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AN EMENDATION TO THE GENUS *STYPOPODIUM* KÜTZ., AND ITS NEW SPECIES FROM THE COAST OF PAKISTAN

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Abstract

Stypopodium shameelii Nizam. *et* Aisha *sp. nov.*, has been described from the coast of Pakistan. It is characterized by regular tiers of central cells both in cross as well as in longitudinal sections, surfaces of the distal and proximal portions of the frond are elevated and smooth respectively, sporangia scattered in between the hair-lines on both surfaces and restricted to the distal portion of the frond or blade. Vegetative growth occurs by simultaneous transverse and longitudinal segmentations of the apical cells. The genus *Stypopodium* Kütz., is also emended. The validity of *S. tubruqense* Nizam. & Godeh is also discussed.

Introduction

The genus *Stypopodium* Kütz., is a sub-tropical and tropical alga. Presently characterized by non-tiered central cells (medullary cells or layers) in cross sections, a layer of several photosynthetic cells (peripheral/epidermal cells), vegetative growth by means of a series of apical cells, non-indusiate, lacking sterile paraphyses in sporangial sori and formation of 4 spores.

In the year 1988 a large number of dictyotalean members were collected from the coast of Pakistan including a new taxon of the genus *Stypopodium*. This new taxon is designated as *Stypopodium shameelii* Nizam. *et* Aisha after the name of Professor Dr. Mustafa Shameel of the Department of Botany and Director, Institute of Marine Sciences, University of Karachi for his devotion and contributions in the field of Phycology. Previously Nizamuddin & Perveen (1986) described *S. zonale* (Lamour.) Papenf., from the coast of Pakistan.

Materials and Methods

Collected materials were fixed in 4% formalin-seawater solution, mounted on herbarium sheets and deposited in Seaweed Biology and Phycochemistry Lab., MAH Qadri Biological Research Centre, University of Karachi (KUH-SW). Hand sections were made and stained in 1% aniline blue or studied without staining. Drawings were made with the help of Camera Lucida.

Description

Stypopodium shameelii Nizam. *et* Aisha *sp. nov.*
(Figs. 1-4, 5F)

Frond dark brown in older parts, yellowish brown in younger ones; stipitate, stupose, erect up to 60 cm long, attached by rhizoidal discoid holdfast up to 10 mm across; palmate, flabellate, fan-shaped, broadly expanded, lobed, irregularly cleft, variously divided; segments up to 15 cm broad, variable in shape; surface of the frond or blade distally elevated or wrinkled and concentrically zonate and incipient. The frond reaches the largest size of any species of the genus. Vegetative growth occurs by simultaneous transverse and longitudinal segmentations of a series of apical cells (Fig. 3A) and progressively increasing downward in several layers of cells. Distal portion of the frond or blade comprises 4 layers of cells, 155-235 μm thick, centrally 2 layers of rectangular cells, 20-60 x 35-60 μm, covered by a layer of monostromatic photosynthetic cells on either side of the blade (Figs. 3 A-D). Progressively further downward the frond increases in number of layers of central cells (310-340 μm thick), 4-8 layers of quadrate/rectangular cells of irregular size 20-70 x 45-115 μm, arranged in regular tiers in cross section bounded by a photosynthetic layer of small cells (Figs. 3 and 4). Septate or aseptate rhizoids develop on either side of the surface of the frond in the basal region only. Surface cells are rectangular and arranged in longitudinal series (Fig. 4D). Tetrasporangia ovoid, 112-125 x 100-112 μm, scattered in between the hair-lines on the dorsal as well as on the ventral surfaces of the distal part of the frond or blade but not bordering the hair-lines (Fig. 1B). Sporangial sori, non-indusiate, lacking paraphyses in sporangial sori. Sporangia develop by a transverse division of the peripheral cell forming 1-2 stalk cells (Figs. 3 A-C and 4A). Sexual organs not observed.
Holotype: Hawkes Bay (*Leg.* M. Nizamuddin, 21-3-1988, KUH-SW, 0006. Drift).
Specimens examined: Hawkes Bay (*Leg.* M. Nizamuddin, 21-3-1988. Isotypes N 3-88, 13 specimens; 6-4-1988, N 4-89, 2 specimens). Sandspit (*Leg.* K. Aisha, 15-2-1992, KA 2-92; 17-4-1994, KA 4-94, 2 specimens). Manora (*Leg.* K. Aisha, 6-4-1994, KA 4-94, 3 specimens). Most probably this species is a deep water alga never found growing in littoral zone.
Diagnosis: *S. shameelii* Nizam. *et* Aisha resembles *S. zonale* (Lamour.) Papenf., in habit and texture but differs in size, in apical segmentation, in structure and sporangia scattered distally on the blade.
Diagnose: *S. shameelii* Nizam. *et* Aisha; *habitu et textura S. zonale (Lamour.) Papenf. affinibus similis sed differt magnitudine, segmentis apicis, structura et sporangia ad utrinque paginama distalis dispersa.*

Discussion

Kützing (1843) included three species in his new genus *Stypopodium* i.e. *S. fuliginosum* (Mart.) Kütz., *S. flavum* (C. Ag.) Kütz. (=*Zonaria flava* (Clement) C. Ag.; Nizamuddin, 1981) and *S. atomaria* (Woodw.) Kütz. Later on J. Agardh (1848) made *S. atomaria* type of his new genus *Taonia* J. Ag. and returned *S. flavum* back to *Zonar-*

ia C. Ag. Thus by the residual process J. Agardh lectotypified *S. fuliginosum* (Papenfuss, 1977) and considered *S. zonale* (Lamour.) Papenf., conspecific with *S. fuliginosum*. The type species, *S. fuliginosum* (Fig. 2C), possesses 8 layers of quadrate cells including photosynthetic ones, uniform in size, regularly tiered (Fig. 2Dc) in cross section (Kützing, 1859), whereas *S. zonale* possesses more than 8 layers of tiered or non-tiered central cells of regular or irregular size and in cross section small rectangular photosynthetic cells (Figs. 6D, F, G; 7J, K) [Taylor, 1971; Nizamuddin & Perveen, 1986; Verlaque & Boudouresque, 1991)].

