TAXONOMY OF SOME INDO-PACIFIC SPECIES OF *FOLIOCEROS* BHARADWAJ

D. C. BHARADWAJ

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

A study of Stephani's material pertaining to *Asp. mangaloreus* St., *Asp. spinisporus* St., *Asp. glandulosus* (L. et L.) St., *Asp. amboenesis* (Schffn.) St. and *Asp. fuscus* St. has been undertaken. *Asp. mangaloreus* is described as *Folioceros mangaloreus* (St.) comb. nov. and held distinct from *F. dixitianus* (Mahabale) Bharad. *Asp. spinisporus* is found to be the same as *F. mamillisporus* which is reduced to be its synonym. One sample is found to be distinguishable from *F. spinisporus* and has been referred here as *F.* sp. cf. *F. spinisporus*. Among the material referred to *Asp. glandulosus* by Stephani two are distinctly *Anthoceros* and others are distinguishable as *F. glandulosus* (L. et L.) Bharad. *Asp. fuscus* has been rediagnosed and transferred to *Folioceros* as *F. fuscus* (St.) comb. nov. Stephani's *Asp. amboenensis* is shown to be *F.* sp. cf. *F. glandulosus* and so is one each of the samples labelled as *Asp. mangaloreus* and *Asp. fuscus*.

