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Studies of the green alga *Kornmannia* (Kornmanniaceae fam. nov., Ulotrichales) in British Columbia

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Studies were made on field and cultured material of *Kornmannia* collected at Triple Island and southern Vancouver Island in British Columbia in order to test the taxonomic reliability of morphological characters. While two distinct entities were readily distinguished according to morphology and apparent ontogenies of field material as well as host preference, under controlled culture conditions the differences were negligible. Both had similar ontogenies, morphologies and cytology. Culture data for the British Columbia material resembled that reported from Japan, Norway and Germany. Consequently, it is concluded that only one circumboreal species, *K. leptoderma*, deserves recognition. *Monostroma areolatum* and *K. zostericola* have been synonymized as *K. leptoderma* (KJELLM.) BLIDING and the description of the genus has been emended. In addition, a new family, Kornmanniaceae, has been erected based on unique life history and cytology.

Key Index Words: *Algal systematics*; *British Columbia*; *Chlorophyta*; *culture*; Kornmannia; *life history*; *ultrastructure*.

Northern British Columbia has a rich and varied algal flora that is only recently becoming better known (HAWKES *et al.* 1978, GARBARY *et al.* 1980). Much of this richness may be attributed to the subarctic water temperatures of 5° to 10°C during the colder half of the year, coupled with a mild maritime climate that leaves the shore ice free year round. Green algae with heteromorphic life histories are particularly abundant. Species that may be only insignificant winter ephemerals in phycologically better known areas to the south often dominate the intertidal region during luxuriant spring blooms in northern British Columbia. *Monostroma* and *Kornmannia* are two such monostromatic genera. GOLDEN and GARBARY (1984) studied *Monostroma* in this area, reducing the profusion of reported entities to three circumboreal species. However, *Kornmannia* has not yet been treated.

Members of the genus *Kornmannia* have distinctively thin, small-celled blades, but the relationship of the different geographic entities is not clear. In Europe KORNMANN and SAHLING (1962) and BLIDING (1968) reported an asexual life history for *K. leptoderma* (KJELLM.) BLIDING, but in Japan YAMADA and TATEWAKI (1965) and TATEWAKI (1969, 1972) found a heteromorphic alternation of generations between a macroscopic bladed sporophyte and a microscopic gametophyte of *Monostroma zostericola* TILDEN. To date the North America taxa have not been studied in culture so that the relationship between the Pacific and Atlantic taxa remains unclear. For example, BLIDING (1968) considered the European and Japanese entities to be separate genera on cytological and life history grounds and the Pacific

American one to be cytologically similar to the European. However, contrasted to this was the opinion of KORNMANN and SAHLING (1962) that the European and Japanese taxa are closely related, if not identical.

A field and culture study has now been completed on *Kornmannia* in British Columbia. In contrast to this genus in California which is only 1-2 cm, in northern British Columbia it reaches 10 cm and may cover much of the winter-spring intertidal region. At the primary study site, Triple Island, *Kornmannia* is represented by two entities. *K. zostericola* (TILD.) BLIDING (KZ), the often reported epiphyte on seagrasses referred to as *Monostroma zostericola* in the west coast North American literature (e. g. SCAGEL 1966, ABBOTT and HOLLENBERG 1976), reaches its maximum size and cover in late spring. It has readily observable disc and saccate stages, and usually a single, often funnel-shaped juvenile blade (SCAGEL 1966). The other entity (KH), which grows luxuriantly on the intertidal algae *Halosaccion glandiforme* (GMEL.) RUPRECHT and *Fucus gardneri* SILVA, has not been previously noted in eastern Pacific literature, although it is represented by numerous collections under the name *K. zostericola* in the University of British Columbia Herbarium (UBC). It reaches its maximum size and cover in late winter, never has a saccate stage, and appears to arise directly from an endophytic basal system to produce a cluster of collar-like upright blades.

In this current study field observations of *Kornmannia* were documented at the primary study site and, to test the taxonomic reliability of the characters, plants from Triple Island were cultured in 1984 and 1985 and plants from southern Vancouver Island, in 1985. These data were used to evaluate the characters employed in diagnosing *Kornmannia* at the species, generic, and family levels.

