diameter with a more or less long canal (30–40 μm) that projects into the interior of the surrounding cells. Tetrasporangia, 40–60 μm long by 20–35 μm in diameter, are restricted to the conceptacle periphery. No columella was observed (Fig. 21).

Gametangial plants are monoecious and they are as abundant as tetrasporangial plants. Gametangial conceptacles are very small, with a slightly convex roof (Figs 15, 17). In section, male conceptacles are slightly conical, with a small chamber 40–60 μm in diameter by 30 μm high (Fig. 16). The ostioles are also small, 10–15 μm in diameter. Spermatangia are liberated from spermatangial initials borne above basal cells that occur only on the conceptacle floor (Fig. 22). Spermatangia release their contents as spermatia 2–3 μm long by 1 μm in diameter.

Carpogonial conceptacles are subconical and weakly protruding (Fig. 17), with a small chamber up to 60 μm diameter and 30–40 μm high (Fig. 18). Ostioles are 10–15 μm in diameter. In SEM sections, carpogonial conceptacles can be differentiated from male conceptacles by the presence of larger, thin-walled cells surrounding the conceptacle chamber (Fig. 18). The carpogonial branches, with dense cyto-

FIGS 7–12. Morphology and structure of the holotype of *Spongites wildpretii*. Fig. 7. Young crust. Figs 8–12. Scanning electron micrographs. Fig. 8. Surface of asexual crust with numerous mature conceptacles and conceptacles with collapsed roofs (arrow). Fig. 9. Detail of surface with epithallial concavities and three trichocyte pores. Fig. 10. Section of young crust with the hypothallium (H) and perithallium (P). Fig. 11. Detail of perithallium with numerous cell fusions (arrows) between contiguous filaments. Fig. 12. Section of upper perithallium with two trichocytes.



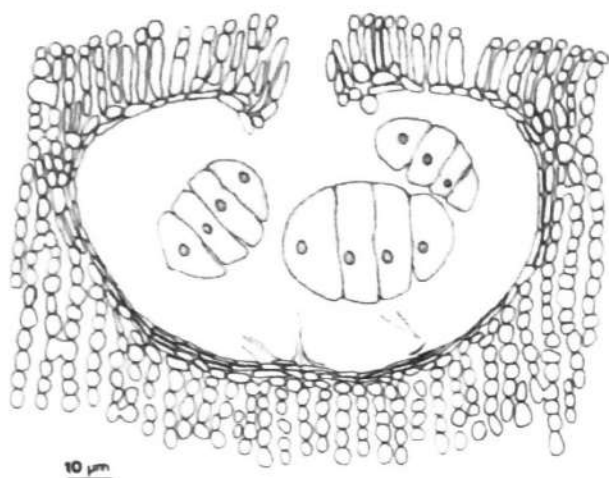


FIG. 21. Section of tetrasporangial conceptacle of *Spongites wildpretii* with tetrasporangia (Holotype).

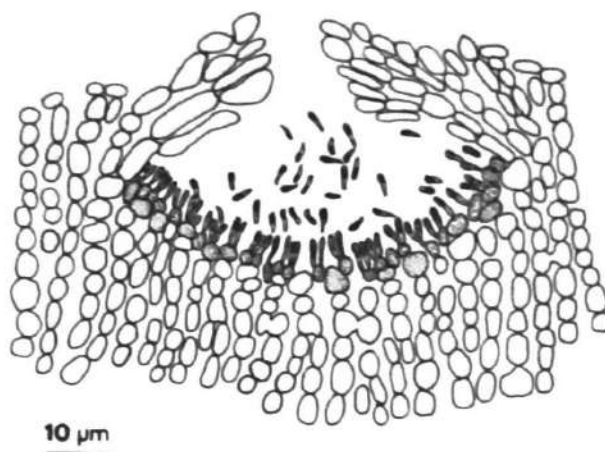


FIG. 22. Section of male conceptacle of *Spongites wildpretii* with spermatangia and spermatia (Holotype).

plasmic contents, form a continuous uniform layer on the floor of the chamber. Each carpogonial branch near the centre of the chamber (Fig. 23) consists of a supporting cell (with a large axial nucleus) with one or two hypogynous cells which support carpogonia bearing long trichogynes that project through the ostiole of the conceptacle. At the periphery of the conceptacle, the carpogonial branches are simpler and presumably non-functional (Fig. 23).