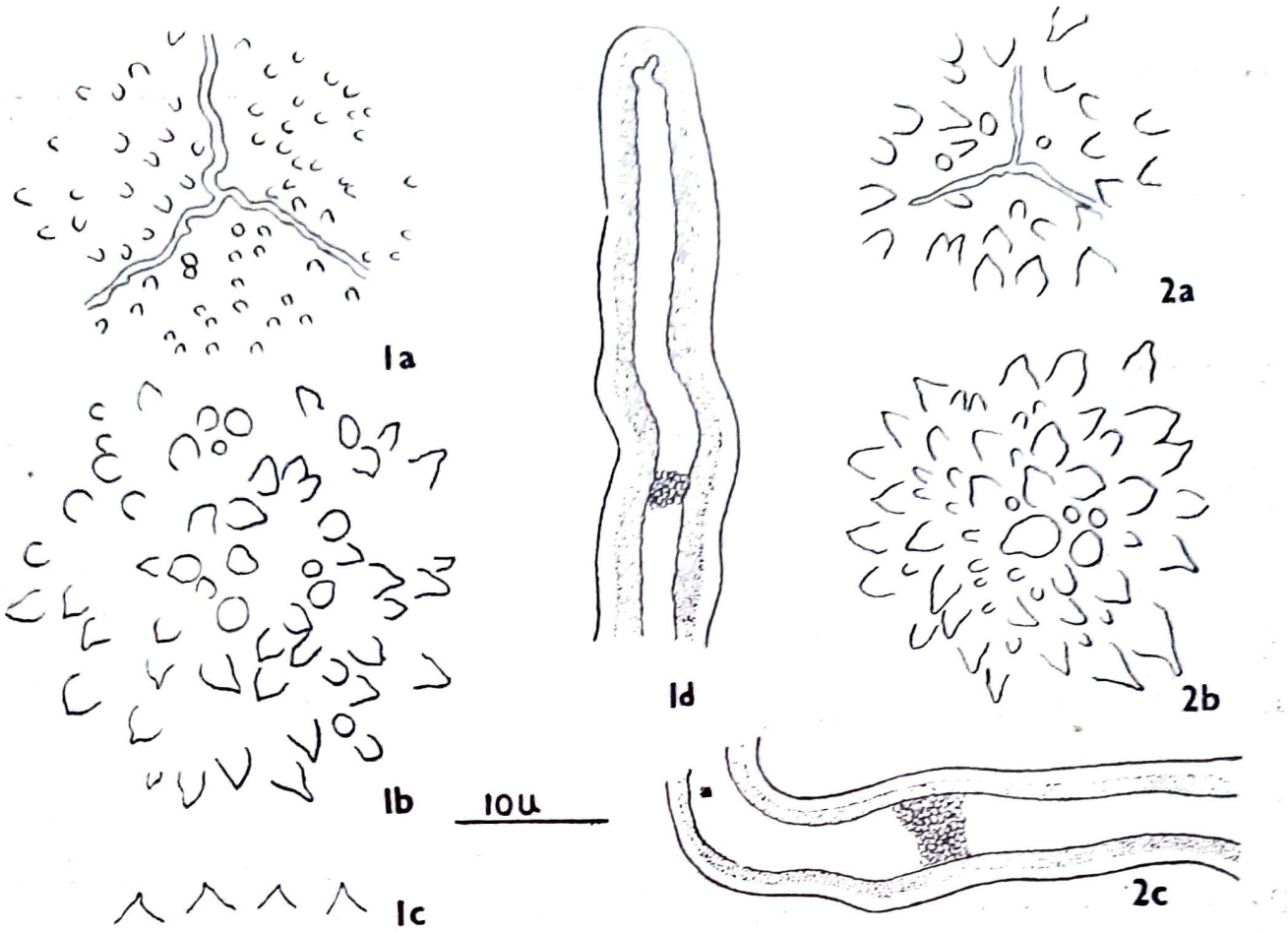
INTRODUCTION

STEPHANI (1916) described a number of species under *Aspiromitus* from the Indo-pacific region which are apparently referable to *Folioceros*. Some of them were restudied by me earlier (BHARADWAJ, 1972) and transferred to *Folioceros* on the basis of their type specimens. Extending such studies further the present paper includes the results of my examination of Stephani's collection pertaining to *Aspiromitus mangaloreus* St., *Asp. spinisporus* St., *Asp. glandulosus* (L. et L.) St., *Asp. amboenensis* (Schffn.) St., and *Asp. fuscus* St.

MATERIAL

Asp. mangaloreus St.	..	(1) Fondation Stephani 14577, Pfleiderer *legit*, Mangalore-Type.
		(2) Fondation Stephani 15056, Buitenzorg, Java.
Asp. spinisporus St.	..	(1) Fondation Stephani 15058, E. H. Man *legit*, Andaman Ils.—Type.
		(2) Fondation Stephani 15067 New Guinea.
		(3) Fondation Stephani 15059 Java.
Asp. glandulosus (L. et. L.) St.	..	(1) Fondation Stephani 15050, 15051; Dietrich *legit*, Brisbane River (Eastern Australia).
		(2) Fondation Stephani 15049, Junghuhn *legit* (Herb. Nees), Java.
		(3) Fondation Stephani 15052, ? *legit* (Herb. Nees), Java.
Asp. amboenensis (Schffn.)St.		Fondation Stephani 15053 Vanoverbergh *legit* , Luzon.
Asp. fuscus St.	..	Fondation Stephani 15054 (Type ?), 15055; Frane *legit*, New Caledonia.

The usual technique and precautions were taken for the study as detailed earlier. None of the spores were acetolyzed in this study.



Text-fig. 1. *F. mangaloreus* (St.) comb. nov. a. spore (proximal face), b. spore (distal face), c. spore (equatorial spines), d. elater (end-cell).

Text-fig. 2. *F. dixitianus* (Mahabalé) Bharad. a. spore (proximal face), b. spore (distal face), c. elater cell.

The author is thankful to Conservatoire et Jardin Botaniques Genève for loaning out Stephani's material referred to in my earlier work (Bharadwaj, 1972) and this one.

Folioceros mangaloreus (St.) comb. nov.

Text-figs, 1, 2.

Syn. *Asp. mangaloreus* St. Fondation Stephani No. 14577.

Diagnosis emend—Planta dioica (?), majescula, terricola. *Frons* ad 15 mm longa, cavernosa, anguste obcuneata, superne remote grosseque lobata, lobis truncatis obtuse angulatis. *Involucra* cavernosa, levia. *Capsula* stomata media. *Sporae* 38 μ (35—42 μ), fuscae, spinosae-echinatee, spina 2.8 ×3.0 μ, cicatrix tetradi perspicua. *Elateres* totradi, 550 μ longi, septati, cavibus aequabiliter angustus. *Androecia* desunt.

Habitat—Mangalore, South Canara, India.