Material and Methods

Specimens of *Kornmannia* were collected in northern British Columbia at Triple Island (54°17'N 130°53'W) and from southern Vancouver Island at Sooke (48°25'N 123°43'W). Triple Island, the primary study site, was described in a recent publication (GOLDEN and GARBARY 1984). Field material from this area was sampled and examined irregularly through the growing season (December to June) on a daily, weekly, or monthly basis. Cultures were set up from March to June in 1984 and 1985 using specimens from Triple Island, and in April and May 1985 using material from southern Vancouver Island. Relevant herbarium material at the University of British Columbia, including Phycotheca Boreali-America (PBA) (COLLINS *et al.* 1905), was also examined.

Cultured material was initiated as follows: 1) freshly collected moist blades, singly or in clusters, were examined with a dissecting microscope; 2) when releasing areas were seen and confirmed, either motile spores were pipetted drop by drop onto a 20×20 mm cover slip, or clean, small fragments of releasing material were transferred to a coverslip and floated in a drop of filtered seawater; 3) after 5 to 30 min fresh seawater was pipetted over the coverslip to remove everything but settled spores; if release was judged insufficient, the hanging drop method described in WYNNE (1969) was used from 1 to 24 h; 4) coverslips were either cultured individually or broken and the fragments of the clonal juveniles were cultured under different conditions; 5) isolates were replicated using three to ten different blades per host; 6) most isolates were kept through one complete life cycle and then discarded in three to twelve weeks.

Cultures initiated at Triple Island were kept in a growth chamber at about 8°C and 12 h light: 12 h dark. After several weeks, they were transferred to growth chambers in the Department of Botany at the University of British Columbia and replicates were maintained under the following conditions: 5°C 8 h light: 16 h dark, 10°C 8 h light: 16 h dark, 10°C 16 h light: 8 h dark, exposed to approximately 210 $\mu E \cdot m^{-2} \cdot s^{-1}$ intensity. Cultures set up from southern

Vancouver Island material were placed immediately into culture chambers at the University of British Columbia under the foregoing conditions. PES medium (PROVASOLI 1968) was used, supplemented with GeO_2 and/or antibiotics when needed (GOLDEN and GARBARY 1984). Cultured material was observed and photographed periodically using the dissecting and compound microscopes.

For light microscopy, whole mounts and freezing microtome sections of blades were viewed unstained and following staining with IKI. In preparation for transmission electron microscopy (TEM), field collected plants were fixed in 2.5% glutaraldehyde-seawater at 4°C overnight, postfixed in 2% osmium tetroxide-seawater for 2 h and then dehydrated using a graded series of methanol-propylene oxide. Materials were embedded in Spurr's low viscosity resin (SPURR 1969). Sections were cut on a Reichert ultramicrotome OMU3 using glass knives. They were stained with a saturated solution of uranyl acetate, followed by lead citrate (REYNOLDS 1963), and viewed in a Zeiss EM10 electron microscope.

Results

Field material:

I. At Triple Island *Kornmannia Z* grew epiphytically on leaf margins of the vascular plant *Phyllospadix*, colonizing the tips of only a few plants in intertidal pools (Fig. 1). Size and habit varied with the season. Early in March many small (approx. 1 cm) cuneate blades were observed arising directly (without apparent saccate stages) from a few scattered, minute crust stages. As the season progressed to its peak in May, plants were more conspicuous; usually there was a single blade per basal crust, and saccate stages were readily observable (Fig. 2). With larger blades (to 10 cm), the crust was often no longer distinguishable from the laciniated, plate-like base of the plant. All blades disappeared by late June; a new crust phase was found occasionally during the summer and autumn.

