Those outer cells become curved and elongate horizontally, thus forming a protective covering around the developing tetrasporangium (Fig. 8).

The lateral perisporial cell cuts off the sporangium and 2 cover cells in very rapid succession. In all but the youngest dichidia they are all formed in passing from one segment to the next. Several very young dichidia were observed, however,
in which the sporangium was first cut off by a curved wall (Fig. 7) in such a way that it was exposed on the abaxial side of the stichodium but protected on the abaxial side by an extension of the old periclinal cell. The abaxial (ventral) cover cell is next cut off, and still protects the sporangium on that side. The abaxial (ventral) cover cell is cut off last and remains small so that the sporangium are more or less exposed on that side of the stichodium (Figs. 6, 7).

As the tetrarospora stage develops, the cover cells and stachial cells enlarge but the stalk cell becomes considerably stretched laterally, forming a very thin but conspicuous cell in the stichodium. The tetrarosporate, which are tetrahedrally arranged, are liberated from the abaxial surface of the blade and after their liberation the cover cells undergo division to form small groups of cells which later merge with the general confluence of the old stichodium. Owing to the apical formation of the tetrarospora, in one stichodium these are usually immature and mature tetra-
osporate as well as the contorted basal region from which the tetrarospora have been shed.

Development of sporosporangial blades

Sporosporangial blades develop endogenously from the central cells. Although these blades often appear to arise from the lateral wing of the branch, the central cell row can always be traced back, within the blade to, the central cell row of the parent branch. As in normal branch development, marginal cell initials are formed at each edge of a segment, and in the sporosporangial bivalve there are two limited divisions, forming short lateral discs of cells. Thus, a narrow winged blade is produced (Figs. 9, 10). The lateral periclinal cells cut off by obliquely periclinal walls 2-4 cortical cells (on each surface), each of which divides by anticlinal walls into 4 or more cells. The number of divisions in each of those series is variable, but ultimately a block of about 16 cells lying in the surface plane is formed. These are the sporosporangial mother cells, each of which cuts off 2-4 elongated sporosporangia (Figs. 10-12). The distal cells of these cells are densely protoplast and become rounded and bunched off as sporosporangia (Fig. 12).

Although sporosporangia production commences from the lateral periclinal cells, it gradually spreads outwards to involve the inner cells of the lateral wing of the sporosporangial blade. However, a sterile margin of 2-4 undivided cells is maintained surrounding the sporosporangial cells (Figs. 9, 10). The transverse pericentral cells take no part in sporosporangia production, but remain as a sterile "midrib" of cells in each sporosporangial blade (Fig. 9). A small amount of continuation develops at the base of the sporosporangial cells where it unites with the parent branch.

Development of spermy

Carposporangial branches form in small fertile blades which are similar to a lateral branch but show only limited division of the 4 lateral initials in each segment. The carposporangial branches develop only from the abaxial transverse periclinal cell. In a fertile segment, the abaxial periclinal cell first cuts off a cell towards its anterior end (Fig. 14). This is the first "sterile cell" and comes to lie horizontally across the anterior end of the central cell (Fig. 13). Following this, another cell is cut off laterally from the abaxial periclinal cell, thus being the carposporangial branch.
initial (Fig. 14). Thus the adaxial pericentral cell itself functions as the supporting cell of the carpogonial branch. By the time the carpogonial branch has become 2-celled, a second sterile cell is cut off laterally, on the opposite side of the supporting cell to the carpogonial branch (Fig. 15). The mature carpogonial branch is 4-celled, the second cell being the largest, and the small carpogonium bears a very short trichogyne, terminating in a large globular head (Fig. 18).

**Development of cystocarp**

Changes taking place immediately following fertilization have not been studied, as only fully mature cystocarps have been observed. These are produced adaxially from small branchlets formed on both surfaces of the blade. Since the procarps develop near the apex of the fertile branchlets, the cystocarps appear pedicellate. The cystocarp wall is considerably corticated except for the cells around the ostiole. The inner layer of the pericarp is composed of vertical chains of cells, from each of which usually 2 cells are produced externally. Each of these outer cells cuts off several smaller cortical cells and these produce another layer of small cells which form the outer layer of the pericarp. Thus the pericarp wall is composed of 4 layers of cells (Figs. 16, 18, 19)—the inner vertical rows of cells, developing from the pericarp initials, and 3 layers of cortical cells. The cystocarp in this species is far more densely corticate than in any other species of the group.

The carpocormophyte shows a thick short central axis from which the gametoblast filaments arise sympodially, developing from near the base as well as from the upper part (Figs. 16, 17). Old cystocarps often break off, leaving the basal part of their pedicel projecting from the blade. Several young procarp-forming branchlets may develop from each of these broken pedicels.


Figs. 20–42; Plate 1, Fig. 2; Plate 2, Fig. 1

*Polystephanos victoriae* Koritzs 1884: 20, t. 58.


Type locality.—Port Phillip, Vic. (Harvey 188).

Type.—In Herb. Agardh, Lund (No. 43372).

**Distribution.**—From Elliotson, S.A., to Western Port, Vic. Sublittoral or in deeper rock pavement pools on rough coasts.

*Sarcocornia victoriae* was first described by J. Agardh from material collected by Harvey at Port Phillip, Vic. The thallus reaches 20–30 cm in height, becoming terete in the lower regions owing to extensive cortication, while the younger branches are flattened. Branching occurs largely from the adaxial surface of the blades and is rather irregular (Plate 1, Fig. 2). The tetraspores and spermatozoids both develop
branch from which it originally arose. At times short lateral branches occur on this spur (Fig. 42).

The thallus when fresh has a greyish iridescence. On exposure or drying it turns a rosy red and disintegrates very rapidly.
It has been impossible to find any real distinction between S. victoriae (Plate 1, Fig. 2) and S. desopioides J. Agardh (Plate 2, Fig. 1) apart from rather more regular branching in the former and a more luxuriant development of these branches. These differences appear readily accounted for as of environmental nature, where the more sparse, axioted S. desopioides form comes from reef growth in shallow water and the S. victoriae form from more sheltered growth in bights and deeper and calmer water. This is supported by the localities from which the specimens seem have been recorded.

The type specimen of S. oppositum J. Agardh (LD: No. 43381) is a reef form showing slightly more prominent opposite branching than usual, and S. villosiss J. Agardh (LD: No. 43409) also appears to be only a form of S. victoriae.

Harvey distributed S. desopioides and also S. corallinae J. Agardh under the former name. The type of S. desopioides (a Harvey specimen) is in Rsth. Agardh (LD: No. 43398), but Harvey's 1435 in MBL is S. corallinae. J. Agardh (1863, p. 1264) also remarks on the confusion among the specimens of S. desopioides distributed by Harvey. S. victoriae and S. desopioides were both first described by J. Agardh (1855) in the same publication. As there is this confusion in Harvey's specimens of S. desopioides, it is proposed to retain that name S. victoriae, relegating S. desopioides to synonymy.

