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ON KALLYMENIA WESTII SP. NOV. (RHODOPHYTA, CRYPTONEMIALES) FROM THE CARIBBEAN SEA [1]

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ABSTRACT: It is shown that the binomial *Kallymenia perforata* J. Agardh (Kallymeniaceae, Cryptonemiales) is applied to 2 distinct perforate species of *Kallymenia,* which are remarkably similar in external morphology, but are very different in the structure of the carpogonial branch system. The genuine *K. perforata* from the Indian and Pacific oceans (Type locality: Ceylon) is a species with a monocarpogonial branch system, with very much lobed cells, whereas the Caribbean Sea material, which was also hitherto referred to *K. perforata,* is polycarpogonial and the cells are not lobed. The Caribbean Sea material is, therefore, given a new name, *K. westii* Ganesan sp. nov.

RESUMEN: Ha sido mostrado que se venía aplicando el binomial *Kallymenia perforata* J. Agarth a dos especies distintas con perforaciones de *Kallymenia,* las cuales son notablemente semejantes en morfología externa, pero son diferentes en las estructuras del sistema de ramas carpogoniales. La verdadera o genuina *K. prforata* de los océanos pacífico e índico (localidad del holotipo Ceilan) es una especie con ramas monocarpogoniales con células muy lobuladas, mientras la especie del mar caribe, la cual también ha sido referido hasta ahora a *K. perforata* es policarpogonial sin lobulaciones en las células. El material del mar caribe se designa por lo tanto, bajo otro nombre *K. westii* Ganessan sp. nov.

INTRODUCTION

Continued collection and study of the marine algae from different parts of eastern Venezuela have brought to light many new additions to the flora (Ganesan, 1976). Besides, fertile female material have helped to clarify the identity and systematic position of some of the red algae, which are already known for our flora. In this paper observations on a new species of red algae, *Kallymenia westii* (Kallymeniaceae, Cryptonemiales) are given. Specimens on which the present study is based, are deposited in the Herbarium, Institute of Oceanography, Cumaná, Venezuela. Duplicate specimens are also deposited in the Herbarium of the University of California. Berkeley, U.S.A.

Kallymenia westii Ganesan sp. nov.
(Figs. 1-14, 16-21)

DESCRIPTION:

Plants subtidal, forming large foliaceous fronds to 20-(30) cm high and broad, attached to the substratum by 1-3 small peg-like discs, dark to bright rose red or pink in colour, delicate, gelatinous, with numerous perforations, scattered throughout the thallus surface (Figs. 1, 14), or perforations rarely few or even absent (Fig. 3, lower right), variable in size, small, circular or oval when young, later becoming large and irregular by fusion of many adjacent ones; thallus 300-500 µm thick, in transections consisting of 1-3 layers of outer cortical cells and a central, essentially hollow, medulla (Fig. 2) with a few thick filaments running vertically or obliquely from cortex to cortex; stellate cells with long, simple or branched radiating arms (Figs. 2, 19, 20, 21) common in the outer medulla.

Carpogonial branch systems polycarpogonial (Figs. 4, 8, 16, 17, 18) with 2-4-(8) three-celled carpogonial branches, very rarely monocarpogonial (Fig. 7), subsidiary cells variable in number, carpogonial branch cells and the subsidiary cells not lobed, supporting cell large, frequently with a constriction in the middle, first cell of the carpogonial branch sometimes lobod (Fig. 17); auxiliary cell systems borne on separate branch systems spatially

1. I have great pleasure in dedicating this article to Mme Marie Lemoine in recognition of her significant contributions to our knowledge of recent and fossil Corallinaceae during the last 68 years. Mme Lemoine will celebrate her 90th birthday on 29 December, 1977

removed from the carpogonial branch sytems, each auxiliary cell surrounded by up to 15 small, simple, densely staining, spherical to slightly elongate subsidiary cells (Fig. 5), subsidiary cells rarely producing trichogyne-like structures; presumably following fertilization, a prominent fusion cell formed by the union of most or all of the cells of the carpogonial branches and subsidiary cells with the supporting cell (Fig. 9), the fusion cell then producing many long, delicate, mostly unbranched and non-septate connecting filaments (Fig. 10); after diploidization of an auxiliary cell (Fig. 6), one to many gonimoblast initials produced at the terminal end of the connecting filament (Fig. 11); gonimoblas initials and their derivatives forming a gonimoblast parenchyma (Fig. 12), which eventully produces small packets of carposporangia; a special pericarpic investment not produced around the developing carposporophyte; mature cystocarps occuring in isolated groups, to 1 mm broad in surface view and without an ostiole; male and tetrasporangial thalli not observed.