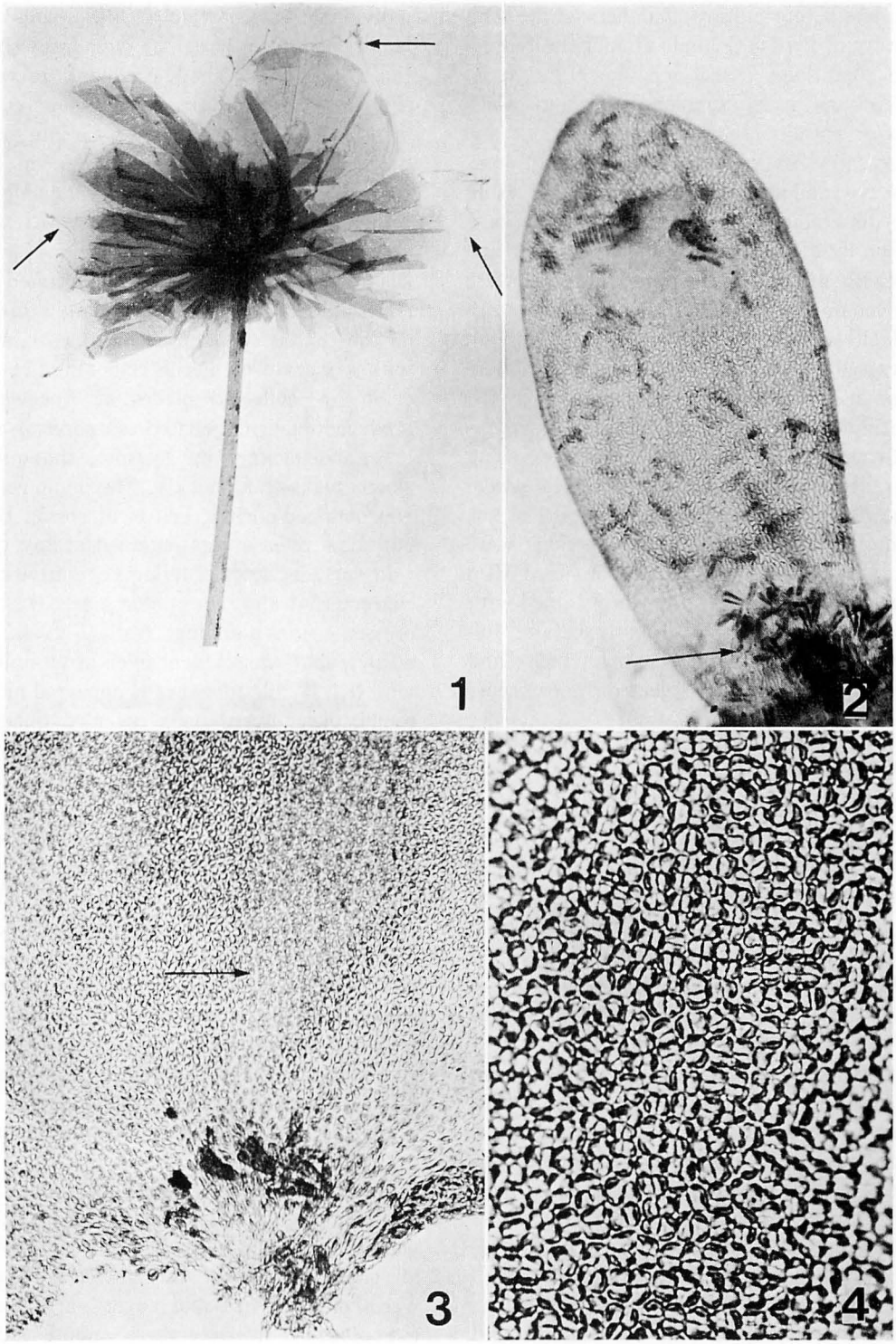
The basal and vegetative regions of typical thalli showed little differentiation, though individuals varied widely. Basal cells often lengthened into irregular, quadrate shapes that occasionally had rhizoidal processes (Fig. 3). Distally, the cells became equidimensional (5 μm×5 μm). In saccate stages they organized in linear files but, in later stages, became increasingly randomly arranged. A "vein-like" (TATEWAKI 1969) arrangement was often apparent (Fig. 3). Distally, vegetative cells differentiated into *Ulva*-like sporangia. These usually remained on the thallus following spore release, along with a margin of sterile cells (Fig. 1).

All field collected blades of *Kornmannia* produced quadriflagellated zoospores, 4–5 μm long and lacking an eyespot, that moved slowly and settled quickly. Maximum release was obtained during periods of spring tides, but some release was obtained at any time.

In surface views of living vegetative cells, characteristically the chloroplast was appressed to an anticlinal wall (Fig. 4), and no pyrenoid was evident even after staining with IKI. While turgid cells appeared almost round, plasmolysed ones revealed quadrate cell walls. Distinctive areolate patterns of cells were usually evident in unfixed dried material.

Ultrastructurally, vegetative cells contained a large, parietal chloroplast with an internal, long, ellipsoid pyrenoid which lacked associated starch plates (Figs 5, 6). The pyrenoid matrix was bound by thylakoid membranes (Fig. 6A) and small starch grains were randomly arranged within the stroma. Mitochondria with long, wide cristae were closely associated with the inner side of the chloroplast, concentrated in the region between the chloroplast and the large nucleus.