This investigation is based largely on material collected at Milliton on the west coast of Rye Peninsula, S.A. These plants were growing under tough conditions in upper sublittoral reef pools and are of the more sparsely branched reef form of this species (= S. desopioides). Cystocarpic, spermatangial, and tetrasporangial plants were all collected at the same time, in February 1934 (AD: A13518).

Structure of thallus

Growth is initiated by a single apical cell, which divides by transverse walls en masse to the apex to form source-shaped cells (Fig. 20). The number of such cells present depends on the rate of growth at any one time. The axial lobes are first formed, then the 2 lateral pericentral cells, and finally the adaxial pericentral cell, leaving the central cell (Figs. 20, 21). Each of the lateral pericentral cells out off a small cell at its anterior outer edge and later a similar cell is cut off posteriorly. These branching cells elongate until each is about half as long as the lateral pericentral cell from which it was derived (Fig. 20). Further changes are produced only by the elongation of the existing cells and by their cortication. Secondary pit connections develop between adjacent pericentral cells (Fig. 22) and these connections are later found more generally throughout the older blade. Lateral branches developing endogenously (Fig. 23). A single cell is cut off from the anterior end of a central cell and this acts as an axial initial, emerging anteriorly to the transverse pericentral cell and developing to form a lateral branch as described above. These lateral initials form only from the anterior end of any central cell.

Cortication of the thallus does not occur until several lateral branches have been initiated, but then follows rapidly and does not appear to follow a very definite pattern—being brought about by numerous pericentral divisions of all pericentral cells and the flanking cells (Fig. 22). The first divisions always occur in the transverse
peripheral cells, usually in the vicinity of a lateral branch, and owing to more intense corticalization about the transverse peripheral cells the branch becomes almost terete. Both primary and corticated branches show strong regeneration after damage or breaking.

Development of stichidia and tetrasporangia

The stichidia are formed in dense masses in the position of lateral branches. Development of stichidia follows the same pattern as that of lateral branches. Tetrasporangia develop in each stichidium in 2 regular longitudinal rows. The tetrasporangium and 2 cover cells are cut off from the lateral peripheral cells in rapid succession (Figs. 24, 25), so that the order of their formation can only be seen in young actively growing stichidia. At about the sixth or seventh segment from the tip, the tetrasporangium is cut off by an oblique wall, leaving an uppermost tip to the remaining cell (Fig. 26). The abaxial cover cell, which includes this uppermost tip, is next cut off, thus protecting the sporangium on the dorsal side of the stichidium. The adaxial cover cell is last formed (Fig. 26). In most cases the abaxial cover cell is only about half the length of the adaxial cover cell and situated posteriorly to the young sporangium, thus leaving the tetrasporangium at least partially exposed. The remaining part of the lateral peripheral cell, now the stalk cell, remains very thin but is nevertheless corticated in the stichidium (Fig. 34). Tetrasporangia develop in superficial succession. While tetrasporangia are still being formed at the tip of the stichidium, gaps occur near the base, from which mature tetraspores have been liberated. After the liberation of the tetrahedrally arranged tetraspores, the cover cells undergo division to form groups of about 6-7 small cells to fill the gap left by the tetraspores. During the development of the tetrasporangia the flanking cells divide further, each cutting off a small cell at its anterior edge (Fig. 25). The original flanking cells, although narrow, are very extended horizontally and curved (Figs. 27, 28), thus forming a protective framework around the edges of the stichidium, while the flanking cell derivatives are far less extended and lie more or less parallel and opposite to the flanking cells, i.e., actually at the edge of the stichidium (Fig. 27).

Development of spermatangial bladders

Spermatangia develop in small lateral branches similar in size to the stichidia (Fig. 29). The spermatangial bladders have a distinctive appearance since only the lateral peripheral cells are fertile. Thus each spermatangial bladder in surface view shows a distinct "narrow" (the transverse peripheral cells) and margin (the flanking cells) of undivided cells. The production of spermatangial mother cells from the lateral peripheral cells does not occur until about the 16th-18th segment from the apex of the blade, leaving a sterile area at the end of each spermatangial bladder. This gives quite a distinctive appearance and appears to be typical of the species (Fig. 29).

Each lateral peripheral cell first cuts off by obliteration periclinal walls 2-4 cortical cells on each side of the blade (Figs. 30, 31). These then divide axially to form a row of 4 cells in the blade plane. When only 2 cortical cells are formed from 1 peripheral cell, these first divide to form 4 cells, then each of these forms a row of 4 cells.
all lying in the same plane. If more than 2 cortical cells are formed, the development of the group of spermatangial mother cells is more irregular. The much elongated remains of the lateral pericentral cell is visible in the median plane of spermatangial branches. Each of the spermatangial mother cells gives off 3-4 elongate spermatangia with dense protoplasmic contents from which rounded spermatia are shed off (Fig. 32).

**Development of procarp**

Carpogonial branches develop only from the adaxial pericentral cells, near the base of young blades. Only 1 procarp develops in each branch, although occasionally 2 or even 3 young carpogonial branches may be seen in 1 blade. A cell is cut off from the anterior end of the fertile adaxial pericentral cell by an oblique wall. This is the first sterile cell (Fig. 33), which comes to lie horizontally across the anterior part of the pericentral cell (Fig. 35). Next the ventral pericentral cell cuts off, laterally, the carpogonial branch initial (Fig. 33). By the time 2 cells of the carpogonial branch have been formed, the second sterile cell has been cut off from the adaxial pericentral cell and lies laterally to this on the opposite side to the carpogonial branch (Fig. 34). Thus the remainder of the adaxial pericentral cell functions as the supporting cell of the carpogonial branch.

A mature carpogonial branch is 4-celled, with the carpogonium surrounded by a short trichogyne with a broad, expanded tip (Figs. 36, 36). Of this 4-celled carpogonial branch the second cell is the largest and is frequently seen to be binucleate (Fig. 36). The larger second cell also lies nearer the adaxial surface of the blade than the other cells of the carpogonial branch, which all lie in the same plane. The large second cell of the carpogonial branch thus occupies the space between the 2 sterile cells on the ventral surface of the blade. The third cell of the carpogonial branch is the smallest. The carpogonium and trichogyne in all cases point towards the tip of the branch.

If fertilization fails to take place the 2 sterile cells divide further and the carpogonial branch disintegrates (Fig. 37). These sterile cell derivatives are the start of extinction of the branch.