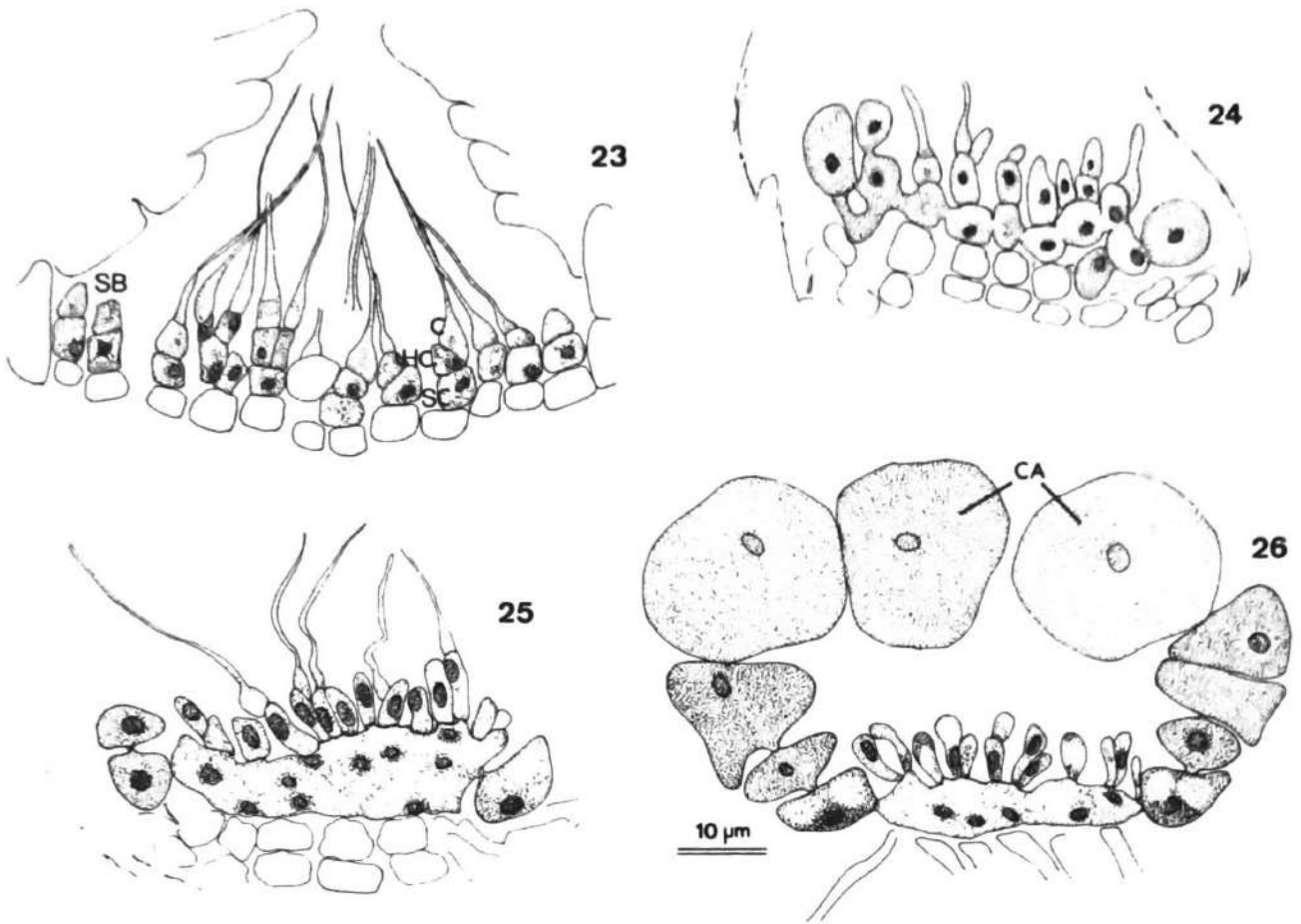
Direct evidence of plasmogamy between trichogynes and spermatia has not been obtained. After presumed fertilization, certain anatomical changes occur. These changes affect: (1) the perithallial filaments which surround the conceptacle chamber, and (2) the carpogonial branches which have to form a gonimoblast. During carposporangial formation, the thin-walled cells surrounding the conceptacle chamber (Fig. 18) collapse, providing space for the enlargement of the carposporangia in the fully mature carposporangial conceptacle (Fig. 20). The chamber is significantly enlarged, becoming up to 100–150 μm in diameter and 70–90 μm high (Fig. 20). The chamber, roof and ostiole (Fig. 19)

