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by

Hisao Ogawa* and Khanjanapaj Lewmanomont**

Abstract

Specimens of the genus *Hypnea* which were collected in the vicinity of Si Racha in the eastern part of the Gulf of Thailand are described. Six species are discussed, four of which are new records for Thailand: *Hypnea cornuta* (Lamouroux) J. Agardh, *H. hamulosa* (Turner) Montagne, *H. charoides* Lamouroux, and *H. cenomyce* J. Agardh.

Introduction

Seaweeds play an important role in the countries of both orientals and occidentals. They are widely eaten by coastal peoples, especially by the people of the Pacific Asian countries. On the other hand seaweeds are of importance not only as foods, but also as industrial resources e.g., agar–agar, carrageenan, sodium alginate and other useful substances are derived from seaweeds. In general, the important economic species are red algae, particularly the species of *Porphyra, Gelidium, Pterocladia, Gracilaria, Grateloupia, Acanthopeltis, Ahnfeltia, Hypnea, Eucheuma* and *Chondrus*. Among them, plants of the genus *Hypnea* are well known to possess a phycocolloidal substance which can be extracted by an appropriate method to give a product similar to agar–agar; and members of this genus are very common in the warm water regions all over the world, but little attention has been devoted to their growth and distribution.

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Thailand is endowed with a long shoreline on which many kinds of seaweeds are abundant, but our knowledge of the general features of the marine algal flora of the Gulf of Thailand is still fragmentary. The seacoast of Thailand is one of the uncharted areas of the world in the field of phycology, although some studies on the marine algal flora of Thailand have been conducted by G.V. Martens (1866), J. Schmidt (1900-1916), A. Weber van Bosse (1913–1928), L. Egerod (1971, 1974, 1975), and Y. Maneerat (1974). According to their studies, there are 204 species, 18 forms and 16 varieties of seaweeds in Thailand. However, it is likely that there are still many species that have not been reported.

Four species of the genus *Hypnea* have been reported from Thailand; *H. musciformis* at Lem Ngob, Rayong, *H. divaricata* at simaharadscha, Chonburi, *H. cervicornis* at Saen Soek, Chonburi, and *H. esperi* at Koh Chang, Trat. It has been found that the species of *Hypnea* produce a gel similar to agar–agar, but no systematic study on this genus have been done in Thailand. Therefore, the present authors made a study on the taxonomy of the phycocolloid algae genus *Hypnea* which grows on the eastern coast of the Gulf of Thailand. In the present paper, six species of the Thai *Hypnea* are described, of which four species are new records for Thailand.

Materials and locations

The genus *Hypnea* was established by LAMOUROUX in 1813. He listed five species which are widely distributed in both hemispheres, especially in warm-waters. J.G. Agardh (1852) made the first effort on the systematic arrangement of this genus, and enumerated 19 species and 3 indefinite species. Tanaka (1941) reported 14 species of plants of this genus which grow on the coast of the western Pacific.

On the other hand, four species of *Hypnea* have been reported from Thailand by the following authors : *H. cervicornis* (Dawson 1954), *H. divaricata* (Martens 1866), *H. esperi* (Dawson 1954, Egerod 1971), *H. musciformis* (Schmidt 1900–1916). Except the works of these authors no study appears to have been made on this genus in Thailand.

Most of the material for the present study was collected on the coast near Si Racha, Chonburi Province from December 1977 to April 1978.

The collected specimens were soaked immediately in formalin, and on arrival at the laboratory they were preserved in 5–10 % formalin in seawater. Herbarium specimens were prepared from the preserved ones, and are kept in the laboratory of the Department of Fishery Biology, Faculty of Fisheries, Kasetsart University, Bangkok.

Cytological examination has been done by sectioning the lower and upper parts of branches and the reproductive organs. These structures were drawn by a camera lucida attached to a light microscope.