Comparison—A comparative study of the main features concerning the stomata, spores and elaters was made with *F. dixitianus* (Mahabale) Bharad. The stomata in *F. mangaloreus* are only 15/sq mm on the capsule surface as compared to 26 in *F. dixitianus*. The unacetolyzed spores of *F. dixitianus* are 34 μ (31—38)μ and the biggest spine size is 4.2 × 4 μ. The nature and distribution of the spines on the proximal and distal faces in two species are also different as illustrated in text-figures 1 and 2. It is evident that in *F. mangaloreus* the spines on proximal face are more numerous and smaller than in *F. dixitianus* and on the distal face smaller and uniformly of the same size as compared to *F. dixitianus* where they are small and big intermixed.

Although both the species, *F. mangaloreus* and *F. dixitianus*, occur in the same area in south-western India, they exhibit difference in the density of stomatal distribution, in the

size and distribution of spines in the spore and the average spore size. These differences being present in the conservative aspects, the two species are considered distinct from each other.

Remarks—Meijer studied the type specimen of *F. mangaloreus* and appended to the type sheet the following observation—"*A. fuciformis* Mont. = *Anthoceros falsinervius* Lindenb. ex Meisner. Probably the same as *A. fuciformis* Mont. Yes! after further study". It is surprising that Meijer should have remarked thus, while the spore of *A. falsinervius* is very different from that of *A. mangaloreus*.

The other sample (15056) from Java, identified by Stephani as *Asp. mangaloreus* is distinctly different from the type of *F. mangaloreus* and agrees in all respects with the samples 15053 and 15055 dealt with here later under *F.* sp. cf. *F. glandulosus*.

Folioceros spinisporus (St.) comb. nov.

Text-fig. 3

Syn. *Asp. spinisporus* St.

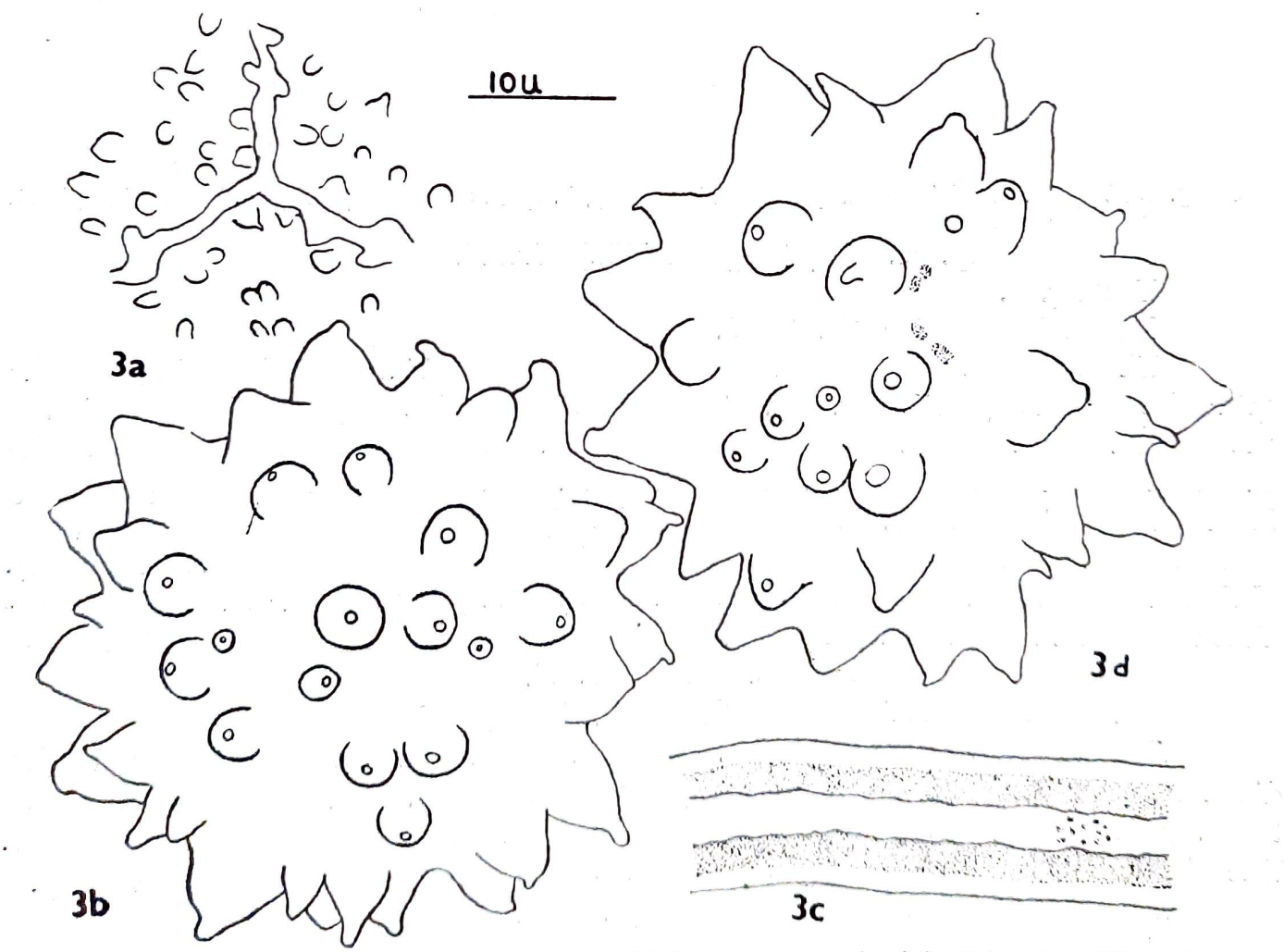
Folioceros mamillisporus (Bh.) Bharad.