DIAGNOSIS:

Thallus foliosus, sine ramis, ruber rosaceux ex obscuro ad clarum aut (rosatus) colore, delicatus, gelatinosus, ad 20 (30) cm altus et amplus, perforatus, diversis formis magnitudinibusque multae perforationes, thallus 250-500 µm crasus, structura kallymenioide, polycarpogonialia cum 2-4 (8) carpogonialis ramis, cellulis ovoideis, sed magnopere non loboides, cellulis auxiliaribus quiae usque ad 15 cellulas subsidiaris habent, cystocarpia 0,5-1 mm diam, comuniter palim ocurrents super talli superficiem.

TYPE LOCALITY:

El Farallon, Isla de Margarita, Venezuela, at 20 m depth.

HOLOTYPE:

EKG 935-A, 28.ix. 73 deposited in the Herbarium, Instituto Oceanográfico, Universidad de Oriente, Cumaná, Venezuela. Isotype EKG 935-B, 28.ix. 73 deposited in the UC Herbarium, Berkeley, California, U.S.A.

DISTRIBUTION:

Tropical and Subtropical western Atlantic ocean.

The specific name honours Dr. John A. West, Department of Botany, University of California, Berkeley, California, U.S.A., in appreciation of the many courtesies extended to me during my stay (1974-75) in Berkeley.

DISCUSSION

On external and anatomical features, the Venezuelan material described above as a new species would appear to agree well with the description and figures given by Borgesen (1915-1920) and Taylor (1960) of the tropical and subtropical western Atlantic material of *"K. perforata* J. Agardh". However, the following analysis of the literature on the genuine *K. perforata* and other perforate species of the genus shows that the Venezuelan plant represents a new species.

Kallymenia perforata was described by J. Agardh (1872) upon specimens from Ceylon (now Sri Lanka). The species was subsequently also recorded from Japan by Okamura (1912), who at first called his plant *K. cribrosa,* but later Yendo (1914) and he (Okamura, 1936) concluded that the Ceylonese and Japanese specimens represented one and the same species. In the tropical western Atlantic ocean, *"K. perforata"* was first collected from Florida by Mrs. G. A. Hall and distributed in PBA (no. 287 and UC 807129) and later from Jupiter Inlet, Florida by Howe and from Bermuda by Farlow (see Borgesen, 1910). Borgesen (*op. cit.* p. 180) while referring his Danish West Indies specimens to *"K. perforata",* also examined a specimen of the genuine *K. perforata* from Ceylon and arrived at the conclusion that "in outer habit my specimens quite agree with the Ceylon specimen and the antomical structure also seems to be quite the same in the specimens in question so far as this can be judged from dried material" (see also Borgesen, 1915-1920). Following this opinion of Borgesen, other phycologists (Collins & Hervey, 1917; Taylor, 1928, 1960) also referred their material to *"K. perforata".* It should be pointed out that carpogonial branch and auxiliary cell morphology of the western Atlantic material of *"K. perforata"* has remained unknown hitherto. Taylor (1960) only mentioned cystocarps as occuring scatered between perforations.

Thallus structure and carpogonial branch morphology (monocarpogonial with much lobed cells) of the Japanese material are known from the observations of Okamura (1912, pls. 86, 87). Unfortunately carpogonial branch systems have never been observed in Ceylonese specimens. Attempts by the present author to get fertile female topotype material were not successful. However, Burmese speciments of *Kallymenia perforata* are monocarpogonial with lobed carpogonial branch cells (U. Min-Thein & H. B. S. Womersley, *pers. comm.*). As shown in the present study, the Venezuelan material of *"K. perforata"* is polycarpogonial with out lobed cells. Hence, it is clear that two different perforate *Kallymenia* species with similar external appearance, but with different carpogonial branch morphology have been passing under the name *K. perforata.* Mention may also be made that two other perforate species, both from Australia, *K. cribosa* Harvey and *K. cribrogloea* Womersley *et* Norris, which have remarkable habit and structural similarities, are differentiated essentially on the basis of the structure

of the carpogonial branch system. *K. cribrosa* is monocarpogonial with carpogonial branch cells that are very much lobed, whereas *K. cribrogloea* is polycarpogonial without lobed cells (Womersley & Norris, 1971).