Key to the species

1. Fronds intricate, not beset with cushion-like lower portion 2
1. Fronds strongly intricate, consisting of cushion-like lower portion, tetrasporangia around the branchlet at basal or middle parts ..... *H. cenomyce*
2. Fronds membranaceous 3
2. Fronds rigid, with thick and short spine-like branchlets ..... *H. hamulosa*
3. Principal axis percurrent, branches monopodial or alternate 4
3. Principal axis not percurrent, branches divaricate dichotomous ..... *H. cervicornis*
4. Spinous process not stellate, short or long 5
4. Spinous process stellate ..... *H. cornuta*
5. Fronds slender and very small, tetrasporangia on basal or apical portions ..... *H. esperi*
5. Fronds caespitose, tetrasporangia on basal or middle portions ..... *H. charoides*

Hypnea cenomyce J. Agardh Fig. 1–6

Tanaka (1941) p. 250, fig. 21; Dawson (1944) p. 292, Dawson (1954) p. 436; Durairatnam (1961) p. 57; Pham-Hoang Ho (1969) p. 197, fig. 2.129; Cordero (1977) p. 143, fig. 130.

Fronds strongly intricate–caespitose in the upper and lower parts, forming a cushion–like mass, 5–8 cm high, 500–650 μm in diameter; branching irregularly in all directions, branches cylindrical, beset with numerous short

and long slender spinous branchlets, and with numerous accessory small discs; tetrasporangia borne in the lower or middle portion of the branchlets, swollen; the number of pericentral cells four to six; lenticular thickenings in the medullary cell walls not observed; color light red or reddish brown.

Although the present specimen is very similar to *Hypnea hamulosa*, it differs from this species by the presence of numerous accessory small discs and a cushion-like mass in the lower part of the plant.

Hypnea hamulosa (Turner) Montagne Fig. 7–13

Weber van Bosse (1928) p. 453, fig. 191; Okamura (1936) p. 611; Tanaka (1941) p. 245, fig. 17; Durairatnam (1961) p. 56, pl. 15, figs. 10–11; Cordero (1977) p. 146, fig. 137.

Frond cartilaginous, strongly caespitose, 13-15 cm high, 650–1000 μm in diameter; loosely intricated in lower parts, branching alternate or irregular, branches cylindrical or slightly compressed, beset with short and long spinous branchlets, numerous; ultimate branchlets short and rigid; the apex acute, the base broader; lenticular thickenings in the medullary cell walls not observed, the number of pericentral cells four to five; tetrasporangia borne in the middle or lower part of the short branchlets, swollen, encircled; cystocarps scattered over the branches, globose, 540–600 μm in diameter; color purple or dark red.

The whole plant is almost clothed with acuminated ramuli. The specimens studied showed similar characteristics to the plants described by Tanaka (1941), Durairatnam (1961), except for the presence of lenticular thickenings in the medullary cell walls by Tanaka (1941) and Cordero (1977).

This species grows on rocks and small stones in the lower littoral area. It is a common species in the Si Racha area.

Hypnea cervicornis J. Agardh Fig. 14–16

Okamura (1916) vol. 4, p. 35, pl. 159, figs. 6–9; pl. 160, figs. 1–5; Weber van Bosse (1928) p. 454; Okamura (1936) p. 611; Tanaka (1941) p. 240, fig. 13; Taylor (1945) p. 228; Dawson (1954) p. 437, fig. 46-d; Taylor (1960) p. 466, pl. 73, fig. 2; Durairatnam (1961) p. 56; Tanaka and Pham-Hoang Ho (1962) p. 38, fig. 14; Pham-Hoang Ho (1969) p. 192, fig. 2.123; Velasquez (1973) p. 31–32; Velasquez and Lewmanomont (1975) p. 17; Cordero (1977) p. 143, figs. 131–132.