Fondation Stephani No. 15058, 15057.

Diagnosis emend—As given for *F. mamillisporus* (Bh.) Bharad. (BHARADWAJ, 1971).

Habitat—Port Monat, along ravines, Andaman Islands and Kottayam, Kerala, India; Kandy, Ceylon; Java, New Guinea.

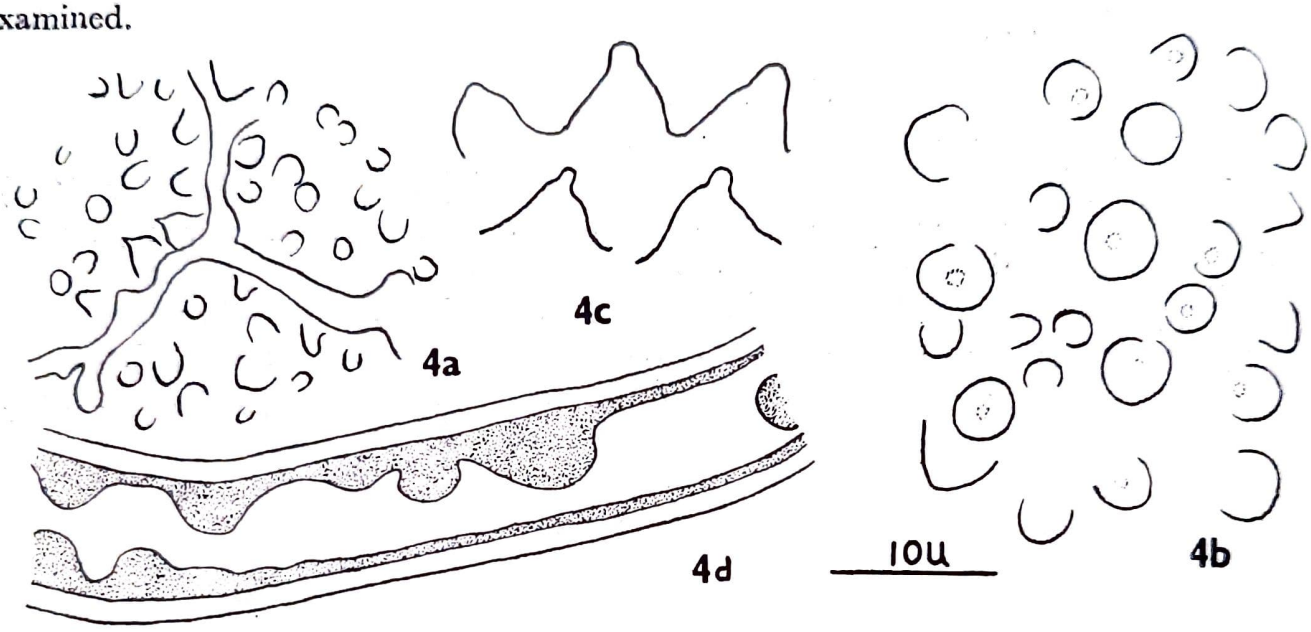
Remarks—Only the type material from Andaman Islands agrees in most respects with *F. mamillisporus*. In the type material the member of stomata/sq mm of the capsule surface is 26. The other sample, 15057, differs from the type of *F. spinisporus* in having