Thanks to the kindness of the Curators of the British Museum (Natural History) and the Agardh Herbarium, Lund, I have been able to examine the original material on which J. Agardh based his description of *Kallymenia perforata* from Ceylon. In the British Museum, there are 5 specimens mounted on 3 sheets. The "type folder" bearing the annotation "Ex. Hb. Gray Ceylon. Species mihi ignota. Ceylon Algae no. 16. Herb. Alg. Dickie" has 2 specimens of which the upper one is marked "type"[1] (Fig. 13, upper figure) Examination of this specimens as also the other 4 specimens showed that the surface cells are well separated and transections show a few longitudinally running filaments. A similar structure was also shown by the 3 specimens (nos. 24566, 24567, 24568) in the Agardh Herbarium. One of the specimens in the British Museum is cystocarpic (Fig. 15). Cystocarps in this specimen are small, 240-500 μm in diameter in surface view and are immersed in the thallus. Examination of representative areas of this plant did not reveal any carpogonial branches.

The Venezuelan material cannot be assigned to any of the 4 currently recognized perforate species of *Kallymenia* from different parts of the world for the following reasons. The thallus structure of the Australian *K. cribrogloea* Womersley *et* Norris is thick and its structure is also quite different (see Womersley & Norris, 1971, fig. 6). *K. cribrosa* has smaller perforations, with large areas of tissue between the holes, and has a unicarpogonial branch system, with elongate much lobed carpogonial branch cells (Womersley & Norris, 1971, fig. 3). The medulla of *K. pertusa* Setchell *et* Gardner, recorded hitherto only from the Gulf of California, is composed of much branched intertwined filaments (Setchell & Gardner, 1924; Dawson, 1954; Norris & Norris, 1973) and the auxiliary cells are surrounded by 3 two-celled subsidiary branches and one unicellular subsidiary branch (Norris & Norris, 1973, fig. 5). The rare subtidal South African *K. papenfussii* Norris (1964) has a cuneate thallus with small rounded holes.

It is probable that the material passing under *"Kallymenia perforata* J. Agardh" from other parts of the tropical and subtropical western Atlantic Ocean may also be referable to *K. westii,* but that remains to be determined.

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1. The type should be a specimen in Herb. Agardh and I here designate no. 24566 as lectotype of the species.

