

## Some Notes on the Genera *Padina* and *Zonaria* in the Southwestern Islands of Japan

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Genus *Padina* hitherto recognized in the Japanese Islands, amounts to six species; *P. arborescens* Holmes, *P. crassa* Yamada, *P. commersonii* Bory, *P. minor* Yamada, *P. australis* Hauck, and *P. japonica* Yamada. Recently, in 1960, another species *P. stipitata* Tanaka et K. Nozawa was newly reported by the writers, adding one species to this group.

As for genus *Zonaria*, except *Z. coriacea* Yamada reported by Yamada from Formosa in 1925, *Zonaria diesingiana* J. Ag. has been the only species known in the Japanese Islands. Some knowledge about these two groups obtained by the writers through the investigations on the Southwestern Islands of Japan and Ryukyu Islands shall be reported as follows:

- (1) ***Padina australis* Hauck v. *cuneata* Tanaka et K. Nozawa**  
var. nov.

### Pl. I, A and Text-fig. 1

Frons erecta, nitidula, membranacea, 7–12 cm. alta, ca. 70–85 $\mu$  crassa, 45 $\mu$  in parte marginalibus, lineari-flabelliformis, saepe multo fissa et cuneata, duobus cellularum stratis composita; tetrasporangiorum in superficie supera in lineis interruptis zonas interpilas occupantibus, sporangiis pyriformibus, 90–125 $\mu$  altis, 85–95 $\mu$  longis, sine inducio; colore nitido-bruvo. Planta typica in loco dicto Amadomari, Nishino-omote, Tanegashima, legit Tanaka, no. 19602, 9 Aug., 1959.

Japanese name. Kirebano-usuba-umiuchiwa.

Habitat and localities. Amadomari, Nishino-omote, Tanegashima; Nha-Trang, Viet-Nam. Growing on the rocks in rather lower sublittoral zone.

Fronde erecta, nitidulus, membranaceus, 7–12 cm. high, about 70–85 $\mu$  thick, 45 $\mu$  at the upper marginal parts, attached to the substratum by means of a hairy base, broadened flabellately upwards, very often split into many segments and cuneate; segments narrowly flabelliform split shallowly at the margin, consisting of two layers of cells throughout the whole length except the apical portion, a thin surface layer consisting of nearly rectangular cells and a layer of slightly larger cells below, provided with short rhizoids on both surface; tetrasporangial sorus disposed concentrically on the middle parts in every interpilar space, tetrasporangia irregularly scattered, pyriformis, about 90–125 $\mu$  high, and 85–95 $\mu$  long, without indicium; colour of the frond bright yellowish brown, but somewhat brown in basal parts, and usually without chalk on the upper surface, except the basal portion.

The most characteristic feature of the present plant is that it is very often split into many segments, each segment being cuneate in shape. The frond is glossy, with yellowish brown colour living condition. The frond consists entirely of two layers of upper and lower cells. Tetrasporangial sorus is disposed concentrically on the middle portion in every interpilar space of the upper surface, and the rows of hairs above the rows of the tetrasporangia are always situated on the opposite side (surface below) of the thallus. Also on the surface view, the portion between the upper hair lines disposed on the tetrasporangial sorus on the surface below and the lower hair lines under the tetraspo-