Text-fig. 3. *F. spinisporus* (St.) Bharad. Sample No. 15058 a. spore (proximal face) b. spore (distal face and equatorial spines), c. elater cell, d. Samp. No. 15057—spore (distal face and equatorial spines).

fewer stomata (18) per sq mm of the capsule epidermis. Meijer who studied this material in 1954, remarked—"indeed Anthoçeros spinisporus St. =A. amboinensis Schffn." This material identifies with the material labelled as *A. spinisporus* St. and sent to Late Dr. S. K. Pande, by Meijer which formed the basis of the data given for this species by me (in table 1, Bharadwaj, 1972) earlier. A more detailed study has revealed that the number of stomata/sq mm in the material sent by Meijer ranges from 18-26 as is also the case in the sample nos. 15057 and 15058.

The only other species with mamillate spines known from the East Indies is *A. amboenensis* Schffn. Meijer (1953) considered *A. spinisporus* and *A. amboenensis* synonymous on the basis of his study of the type material of the former and the material from East Indies. However, a confirmation of this presumption will have to wait till the type of *A. amboenensis* is examined.



Text-fig. 4. *F.* sp. cf. *F. spinisporus* a. spore (proximal face), b. spore (distal face), c. spore (equatorial spines), d. elater cell.

Folioceros sp. cf. **F. spinisporus** (St.) Bharad.

Text-fig. 4.

Stephani Fondation No. 15059.

This specimen differs from 15058 in some respects. The spore size is 38 μ and the spine size is 6×7.5 μ (Text-fig. 4b). The stomata distribution is sparser (15/sq mm) and the stomata-length is 60 μ. However, the most significant difference appears to lie in the thickening of the elater cells which is rather thin with well-spaced tubercles protruding in the lumen (Text-fig. 4d). In extreme cases hardly any tubercles are seen and such cells present a condition quite like that found in *Anthoceros* cf. *gemmulosus* (Bharadwaj, 1958). Unfortunately the material examined was not only scanty but also the capsules were dehisced to such an extent that only slightly immature sporiferous material could be studied.

Folioceros glandulosus (L. et L.) Bharad.

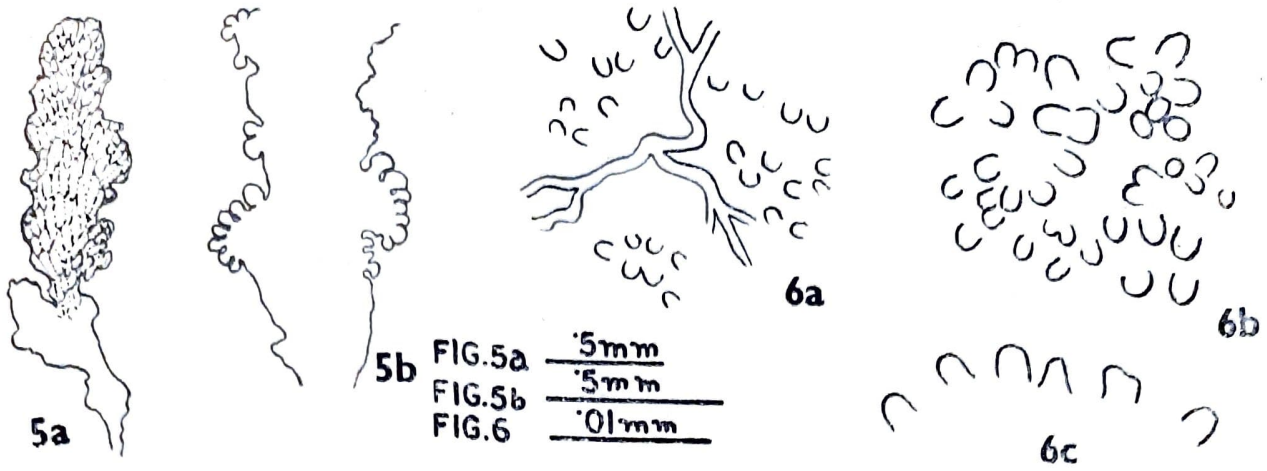
Fondation Stephani No. 15049, 15050, 15051, 15052