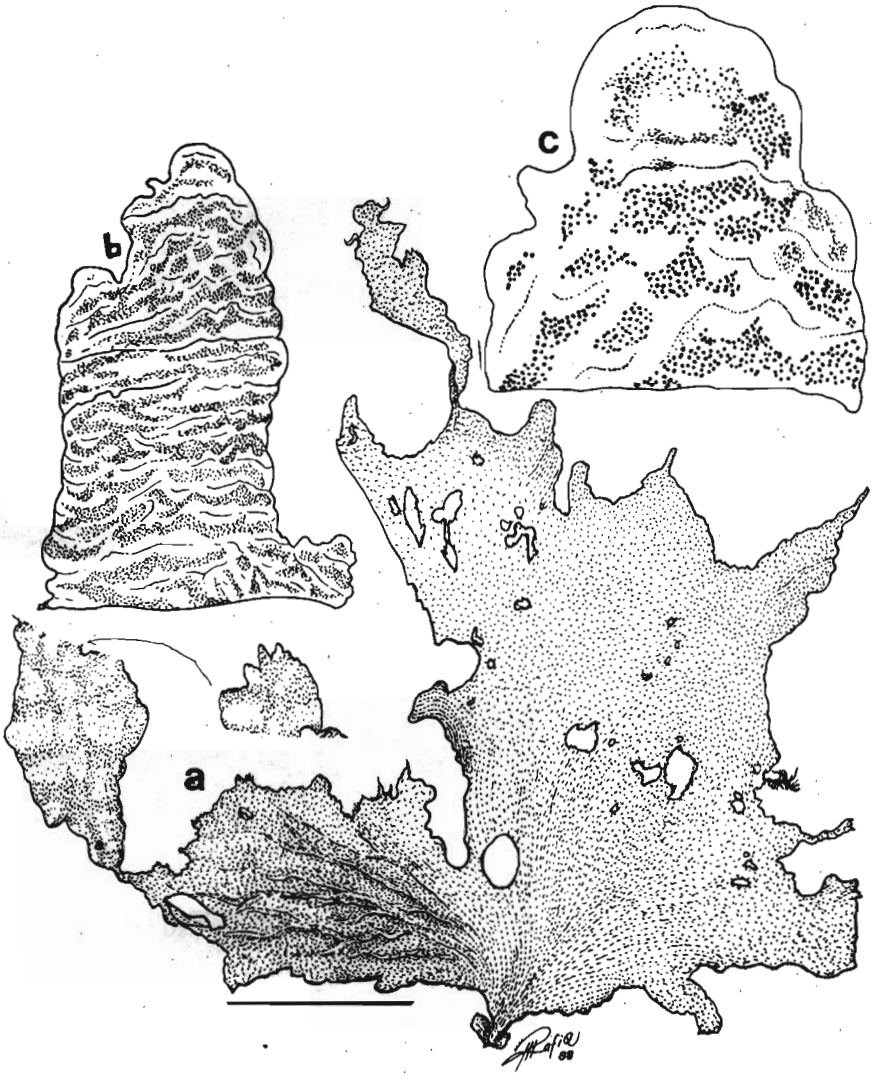


Fig.1. *Stypopodium shamelii* Nizam. *et* Aisha *sp. nov.*
(A) Habit of holotype KUH-SW, no. 0006. Scale bar = 5 cm. (B) Distal fragment of a blade with scattered sporangia. Scale bar = 6.2 cm. (C)Apical portion of segment enlarged. Scale bar = 2 cm.

Durairatnam (1961), Misra (1966) and Earle (1969) reported only 4 layers of irregular central cells in *S. zonale* surrounded by a layer of small photosynthetic cells on either side (Fig. 6A, B). Okamura (1907, as *S. lobatum* Kütz. = (synonym of *S. zonale*) and Durairatnam (1961) figured non-tiered irregular cells in cross sections of the distal portions of the frond or blade. Photosynthetic cells are quadrate in *S. fuliginosum* (Fig.2Db) whereas radially elongated (rectangular) cells in *S. zonale*. There are