II. *Kornmannia H* epiphytized all available overwintering *Halosaccion*, and some *Fucus* was also infected. In good growing years all substrates in the mid intertidal region were covered; size and cover varied with the season. In December, minute sterile blades were seen on a few *Halosaccion* plants, arising endophytically (Fig. 7). By spring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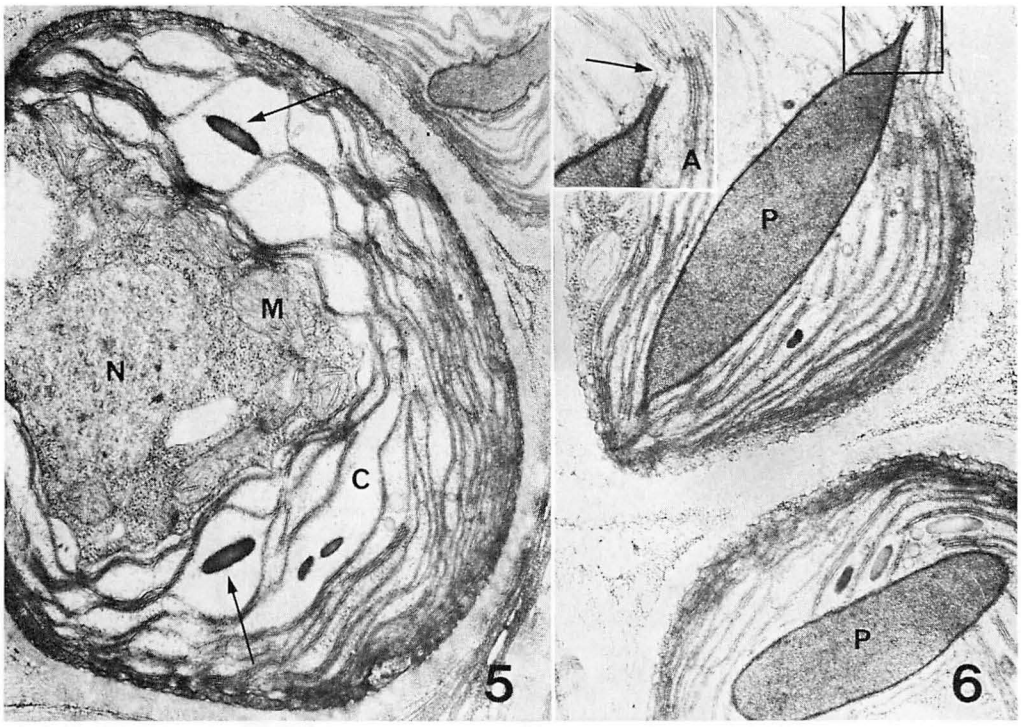


Figs. 5, 6. *Kornmannia Z*: electron micrographs of sections through vegetative cells. 5. Whole cell showing large, parietal chloroplast (C) and starch (arrows) within the stroma. Note many mitochondria (M) with long, wide cristae concentrated in the region between the chloroplast and nucleus (N). ×20,000. 6. Long, ellipsoid pyrenoid (P) lacking associated starch plates within each chloroplast. The dense matrix is bound by thylakoid membranes. ×20,000. Inset A is an enlargment of the tip of the pyrenoid showing the thylakoid association (arrow). ×35,000.

most hosts were covered with 1–3 cm blades (Fig. 8) which appeared to arise directly from uniseriate or multiseriate endophytic filaments. Saccate stages were never found. Individual blades were broader apically, narrowing to a funnel-like stipe which appeared closed but was actually open (Fig. 9). Most of the host plants from the previous year had disappeared by late May. Few-celled *Kornmannia* crusts were common on lower parts of the current year hosts throughout the summer and autumn.

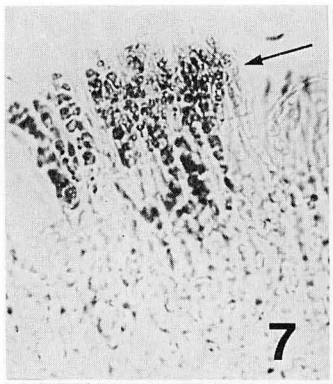
Typical thalli were differentiated into basal and vegetative regions. The cells in the stipe were long, narrow and quadrate (Fig. 9), measuring 25+ μm×approx. 6 μm. Rhizoidal processes were common, occurring even in juveniles. Distally, cells developed into equidimensional vegetative cells. Cytologically, vegetative and reproductive cells of KH were similar to those of KZ reported above.