Remarks—Nos. 15049 and 15052 correspond to the material received from Meijer, diagnosed and described earlier by me (Bharadwaj, 1972). Nos. 15050 and 15051 are typically *Anthoceros* referable to *A. punctatus* complex and are no where near *F. glandulosus*. The diagnosis of *F. glandulosus* given by Stephani (1916, p. 971) seems to be a mix-up.

Folioceros sp. cf. **F. glandulosus** (L. et L.) Bharad.

Text-figs. 5, 6.

Fondation Stephani Nos. 15053, 15055, 15056.



Text-figs. 5, 6. *F.* cf. *F. glandulosus* (L. et L.) Bharad. 5 a. frond, b. frond margin; 6 a. spore (proximal face), b. spore (distal face), c. spore (equatorial bacula).

Thallus—The plant is dioecious. The fronds are small, long and narrow (Text-fig. 5). The margin of the fronds is beset with small, circular, multicellular, truncate, spongy bodies of various sizes. Surface is lamellate.

Androecia—In a row on the upper surface of male fronds. More than 60 young and old antheridia are seen occurring in a well developed androecium. Mature antheridium is typically anthoceroid. Antheridial body measures as much as 250 μ in height.

Involucre—The surface is slightly fluted and lamellate.

Capsule—The epidermis has up to 30 stomata per sq. mm. Stomata are 47 μ long.

Spore—The spore is light brown in colour and subcircular to circular in polar view. Trilete mark is well developed (Text-fig. 6). The equatorial and distal bacula are roundly truncate and 2×2 μ. The average diameter of the spore is 31 μ (28-33 μ).

Elater—Elaters are brown, slender, wide at the middle septum and usually four-celled with tapering ends. The wall of the elater cells is irregularly thickened and the lumen is narrow. A four-celled elater measures 280-400 μ in length and 5-12.5 μ in width.

Comparison—The species though not *F. glandulosus* as described by me (Bharadwaj, 1972) on the basis of a specimen sent to us by Meijer from Indonesia, is quite close to it in general features. It differs in the size of the antheridial body, density of stomata distribution and the stomata size and in the size of the bacula on the spore.

Meijer, who examined two of the specimens, 15053 and 15056, studied by me here, appended the following remarks to the specimen sheet—"*Anthoceros gemmulosus* Meijer, to be published in Notes II". Meijer has not published his Notes II so far. Specimen 15056 was identified by Stephani as *Asp. mangaloreus* but it is certainly not so. Specimen 15055 assigned to *Asp. fuscus* St. by Stephani also belongs here and has no similarity with Specimen 15054, which is the type of *Asp. fuscus*. Most surprisingly Stephani assigned 15053 to *Asp. amboenensis*. Evidently he did not have a correct idea of what *A. amboenensis* was like.

Folioceros fuscus (St.) comb. nov.

Text-figs. 7, 8

Syn. *Aspiromitus fuscus* St. in Stephani 1916.

Fondation Stephani No. 15054

Diagnosis emend—Planta dioica (?), *Frons* ad 3 cm., longa, cavernosa, longe furcata, ramis linearibus, regulariter pinnatim lobatis, lobis obtusis vel truncatulis angustis. *Involucra* levia. *Capsula* exigue stomatifera. *Spores* 31 μ (27-34 μ), fulvae, baculosae, bacula 2×1-2 μ, cicatrix tetradi parum perspicua. *Elateres* 440 μ (350-550 μ) longi, septati, spadici, anguste foramini. *Androecia* desunt.