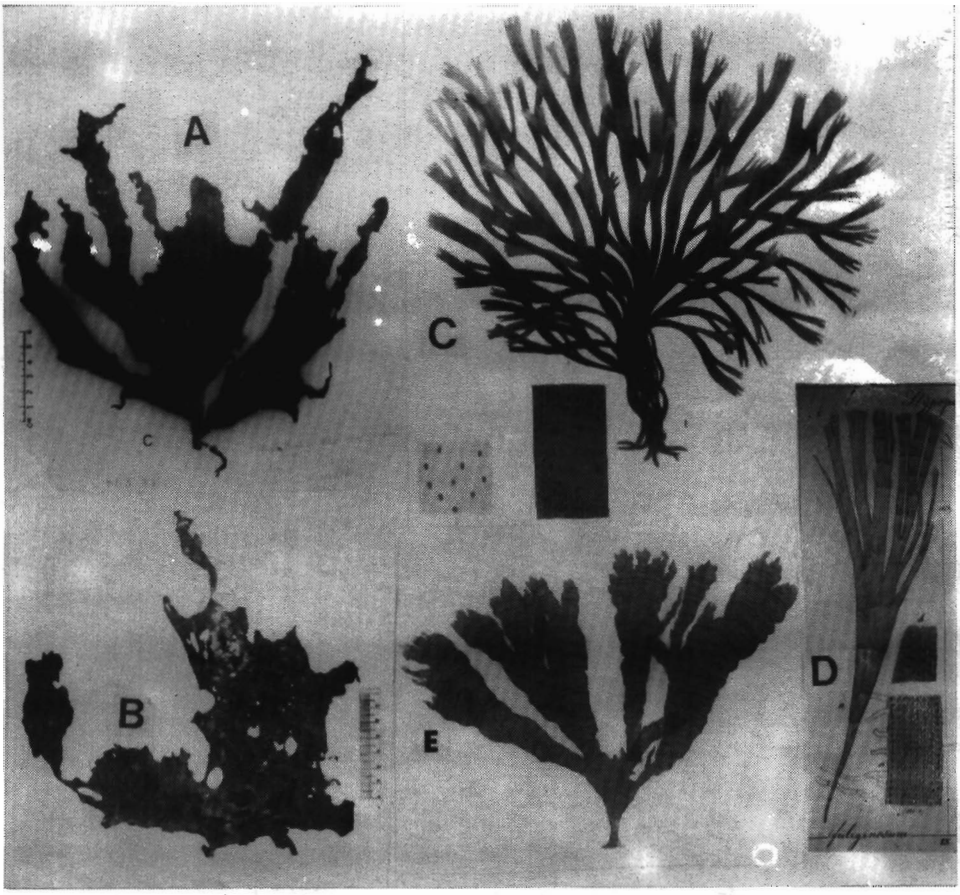


Fig.2. *Stypopodium shamelii* Nizam. *et* Aisha *sp. nov.*
(A) Isotype in KUH-SW, N 3-88. Hawkes Bay (*Leg.* M. Nizamuddin, 21-3-1988. Drift). Habit. (B) Holotype in KUH-SW, no. 0006. Hawkes Bay (*Leg.* M. Nizamuddin, 21-3-1988. Drift). Habit. (Ca)*Zonaria fuliginosa* Martius 1828, Pl. II, f. 1 Icnotype. (Photograph by courtesy of MRS. M. DUMOUNT, Laboratoire de Cryprogamie du Museum National d'Histoire Naturelle, Paris (PC). (D) *Stypopodium fuliginosum* (Mart.) Kütz. 1859, Pl. 62, f. a-c. (a) Plant-natural size (b) Surface view of thallus (c) cross section through the upper part of thallus. (Redrawn after Kützing 1859) (E) Habit of *Fucus zonalis* Lamouroux, 1805, Pl. 25 Holotype (=*Stypopodium zonale* (Lamour.) Papenf.).

great variations in size, in habit and in number of central cells (structure) as well as in their arrangements in *S. fuliginosum* (Fig.2C,D) and *S. zonale* (Fig.2E). These species are two distinct taxa and not conspecific with each other as reported by Papenfuss (1940). Type descriptions of the two species are:

1. ***Stypopodium zonale*** **(Lamour.) Papenf.**: Notes South Afric. Mar. Alg. p. 205. Bot. Nots. 1940. Basionym: *Fucus zonalis* Lamour.- Disser. plus. esp. *Fucus*, p. 38, tab. 25, f. 1, 1805. [See Papenfuss, 1940: 205] (Fig. 2E). "*F. Fronde plana, avenia, sub-*

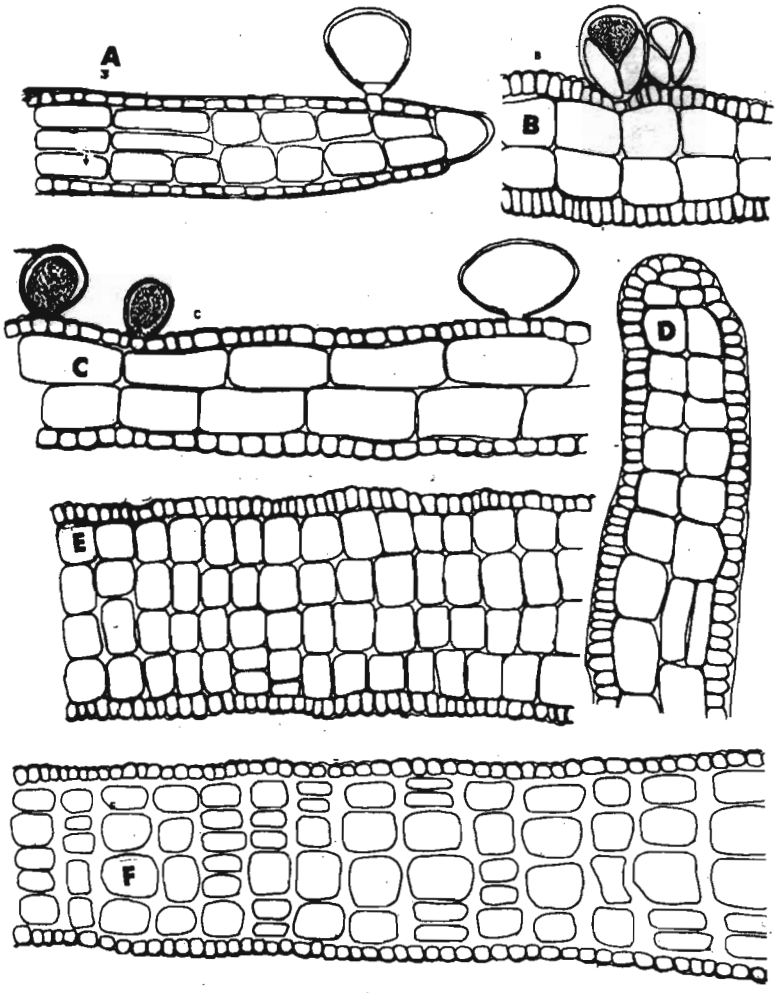


Fig. 3. *Stypopodium shameelii* Nizam. *et* Aisha *sp. nov.*

(A) Longitudinal section through the blade apex with 2-celled stalk sporangia. (B) Cross section through distal elevated portion of the blade bearing sporangia. (C) Longitudinal section through the blade bearing 1-celled stalk sporangia. (D) Cross section through the blade margin. (E) Cross section through mid-frond/blade (Hawkes Bay specimen 21-3-1988). (F) Cross section through lower smooth portion of the blade (Sandspit specimen 15-2-1992) - Scale bar = 150 μm.

dichotoma, parum ramosa; tuberculis in lineis duabus parallelis, incurvisque, frondem in zonas plurimas turgentes dividentibus per intervalla tuberculis aliis vermiculares prae se ferentibus (sp. nov.). Type locality: Santo Domingo, Haiti [in Sancti Dominici insula oris habitat]".

Mayhoub & Billard (1991) reported the type specimen of *S. zonale* from Antilles conserved in Lamouroux herbarium at Caen (CN) under the name *Dictyota zonata* (Lamouroux) Lamouroux (1809).