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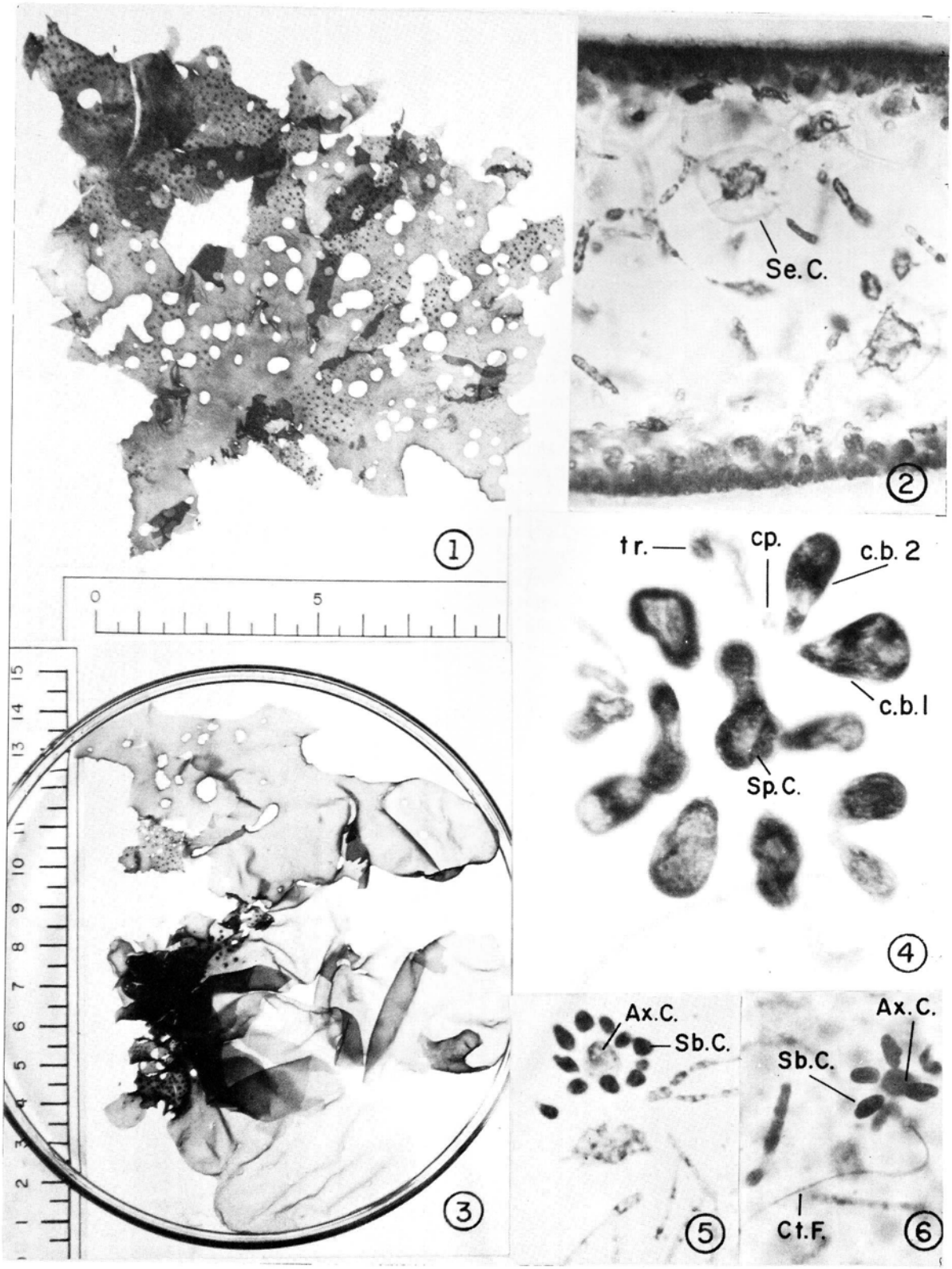
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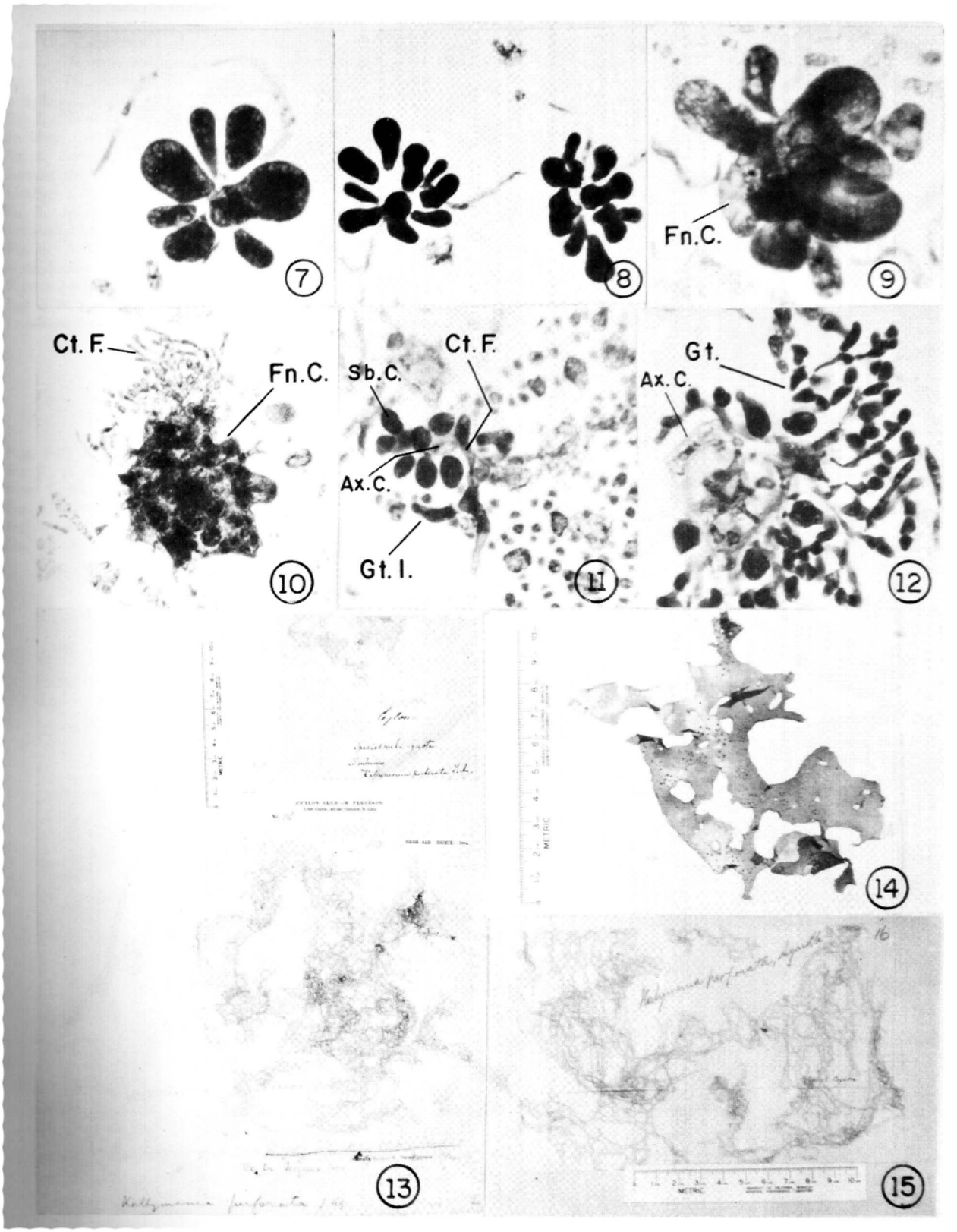