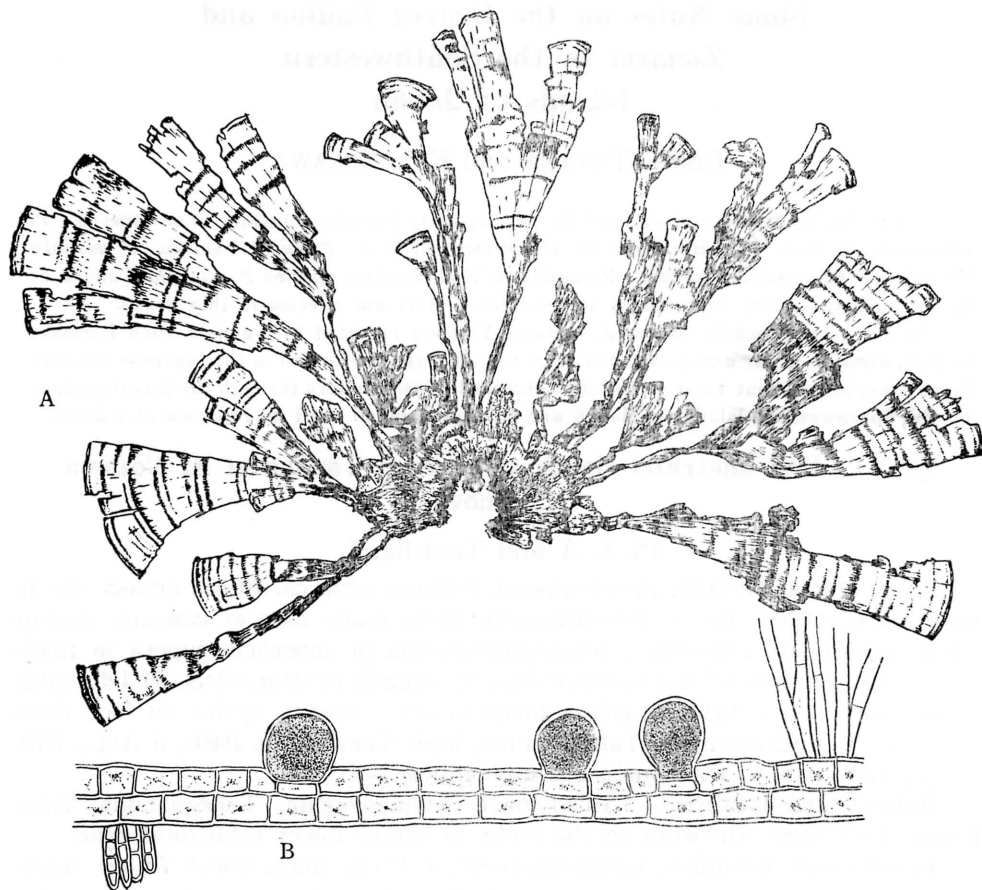


Fig. 1. *Padina australis* Hauck var. *cuneata* Tanaka et K. Nozawa.

A. Habit of the plant.  $\times \frac{2}{3}$ , B. Transverse section of the thallus with sporangia and hairs.  $\times 75$ .

rangial sorus on the upper surface seems to be a sterile part.

The above mentioned fact, especially the relationship between the hair lines and the sorus lines in *Padina australis* Hauck and *P. gymnospora* (Kg.) Vickers was described already by Dr. Boergesen (1930) and Dr. Yamada (1950). And besides, *P. australis* Hauck is treated there by Boergesen as a synonym of *P. gymnospora* (Kg.) Vickers.

But, since the present plant always consists of two layers, in accordance with Dr. Yamada's opinion, the writers prefer to adopt the name of *P. australis* Hauck as the specific name of the present plant.

(2) The prostrate rhizome of *Padina commersonii* Bory  
Pl. II, A. and Text-fig. 2

*Padina commersonii* Bory is widely distributed in the southern Pacific coast. In 1959, abundant materials of the fructiferous prostrates rhizome of *Padina* were collected from Hikawa, Yonakuni Island, Ryukyu Islands by the writers, which

were assumed to be the rhizomes of *P. commersonii* Bory.

These prostrate rhizomes of *P. commersonii* Bory are usually deep brown in colour, forming cushion-shaped on sandy rocks. Each filament is felted together with those of the other small algae. They are fastened to the substratum by means of numerous longer or shorter rhizoids issuing from the epidermal cells of the under side of the thallus. The frond is usually 2-3 cm. long, ramified irregularly in an opposite direction or alternately here and there. The branches and branchlets are short and slender, with more or less narrowed at the base, and gradually acute at the apex.

Among these materials, some filaments and transformed into newly developed fan-shaped thalli. Structurally, the prostrate rhizome is similar to Okamura's *Dilophus radicans* (1916) and also to Boergesen's *Vaughaniella rupicola*