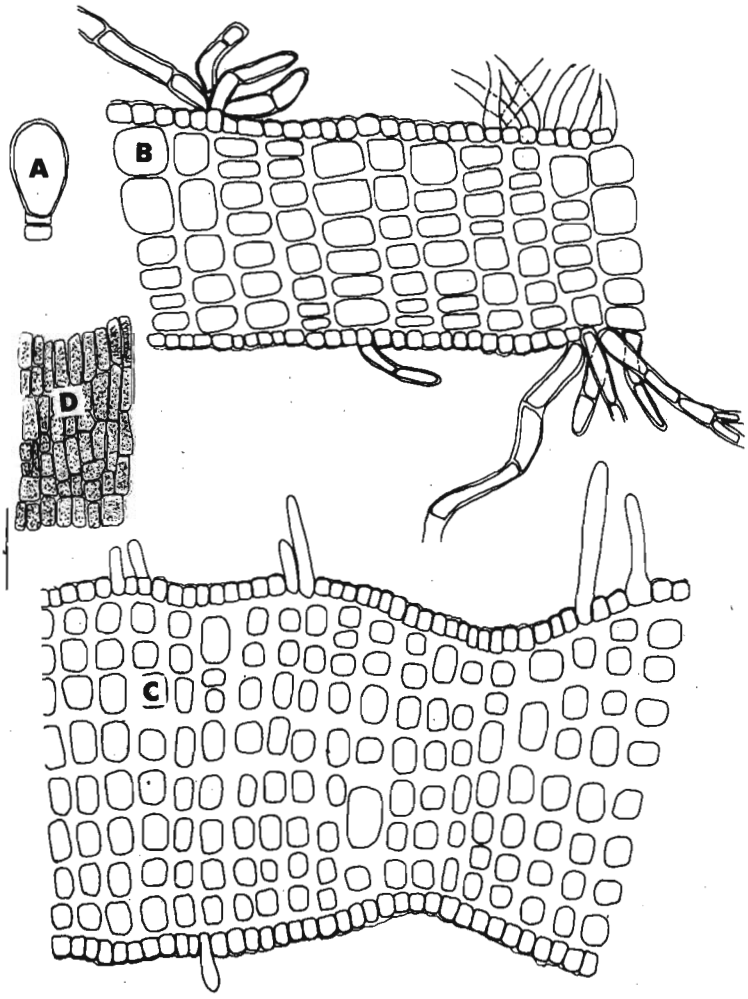


Fig. 4. *Stypopodium shameelii* Nizam. *et* Aisha *sp. nov.*

(A) sporangium - 2-celled stalk. (B) Cross section through the basal part of the frond, a little above the holdfast bearing septate and aseptate rhizoids (Hawkes Bay, 21-3-1988). (C) Cross section through the stipe bearing aseptate rhizoids (Sandspit, 15-2-1992). (D) Arrangement of cells in surface view - Scale bar = 150μm.

2. ***Stypopodium fuliginosum*** **(Mart.) Kütz.:** Phyc. Gen. p. 341, 1843.; Tab. Phyc. p. 25, tab. 62, 1859. **Basionym:** ***Zfonaria fuliginosa*** Martius 1828: 6, Tab. II, Fig.1. ***"Z. fronde subflabelliformi profunde dichotoma subcoriacea, laminis linearibus vel cuneatis truncatis apice incisis, caeterum integerrimis, zonis transversalibus parum conspicuis concoloribus obscure fuscis.*** Flor. Bras. I. p. 25 (Fig. 2C, D). ***Ulva fuliginosa***, Mertens in litteris.

Crescit in littore Brasiliae orientalis, prope Sebastianopolin, Cabo Frio et alibi. Tab. II. Fig. I. 1. Type locality: Pars frondis, cui ex parle stratum superius cellularum demlam est, ut co melius conspici possit zona incipieus et sori inter hanc et vicinas eliptici.

This *nov. comb.* was made by Kützing, 1843, p. 341 probably from *Zonaria fuliginosa* Martius, 1828: 6, t 2. f.1 also in 1833, p. 25 as Kützing indicated Mart. Fl. Bras. prodr., the usual abbreviation should be "Fl. bras. enum. pl." according to Stafleu & Cowan (1981, p. 332), however, no other work by Martius seems to correspond with the abbreviation listed by Kützing. At p. 25 Martius (*loc. cit.*) notes "Mart. *Ic. select. Crypt.* t. 2, f. 1", this is the reference of a plate in Martius (1828-1834); the corresponding text is p. 6 and includes a latin description of the taxon.

Stafleu & Cowan (1981) indicated that pls. 1-14 are from 1828. Also, Martius (*loc. cit.*) noted: *Ulva fuliginosa*, Mert. *in litt.* which has no taxonomical value regarding a possible anteriority. Therefore, description of *Zonaria fuliginosa* in Martius, 1828 (1828-1834), p. 6 and pl. 2, fig. 1 has priority on that in Martius 1833, p. 25 which is indicated in Kützing (1843, p. 341). In 1828 also, Martius listed "*Ulva fuliginosa* Mertens *in litteris.*" As Martius indicates no other holotype, pl. 2 from 1828 can be considered as the icnotype (Fig.2Cl)" - (Personal communication, Dr. B. de Reviers).