**Development of archegonycarp**

Following fertilization of the carpogonium, the anterior end of the supporting cell enlarges and is cut off to form the auxiliary cell (Figs. 38, 39), with which the enlarging carpogonium comes to lie in close proximity. A short tube forms between the carpogonium and this auxiliary cell (Figs. 39, 40) and the carpogonial branch soon begins to disintegrate. Fusion occurs between the supporting cell, auxiliary cell, and central cell to form a large, irregular fusion cell, from which an erect prolongation develops (Fig. 41). From this arise numerous much-branched gonimoblast filaments which ultimately develop terminal oval carpogonangia which are 80-100 μ in length and densely cytoplasmic. The cytoplasmic connections between the fusion cell and the lower cells of the carpogonangium become very much enlarged and a massive column is formed from which the gonimoblast filaments arise (Fig. 41). The upper cells of this column are characteristically umbrella-shaped. The 2 sterile
cells undergo no further development, and following fertilization they appear to degenerate.

Following fertilization of the carposporangium and formation of the ancillary cell, the development of the proterozoic cercus is initiated by the lateral pericentral cells and flanking cells of the fertile segment and the adaxial pericentral cells of the segments anterior and posterior to the fertile one (Fig. 36). From these cells are formed a ring of vertical chains of cells, which surround the developing carposporangium. Each of the cells of these vertical chains cuts off, one above the other, 2 laterally elongate cells on the outside, so that the cercus has a double wall of cells. Cells of the adaxial outer rows usually alternate. Secondary pit connections develop between the horizontal outer cells but not between the vertical rows of cells. The globose perinuclear apex at the apex by a small circular ostiole, through which the mature carposporangia are liberated (Fig. 45). The cercus becomes greatly in size, reaching 1600-1600 μ in width and 200-1400 μ in length, by enlargement of the cells and their separation during growth. As the cercus matures, cortication of the basal portion occurs along with cortication of the parent branch.


P. 43-50; Plate 2, Fig. 2

Type locality.—Western Port, Vic. (J. B. Wilson No. 41).

Type.—Marl. Agardh, Local (No. 4395).

Distribution.—From Swift Bay, B.A., to Phillip L., Vic., and the north coast of Tasmania. Subtidal on rough coasts.

The thallus of this species reaches a height of about 30 cm. The main branches are generally alternate, while the tine of the branches show very distinct unilateral branching (Plate 2, Fig. 2). Branching is largely from the adaxial surface of the parent branch. Owing to this and to the density of branching in the younger parts of the thallus, the top of the plant tends to be flat or corymbous in form. When the plant is undergoing rapid vegetative growth, all of these upper unilateral branches are uncorticate. Fertile apomictic show a greater degree of cortication in these upper branches, although even then the younger branches are not corticate. There has been some confusion between S. victoriae and S. corymbosa, but study of the types of both species and a range of specimens shows the following distinctions.

S. victoriae has basically opposite branching, with long lateral branches from near the base of the plant. Lesser branches are pinnately arranged with the plant in dense corticate except for the ultimate branches. S. corymbosa has alternate branching in the older parts and the ultimate branches are distinctly unilateral, arising axially. Thus the upper parts of S. corymbosa are dense and corymbous. Branches formed near the base of the plant are often lost relatively early. In rapidly growing plants the upper branches up to the fourth and sometimes higher orders are uncorticate. The apomictic end of S. victoriae and S. corymbosa are also distinct, those of the former being simple and determinate while in the latter they are often branched and relatively indeterminate.
As *S. corystis* is very similar to *S. victoriae* in many details of its structure and development, the main features only are described. The material available permitted a detailed study of all phases of the species.

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*Fig. 41*-55.—*Sarcosoma corystis.* Fig. 42.—Upper part of stella with stichoblast and showing bilateral branching. Fig. 44.—Stemma, showing segmentation. Fig. 45.—Upper part of a stichoblast. Fig. 46.—Branches of a male peduncle bearing spermatogonial cells. Fig. 47.—Matteo spermogonia branch and sterile cells (one of which has divided). Fig. 48.—Prambus between auxiliary cell and spermogonia; unit in embryo of *prototroch.* Fig. 49.—Protoplan tetragonal, auxiliary cell and central cell, and early formation of germinal sheet. Fig. 50.—Upper part of a gemmulated stella with strong terminal corymme.

**Structure of thallus**

Segmentation of the apical cell, the order of development of pericentral cells and flanking cells (Fig. 44), and the development of endogenous lateral branches are the same as described for *S. victoriae*.

The basal portions of plants of *S. corystodes* are densely corticate and become tetras. Depending on the stage of growth, the upper parts of the thallus are more or less densely corticate. The corticating cells in this species tend to be rather elongate and occur in longitudinal rows, in contrast to *S. victoriae*, *S. muschelis*, and *S. hognaoides*, where the corticating cells are rhomboidal in form.

**Development of stichidia and tetrasporangia**

The stichidia are always produced adaxially on the parent branches (Fig. 45) and are essentially similar in form to those already discussed in *S. victoriae*. The tetrasporangia and the cover cells are cut off in rapid sequence from the lateral pericentral cells, the adaxial cover cell usually being the larger, though occasionally the adaxial and abaxial cover cells alternate in size in successive segments (Fig. 46). Secondary pit connections may occur between the cover cells and transverse pericentral cells (Fig. 45). In the stichidia the posterior of the 2 flanking cells in each segment divides horizontally before the anterior one, but eventually 4 cells are formed (Fig. 45). These cells, especially the original flanking cells, elongate horizontally and form a curved protective edge around the stichidium. After the tetrasporps are liberated, cell divisions occur in and around the small ventral cover cell (occasionally also around the dorsal cover cell), and the ends of the curved flanking cells may also be cut off.

**Development of spermatangial blades**

The spermatangial blades of *S. corystodes* differ from those of all other species investigated. They are lateral branches of unlimited growth and the patches of spermatia occur near their base (Fig. 46). These branches continue to grow in length and also themselves produce branches which may bear spermatia. The spermatangia are formed from the 2 lateral pericentral cells. In a few cases transverse pericentral cells were seen to divide to form spermatangia, but this was exceptional. Each lateral pericentral cell cuts off a group of spermatangial mother cells on both surfaces of the blade. From each of these spermatangial mother cells 2 or 3 elongate spermatangia are formed by antapical divisions and spermatia are budded off from their tips.

**Development of protonema**

Protonema develop from the adaxial pericentral cells in lateral branches. The first sterile cell is cut off from the anterior end of the pericentral cell, followed by the carpogonial branch initial. By the time the carpogonial branch is 2-celled, a second sterile cell has been cut off from the adaxial pericentral cell, lying lateral to the pericentral cell and opposite the young carpogonial branch.
The mature carpogonial branch is 4-celled, the second cell being the largest and often showing 2 nuclei (Fig. 47). The carpogonium is surrounded by a short trichogyne with a globular tip.

**Development of cystocarp**

After fertilization of the carpogonium the anterior part of the supporting cell is cut off to form the auxiliary cell. The carpogonium enlarges and lies in close proximity to this cell and fusion occurs between the fertilized carpogonium and the auxiliary cell (Fig. 48). Subsequently fusion also occurs between the auxiliary cell, central cell, and supporting cell (Fig. 49), forming the large basal fusion cell, from which the entire carpogonial structure develops in an irregularly sympodial manner, producing gonimoblast filaments with terminal, ellipsoidal carpogonial sacs (Fig. 50).