characters of the carposporangial conceptacles are similar to those of the tetrasporangial conceptacles.

The first changes after fertilization are difficult to observe and they are not often seen in anatomical sections. The transfer of the zygotic nucleus from the fertilized carpogonium to the auxiliary cell (supporting cell) has not been observed. Contiguous supporting cells of different carpogonial branches fuse with one another (Fig. 24). A single, continuous, discoid fusion cell forms on the floor of the chamber. This fusion cell has dense cytoplasm with many nuclei (Fig. 25). Senescent carpogonial branches remain on the upper surface of the fusion cell. Simultaneously with development of the gonimoblast, some layers of perithallial cells placed below the fusion cell degenerate progressively. Six to eight gonimoblast filaments arise at the periphery of the fusion cell (Fig. 26). Gonimoblast filaments consist of four to six cells, the most distal, spherical or ovoid, being the carposporangium. The remaining carpogonial branches on the surface of the fusion cell become clavate (Fig. 26).

Both tetrasporangial conceptacles and carposporangial conceptacles are sloughed

FIGS 13–20. Scanning electron micrographs of the conceptacles of the holotype of *Spongites wildpretii*. Fig 13. Thallus surface with tetrasporangial conceptacle. Fig 14. Section of tetrasporangial conceptacle. Fig 15. Thallus surface with spermatangial conceptacle. Fig 16. Section of spermatangial conceptacle. Fig 17. Thallus surface with carpogonial conceptacle. Fig 18. Section of carpogonial conceptacle. Fig 19. Thallus surface with carposporangial conceptacle. Fig 20. Section of carposporangial conceptacle



FIGS 23–26. Carposporophyte development in *Spongites wildpretii* (Holotype). Fig. 23. Carposporophyte with fertile carposporophytic branches near the centre of the chamber; sterile branches on the periphery. SC, supporting cell; HC, hypogynous cell; C, carposporonium; SB, sterile branch. Fig. 24. First fusions between supporting cells. Fig. 25. Fusion cell and gonimoblast filament formation. Fig. 26. Fusion cell with gonimoblast filaments arising only at the periphery. CA, Carposporangium.

off after liberation of the reproductive cells. This process is initiated at the conceptacle periphery, where decalcification and degeneration of cells occurs, causing the roof to collapse (Figs 27, 28). At the same time, cells placed low on the chamber floor are transformed into perithallial meristematic cells (Fig. 29). Cicatrization (regeneration of perithallial tissue) of the conceptacle chambers is effected by the meristem. These cicatrizations are recognizable on sections by the convergent growth of the perithallial filaments concerned (Fig. 30). Stages of male conceptacle cicatrization have not been observed but spermatangial chambers do not persist in the perithallium.