Fronds loosely entangled or caespitose, forming dark olive brown or reddish green color mats, the main axes cylindrical, 7–12 cm long, 400–900 μm in diameter; branching for the most part irregularly divaricate, dichotomous, the lower branches decumbent and the upper cervicorn, the ultimate branches tapering to the tips; attached by a small discoid holdfast, or secondarily attached by accessory discs; cortex consisting of one or two layers of small cells with a thick membrane; number of pericentral cells in lower axis five or rarely six; lenticular thickenings in the medullary cell walls not observed; tetrasporangia usually elliptical and around the middle or basal part of the branchlets; cystocarpic and antheridial plants not found.

Our specimens are small and intricate, but in general appearance they agree well with the descriptions by Dawson (1954), Tanaka (1941) and Tanaka and Pham-Hoang Ho (1962). The habit of this species frequently varies in specimens collected from different places. Tanaka (1941) observed the presence of lenticular thickenings of the medullary cell walls in the Japanese specimens, but Tanaka and Pham-Hoang Ho (1962) reported that lenticular thickenings in the medullary cell walls were very rare in the Vietnamese specimens. In our specimens from Thailand, we could not find lenticular thickenings. This may depend on differences in ecological conditions at the various collection sites and the variation is accepted by many authors.

Hypnea cornuta (Lamouroux) J. Agardh Fig. 17–19

Weber van Bosse (1928) p. 453; Taylor (1928) p. 156, pl. 22, fig. 12; Tanaka (1941) p. 242, fig. 14; Dawson (1954) p. 436, fig. 46–c; Taylor (1960) p. 467; Pham-Hoang Ho (1969) p. 193, fig. 2.124.

Fronds caespitose or loosely intricate caespitose, 10–12 cm high, 500–800 μm in diameter; vegetative frond membranaceous, cylindrical and tapering; branching freely alternate, branches tapering to the extremities; the principal branching of the axes loose, forming large and small divisions; the ultimate branchlets spinous or stellate spinous, the stellate spinous process consisting of 3–6 ways, attached peltately on the branchlets of 2–5 points; no lenticular thickenings in the medullary cell walls; tetrasporangia forming small swellings encircling the middle or lower part of the branchlets; cystocarpic and antheridial plants not collected; color light red or pale red.

The most characteristic feature of this species is the stellate spinous process. Our specimens described here are fragments, but they had a number of characteristic stellate spinous process. The feature was very similar to the description and text figures by Weber van Bosse (1928), Tanaka (1941), Dawson (1954) and Pham-Hoang Ho (1969). According to Edwards (1970) the stellate spinous process are readily detached and develop into new individuals, and thus constitute a means of asexually reproducing the species.

Hypnea esperi Bory Fig. 20–22

Schmidt (1929) p. 64; Tanaka (1941) p. 243, fig. 15; Yamada (1944) p. 39; Dawson (1954) p. 436, fig. 46, h–j; Pham-Hoang Ho (1969) p. 194, fig. 2.125; Egerod (1971) p. 133, figs. 58–61; Velasquez and Lewmanomont (1975) p. 17; Cordero (1977) p. 146, fig. 134.

Fronds minute 4–6 cm high, 350–400 μm in diameter in lower parts; loosely intricate to caespitose, forming an entangled mass, attached by a small discoid holdfast; branching irregularly or subdichotomously in all directions, branches membranaceous, cylindrical and tapering; medullary cells enlarged, lenticular thickenings in the medullary cell walls not observed in the older part, the number of pericentral cells five rarely six; zonate tetrasporangia found on the basal or upper part of the ultimate branchlets, swollen; cystocarpic and antheridial plants not collected; color pale red or light red.

Hypnea esperi is the smallest plant in size and with the most slender branches among the species collected from Si Racha. The present specimens are fragments, but have similar characteristics to the plants described by Tanaka (1941), Pham-Hoang Ho (1969), and Egerod (1971). The lenticular thickenings in the medullary cell walls were not found in our specimens. The authors have some doubt as to whether this specimen is *Hypnea esperi*, so the identification is tentative. The frond grew on rocks or on other algae in the lower littoral zone.