Following fertilization of the carpogonium, the parietal arch is initiated and a ring of cells develops around the protocarp. These cells divide to form arched chains of cells and each cell off externally 2 micro- or less medullar cells lying horizontally. The wall of the mature gonimoblast cystocarp then consists of 2 distal cell layers. Controlling cells develop in the basal part of the cystocarp when formation of the supporting branch occurs.


**Figs. 51-54; Plate 3, Fig. 1**

**Type locality.**—"Fremantle and Garden Island", W.A. (Harvey 147)

**Type.**—In Herb. Harvey (TCD) No. 142A.

**Distribution.**—Only known from Fremantle and Garden L., W.A. Apparently rare.

This species has been studied from dried herbarium specimens only (13): A18460, A18001 collected near Fremantle by Harvey and G. Clifton. The thallus, which reaches a length of about 20 cm, shows opposite branching in most parts. In one specimen (Plate 3, Fig. 1) the ends of several branches had become curved in a twist-like manner—similar to those found in some species of *N. desminervis*.

The thallus is basically flat and velutinous in structure, differing principally in the greater degree of curvature, which produces a crescent shape.

**Structure of thallus**

Growth is initiated by a hemispherical apical cell, which cuts off segments by transverse walls (Fig. 51). Each of these subapical cells very soon develops 4 peripheral cells, the abaxial pericentral cell being formed first. This is followed by 2 lateral pericentral cells and lastly by the adaxial pericentral cell. Each of the lateral pericentral cells cuts off 2 branching cells towards the edge of the blade (Fig. 51).

Lateral branches arise endogenously from the anterior end of a central cell. The lower segments of lateral branches are immersed in the thick thallus and the
basal 6 segments or so do not develop pericentral cells or flanking cells. A chain of central cells may be seen between the lateral branch and the central cell of the parent branch (Fig. 54). Cortication occurs very rapidly following branch initiation, leaving only the growing tips scutellate (Fig. 51). Ciliated cells are cut off first by the abaxial pericentral cells and this is followed by divisions of the adaxial pericentral cells and lateral lateral pericentral cells and flanking cells. All the branches become covered by several layers of small corticating cells (Figs. 53, 54), which are rhomboidal in shape, similar to those of S. victoriosa. The branches remain slightly flattened even when fully corticate. Prominent secondary pit connections are visible between the pericentral and flanking cells. Secondary connections are also visible between the corticating cells.

Figs. 51-54.—Streptospondyloides. Fig. 51.—Apex of branch, showing segmentation and early cortication. Fig. 52.—Apex of a stichodium, showing early cortication. Fig. 53.—Transferous aperture of a branch. Fig. 54.—Young lateral branch. Figs. 55, 56.—Streptospondyloides monticola. Fig. 55.—Appearance of a lateral branch. Fig. 56.—Apex of a stichodium.
Development of stichidia and tetracapsa

The stichidia (Fig. 52) are similar in form to those of *S. mendax*. The tetracapsa are produced from the lateral perisarc cells and 2 cover cells are cut off almost simultaneously. The cover cell formed on the axial surface of the blastula is generally only half the length of the lateral cover cell, which is equal to the transverse perisarc cell in length. Each flasking cell in the stichidia divides horizontally into two. Carination of the stichidia commences even before the formation of the tetracapsa and cover cell (Fig. 52), cells being cut off from both transverse perisarc cells. After the tetracapsa have become liberated, the axial cover cell divides further, merging with the general carination. As in the receptive thallus, the stichidia of *S. mendax* is more heavily carinated than in other species.


*Polyplacotheca mutabilis* Harvey 1861: 345; Kuetheil 1861: 26, t. 569–y.

Type locality.—Fremantle, W.A. (in Zoodon).

Type.—In Herb. Harvey (CUD) No. 154A. Index.—AD: A18390.

Description.—From Fremantle, W.A., to Port Stephens, N.S.W., and Lae Hand, Pap. Sublittoral, not common.

*Saccocoma mutabilis* was available for study only from dried herbarium specimens. Isotype material (AD: A18390) was used for the most part, but other specimens were also studied. Stichidia were present on the isotype material. The thallus is of definite form and usually 4–10 cm in height (Plate 5, Fig. B). The size, form, and slight degree of carination are identically separated from all other species of the group.

Structure of the thallus

As in the other species of the *Saccocoma* group already discussed, growth is initiated by a homosporous axoral cell (Fig. 56). The cells cut off by horizontal divisions each produce 4 perisarc cells. The lateral perisarc cell is formed first, followed by the lateral perisarc cells and finally the axial perisarc cell. Each lateral perisarc then cuts off 2 flasking cells, giving a flattened branch 5 cells wide and 3 cells thick in the centre. The statement of Silveira and Chasey (1952, p. 269) that flasking cells are lacking is incorrect. The stichidia is based on a misidentification of *Polyplacotheca mutabilis* (see below).

Branching is analogous (Fig. 55), originating from the anterior end of a central cell. The basal segment of a lateral branch often lacks flasking cells.

Carination is slight and only becomes complete in the lower branches of the thallus. The corbiciulate cells are small and generally rhomboidal in outline, similar to those formed in *S. mendax*.
branches, become more scattered away from the tip, and are usually actively absent from older branches.

Lateral branches develop emanating from the anterior end of a central cell (Fig. 60), similarly to previously described species. Circinate constrictions relatively early in S. tenera (nearly at about the 15th–18th segment) and only the young growing tips are uncircinate. Circinate cells are first cut off from the transverse pericentral cells, then from the lateral pericentral cells and flanking cells, until the branch becomes completely circinate and terete. A greater degree of circimation occurs in this species than in S. tenera.

**Development of anthocidium and tetrasporangia**

Solitary anthocidia are produced laterally from mature circinate branches, mainly from the adaxial surface. The anthocidia develop similarly to lateral branches (Fig. 61). Each of the flanking cells cuts off a small cell anteriorly and these flanking cells become horizontally elongate and curved, forming a protective edge to the anthocidium. The lateral pericentral cells of the anthocidium cut off the tetrasporangium, adaxial cover cell, and adaxial cover cell in rapid succession in other species of the *Sarcosoma* group and the spermatangia is partly exposed on the adaxial side of the anthocidium. Following the hatching of the tetrasporangially arranged tetraspores, the cover cells undergo further division and the anthocidium becomes progressively circinate from the base.