One of the main characters of the genus is the presence of regular tiers of central cells based on type species, *S. fuliginosum* (Fig. 2C). Now there are eight species of the genus possessing not only regular tiers of cells but also non-tiered irregular cells (Figs. 6C, D, F, G, R, Figs. 7A, B, E-K). The occurrence of non-tiered or irregular layers of central cells is mostly in the proximal portions of the frond in *S. flabelliforme* (Reinb. *in* W.v. Bosse 1913, Fig. 10. Allender & Kraft 1983, Fig. 11F) Fig. 6P, R, *S. tubruqense* (Nizamuddin & Godeh 1989) Fig. 6H, M, N and *S. zonale* (Taylor 1971. Fig. 21) Fig. 6F. More than one layer of photosynthetic cells occur in the basal portions of the fronds in *S. flabelliforme* (Reinbold *in* W.v. Bosse 1913, Fig. 10) Fig. 6R and in *S. tubruqense* (Nizamuddin & Godeh 1989, Figs. 4, 7) Fig. 6J, N. In Allender & Kraft's findings (1983) there are no multi-layer photosynthetic cells (surface cells *sensu* Allender & Kraft, 1983) in *S. flabelliforme* of Lord Howe Island and also in Holotype examined by them. Their studies or observations were based, in either case, on the distal portions of the fronds possessing 4 layers of central cells in the type examined by them but in original type description there are 4-8 layers of small central cells in longitudinal sections and 2-6 layers of cells in cross sections. The occurrence of 4 layers of cells is usual in the distal portions of the fronds of the species of *Stypopodium* (Figs. 6A-B, I-K, O. Figs. 7D, G-H). We are of the opinion that neither Allender & Kraft nor Reinbold *in* W.v. Bosse were in error because their observations were based on sections passing through different regions i.e., distal or proximal.

There are three types of apical segmentation (Fig. 5) in the species of the genus *Stypopodium* (A) successive transverse and longitudinal divisions in (i) *S. australasicum* (Zan.) Allend. *et* Kraft, (ii) *S. flabelliforme* var. *rabdoides* Allend. *et* Kraft, (iii) *S. fuliginosum* (Mart.) Kütz. (?), (iv) *S. hawaiiensis* (Doty & Newh.) Abbott, (v) *S. zonale* (Lamour.) Papenf.; (B) simultaneous transverse and longitudinal divisions in (i) *S. flabelliforme* Reinb. *in* W.v. Bosse, (ii) *S. shameelii* Nizam. *et* Aisha, (iii) *S. tubruqense* Nizam. *et* Godeh.; (C) successive simultaneous, transverse and longitudinal divisions in *S. schimperi* Verl. *et* Boud. (Fig. 5H A-D).

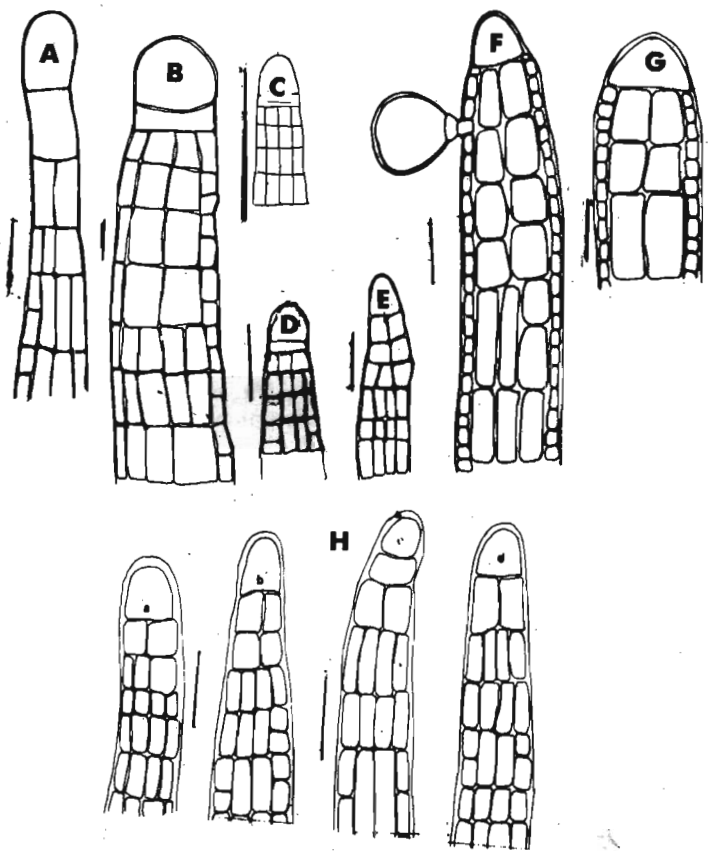


Fig. 5. Longitudinal sections through the blade apices of *Stypopodium* showing apical segmentations: (A) *S. australasicum* - [Redrawn after Allender & Kraft 1983, Fig. 11B]. Scale bar = 190 μm. (B) *S. flabelliforme* var. *rabdoides* - [Redrawn after Allener & Kraft 1983, Fig. 14C]. Scale bar = 25 μm. (C) *S. hawaiiensis* - [Redrawn after Abbott 1977, Fig. 1B]. Scale bar = 225 μm. (D) *S. zonale* - Scale bar = 110 μm. (E) *St. flabelliforme* - [Redrawn after Allender & Kraft 1983, Fig. 11E]. Scale bar = 100 μm. (F) *St. shameelii* - Scale bar = 150 μm. (G) *St. tubruqense* - Scale bar = 200 μm. (H) *St. schimperi* - Scale bar = 50 μm (a-d).