Cultured material:

Gametophyte generation—

Zoospores released from *Kornmannia Z* collected at Sooke and cultured at 5° and 10°C and 8 h light: 16 h dark conditions germinated directly into prostrate filaments.

Figs. 1–4. *Kornmannia Z*: light micrographs of living material growing epiphytically on *Phyllospadix*. 1. Blade-like thallus on tip of *Phyllospadix*. Note clear distal areas where spores have been released (arrows). Some sterile vegetative cells remain along the outer margins. ×1.5. 2. Saccate stage with unistratose basal disc (arrow) which was lifted off the cuticle of *Phyllospadix*. ×110. 3. Basal region of a long laciniated blade showing "vein-like" arrangement of cells (arrow) and rhizoids. ×180. 4. Surface view of vegetative cells showing the chloroplast appressed to the walls. ×650.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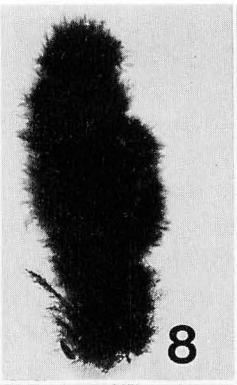
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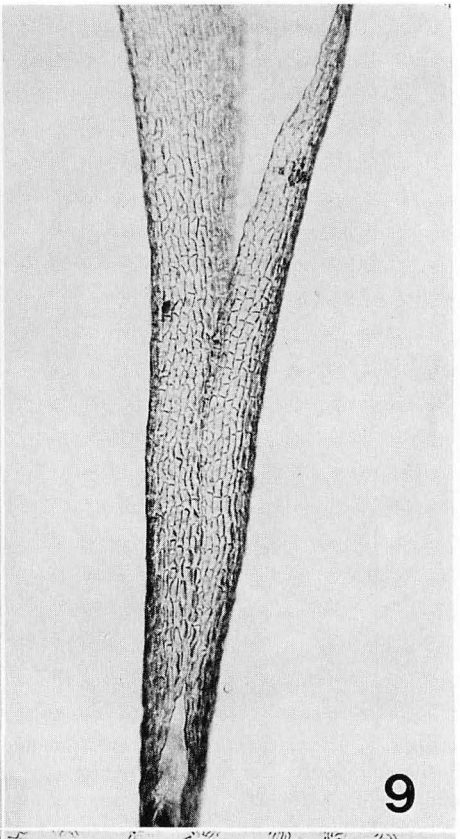
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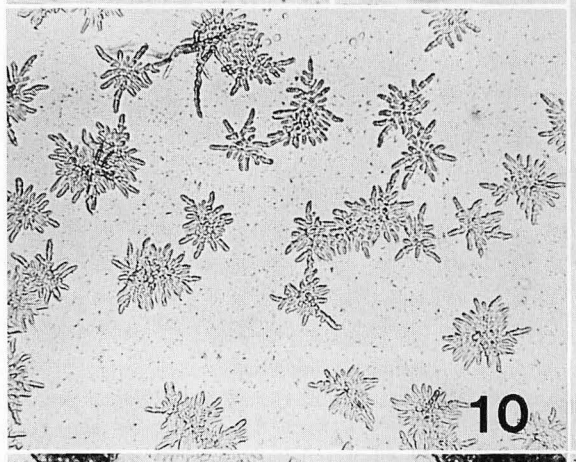
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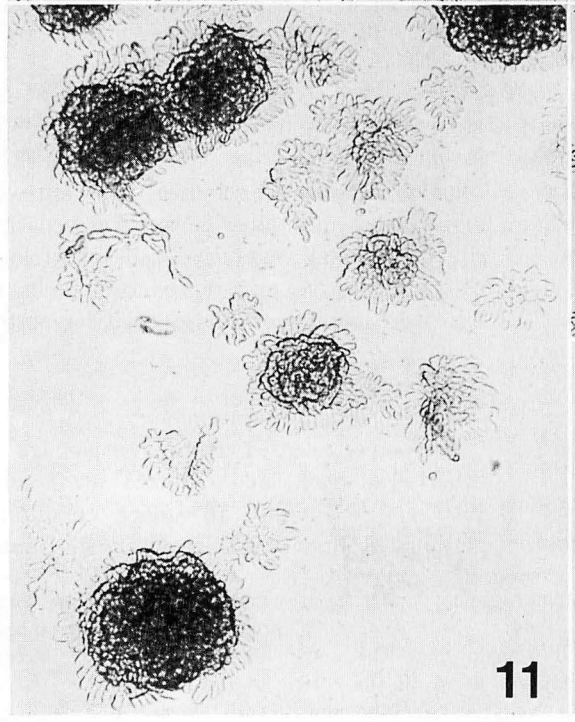
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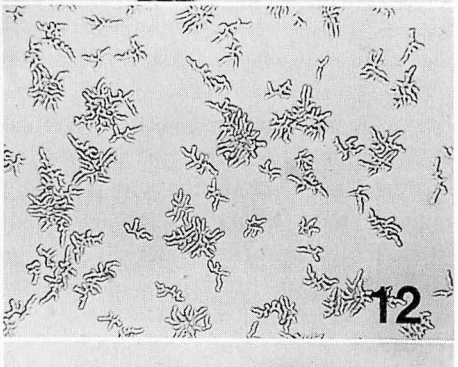
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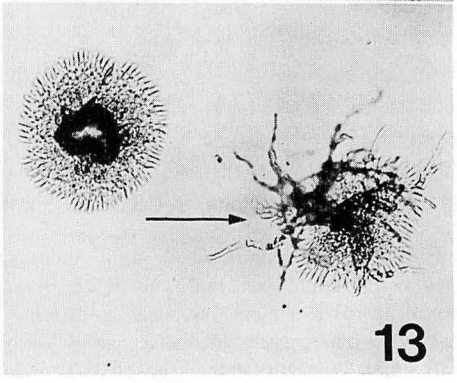
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At the three- to five-celled stage branching commenced and four or more files of cells soon radiated outwards. Distal cells were usually longer and unbranched (Fig. 10). This produced a small, irregular, pseudo-parenchymatous disc which then began to thicken centrally as the lateral growth slowed or ceased (Fig. 11). The plants became reproductive in three to four weeks; gametangia covered the surface of a crust. The onset of release was signalled by the rapid movement of gametes inside the gametangia. All the gametes were released within a short time, rising in a cloud that remained just above the disc. This swarm was composed of conjugating, biflagellated isogametes that were about 4 μm long and fast moving. The crusts released randomly and no mixing of gametes between neighboring crusts was observed.