**Development of spermatangial blades**

Small spermatangial blades are formed in groups on the main branches. They develop as normal lateral branches, and spermatangial mother cells are formed by axial division of cortical cells cut off from the lateral pericentral cells (Figs. 62, 63). More spermatangial mother cells (16–32) are produced from each lateral pericentral cell in this species than in other species of the group. In a transverse section, the spermatangia-producing blade (Fig. 64) about 8 spermatangial mother cells correspond to each lateral pericentral cell, compared to about 4 in the previously described species of *Sarcosoma*. Initiation of divisions producing spermatangial mother cells appears to decrease formation of pericentral cells and flanking cells, so that each spermatangia-producing blade is surrounded by a long mononucleate area (Fig. 62).

**Development of procarp**

Initiation of the procarp occurs near the tip, usually in about the fifth, to eighth segment, of a lateral branch (Fig. 65). Owing to this position of procarp initiation the mature cystocarp is borne on a longer "stalk" than in some other species (e.g., *Z. echinata*), where procarp initiation occurs near the base of the fertile lateral branch. In each fertile lateral branch usually only one procarp is initiated. The first sterile cell is cut off at the anterior end of the fertile adaxial pericentral cell. A cell is then cut off laterally by the pericentral cell and this acts as initial for the 4-celled carpogonial branch. A second sterile cell is next cut off and lies over the carpogonial branch. The remainder of the adaxial pericentral cell acts as the supporting cell of the carpogonial branch (Figs. 65, 66). The 4-celled
carpogonial branch is surmounted by a short trichogyne with a very prominent tip (Fig. 60) and the second cell of the carpogonial branch is the largest and frequently bisected. In S. tenerum additional protection is given to the developing procarp by the adaxial pericentral cell of the next posterior segment, which acts as an essay cell.

They are used by the eggs. In Figs. 62, the lateral primordium of the ovule develops closely about the egg cells. In the ovules of the S. tenerum, the egg cells are each surrounded by a single egg cell.
means of a short fusion tube and a binucleate cell is formed. This cell enlarges considerably and produces large "capping cells" connected by wide pit connections (Fig. 7). Fusions occur between auxiliary cell, supporting cell, and central cell to form the large fusion cell from which the ventral structure of capping cells arises. Repeated sympodial branching of this structure produces numerous gametophytic filaments, each of which terminates in a large silicified carpogoniun.

The developing carpogoniun is surrounded by a protective pericarp which is initiated only after fertilization of the carpogoniun has occurred. The adaxial pericentral cell anterior and posterior to the fertile segment, the lateral pericentral cells, and the flanking cells all take part in the production of the pericarp. A complete ring of cells is formed which grew up around the developing carpo-
goniun. Each cell of the ring produces a vertical chain of cells, from each of which, except the apical cell, 2 cells are cut off successively, one above the other, lying horizontally across the inner row of cells. Thus the protective pericarp is made up of 2 layers of cells (Fig. 71).


Figs. 72-73; Plate 4, Fig. 2

Type locality.—Brighton Rocks, Port Phillip, Vic. (Harvey 2055).

Type.—In Herb. Agardh, Lund (No. 4344).

Distribution.—From King George's Sound, W.A., to Port Phillip, Vic., and at Gordon, Tas. Usually found in relatively sheltered places, sublittoral.

This species is similar to S. tenera but is of more slender form and in general smaller at maturity (Plate 4, Fig. 2). Ovulation is done and only the young growing tips are unsegmented. The older parts of the thallus are sterile. The apices of the branches are densely clothed with mononuclear filaments which give a distinctive appearance to the species (Fig. 72). These mononuclear filaments contain numerous chromatophores and may branch on older parts of the thallus, frequently each filament having 3 branches. The filaments are sparse away from the actual growing tip and finally in older parts of the thallus they are lost altogether. As with other species of the Sarcocystis group, S. dolichocystides on exposure or when confined in a small amount of water becomes a bright rose red and rapidly disinte-
grates. The material used in this investigation was collected in August 1904 at American River inlet, Kangaroo I., S.A. (Add: 1975).

Structure of the thallus

In cell structure and cell formation S. dolichocystides differs from S. tenera only in the position of the mononuclear filaments. Only the upper part of each pair of flanking cells produces filaments, i.e., the filaments are formed only laterally (Figs. 72, 73). At first the filaments tend to be formed on alternate sides in successive seg-
ments, but later they form on both sides of the same segment. The filaments themselves are rather narrower than those of S. tenera, this being especially evident in the terminal cell of the filament, which is here much longer and somewhat broader,
Fig. 72—A spore of a brachy, with monosiphonous filaments from the banding cells only. Fig. 73—A branch apex, showing segmentation and formation of monosiphonous filaments. Fig. 74—A bifurcation. Fig. 75—Optical longitudinal section of monosiphonous filament. Fig. 76—Nodal axes. Fig. 77—A spore with a bifurcated axis. Fig. 78—A section of a bifurcated axis. Fig. 79—Nodal axes. Fig. 80—Nodal axes and spore sacs. Fig. 81—Nodal axes and spore sacs. Fig. 82—Further development of fusion cells, and a comparison between apicoplasmodia and supporting cells.
measuring on an average 39 by 8·6 μ (Fig. 72). Lateral branches are formed endogenously, as in S. teverna and the other species discussed previously.

Correlative cells are formed, as in S. teverna, on the branches quite near the growing point and although the young branches are flat the rest of the thallus is tenuate in form.

**Development of aecidiella and tetrasporangia**

The aecidiella in this species are rather longer than those of S. teverna (Fig. 74) and tend to become considerably corroticate. However, the formation and development of tetrasporangia occur in the same manner as described for S. teverna, with the tetrasporangium being cut off before the cover cells (Fig. 78).

**Development of spermatangial bladders**

Bladders producing spermatangia are exactly like those of S. teverna in structure and formation of spermatangia-bearing cells. These bladders have the same sterile monosiphonous wall at the tip of the spermatangia-bearing tissue as in S. teverna.

**Development of pericyct and cystocarp**

Formation and development of pericyct follow the normal pattern previously described for other species. The fertile axial pericyctal cell cuts off the carposporangial branch initial and 2 sterile cells. It then remains as the supporting cell (Figs. 76, 77). The mature carposporangial branch is 4-celled and the trichogyne has a very pronounced globular tip at the end of a short, slender stalk (Fig. 78). After fertilization the supporting cell cuts off the auxiliary cell towards the tip of the branch, and the carposporangium and auxiliary cell fuse (Figs. 79-81). Also, in this species, connection has been seen between the carposporangium and the supporting cell (Fig. 82). Cystocarps develop as described previously and carposporangia are produced terminally. The structure of the pericyct is the same as in S. teverna, the wall of the cystocarp being composed of 2 layers of cells. The lower part of the urocycte cystocarp becomes corticated and this cortication merges with that of the branch bearing the cystocarp.

**IV. Other taxa allied to BARCOENIA**


**Type locality.—**Cabinet, Spain (Cádiz).

**Distribution.—**From Kangaroo L. S.A., around the south-east coast of Australia to the Bunna River, Qld. Mostly telliniform, extending into lower laminar at least on Kangaroo L. Crith (1968: 187) has recorded *P. miniana* from Devonport, Tas. Also known from Spain, South Africa, and India.