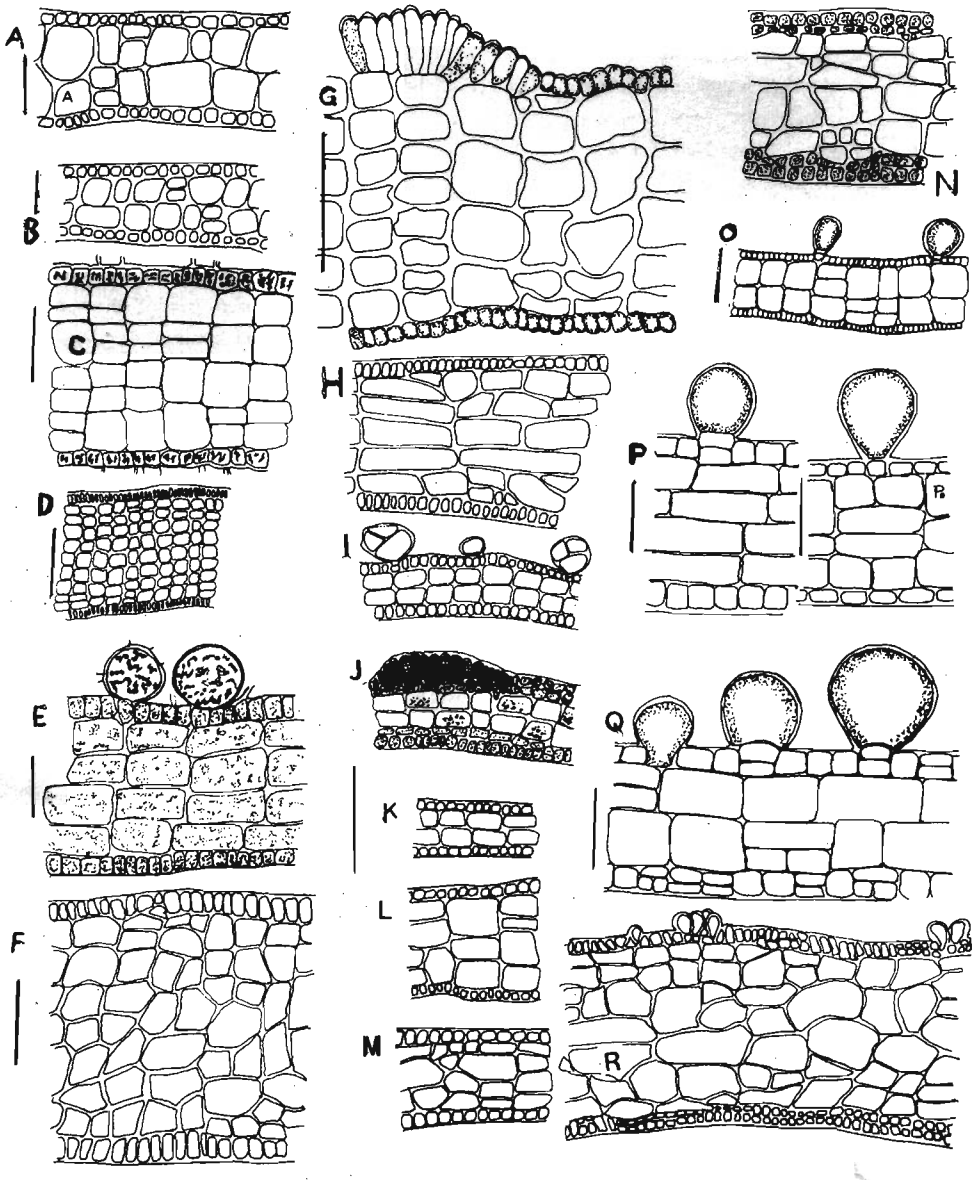


Fig. 6. Sections through fronds of *Stypopodium* spp.

(A) Cross section through young part of *St. zonale* (Redrawn after Okamura 1907, Pl. 25, fig. 3 as *St. lobatum* Kütz.). Scale bar = 70 μm. (B) Cross section through upper part of frond of *St. zonale* (Redrawn after Durairatnam 1961, Pl. 7, fig. 8). Scale bar = 110 μm. (C-E) Sections through frond of *St. zonale* (Redrawn after Nizamuddin & Perveen 1986, Figs. C, E, F). Scale bar = 100 μm). (C) Longitudinal section through mature part of frond, Fig. F. (D) Longitudinal section through mature part of frond, Fig. E. (E) Cross section through mid part of frond bearing sporangia, Fig. C. (F) Cross section through mature part of frond of *S. zonale* (Redrawn after Taylor 1971, Fig. 21) Scale bar = 100 μm. (G) Cross section through frond of *S.*

zonale bearing antheridia and central cells in regular tiers (Redrawn after Joly and Braga 1966, Fig. 1). Scale bar=150 μm. (H-N) Sections through frond of *S. tubruqense* (Redrawn after Nizamuddin & Godeh 1989, Figs. 1-7). Scale bar = 200 μm. (H) Longitudinal section through lower part of frond, Fig. 5. (I) Cross section through apical part of frond bearing sporangium, Fig. 6. (J) Cross section through antheridial part of frond bearing antheridia and 2-layered photosynthetic cells, Fig. 7. (K) Cross section through apical region of frond. (L) Cross section through mid part of frond with central cell in tiers, Fig. 2. (M) Cross section through lower part of frond above the base, Fig. 3. (N) Longitudinal section through frond little above base with 2-layered photosynthetic cells, Fig. 4. (O-Q) Sections through fronds of *S. australasicum* and *S. flabelliforme* (Redrawn after Allender & Kraft 1983, Figs. 11, 14). Scale bar=100 μm. (O) Cross section through blade with sporangia (*S. flabelliforme* var. *rabddoides*, Fig. 14E). (P) Longitudinal section through mid sporangial blade (*S. flabelliforme*, Fig. 11F). (P_o+Q) Longitudinal sections through mid and lower frond bearing sporangia with 2-celled stalk (*S. australasicum*, Fig. 11C). (R) Cross section through frond of *S. flabelliforme* showing irregular tiers of central cells and 2-layered photosynthetic cells (Redrawn after Reinbold in W.v. Bosse 1913, Fig. 10).

Key to the species of *Stypopodium*

1. Frond erect, stipitate, stupose. ---------- 2
   Frond recumbent/decumbent or in circular patches or in clumps ----*S. flabelliforme*
   Frond wholly prostrate with prominent striations --- *S. flobelliforme* var. *rabdoides*
2. Surface of the frond (distal) elevated/wrinkled. ---------- *S. shameelii*
   Surface of the frond throughout smooth. ---------- 3
3. Photosynthetic and central layers of cells quadrate, uniform in size and in regular tiers. ---------- *S. fuliginosum*
   Photosynthetic cells small and rectangular; central layer of cells irregular in size, tiered or non-tiered. ---------- 4
4. Sporangia scattered on the upper surface of the frond or blade. ---------- 5
   Sporangia on both surfaces of the frond. ---------- 6
5. Thallus rosette-bouquet forming 20 cm tall ---------- *S. tubruqense*
   Thallus delicate, small (4-6) cm tall. ---------- *S. hawaiiensis*
6. Sporangia bordering the hair-lines, sessile.---------- *S. zonale*
   Sporangia scattered in between the hair-lines and 2-celled stalk. ---------- 7
7. Sporangia scattered on the upper surface only. ---------- *St. schimperi*
   Sporangia scattered on both surfaces.---------- *St. australasicum*

The genus *Stypopodium* Kützing emend. Nizam. *et* Aisha is characterized as: "Frond erect or prostrate, decumbent, stipitate, stupose, flat, flabellate, fan-shaped, irregularly cleft, concentrically zonate, non-indusiate; sori scattered between the hair-lines or bordering the hair-lines either on upper surface or on both surfaces; vegetative growth by means of successive-simultaneous transverse as well as longitudinal segmentation of the apical cells. Structurally central cells tiered or non-tiered in cross and longitudinal sections, photosynthetic cells one or more layered. Spores 4 and sterile paraphyses lacking".