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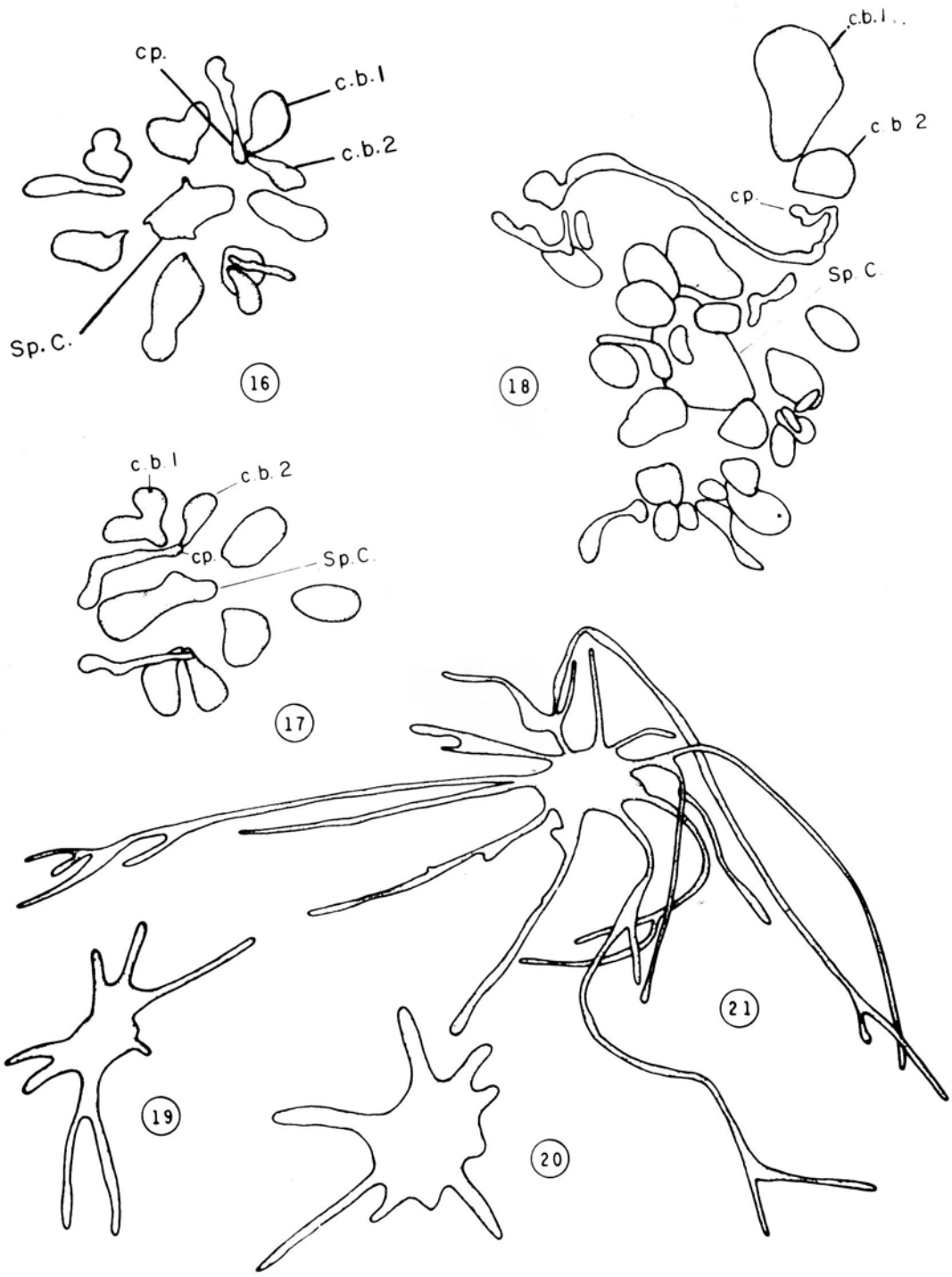
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17
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50 µm