P. *miniana* var. *miniana* C. Agardh 1852: 64.

*P. miniana* var. *fuscata* (C. Agardh) Boergesen 1949: 870.


**Type locality.—**Cabinet, Spain (Cádiz).
Study of *P. minuta* was made on preserved material collected from rock platform at Vrelin Bay on Jan. 31, 1956. The material has been compared with the type and agrees with it well. Individual plants are only 1-1.5 cm high, and together form a text-like mat with small oval leaves. Tetrasporic plants were abundant, spermatangial plants rare, and a very few female plants were found.

The Vrelin Bay material is diocious, as was that studied by Boergesen (1931) from India, and Silva and Cleary (1954) from South Africa. Weber von Bose (1980) stated that her only extant plant was monocious.

The genus *Phlyctophyllum* is based on *Phlyctophyllum minuta* (C. Agardh) J. Agardh, was described by Boergesen in 1931. He also suggested that *S. reniformis* and *S. variabilis* should be placed in *Phlyctophyllum*. Boergesen based his new genus primarily on the marked difference in size between *P. minuta* and the type species of *Sarcocoma* (*S. ulicina*), and on the difference in thallus construction between them. The fact that a blastoecus system is developed in *S. minuta* was also taken into consideration. At present the genera *Phlyctophyllum* includes *P. minuta* (C. Agardh) Boergesen, *P. reniformis* (J. Agardh) Boergesen, *P. rimonifera* (Kuetzk. ex Reisse) Boergesen, and *P. grossa Silva & Cleary*. *P. variabilis* is described above as *Sarcocoma variabilis*, though as shown later it is a species of *Phlyctophyllum*. *P. minuta* has been studied by Weber von Bose (1980), Boergesen (1931), and Silva and Cleary (1954). A brief account only, based on the Vrelin Bay material, is given here.

**Structure of the thallus**

In general structure and arrangement of cells *P. minuta* is essentially similar to *Sarcocoma teretica* and *S. coriacea*.

Growth is initiated by a bispherical apical cell (Fig. 43). The axial and pericentral cell is formed first, followed by the 2 lateral centripetal cells, and the axial pericentral cell is produced last. Weber von Bose (1980) considered that the 2 lateral pericentral cells are formed first, *Sarcocoma* and Cleary (1954), however, stated that the axial pericentral cell is formed first in South African material of *P. minuta*, and this is certainly so in the Vrelin Bay specimen. Two subcubical cells are cut off by each lateral pericentral cell, and each elongates to half the length of the lateral pericentral cell. Lateral branches arise exogenously from the central cells, and pericentral cell formation follows as in the parent branch. The erect branches in *P. minuta* arise from prostrate basal branches which are attached to the substratum by multicellular rhizoids developed from the anterior branching cells, usually on one side only. The thallus is isodiametric.

**Development of rhizoids and tetrasporangia**

Rhizoids develop as small lateral branches as in previously described species of the group, but very little if any cortication occurs even after the tetrasporangia are shed (Fig. 44). Each lateral pericentral cell off the tetrasporangium, followed by the axial pericentral cell, and let the axial cortex next) (Figs. 82-87). The latter is about half the length of the transverse pericentral cells, and as the tetrasporangia
Figs. 22-24.—Thaliphidium哥伦比亚. Fig. 22.—Branch apex, showing segmentation. Fig. 23.—Apex of a stichodium, showing formation of tetrasporangia and scar cells. Fig. 24.—The same, side view. Fig. 87.—Transverse section of a stichodium. Fig. 88.—Mature spermatangial blade in which the transverse pericentral cells have formed spermatangia. Fig. 89.—Spermatangial blade, showing partial division of transverse pericentral cells. Fig. 10.—Apex of a spermatangial blade, showing segmentation. Fig. 91.—Optical longitudinal view of apex of a young spermatangial blade, showing the transverse pericentral cells (outer row) and direct division of the lateral pericentral to form spermatangial mother cells without a central cell. Fig. 92.—Surface detail of a spermatangial blade. Fig. 93.—Transverse section of a mature spermatangial blade.
mature all the cells of the stichodium separate further, so that at maturity the tetrarugaria receive little protection from either of the cover cells.

Weber van Bosse (1886) refers only to a dorsal (abaxial) cover cell formed before the tetrarugaria; but Silva and Clancy (1904) have also found that this was not so in South African material. Each flanking cell divides horizontally soon after its formation, cutting off a derivative anteriorly. These marginal cells elongate considerably and become strongly curved, especially the posterior one of each pair (Figs. 84, 86). In mature segments the marginal cells give as much, if not more, protection to the tetrarugaria as do the cover cells. No stolobas were seen with the posterior of each pair of marginal cells divided vertically as stated by Weber van Bosse (1886). Silva and Clancy (1904) found that the posterior cell usually remains undivided in South African material.

Development of spermatangial bladders

The spermatia are formed on small lateral branches, similar to but more delicate than those previously described (Figs. 88, 89). They differ, however, in that the transverse perilental cells are usually involved in spermatia production, and thus the branch lacks the distinct "match" of undivided perilental cells (Fig. 88).

Boegeman (1931) also noted the activity of the transverse perilental cells in spermatia production, but Weber van Bosse (1886) and Silva and Clancy (1904) found spermatia produced only from the lateral perilental cells in South African material. Whether or not the transverse perilental cells divide to form spermatia is apparently variable, since various stages showing partial involvement of the cells, or in some cases no division, were observed in the Vincennes Bay material. Figure 89 illustrates a spermatangial branch showing various degrees of division of the transverse perilental cells. The flanking cells of the spermatangial branch of P. minuta divide longitudinally up to 3 times, and the first- and often the second-formed derivatives contribute to spermatia formation. On the margin of the blade a rather irregular line of undivided flanking cell derivatives remains, sometimes 1 and sometimes 2 cells wide (Fig. 90).

The lateral perilental cells divide by a longitudinal perilental wall into two, each of which divides antitudinally to give a row of 4 cells on each surface (Figs. 90, 91). Further antitudinal divisions may take place, giving on each surface 2 rows of up to 8 cells each from each lateral perilental cell. These are the spermatangial mother cells. The derivatives of the flanking cells divide similarly but usually give a single row of 4 spermatangial mother cells. The transverse perilental cells divide directly into a row of 4 spermatangial mother cells (Figs. 90, 91). Each spermatangial mother cell cuts off by oblique antitudinal walls 2-4 spermatangia (Figs. 92, 93).

Thus, in our spermatangial material of P. minuta there is no residual cell resulting from the first division of the lateral perilental cells (Figs. 81, 82). In contrast to all other species of the Sarcocoma group, Boegeman (1931) found no residual cells in Indian material of P. minuta, but Silva and Clancy (1904) believed
him to be mistaken on the grounds that "in all Deloeraeae the spermatangium mother cells represent cortical cells, at least in part".