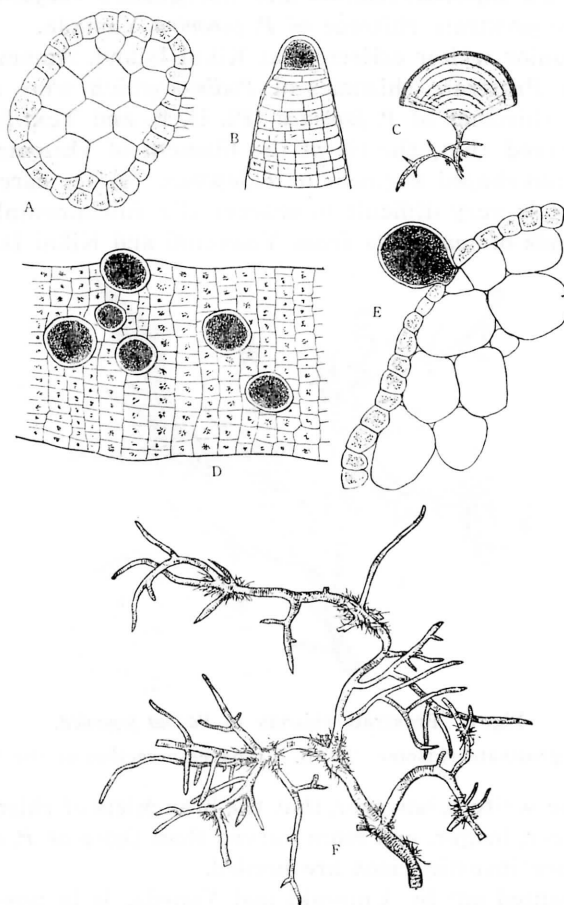


Fig. 2. Prostrate rhizome of *Padina commersonii*.

A. Transverse section of the filament.  $\times 125$ , B. Apical cell of the branchlet.  $\times 125$ , C. Fragment of the rhizome on which a young fan-shaped blade is connected.  $\times 1$ , D. Surface cells of the filament with tetrasporangia.  $\times 125$ , E. Part of the transverse section of the filament with tetrasporangium.  $\times 125$ , F. Habit of the prostrate rhizome.  $\times 2$ .

(1950). The cross section of the frond, is 300–500 $\mu$  in diameter, depressed spherical or ellipsoidal in shape and is composed of 2–5 layers of inner cells, rectangular, and one layer of cortical cells, small but quadrate. At the apex of the branchlets there is a single large cell. The tetrasporangial sorus formed on the upper surface or margin of the filaments. The sporangia is formed singly or in small groups, scattering, semiglobose or pyriform, and has a diameter of about 85–90 $\mu$ .

The prostrate rhizome of *P. commersonii* Bory is similar to the so-called *Vaughaniella rupicola* Boergesen whose taxonomical invalidation was already pointed out by Cribb (1951), Boergesen (1951), Fan (1953). Besides, Fan pointed out that the so-called Okamura's *Dilophus radicans* was nothing but the prostrate rhizome of *P. commersonii*. Furthermore, Umezaki and Yoneda (1962) reported that both Okamura's *Dilophus radicans* and Boergesen's *Vaughaniella rupicola* were nothing but the prostrate rhizome of *P. japonica* Yamada.

In 1962, the junior writer collected, at Kikai Island, Amami Islands, numerous materials of Prostrate rhizomes of *Padina*, which were assumed by the writers to be the rhizomes of *P. japonica* (Pl. II, B, and Text-fig. 3). Because, it was often observed that, the tip of the filament of rhizome was connected directly into the fan-shaped segment of *P. japonica*. After careful examination, however, so far, it is very difficult to observe the fundamental differences between the two kinds of materials from Yonakuni and Kikai Island.

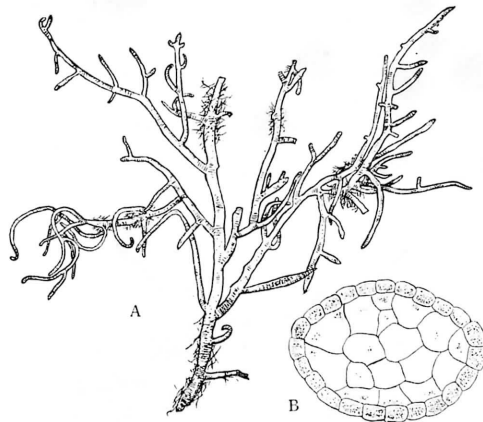


Fig. 3. Prostrate rhizome of *Padina japonica*.

A. Habit of the prostrate rhizome.  $\times 2$ , B. Transverse section of the filament.  $\times 125$ .

It seems to the writers, however, that the branchlets of rhizome of *P. japonica* are a little narrower, longer, and more curved than those of *P. commersonii*. Due to this fact, further investigations are needed.

As already pointed out by Umezaki and Yoneda, it is possible to classify the Japanese species of the genus *Padina* into two groups by the basal form of the plant, namely, the rhizomatous form, to which *P. minor* Yamada, *P. japonica* Yamada, *P. commersonii* Bory, belong, and the disk-like form, to which *P. arborescens* Holmes, *P. crassa* Yamada, *P. australis* Hauck, and *P. stipitata* Tanaka et K. Nozawa, belong.