EXPLANATION OF FIGURES 1-6

Figs. 1-6. *Kallymenia westii* Ganesan sp. nov.
Fig. 1. Holotype specimen (cystocarpic, EKG 935 A, 28.ix.73).
Fig. 2. Transection of sterile thallus, showing the essentially hollow medulla and stellate cells X 235.
Fig. 3. Habit of two plants. Note the absence of perforations in the lower one.
Fig. 4. Squashed preparation of a carpogonial branch apparatus, showing the central supporting cell and 3 three-celled carpogonial branches X 680.
Fig. 5. Auxiliary cell apparatus, showing the central auxiliary cell surrounded by many subsidiary cells X 277.
Fig. 6. A connecting filament approaching the auxiliary cell for diploidization X 377.
Figures 2-6 from the Holotype specimen. One space in the scale in figs. 1 & 3 corresponds to 5 mm.
(Abbreviations used: Ax.C = Auxiliary Cell; C.b.1. = first cell

EXPLANATION OF FIGURES 7-15

Figs. 7-12. *Kallymenia westii* Ganesan sp. nov.
Fig. 7. A monocarpogonial branch system. Note the cells are not lobed X 400.
Fig. 8. Two bicarpogonial branch systems X 280.
Fig. 9. Advanced stage in the formation of fusion cell X 480.
Fig. 10. Fusion cell sending out connecting filaments X 450.
Fig. 11. Terminal part of a connecting filament with a gonimoblast initial X 300.
Fig. 12. More advanced stage in the development of gonimoblast parenchyma X 490.
Fig. 13. Two sterile specimens (upper one masked "type", however see f.n.1.) of *Kallymenia perforata* J. Ag. from Ceylon (British Museum, Natural History London).
Fig. 14. Cystocarpic specimen of *Kallymenia westii*. This specimen showed up to 8 carpogonial branches.
Fig. 15. Cystocarpic specimen of *Kallymenia perforata* from Ceylon (British Museum, Natural History, London).
Abbreviation used: Fn.C. = Fusion cell; Gt.I. = Gonimoblast initial.
For explanation of other abbreviations, see legend for figures 1-6.

EXPLANATION OF FIGURES 16-21

Figs. 16-21. *Kallymenia westii* Ganesan sp. nov.
Fig. 16. Two 3-celed carpogonial branches and 2 unicelluar subsidiary cells.
Fig. 17. Two 3-celed carpogonial branches and 3 unicellular subsidiary cell branches. Note the first cell of the carpogonial branch is bilobed.
Fig. 18. Carpogonial branch apparatus with 7 carpogonial branches.
Figs. 19-21. Stellate cells.
For explanation of abbreviaitons see legend for figures 1-6.