Hypnea charoides Lamouroux Fig. 23–28

Weber van Bosse (1928) p. 499; Tanaka (1941) p. 243, fig. 16; Cordero (1977) p. 144.

Fronds caespitose and loosely intricate at the lower parts 10–14 cm high, 450–600 μm in diameter; attached by a small holdfast, and secondarily

attached by accessory small discs; branching alternate; branches membranaceous and sub-cylindrical, the principal axes percurrent, beset with short and spinous branchlets coming out in all directions; the ultimate branchlets long and slender, tapering to the tips; the number of pericentral cells five to six, lenticular thickenings in the medullary cell walls not observed; tetrasporangia borne on the basal or middle part of the ultimate branchlets, swollen; color brown or pale red.

In referring to the descriptions by Weber van Bosse (1928) and Tanaka (1941), it is known that this species has many similarities to *Hypnea seticulosa* and *H. valentiae*, but in *Hypnea seticulosa* was referred as *H. charoides*, and *H. valentiae* differs in the number of pericentral cells and the feature of the ultimate branchlets. The present specimens were assigned to *Hypnea charoides* from the above reasons. It is also known that this species has a good quality phycocolloidal substance, so that this species is one of the most important plants in the genus. This species was easily found at any place near Si Racha through our collecting period.

Discussion

The demand for marine products, including seaweeds, is now expanding throughout the world. Plants of the genus *Hypnea* may be important marine resources of Thailand, because the species contain a phycolloidal substance.

It has been reported that four species of *Hypnea* grow on the seacoast of the Gulf of Thailand: *H. musciformis* at Lem Ngob, *H. divaricata* at Simaharadscha, *H. cervicornis* at Saen Soek and *H. esperi* at Koh Chang. From our present observations, six species of *Hypnea* from Thailand grow along the eastern coast of the Gulf of Thailand, of which four species are new records for Thailand: *Hypnea hamulosa, H. cornuta, H. charoides*. and *H. cenomyce*.

Although the plants of *Hypnea cervicornis, H. hamulosa* and *H. charoides* were easily found in our small collections from December 1977 to April 1978, we could not find the species *Hypnea musciformis* and *H. divaricata* which are important phycocolloid producers. Through our present work, we did not have enough time for collecting and the collecting place was also

limited. Therefore, we could not also pay much attention to observations of the standing crop and the rate of matured tetrasporic or cystocarpic plants. In future, if we want to propagate or culture these algae, it will be necessary to conduct ecological studies, especially on the reproductive season, spore culture or environmental conditions.

During our survey not only *Hypnea* specimens were collected, but also other economically important seaweeds growing along the eastern coast of the Gulf of Thailand were collected.

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Explanation of figures

Hypnea cenomyce

1) Habit of an axis with stichidia and accessory small discs x 37; 2) Transverse section of stichidium x 325; 3) Transverse section of branch with stichidium x 90; 4, 5, 6) Transverse sections of axes x 90

Hypnea hamulosa

7) Habit of portion of branch x 9.2; 8, 9) Habit of branches bearing cystocarps x 8.2, x 19.3; 10) Habit of tetrasporic branch x 13.6; 11) Transverse section of branch x 90; 12) Transverse section of stichidium x 143; 13) Transverse section of cystocarp x 90

Hypnea cervicornis

14) Habit of portion of frond x 1; 15) Habit of portion of branch x 7.8 16) Transverse section of branch x 90