Culture data from KZ and KH collected at Triple Island differed in that the zoospores had an empty spore germination type. Gametophytes of KH were also more regular in outline and indistinguishable from young sporophytes (see below).

Gametophytes cultured at 10°C under long day conditions had an isomorphic life history. Instead of developing into paranchymatous crusts, they usually became dense tufts of uniseriate, branched filaments (see Fig. 13 arrow for a similar early stage in the sporophyte). Monoecious isogametes were produced which recycled similar irregular tufts or crusts, some of which produced zoospores when mature.

Sporophyte generation:

All cultured zygotes grown at 5° and 10°C under short day conditions germinated directly into prostrate filaments which often began branching at the second two-celled stage (Fig. 12). Cells at the end of filaments often had a bifurcating from of division not seen in the gametophytic stages. A small, circular disc was soon formed which then began to thicken and upheave centrally (Fig. 13). The resulting saccate stages either opened at the apex immediately, or grew into a long narrow tube.

Sporophytic grow in the 1984 KH (Triple Island) cultures was atypical in that saccate stages were not formed. Instead, a blade was produced by a "horse shoe"-shaped upheaval (BLIDING 1968), or else by irregular upright filaments that developed directly into blades. The 1985 KH cultures had normal disc-sac ontogeny.

Cultured material from zygotes grown at 10°C short day conditions showed some abnormal growth forms which were not present in material grown at 5°C short day conditions (Fig. 13). In addition, some sporophytic cultures that became overgrown with germlings developed blades on the water's surface without an intervening disc stage. Sporophytes normally became reproductive at sizes of 2–3 mm when grown under 10°C short day conditions; those under 10°C long day conditions grew vegetatively indefinitely, reaching lengths of 2–3 cm in four weeks.