**Development of procorpus**

Both Weber van Bosse (1889) and Bourgeois (1913) had only very limited female material of P. ministis, and only a very few of the Vivonne Bay plants were female. Weber van Bosse and Bourgeois both described and figured the mature cystocarp, and Bourgeois also described what he thought were stages in procorpus development. He shows, however, a well-developed procorpus in his figures, and it seems likely, as Silva and Clary (1964) have stated, that Bourgeois was dealing with post-fertilization stages. In the Vivonne Bay material the procorpus is not initiated until after fertilization, as in all other species of the Sarcocentria group.

Procorpus arises on the adaxial surface of young lateral branches which develop rapidly, so that the procorpus and later the mature cystocarp occur near the base of a long branch. The adaxial portion of the leaf is off 2 sterile cells and the initial cell of the carpogonial branch (Figs. 94, 95), the latter being formed before the second sterile cell. The carpogonial branch is 4-celled, the first cell becoming elongate and only lightly staining; the second cell is the largest (Fig. 96). The cystogonium bears a short trichogyne with a bulbose end, as in other members of the Sarcocentria group.

**Development of cystocarp**

Accurate material was not available to follow the post-fertilization development, but initial development of the fusion cell resembles that in previously described species (Figs. 97, 98). The procorpus is initiated after fertilization (Fig. 97). The mature cystocarp is relatively small (about 300 μ in nature), globose, and sessile on a short lateral branch (Fig. 99). The megaphyllephyte bears terminal carposperms but does not show the massive, erect band path found in the species of Sarcocentria described above.

The procorpus is 2 cells thick. The inner cystocarp filament of cells each cut off 2 cells (sometimes 3 near the base externally, but these cells remain more or less isodiametric in surface view and do not elongate horizontally. The very few cystocarps in the Vivonne Bay material agree with Bourgeois's figure (1913, Fig. 9) but not with that of Weber van Bosse (1889, Fig. 9), who shows horizontally elongate cells.

2. Cottontelia Bourgeois

*Cottontelia* was established by Bourgeois (1913, p. 333) for an algæ from St. Thomas in the West Indies, which he named *C. arcuata*. A second species was added to the genus in 1920 when Bourgeois transferred *Sarcocentria flavescens* Howe (1905) which was based on a specimen from Cape Florida. *C. arbuscula* was described by Howe (1928) from Brazil and *C. furlowae* by Bourgeois (1930, p. 144) from the Canary Is. Schofield (1961), however, regarded *C. arcuata*, *C. flavescens*, and *C. furlowae* as forms of one species, in which he described a new variety **algeriensis** from Algeria.
A comparison of the published figures of C. arcauta, C. fuliformis, and Schottner's var. algeriensis shows certain marked differences. Bourgeseen's (1919, pp. 330, 331) figures of C. arcauta in general do not show flanking cells, yet when describing C. fuliformis Bourgeseen (1930) compares it with C. arcauta and C. filamentosum and states that all three species are closely related and almost identical in cell development. Flanking cells are formed regularly by each segment of C. fuliformis and C. filamentosum. C. arcauta var. algeriensis appears to be identical with C. filamentosum. The latter is discussed below on the basis of material from Florida. C. fuliformis is distinguished from the other taxa of Cottostellia by the formation of monocospophalous filaments, usually in pairs anterior to the adaxial pericentral cells. Bourgeseen states that this is not always so, but on present knowledge this appears to be an adequate character on which to separate C. fuliformis from the other species of Cottostellia.

In view of the discrepancy between Bourgeseen's original figures of C. arcauta (without flanking cells) and his later inference of close resemblance between this species and others, type material from St. Thomas of C. arcauta has been examined. This material, kindly made available by Dr. Type Christensen, had been preserved in liquid in the Botanisk Museum in Copenhagen, but had dried up. A small fragment was found amongst other algal material, as recorded by Bourgeseen. This material shows that Bourgeseen's figures are essentially accurate, but what he referred to as curveting cells (Bourgeseen 1919, Fig. 936 and probably 335p) are actually flanking cells which are formed only apically along the branches. This is shown in our Figure 100. This appears to give a clear-cut distinction between C. arcauta and C. filamentosum, which otherwise are very similar.

On present knowledge it appears that C. arcauta Bourgeseen, C. filamentosum (Howe) Bourgeseen, and probably C. Punctiforme Bourgeseen should be recognized as distinct species. Schottner's Algerian variety should be known as C. filamentosum var. algeriensis (Schottner) comb. nov. C. arcauta Howe is discussed below.

Although C. arcauta only forms flanking cells occasionally, and the other species do so in each segment, the characteristic endospophalous monocospophalous filaments formed anterior to the adaxial pericentral cells, and the characteristic habit of the species, indicates that they should be placed in one genus.

Reproductive organs are completely unknown in Cottostellia, but this structure is also it with other genera of the Scytonema group.

Cottostellia filamentosum (Howe) Bourgeseen 1929: 477.  

Type locality.—Florida (Howe).

Type.—In Herb. New York Botanical Garden (No. 2944).

The basic structure of C. filamentosum as given by Howe (1905), Bourgeseen (1930), and Schottner (1930), and as observed in material of C. filamentosum from Bald Point, Florida (coll. H. J. Hunn), is summarized below.
Structure of thallus

The hemispherical apical initial cuts off segments which divide to form 4 pericentral cells. The adaxial pericentral cell is first formed, followed by the 2 lateral pericentral cells, and finally the adaxial pericentral cell (Fig. 101). Schotte (1951) states that the lateral pericentral cells are formed first in his Algebrica material, but Silva and Cleary (1984) found the adaxial pericentral to be formed first in C. arcuata from Bermuda. This is also true in the type material of C. arcuata longissima. The lateral pericentral cells each form 2 flanking cells each about half as long as the pericentral cell. This basic structure is typically that of the Barracouta group.

The distinctive feature of Cottoniella is the formation of monosiphonous filaments from the adaxial face of the branches. Cells of the filaments contain chromatophores. The filaments are conspicuous near the branch apex but fall off away from the tip. They develop adaxially from the central cell, at the interior end of the adaxial pericentral cell, which is shorter in length than the other pericentral cells (Figs. 101, 103). They arise very quickly after the adaxial pericentral cell is formed. Five filaments tend to emerge from the branch in 2 rows, alternately to either side. When the filaments are shed the basal cell only is retained. Monosiphonous filaments are not formed near the base of lateral branches; here the adaxial pericentral cell is about as long as the other pericentral cells.