Hypnea cornuta

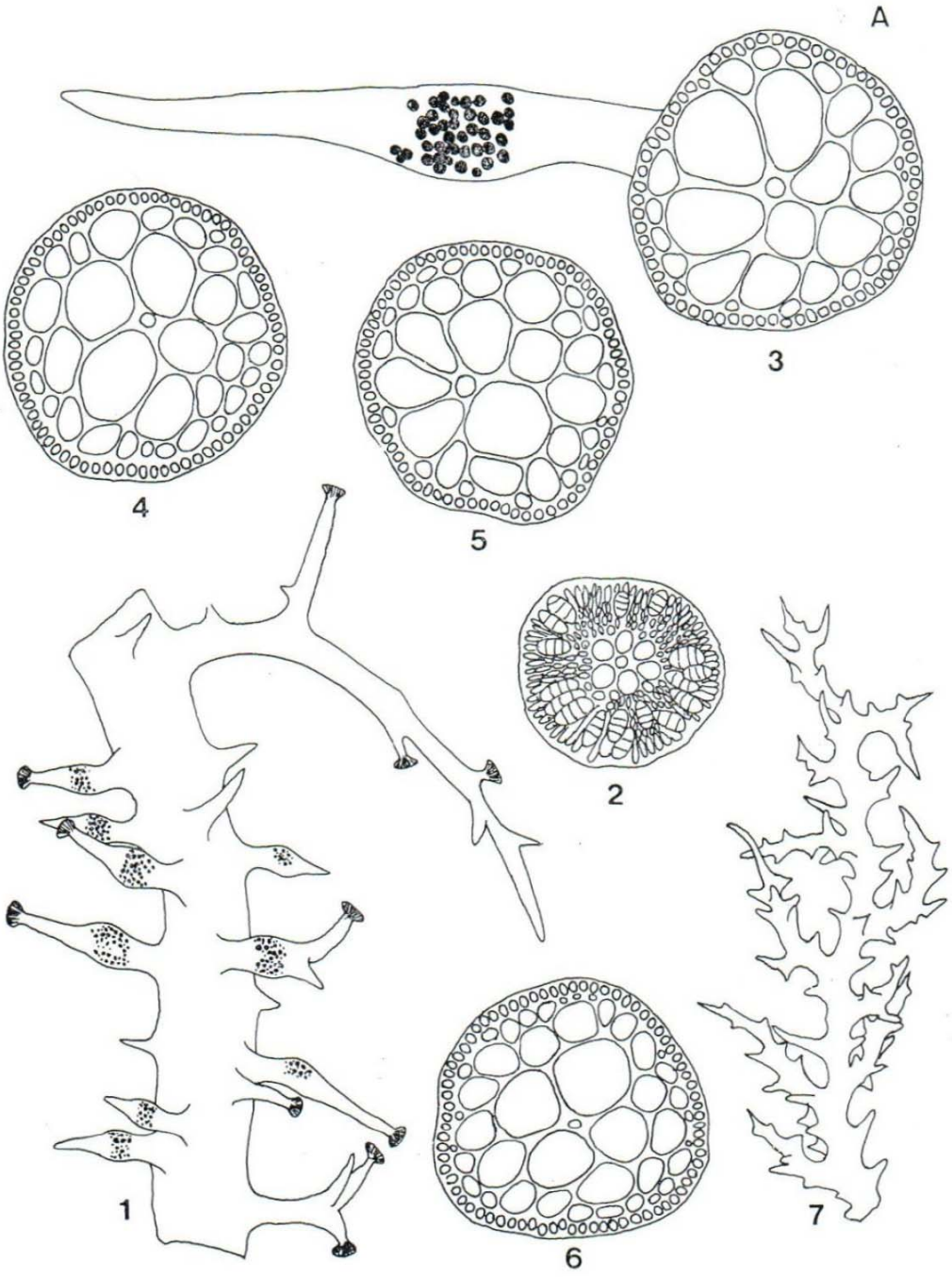
17) Habit of lower part of axis with several stellate processes x 14; 18, 19) Apical part of branches with stellate processes x 9.4