Asexual plants:

Kornmannia H from Sooke was asexual. Under all conditions germinating zoospores had a disc-sac ontogeny similar to that of the sporophytic phase described above. However, growth was less affected by the 10°C long day conditions, and some clones showed no abnormalities at this temperature.

Figs. 7–9. *Kornmannia H*: living material growing epiphytically on *Halosaccion*. 7. Minute endophytic germlings (arrow) growing out from *Halosaccion* tissue in December. ×300. 8. *Halosaccion* plant in the spring covered with blades arising from uniseriate and multiseriate endophytic filaments. ×0.5. 9. Portion of an individual blade showing the open, collar-like, tubular stipe. ×120. Figs. 10, 11. *Kornmannia Z.* epiphytic on *Phyllospadix*: developing gametophytes. 10. Early stages following germination. Note longer unbranched distal cells. ×160. 11. Later stages showing polystromatic gametophytes. Note centrally thickened pseudo-parenchymatous discs. ×220. Figs. 12, 13. *Kornmannia H.* epiphytic on *Halosaccion*: developing sporophytes. 12. Early stages following germination. Note branching commencing at two-celled stage. ×100. 13. Later stages showing a circular disc with thickened central upheaval and an abnormal form (arrow) with irregular filament growth. ×380.

Discussion

Species:

Historically, putative differences in blade morphology, habit and size have been used to differentiate taxa in the *Kornmannia* complex, i.e. thin (approx. 10 μm), small-celled (approx. 5×5 μm) blades lacking pyrenoids. This group included *Monostroma leptodermum*, *M. zostericola*, and *M. areolatum* (UBC #A114, "co-type"). Small cell sizes were sufficient to separate *M. leptodermum* from previously described *Monostromas*. KJELLMAN (1877) based his description upon fragments of drift found along the shores of Novaya Zemlya in the Russian Arctic. Working in Greenland, ROSENVINGE (1893) and JÓNSSON (1904) found large (to 10 cm) plants, attached to the substrate by long tubular stipes, which they equated to KJELLMAN's stipeless fragments. TILDEN (1900) erected *Monostroma zostericola* for the small, sessile blades epiphytic on the seagrass *Zostera* in the Puget Sound area of Washington State. But, as COLLINS (1909) pointed out, the Pacific plants are identical to those epiphytic on *Zostera* along the New England coast (PBA #1272), and neither is incompatible with KJELLMAN's description. COLLINS also questioned the conspecifity of the Greenland and North American material. SETCHELL and GARDNER (1920a) agreed with TILDEN's designation of *M. zostericola* from Puget Sound. However, they erected *M. areolatum* S & G for a similar but much larger (20-35 cm) *Zostera* epiphyte from Sitka, Alaska, which they further believed had a distinct areolate cellular pattern and more ephemeral saccate stage. Northwestern Pacific workers have identified their seagrass epiphyte as *M. zostericola* (TOKIDA 1954, VINOGRADOVA 1979), although SCAGEL (1966) suggested that the entity described by YAMADA and TATEWAKI (1965) differs significantly in zoospore and vegetative cell size from that in the type locality. Despite the above reservations, in practice the Atlantic plants have been referred to *K. leptoderma* even when only present as *Zostera* epiphytes (SOUTH and HOOPER 1980), or quite small (PEDERSEN 1976), and Pacific plants to *K. zostericola*, regardless of size (VINOGRADOVA 1979) or host (NAGAI 1940).

The differences in field collected KH and KZ at Triple Island are comparable to those previously used to distinguish species. These differences may be summarized as a single large, irregular blade with an ephemeral tubular stipe and a distinct saccate stage (KZ), contrasted with a cluster of small, collar-like blades differentiated into a stipe and a blade which develops directly without saccate stages (KH). However, under controlled culture conditions, the differences in blade morphology between the two entities became negligible. Whatever the variations between and among isolates, basically both KH and KZ had a disc-sac ontogeny. Size, stipe morphology, number of blades per crust, etc. varied with culture conditions, particularly crowding. It is concluded that the field differences noted for the sporophytic blades were phenotypic and taxonomically unreliable.