Japanese plants

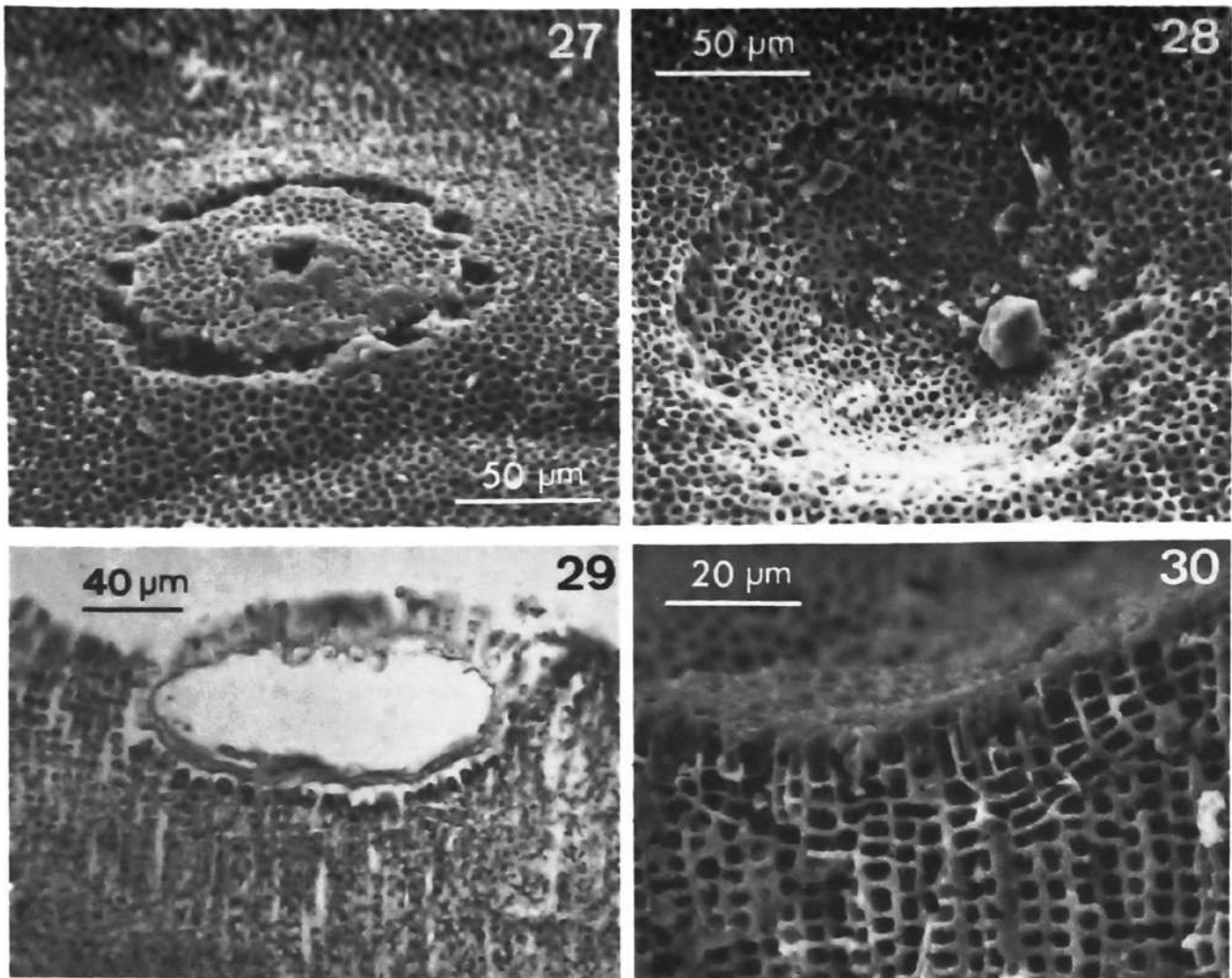
The crust and the microscopic slides loaned by Masaki and identified as

Lithophyllum absimile, were examined and found to have all the morphological, anatomical and reproductive features previously reported by Masaki (1968; p. 29; pl. XIV figs 1–3; pls XV, LII–LIV).

DISCUSSION

Taxonomic implications

Within the last few years, the abundant changes generated in the taxonomy of coralline algae have modified the generic placement of *L. absimile*. The genus *Neogoniolithon* was established by Setchell & Mason (1943) for plants with the following characteristics: (1) absence of genicula; (2) coaxial hypothallium; (3) trichocytes arranged in vertical series; and (4) uniporate sporangial conceptacles. This