Hypnea esperi

20) Habit of portion of frond x 9.2; 21, 22) Transverse section of branch x 90

Hypnea charoides

23,24) Habit of tetrasporic branches x 11.5, x 20.1; 25) Transverse section of stichidium x 143; 26) Transverse section of branch x 90; 27,28) Transverse sections of branch with stichidium x 90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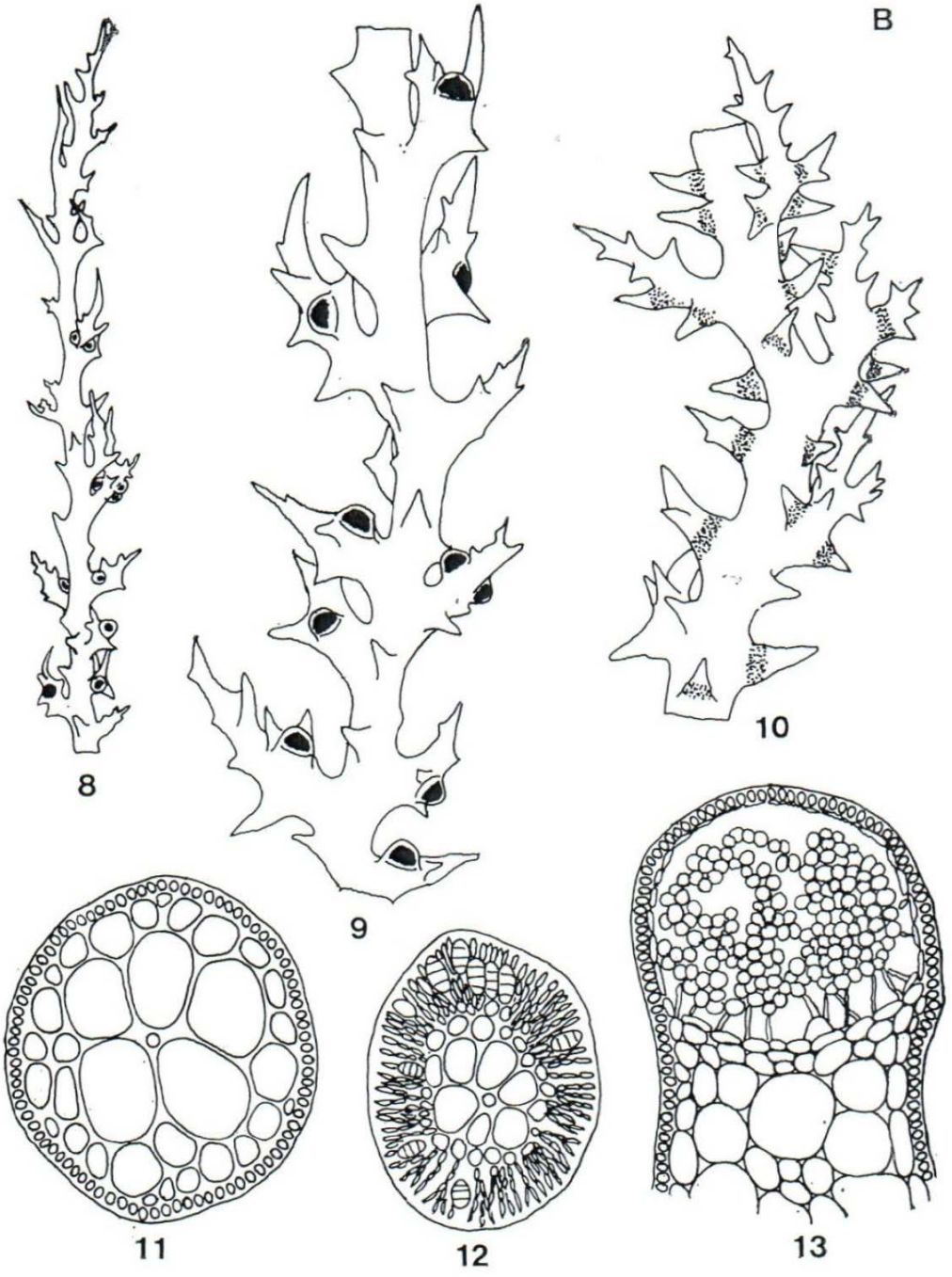