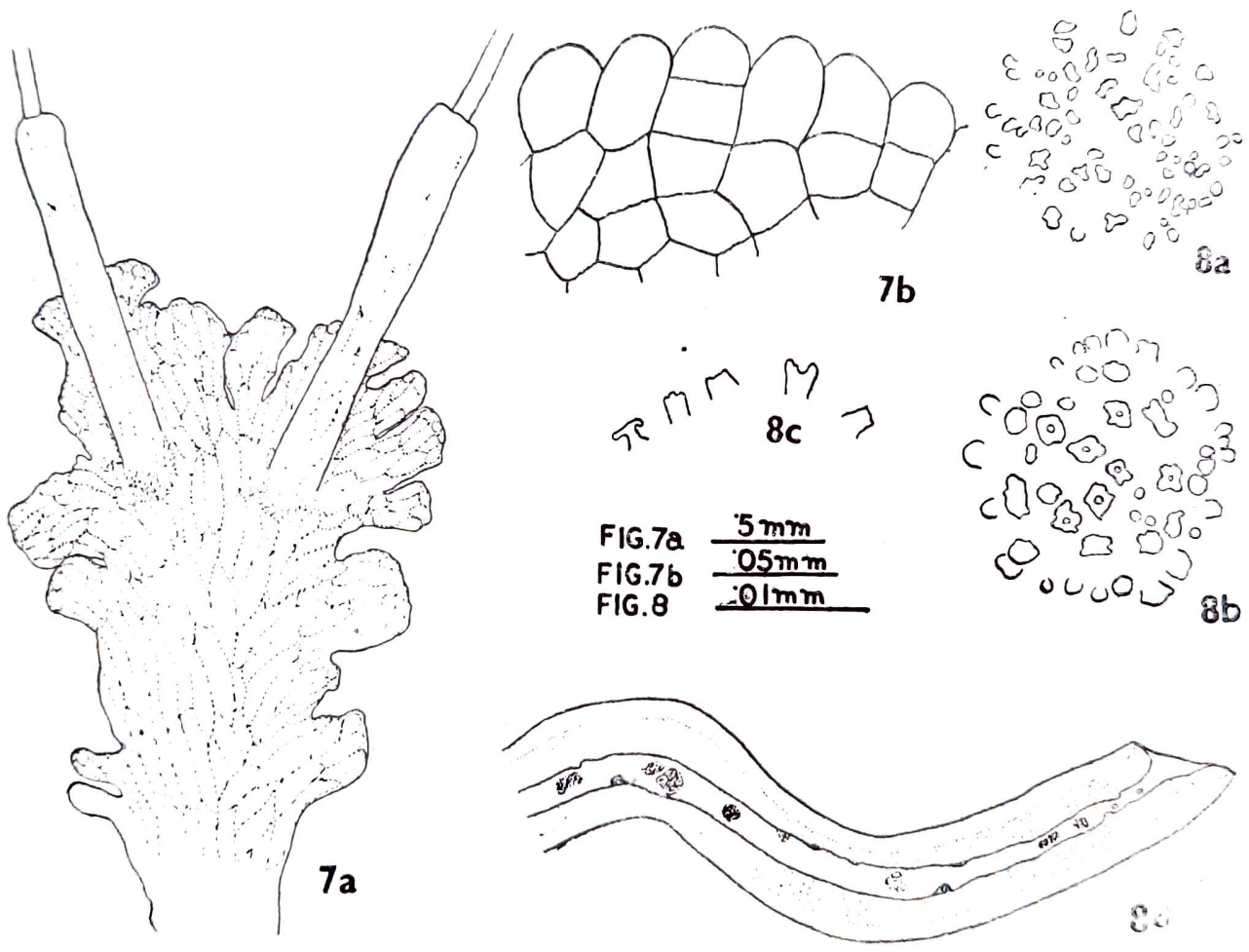
Habitat—New Caledonia.

Thallus—No androecia were found on the capsule bearing fronds. Distinctly androecia bearing fronds were also not found in the material. Hence, it is not certain whether the species is dioecious or monoecious. Fronds are longish and pinnately lobed. Lobes are truncate or spathulate. The lobe margin has longish marginal cells (Text-fig. 7b). The frond surface is smooth. Internally the thallus is cavernous.