FIGS 27–30. Scanning electron and light micrographs of the holotype of *Spongites wildpretii* showing the collapsed roof and cicatrization of the carposporangial conceptacle. Fig. 27. The collapse of the conceptacle roof for margin cell degeneration. Fig. 28. Detail of conceptacle concavity after collapse of the roof. Fig. 29. Cells placed low on the conceptacle floor transformed to perithallial initial cells for chamber cicatrization. Fig. 30. Section of conceptacle chamber cicatrization with convergent growth of perithallial filaments.

characterization was extended by Hamel & Lemoine (1953) to all plants with these characters and multistratose hypothallium (coaxial or not), and Cabioch (1972) proposed *Neogoniolithon absimile* (Foslie & Howe) Cabioch. [The combination *N. absimile* (Foslie & Howe) Cabioch is not valid since Cabioch (1972, p. 272) did not cite the basionym (Article 33.2 of the *International Code of Botanical Nomenclature*, see Voss *et al.*, 1983)]. Previously, Adey (1970) recognized *Pseudolithophyllum* Lemoine (1913) for the plants, close to *Neogoniolithon*, but with uni- or multistratose hypothallium (non-coaxial) and without trichocytes. Adey proposed *Pseudolithophyllum absimile* (Foslie & Howe) Adey.

Recently, however, Mendoza & Cabioch (1985) demonstrated the existence of a unistratose hypothallium in the lectotype specimen of the *Pseudolithophyllum* (*P. discoideum* Foslie) and accordingly subsumed the type species of *Pseudolithophyllum* Lemoine (1913) in *Hydrolithon* Foslie.

Since the holotype collection of *L. absimile* Foslie & Howe bears only senescent conceptacles, the proper disposition of this taxon is attended by some uncertainty. Nevertheless, the presence of a multistratose non-coaxial hypothallium and cell fusions between contiguous filaments prevents the inclusion of this taxon in the genera *Lithophyllum* Philippi or *Neogoniolithon* Setchell & Mason. The vegetative thallus,

however, possesses six characters which allow for proper generic assignment. These are: (1) thallus non-geniculate; (2) thallus filaments organized into definable tissues; (3) cells of contiguous filaments interconnected by cell fusions; (4) hypothallium multi-stratose, non-coaxial; (5) perithallium multi-stratose, present throughout the thallus; and (6) trichocytes (megacells), when present, solitary or in a vertical series. The only currently recognized genus of Corallinaceae possessing the above combination of characteristics is *Spongites* Kützing (Woelkerling, 1985). The uniporate attribute of the tetrasporangial conceptacle is the only character not recognizable in the holotype. Nomenclatural details and related taxonomic data on *Spongites absimile* are summarized as follows:

Spongites absimile (Foslie & Howe) *comb. nov.*

Basionym: *Lithophyllum absimile* Foslie & Howe in Foslie, 1907, p. 27.

Nomenclatural synonyms:

Pseudolithophyllum absimile (Foslie & Howe) Adey, 1970, p. 12.

Neogoniolithon absimile (Foslie & Howe) Cabioch, 1972, p. 272; *non. rite publ.*

Type locality: Sandy Bay, near Montego Bay (Jamaica).

Holotype specimen: TRH, Foslie Crustose Coralline Herbarium. No. 4965, prep. 1460 and 1477.

The plants studied from the Canary Islands and Japan possess the seven characters that Woelkerling (1985) used to circumscribe *Spongites*.

The result of the comparative study of the holotype of *S. absimile* with thalli from the Canary Islands and from Japan which were previously designated to this species, has demonstrated the existence of some evident differences (Table I), and consequently, the present conspecific placement is in need of revision. Fundamental differences in reproductive anatomy occur between the Japanese and Canary Island plants. The Japanese plants studied by Masaki (1968) have larger conceptacle chambers, the tetrasporangial

conceptacle is strongly convex and presents columella and differences in roof structure also occur. Moreover, other differences in morphology, perithallial development and number of epithallial cells have been observed (Table I). The differences are sufficient to consider these plants as different species. The relation between the holotype of *S. absimile* and the plants from Japan, assigned by Masaki to this species, remains uncertain in the absence of reproductive information in the holotype.