From the anatomical structure of the frond the analytical key to the seven



species of *Padina* from the Japanese Islands is as follows:

- The lower part of the frond consists of six or more layers of cells.  
 Gell layer more than eight.....*P. arborescens*.  
 Cell layer less than eight.....*P. crassa*.  
 The lower part of the frond consists of three or four layers of cells.  
 .....*P. stipitata*.  
 The lower part of the frond consists of two or three layers of cells.  
 Cell layer become three .....*P. commersonii*.  
 Cell layer always two.  
 Tetrasporangial sorus with indicium. ....*P. japonica*.  
 Tetrasporangial sorus without indicium.  
 Frond more than 5 cm. high.....*P. australis*.  
 Frond less than 5 cm. high.....*P. minor*

(3) ***Zonaria stipitata*** Tanaka et K. Nozawa spec. nov.

Pl. I, B. and Text-fig. 4.

Frons erecta, 7-10 cm. alta, 120-190 $\mu$  crassa, membranacea, longe stipitata, flabelliformis, plerique 5 stratosis cellularum, ad basin 6-8 stratosis composita; stipites cylindraco-teretis, 1.5-2.5 cm. longo, 0.8-1.2 mm. diametro; segmentis flabellatis vel palmato-multifideis, lacineis flabellatis, margine integris vel subfissus, ad basin plus minus discalis pilloso adfixis; sporangia ignota; colore brunneo vel flavido. Planta typica in loco dicto Nishino-omote, Tanegashima, legit Tanaka et K. Nozawa, no. 19601, 24 Aug. 1960.

Japanese name. Etuki-shimaōgi.

Habitat and localities. Nishino-omote, Tanegashima; Koniya, Amami-oshima, Wan, Kikai Island, Inobe, Okinoerabu Island, Amami Islands; Funauke, Iriomote Island, Ryukyu Islands; Nha-Trang, Viet-Nam. Dredged from 20-30 meter's depth at rocky bottom, or washed ashore.

Frond erect, membranaceous, 7-10 cm. high, 120-190 $\mu$  thick, flabelliformis or palmate, provided with a long stipe; stipes very long, cylindrical, 1.5-2.5 cm. long, 0.8-1.2 cm. diam., composed of parenchymatic tissue, basal part of the stipe somewhat disc, hairy, often divided; segments flabellate or often palmate, marked by vague stuposse lines radiating from the upper portion of the stipe, and gradually indistinct toward the marginal parts, entire or often shallowly split at the margin, composed of usually five layers of cells, increasing to six or eight layers in the lower part, and about 230 $\mu$  thick; sporangia unknown; colour of the frond yellowish brown or dark brown.

The present plant is a rather special one among the genus *Zonaria* in having a very distinct character of long stipe like that of *Padina stipitata* Tanaka et K. Nozawa. The stem-like stalk is usually divided into two portions, namely, the basal segment which is short and hairy and the other one which is long and cylindrical. The basal hairy part is more or less discoidal and it often is divided several times. The upper long stem-like portin is straight and not ramified, reaching the length of about 2.5 cm. In anatomical structure, the stalk consists of parenchymatic tissue, and medullary layer consisting of somewhat vertically elongated cells.