Geographical distribution: The genus *Stypopodium* Kütz., now comprises eight species and a variety which are widely, distantly distributed from each other in sub-tropical as well as in tropical seas and oceans (Map 1). *S. australasicum* grows as scattered indi-

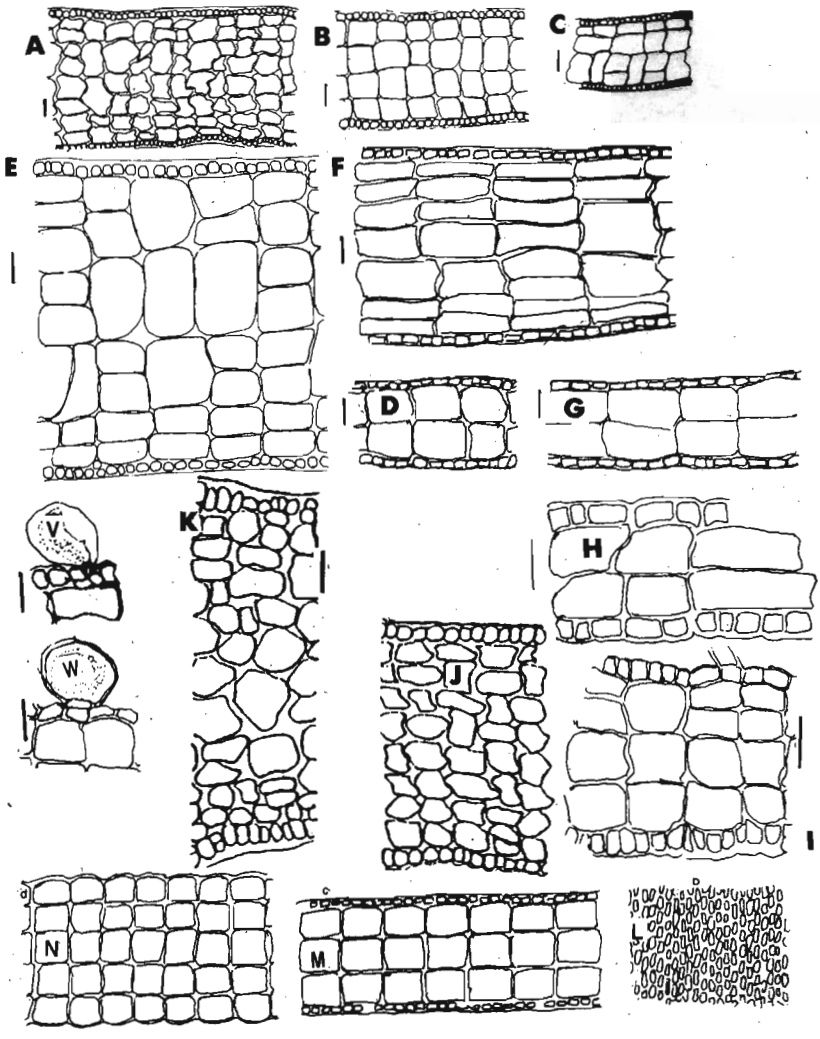
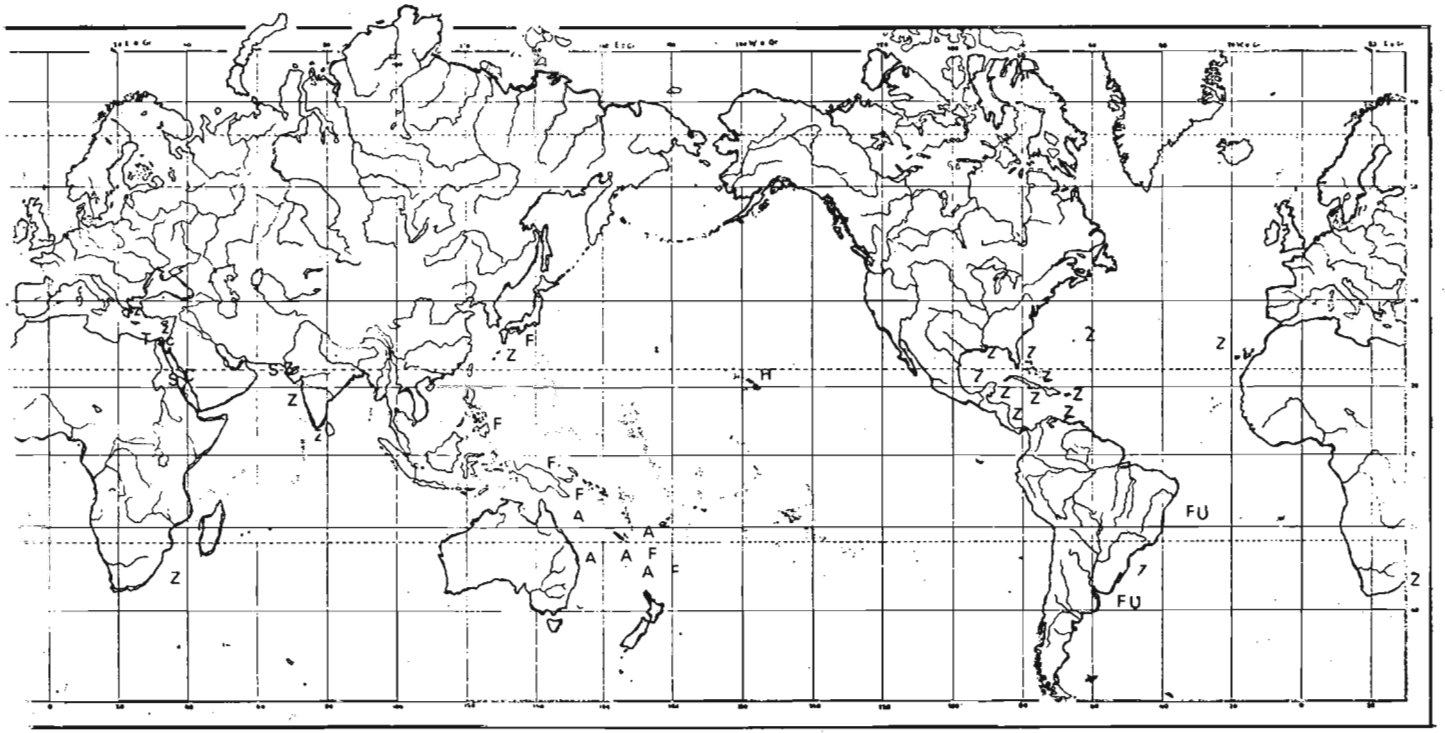