The differences between the holotype of *S. absimile* and the Canary Island plants (Table I) require further comments. Lemoine (1917, 1929) studied thalli from the Danish West Indies and the Canary Islands but did not find sufficient differences to warrant their separation into different species. According to Lemoine (1929), the thalli from the Canaries differ from those of the Caribbean by their thinner crusts and smaller size. Nevertheless, the results of this study indicate that, despite the absence of reproductive comparison, some morphological and anatomical differences are evident. The morphological distinction between *S. absimile*, based on characters of the holotype specimen, and the plants from Canary Islands is obvious. *Spongites absimile* is characterized (Fig. 1) by numerous regular excrescences 1–3 mm in diameter which protrude from the basal crusts, whilst Canary Island plants lack excrescences (Fig. 7). Anatomical differences in perithallium development (very large in *S. absimile*) and cell dimensions (smaller in Canary Island plants) also occur. In addition, the thalli from the Danish West Indies studied by Lemoine (1917) are characterized by the presence of strongly convex tetrasporangial conceptacles, whilst Canary Islands thalli have slightly raised tetrasporangial conceptacles. The above combination of characteristics precludes the assignment of the plants from the Canary Islands to *S. absimile*. The plant from the Canary Islands also appears to differ from all other species assignable to *Spongites*, at least judging from the published literature.

TABLE I. Summary of data (in μm) relating to vegetative and reproductive characters of the plants studied

	<i>S. absimile</i> (Holotype)	<i>S. wildpretii</i>	<i>S. absimile</i> (?)
Locality	Jamaica	Canary Islands	Japan
Crust depth	up to 1000	up to 600	up to 1200
Surface crust	with excrescences	without excrescences	with excrescences
No. of epithallial cells	1	1	2-3
Perithallium depth	large, up to 900	small, up to 400	large, up to 1000
Perithallial cells			
Height	5-7(10)	4-7	5-9
Diameter	5-7(10)	4-7	5-9(13)
No. of hypothallial filaments	4-8 layers	6-10 layers	8-10 layers
Hypothallial cells			
Length	10-22	8-17	9-22
Diameter	7-11	4-8	4-9
Tetrasporangial conceptacle		Weakly convex	Strongly convex
Height		60-85	(90)100-155
Diameter	?120-160	100-160	(125)135-210
Columella		absent	present
Roof thickness		3 cells	6-7 cells
Tetrasporangium			
Length		40-60	(40)50-85
Diameter		20-35	20-50
Spermatangial conceptacle			
Height		30	(40)55-85(105)
Diameter		40-60	85-150(175)
Carpogonial conceptacle			
Height		30-40	65
Diameter		60	65
Carposporangial conceptacle			
Height		70-90	100-150
Diameter		100-150	125-250
Roof thickness		3 cells	5-6 cells

Consequently, this plant is described as a new species: *Spongites wildpretii* sp. nov. (dedicated to Prof. Wolfredo Wildpret).

Diagnosis

Spongites wildpretii sp. nov. (Figs 7-30). Crustae rosea usque ad 30 mm diametro, tenues (0.6 mm), sine excrescentibus, cum albidis marginibus, conceptaculis paululum elevatis in superficiem sparsis. Hypothallus multistratosus (non coaxialis), 6-10 stratis cellularum constans, cellulis 8-17 μm longis, 4-8 μm latis. Perithallus multis cellulis crassus, usque ad 400 μm crassitudine, coniunctionibus communibus, cellulis 4-7 μm latis. Trichocytæ per perithallum dispersæ, 6-10 μm latae. Epithallus unistratosus. Con-

ceptacula tetrasporangialia cum uno poro, paululum elevata, 100-160 μm diametro interno, 60-85 μm alta, tetrasporangiis 40-60 μm longis, 20-35 μm latis. Thalli monoecii. Conceptacula spermatangialia paululum elevata, 40-60 μm diametro interno, 30 μm alta, cellulis-matricalibus spermatangialibus ad conceptaculi pavimentum restrictis. Conceptacula carpogonialia paululum elevata, 60 μm diametro interno, 30-40 μm alta. Conceptacula carposporangialia paululum elevata, 100-150 μm diametro interno, 70-90 μm alta, cellulae coalescentia crassa parvaque cum gonimoblastis filamentis tantum in periphæria.