The frond of the flabellate segment consists of a medullary layer of several

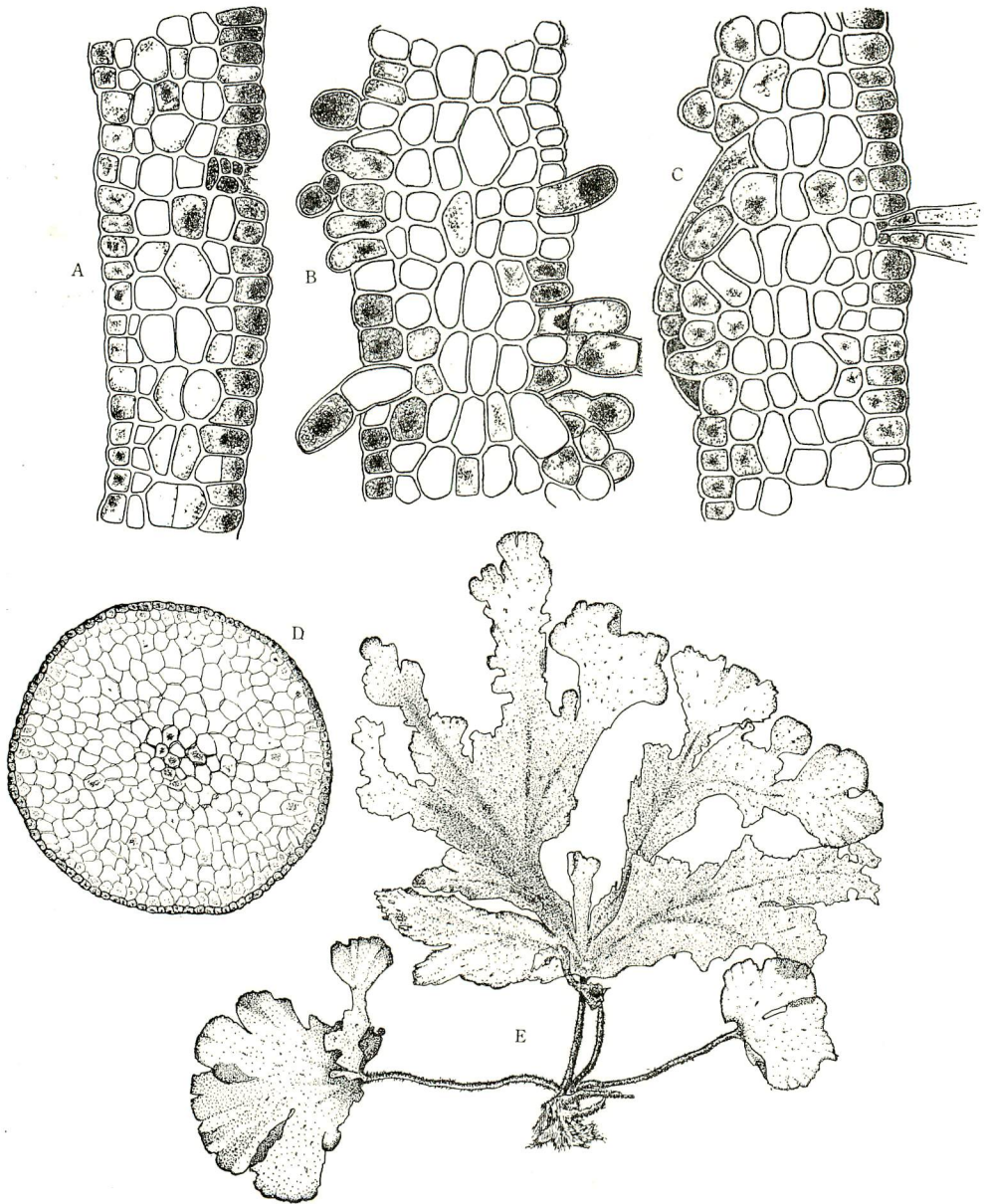


Fig. 4. *Zonaria stipitata* Tanaka et K. Nozawa.

A. Transverse section of the upper part of the thallus.  $\times 125$ , B-C. Transverse section of the lower part of the thallus.  $\times 125$ , D. Portion of the cross section of the stipe.  $\times 50$ , E. Habit of the plant. Slightly reduced.

rows of long rectangular cells, covered on both sides by smaller epidermal cells richer in chromatophores. Unfortunately our materials were sterile.

In general appearance, the present species is most closely allied to *Zonaria tournefortii* (Lamx.) Mont., in having a long stipe, but it differs from it in the

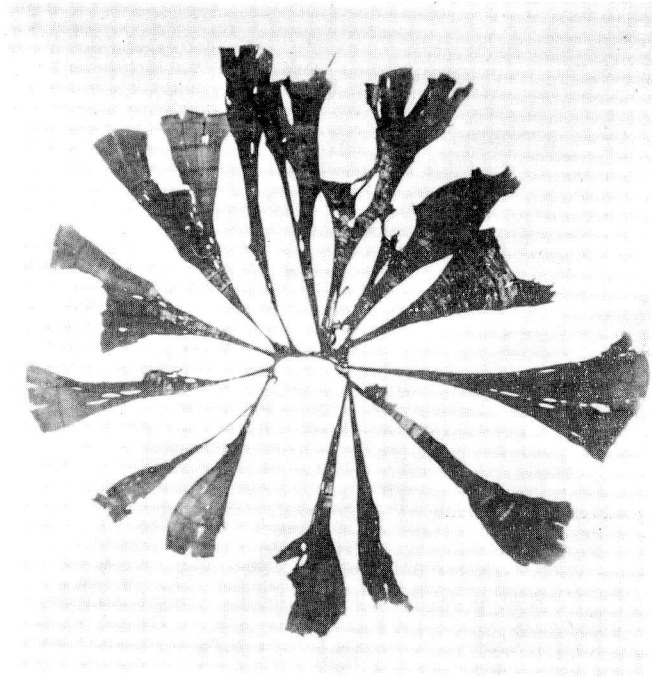
shape of the cylindrical stipe and flabellate segments.