The adaxial origin, anterior to the adaxial pericentral cell, of the monosiphonous filaments distinguishes Cottoniella from Sacromenata lemniscata and S. dolichostephanus, where the filaments arise exogenously from the flanking cells or from the transverse pericentral cells. Cottoniella lemniscata Douty & Walsingham, the Hawaiian is. holds flanking cells except in the ultimate and the monosiphonous filaments, superficially like those in C. filamentosus, arise exogenously from a lateral pericentral cell. These features separate C. lemniscata generally from C. filamentosus (see below).

Lateral branches arise adaxially from the central cells in C. filamentosus, and orientation commences some distance from the apex and develops extensively, at least in some varieties. The thallus is attached by means of several-celled rhizoids from prostrate branches.

Cottoniella sanguinea Hervé 1928

Cottoniella sanguinea Hervé from Brazil is apparently known only from the type material. It is described as differing in the presence of 5 pericentral cells instead of 4.

The type material (NYBG, fragment in AD) is strongly adherent to the mounting paper and difficult to examine. Near the tip there appear to be only 4 pericentral cells, but 5 in older parts. In a few cases it appeared that the fifth cell might be cut off from one of the first 4 pericentrales but lie in the same circle of pericentral cells. The monosiphonous filaments were short and rather unlike those of C. filamentosus; their origin could not be determined. Flanking cells are not present.
3. Cottoniella hawalliensis Doty & Walsingham 1938

Figs. 103–105

Doty and Walsingham (1938) have recently described a new species of Cottoniella from Hawai. Their account, and an examination of type material kindly made available by Dr. M. S. Doty, shows, however, that this species cannot be placed in Cottoniella. A brief description and reasons for placing this taxon in a new genus are given below.

The thallus consists of prostrate filaments attached to other algae by rhizoids and bearing lax unbranched branch systems up to 2 cm tall. The thallus is echiomorphic, with 4 pericentral cells and no flanking cells in the vegetative parts (Fig. 103). The pericentral cells are formed in typical Rhodophyta filamentous algal, lateral, and adaxial in that order. Lateral branches arise endogenously from the adaxial surface of the thallus.

Monosporophytic filaments, containing chromosomes, are formed in characteristic manner from the lateral pericentral cells and are thus endogenous in origin. They occur alternately on the right and left pericentral cells of successive segments (Fig. 104), but are lost from older parts of the thallus. Branches tend to be concave towards the parent axis, and both rows of monosporophytic filaments are turned towards the concave side, i.e., adaxially.

The only reproductive organs known are stichidia. These are typical of the Serronemiae group. The lateral pericentral cells each cut off 2 flanking cells (referred to by Doty and Walsingham as "cover" cells) which may each cut off a smaller cell (Figs. 104, 105). The tetrasporangium is cut off before the 2 cover cells on the adaxial and abaxial surfaces, of which the first-formed cover cell is extended adaxially to partly protect the tetrasporangium while the last-formed cover cell is small and leaves the tetrasporangium exposed on that surface of the stichidia (Fig. 105). The flanking cells become curved and greatly extended horizontally, often with enlarged ends which give some protection to the tetrasporangia (Fig. 105). The flanking cell derivatives elongate but not to the same extent. Doty and Walsingham state that only an adaxial cover cell is formed, but both adaxial and abaxial cover cells are clearly present in our material. Doty and Walsingham also do not mention division of the flaking cells.

The stichidia, development and number of pericentral cells, and endogenous lateral branching closely fit this plant with the Serronemiae group. It differs from Cottoniella, however, in two important points:

1. Flanking cells are completely lacking from the vegetative thallus.
2. The monosporophytic filaments, superficially somewhat like those of Cottoniella, are endogenous in origin, from the lateral pericentral cells, whereas in Cottoniella they are endogenous from the central cells.
SCHIZOMELLA GROUP

Figs. 103-105. Schizomella arbusculae. Fig. 103. —A branch apex, showing formation of exogenous monosporous filament from the lateral preterminal cells. Fig. 104.—A young stichillum. Fig. 105.—Side view of a young stichillum, showing cover cells and flanking cells. Figs. 106-108. Polysiphonous region. Fig. 106.—Side view of a slightly flattened branch apex, showing cell-segmentation. Fig. 107.—Three views of a branch apex. Fig. 108.—Transverse section of a branch, with slight exostomial. Fig. 109.—An older branch, showing cortex and flaking cells.

On these grounds, C. arbuscula is considered generally distinct from Schizomella and is renamed Decella in honour of Dr. Maxwell S. Drey (see below).

Figs. 109-110: Plate 5, Fig. 1

Type locality.—Port Moresby, W.A. (Harvey).

Types.—In Herb. Harvey (TCP), No. 165A.

Distribution.—Port Moresby, W.A; Torres Strait and Amur River Inlet on Kangaroo I., S.A. Sublittoral under calm conditions.

The thallus is composed of fine, much-branched filaments reaching a height of 20 cm (Plate 5, Fig. 1). The branches of the thallus frequently show a distinct, though slight, lateral flattening (Fig. 1). The thallus has a greyish vividness when fresh which very quickly changes to rosy red on exposure or on confinement in a limited volume of water. Degeneration and decomposition of the thallus occur rapidly. The material studied was collected on shelf at Amur River Inlet, Kangaroo I., on July 1947 (AD: A5784), August 1964 (AD: A19767), and May 1966 (AD: A21268). No fertile material was included in these collections, although some hundreds of plants of the August 1964 collection were examined. The material from Port Moresby, originally described and figured by Harvey, was not fertile, and no reproductive organs have ever been described. However, a specimen in Adelaide University Herbarium (AD: A1440) from "Torrers Strait" (probably Torres I., near Outer Harbour, S.A.) proved to be tetrasporic.

Structure of thallus

Growth is initiated by a large hemispherical apical cell, which cuts off disc-shaped segments posteriorly. These segments each form 4 pericentral cells around the central cell. The apical pericentral cell is the first formed (Figs. 108, 107), followed by the 2 lateral pericentral cells, and finally by the adaxial pericentral cell. In the vegetative parts no lateral flattening cells are produced after the formation of the 4 pericentral cells. The cells of each segment elongate considerably, until in the older contracted branches each segment measures up to 1 mm in length. Small, elongate contractile cells are formed in fairly regular longitudinal rows from the external surface of each pericentral cell (Fig. 109). Lateral branches are endogenous in origin, developing from the anterior end of the central cell of the parent branch. Branching is largely from the adaxial face of the parent branch. The branches show a definite, although slight, lateral flattening due to the larger diameter of the lateral pericentral cells (Fig. 108). The typical tetrasporic thallus of Polyphysia is completely absent.

Development of tetrasporic and zoospores

The single dried tetrasporic specimen of P. ramosa available did not prove suitable for a detailed study of tetrasporic development, but the broad features can be given with some assurance.

Tetrasporangia form near the ends of lateral branches and the ascidians are less well defined than in other species of the Scornavacca group. Small lateral branches may be largely fertile, but more usually only the end 10 or more segments of a long