Spongites wildpretii sp. nov. (Figs 7-30). Crusts pink up to 30 mm diameter, thin (0.6 mm), without excrescences, white

margins, conceptacles with a weakly convex roof protruding above the surrounding thallus surface. Hypothallium multistratose (non-coaxial), six to 10 hypothallial filaments, with cells 8–17 μm long, 4–8 μm diameter. Perithallium many cells thick, up to 400 μm thick, fusions common, cells 4–7 μm diameter. Trichocytes scattered throughout perithallium, 6–10 μm diameter. Epithallium unistratose. Tetrasporangial conceptacle single pored, little raised, 100–160 μm internal diameter, 60–85 μm high, tetrasporangia 40–60 μm long, 20–35 μm wide. Gametangial plants monoecious. Spermatangial conceptacles little raised, 40–60 μm internal diameter, 30 μm high, spermatangial initial cells only on the conceptacle floor. Carpogonial conceptacles little raised, 60 μm internal diameter, 30–40 μm high. Carposporangial conceptacles little raised, 100–150 μm internal diameter, 70–90 μm high, fusion cell thick and small with gonimoblast filaments only at the periphery.

Holotype: TFC (Phyc. 2535).

Type locality: Canary Islands, Tenerife, Las Caletillas.

Habitat: Stones and glass fragments collected from the tide pools.

Phenology: Tetrasporangial, spermatangial, carpogonial and carposporangial conceptacles are present throughout the spring. In the summer only carposporangial conceptacles occurs.

Distribution: Canary Islands and possibly the localities of Lemoine's records in Eastern Atlantic: Bay of Biscay (SW France), Azores and Cape Verde Islands (Lemoine, 1964).

Comments on *Spongites wildpretii*

Some characters of *Spongites wildpretii* merit additional comments. *S. wildpretii* possess young (primary) crusts which fuse with one another to compose the collective thallus. The occurrence of cell fusions between filaments of different asexual crusts, described by Afonso-Carrillo (1985) (as *N. absimile*), may be the first reliable record of this phenomenon. Previously, Turner &

Woelkerling (1982a), examining species of the *Mastophora-Lithoporella* complex, have detected the occurrence of adjunctive cell fusions between cells belonging to two non-contiguous filaments of the same thallus and involving at least one terminal meristem cell. In *S. wildpretii*, adjunctive cell fusions occur between perithallial cells from opposite margin of young plants.

Post-fertilization development in *Spongites* and the closely related genera *Neogoniolithon* Setchell & Mason and *Pseudolithophyllum sensu* Adey has not previously been described although, as will be discussed, many of the significant features were, in fact, illustrated by Masaki (1968). Results from the present study indicate three significant features in *S. wildpretii*: (1) central fertile and peripheral sterile carpogonial branches in the carpogonial conceptacle; (2) a single, continuous, relatively thick fusion cell in the carposporangial conceptacle; and (3) gonimoblast filaments development only from the periphery of the fusion cell. Intermediate aspects of post-fertilization development are described, with the exception of the transfer of the zygotic nucleus from fertilized carpogonium to the subtending supporting cell, which may be considered the auxiliary cell. Possibly fusion with the intermediate hypogynous cell occurs along the route by which the zygotic nucleus passes from the carpogonium to the supporting cell below. This appears to be the pathway in the greater part of coralline algae (Johansen, 1981; Turner & Woelkerling, 1982b). The possibility reported by some authors (Suneson, 1937; Ganesan, 1962; Lebednik, 1977) of development of transfer tube appears remote and difficult to verify owing to the small size of the implicated cells.