In the Vietnamese materials at hand, the frond is rather regular at the margin and generally palmate in shape, and also the stypose lines of the blades are very indistinct.

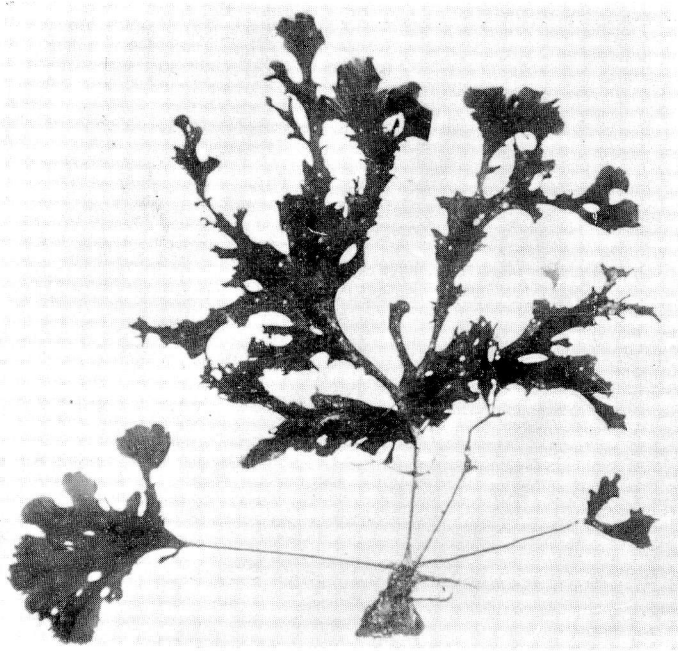
This species is distributed widely in the warmer deep sea of the Southwestern Islands of Japan, Ryukyu Islands, and also Viet-Nam.

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A



B

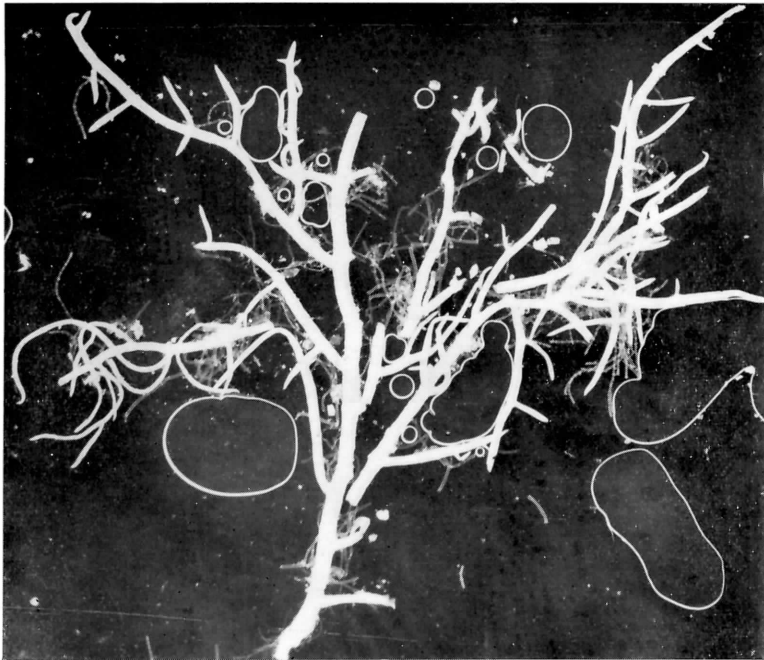
Plate I

- A. *Padina australis* Hauck var. *cuneata* Tanaka et K. Nozawa.  $\times 1/2$ .
- B. *Zonaria stipitata* Tanaka et K. Nozawa. Slightly reduced.





A



B

Plate II

- A. Prostrate rhizome of *Padina commersonii*.  $\times 4$ .  
B. Prostrate rhizome of *Padina japonica*.  $\times 4$ .