Involucre—The involucre is cavernous, the cavities are in one row.

Capsule—The epidermis is very scantily stomatiferous. The number of stomata is 2 per sq mm of the epidermal surface. Stomata are 56 μ in length.

Spore—The spore is light brown and subcircular in polar view. Tetrad mark is hardly perceptible. The bacula are 2 μ high and 1-2 μ broad at the base. The tips of bacula are bifid, anchor-shaped or truncate. The bacula are smaller on the proximal face than those on the distal face (Text-fig. 8). The average diameter of the spores in polar view is 31 μ ranging between 27 μ and 34 μ.



Text-figs. 7, 8. *F. fuscus* (St.) comb. nov. 7*a*. capsules bearing frond, b. marginal cells. 8a. spore (proximal face), b. spore (distal face), c. spore (equatorial bacula), d. elater cell.

Elater—The elaters are brown, slender, vermiform and usually four-celled with tapering ends. The walls of the elaters are substantially regularly thickened enclosing a darker lumen of variable width. A mature, four-celled elater averagely measures 440 μ (350-550 μ) and the cell width ranges between 5-10 μ.

Comparison—As compared to *F. falsinervius*, the stomata are fewer and smaller, the spore is smaller but the bacula are bolder in *F. fuscus*. As compared to *F. vesiculosus* the spore

diameter is distinctly smaller. However, the details regarding *F. vesiculosus* are not conclusively known, hence, the comparison is only tentative. The thallus habit of *F. fuciformis* is quite different. In *F. incurvus* besides the linear pinnate thallus habit the spore ornamentation is distinctly finer and stomata are totally absent.

Remarks—The characters of *Asp. fuscus* St. ms. noted by Stephani on the specimen sheet for 15054 read as—"*Fr. cavernosa;* Sp. 27, fuscae muriculatae; Po El. longi, 360 μ, fusci; caps 4 cm; Inv 8 mm; ♂ monoica ramis aggregata." This description compares closely with the diagnosis of *Asp. fuscus* published by STEPHANI (1916, p. 967). Evidently his specimen No. 15054 is the type of *F. fuscus*. Specimen No. 15055, as remarked earlier is *F.* sp. cf. *F. glandulosus*.

GENERAL REMARKS

From my selective study of Stephani's material undertaken so far it is apparent that most of his collection needs re-examination for taxonomic assignments. It is also necessary that such taxa which were instituted prior to Stephani, viz., *A. glandulosus*, *A. amboenensis*, *A. fuciformis*, *A. tuberculatus*, *A. falsinervius A. vesiculosus* and *A. guadalupensis* must be correctly diagnosed and described on the basis of their type material before a final decision on the validity of the species instituted by Stephani and others later, could be taken.

Within the genus *Folioceros*, three sections each containing a number of distinct species based upon differences in spore characters and stomatal density as well as size are distinguishable so far, viz., (1) spores with dentate bacula, (2) spores with laevigate bacula and (3) spores with spines. In the last section there seem to be two groups of species, viz., those with mamillate spines having a huge, bulbous base and small spine and others with a small bulbous base and long spine. The former also uniformly has a monoecious thallus and the latter a dioecious thallus as known so far. Dioecism also seems to be a rule in section (2). In section (1) some species are monoecious and others are dioecious.

REFERENCES

BHARADWAJ, D. C. (1958). Studies in Indian Anthocerotaceae—II. The morphology of *Anthoceros* cf.*gemmulosus* (Hattori) Pande. *J. Indian bot. Soc.* **37:** 75-92.

BHARADWAJ, D. C. (1971). On *Folioceros*, a new genus of Anthocerotales. *Geophytology*. **1:** 6-15.

BHARADWAJ, D. C. (1972). On some Asian and African species of *Folioceros* Bharadwaj. *Geophytology*. **2:** 74-89.

MEIJER, W. (1953). Notes on some Malaysian speciès of *Anthoceros* L. (Hepaticae)-I. *Reinwardtia*. **2:**411-423.

STEPHANI, F. (1916). *Species Hepaticarum*. **V.** Genéve.