At present, according to Woelkerling (1985), *Spongites* is delineated from *Neogoniolithon* only by multistratose hypothallium characters. *Neogoniolithon* is recognized for taxa with a coaxial hypothallium and *Spongites* for taxa with non-coaxial hypothallium. Critical studies of reproductive characters may offer accessory

criteria for delineating these two genera. In this respect, female conceptacle and carposporophyte development characters are significant. In the species of *Neogoniolithon* in which these characters have been described—*N. accretum* (Foslie & Howe) Setchell & Mason, *N. pacificum* (Foslie) Setchell & Mason (see Masaki, 1968), *N. rufum* Adey, Townsend & Boykins and *N. clavacymosum* Adey, Townsend & Boykins (see Adey, Townsend & Boykins, 1982)—numerous carpogonial branches are produced in the female conceptacle, and the carposporangial conceptacle has a large chamber (more than 200 µm in diameter) with a thin and expanded fusion cell with gonimoblast filaments arising from the margins and/or upper surfaces. However, in *Spongites*, according to the results of the present study, few carpogonial branches are produced in the female conceptacle, and the carposporangial conceptacle has a small chamber (less than 200 µm in diameter) with a relatively thick and compact fusion cell with gonimoblast filaments arising only from the periphery. These reproductive characters are shared with other species studied by Masaki (1968)—*Lithophyllum samoense* Foslie, *L. shioense* Foslie, *L. yendoii* Foslie and *L. absimile* Foslie & Howe—all of which were assigned by Adey (1970) to *Pseudolithophyllum* Lemoine *sensu* Adey. However, as Mendoza & Cabioch (1985) have subsumed species of *Pseudolithophyllum sensu* Adey with a single-layered hypothallium in *Hydrolithon* Foslie, the remaining species with a multistratose hypothallium should possibly be transferred to *Spongites*.

The diagnostic value of these post-fertilization characters may be high, as has been demonstrated in other coralline algae. Johansen & Silva (1978) employed these attributes to help delineate two tribes within the Corallinoideae. In the tribe Corallineae, fusion cells are thin (< 12 µm), expanded (90–300 µm broad) and produce gonimoblast filaments from the margins and/or upper surfaces. In the tribe Janieae, fusion cells are thick (up to 35 µm), compact (40–130 µm broad) and produce gonimoblast

filaments only from the margins. Recently, Turner & Woelkerling (1982b) have indicated these same differences between *Lithoporella* Foslie and *Mastophora* Decaisne. The taxonomic significance of these differences is difficult to assess at present, in the absence of carposporophyte information in the type species of *Spongites*. Since there are no comparable data for many other species currently assigned to *Neogoniolithon*, *Pseudolithophyllum sensu* Adey and *Spongites*, carposporophyte development in the type species of most genera requires detailed examination. The lectotype of *Spongites* appears to be a tetrasporangial plant according to Woelkerling (1985). Of the species retained by him in the genus *Spongites*, only in *S. racemosa* Kützing have presumptive carposporangial conceptacle chambers been examined (Woelkerling, 1985). These chambers are up to 488 µm in diameter and 215 µm high and reproductive structures were not found. The large diameter of the presumptive carposporangial conceptacle of *S. racemosa* accords with the *Neogoniolithon*-type conceptacle (more than 200 µm diameter) mentioned previously and not with *Spongites* as exemplified by *S. wildpretii*. It is possible, therefore, that *Neogoniolithon* and *Spongites*, with the same carposporophytic characters but differing in hypothallial structure, will have to be retained, while *S. wildpretii* and related species, with a *Spongites*-type hypothallium but small carposporangial conceptacles, will have to be segregated into a further genus; but further studies are needed before this matter can be firmly settled.

Collapse of the conceptacle roof and regeneration of perithallial tissue of the conceptacle chambers have been scantily reported in nongeniculate coralline algae. In contrast, buried conceptacle chambers have usually been delineated in the literature. It is possible that old conceptacles commonly fall out and that, on the whole, authors only mention this character when they become buried. This phenomenon is possibly a useful specific character of *Spongites wildpretii*.

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr Y. Chamberlain (Portsmouth Polytechnic) and an anonymous reviewer for their critical reading of the manuscript, comments and suggestions. Sincere thanks are due to Professor T. Masaki (Hokkaido University, Japan) for the loan of a specimen and personal slides from Japan. Thanks also are due to Dr S. Sivertsen for the loan of specimens from TRH, Dr J. B. Hansen for the loan of specimens from C, to Dr F. González Luis for providing the Latin diagnosis, and Mr A. Padrón for providing technical assistance with the electron microscopy.

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(Accepted 16 July 1987)