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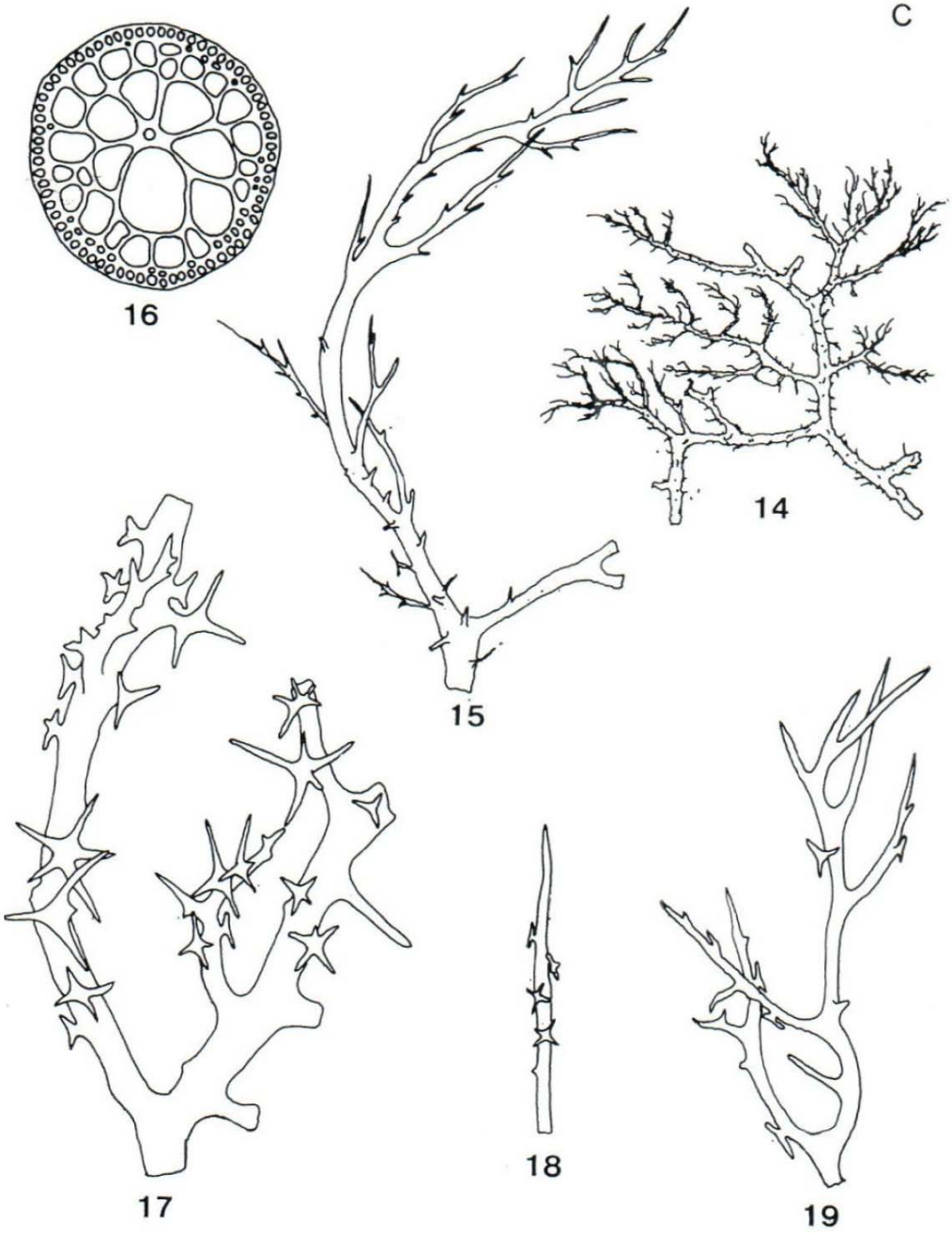
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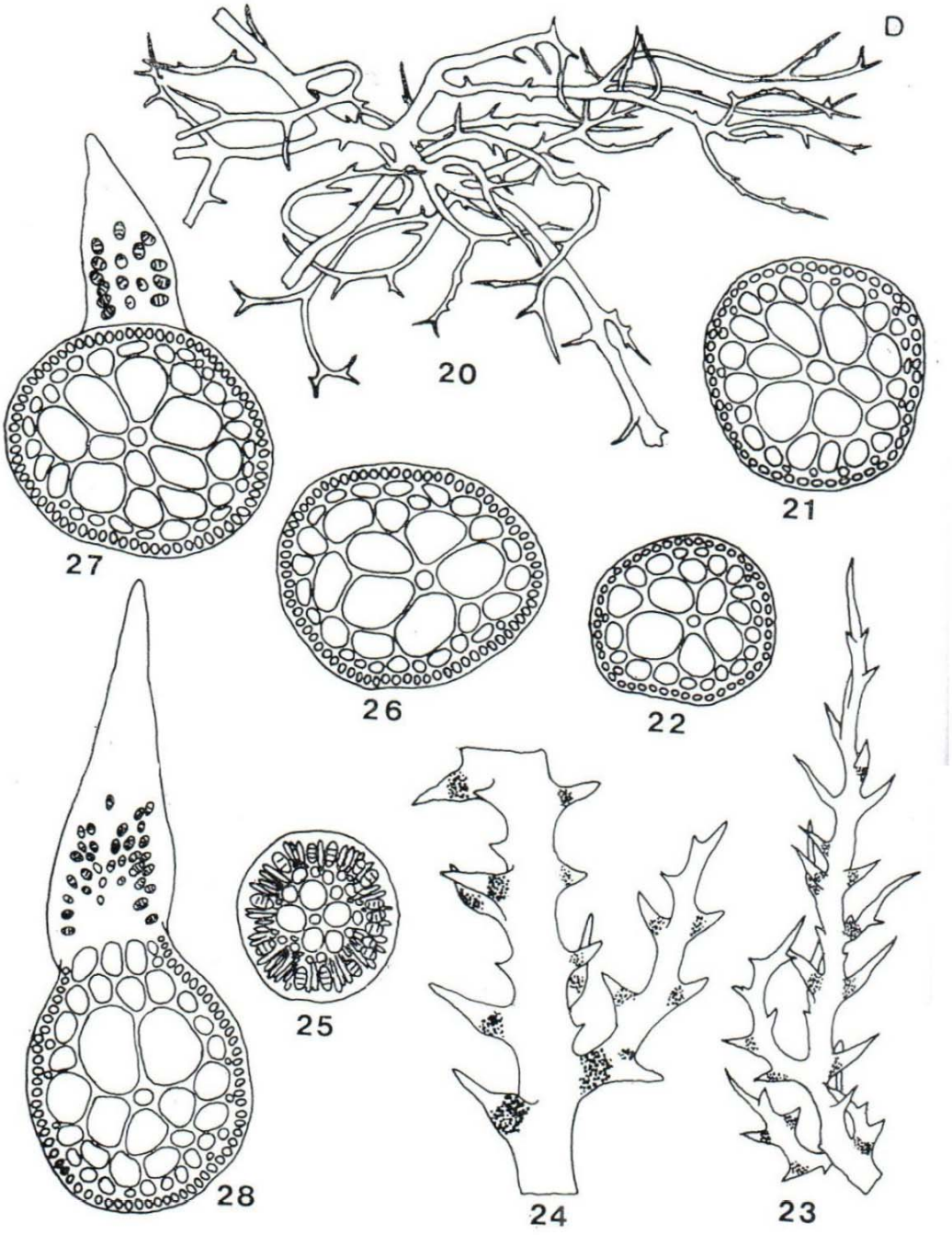
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