Fig. 7. Sections through fronds of *S. schimperi* (Redrawn after Verlaque & Boudouresque 1991, Figs. 10-12, 18, 39, 41, 45, 50). Scale bar = 50 μm.

(A-C) Cross section through basal region. (D) Cross section through apical region. (E, F) Longitudinal section through basal region of frond. (G) Longitudinal section through apical region of frond. (V+W) Cross section through frond bearing sporangia. (H-I) Section through frond of *S. hawaiiensis* (Redrawn after Doty & Newhouse 1969, Fig. 2C, 2D). Scale bar = 50 μm. (H) Longitudinal section through frond from near apical region. (I) Corss section through frond from near base. (J, K) Cross sections through base of *S. zonale* (Redrawn after Verlaque & Boudouresque 1991, Figs. 64, 66). Scale bar = 50 μm. L-N-*Zonaria schimperi* Buch. *ex* Kütz. Illustrations of original (Kutzing, 1859, TAb. 74, Figs. b-d). (L)- Surface view of thallus (M)-Cross section through upper part of thallus. (N)-Cross section through basal part of thallus.



Map I. Geographical distribution of *Stypopodium* spp.

1. *S. australasicum* = A, 2. *S. flabelliforme* = F, 3. *S. fuliginosum* = FL, 4. *S. hawaiiensis* = H, 5. *S. schimperi* = SC, 6. *S. shameeli* = S, 7. *S. tubrugense* = T, 8. *S. zonale* Z.

viduals across reef flats in Lord Howe Island (Allender & Kraft, 1983). *S. flabelliforme* grows in shallow waters from Sulu Sea to Central Luzon, Philippines; Rotti Island, Indonesia (Type locality); southern Great Barrier Reef; Eastern coast of Australia-Queensland, New South Wales; Lord Howe Island and Norfolk Island, Australia. *S. flabelliforme* var. *rabdoides*, so far endemic to Lord Howe Island, Australia, grows on reefs or bases of undercuts (Allender & Kraft, 1983). *S. fuliginosum* grows in Atlantic Ocean along the coast of Canary Islands, Rio de Janeiro, Brazil to the South (Kützing, 1849; Joly & Braga, 1966, reported as *S. zonale* (Lamour.) Papenf.). *S. hawaiiensis* grows along the coast of Hawaiian islands and Micronesia, Pacific Ocean (Trono, 1969). *S. tubruqense* grows in deep water along the coast of Tubruq Bay, Mediterranean Sea and so far endemic to the Eastern coast of Libya (Nizamuddin & Godeh, 1989).

Stypopodium zonale is the most widely distributed species in most seas and oceans. This species grows in shallow waters, in exposed localities and also in deep water (Nizamuddin & Perveen, 1986). Taylor (1979) reported this species growing from lower intertidal zone to a depth of 55 m but mostly common in water 1-10 m deep. This species has been reported growing in Atlantic Ocean: Canary Islands, West Indies: Santo Domingo, St. Croix (Santa Cruz); Bermuda, Lesser Antilles (Taylor, 1969), Columbia, Venezuela, Panama, Dry Tortugas, Florida, South to Brazil; Pacific Ocean: Galapagos Island; Southern Japan: Amakasa Island, Nagasaki, Coast of Luzon, Philippines, Micronesia; Indian Ocean: Sri Lanka, West coast of India, Pakistan. Red Sea; Eastern coast of Mediterranean Sea [Cyprus. Israel, Syria, Turkey]; Cape of Good Hope, South Africa. *Stypopodium schimperi* (Buch. *ex* Kütz.) Verl. *et* Boud. is endemic to the eastern coast of mediterranean and Red Sea (Noweiba. Suez. Straits of Jabal. Port Sudan) is a deep water alga dredged at 80 ms depth (Nasr, 1947).

Note: *Stypopodium tubruqense* Nizam. *et* Godeh completely differs from *S. schimperi* (Buch. *ex* Kütz.) Verl. *et* Boud. in rosette-bouquet forming habit, in apical segmentation (Fig. 5G), in possessing 2-layered photosynthetic cells in lower parts of thallus (Nizamuddin & Godeh 1989, Figs. 4 & 7), in 1-celled stalk sporangia and possessing photosynthetic layers throughout thallus whereas lacking in *Zonaria schimperi* Buch. *ex* Kütz. 1859, t. 74, f.d) Figs. 7L-N and cells are regular, uniform and sub-quadrate, also variation in apical segmentation. We consider *S. tubruqense* and *S. schimperi* as two distinct taxa and not conspecific. *S. zonale* (Mayhoub *et* Billard, 1991) resembles *S. schimperi* (Verlaque *et* Boudouresque, 1991) in variable apical cell segmentation as well as in bearing 2-celled stalk sporangia but differs from that of Pakistan coast (Nizamuddin & Perveen, 1986) in apical cell segmentation, in sessile sporangia and also in the arrangement of central cells.

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