Kornmannia culture data from Japan, Germany and Norway were indistinguishable from those obtained from British Columbia in the current study. In Europe, cultures grown at temperatures less than 10°C and unstated daylengths produced blades which recycled asexually by means of a disc-sac ontogeny (KORNMANN and SAHLING 1962). BLIDING (1968) further reported that in some plants the disc's central upheaval was incomplete, producing a collar rather than a sac, the "horseshoe" ontogeny. At 15°C and unspecified photoperiod, irregular thalli ("tufts", this paper) developed which produced zoospores (KORNMANN and SAHLING 1962). In Japan, YAMADA and KANDA (1941), using cultures grown in windows, found the macroscopic blade recycles itself by the disc-sac ontogeny, the disc being present all summer and autumn and the upheaval commencing with winter conditions. Later, YAMADA and TATEWAKI (1965), using controlled temperatures and photoperiods, reported a heteromorphic life cycle at 5°C and

short day conditions. While the zygotes usually followed a disc-sac ontogeny, there were variations including uniseriate filaments arising from the disc as precursors of the blade. At 13°C and a 14 h light: 10 h dark photoperiod, there was an isomorphic alternation of generations with the blade phase suppressed.

Cytologically, the Japanese, European and British Columbia taxa are indistinguishable at the light microscope level. All lack apparent pyrenoids, even when stained with IKI, contrary to some earlier reports [SCAGEL 1966, BLIDING 1968-interpretation of YAMADA and TATEWAKI (1965) figures]. At the TEM level, HORI (1972) dealt incidently with the pyrenoid of *Kornmannia* in a comparative study. He pointed out that this pyrenoid is unique among green algae, both in shape and the lack of a starch sheath, and so is practically invisible in the light microscope. The results of the current study confirm HORI's data.

Summarizing, it has been demonstrated in the present investigation that using field material the two *Kornmannia* epiphytes, KZ and KH, at Triple Island are more clearly distinguished morphologically than are the Atlantic *K. leptoderma* and the Pacific *K. zostericola*. However, it has also been shown that these differences are not evident in cultured material and are phenotypic. As the culture data of *Kornmannia* in Japan, Norway, and Germany were similar to those obtained for British Columbia, it is concluded that only one circumboreal species, *K. leptoderma*, deserves recognition at this time.

The small, consistent differences noted between the two epiphytes, KZ and KH, in British Columbia suggest that the two separate and independent populations of *Kornmannia* may be in the process of speciating. The development of KZ and KH gametophytes and sporophytes cultured from Triple Island material differed slightly and, at Sooke, field material of KH was asexual and grew adjacent to that of KZ which was sexual. In addition, the distribution of KZ is more southerly, into California. The application of modern techniques such as electrophoresis may reveal a greater genotypic distance between these populations than that shown by morphology and ontogeny.

Genus:

As BLIDING (1968) did not consider the Japanese material to be congeneric with the European, his generic description of *Kornmannia* included only the monophasic, asexual life history, and his diagnosis relied upon anatomical features such as the blades, small cells, the absence of pyrenoids and rhizoids. In light of the present study, the generic diagnosis requires emendation, which is done formally at the end of this paper. The diagnostic characters of the genus are considered to be the heteromorphic life history of a macroscopic sporophytic blade alternating with a gametophytic microthallus and the unique cytology.

Family:

Ulvalean algae are usually separated into two families based upon life histories; this dichotomy is supported ultrastructurally (O'KELLY *et al.* 1984). KUNIEDA (1934) erected the Monostromaceae to include those taxa with a heteromorphic life history in which a macroscopic gametophytic blade alternates with a single-celled *Codiolum* sporophyte, in contrast to the isomorphic life history in the Ulvaceae. Considering the life history and unique cytology, *Kornmannia* does not fit into either family. Therefore, it is necessary to erect a new family, the Kornmanniaceae. This is done formally at the end of this paper.

Many authorities consider *Blidingia* and *Kornmannia* to be closely related because of their similar blade development and more recently, a report of heteromorphic life history in the former (TATEWAKI and IIMA 1984). However, ontogeny is not a good indicator of taxonomic relationship. For example, GOLDEN and GARBARY (1984) using spore release characters and O'KELLY *et al.* (1984) using flagellar apparatus ultrastructure showed that *Ulvaria obscura* (KÜTZ.) GAYRAL var. *blyttii* (ARESCH.) BLID. is not conge-

neric with *Monostroma oxyspermum* (KÜTZ.) DOTY as BLIDING (1968) had held based upon their similar ontogenies. Regarding TATEWAKI and IIMA's (1984) interpretation of heteromorphy in the life history of *Blidingia*, GOLDEN and COLE (unpublished data) have observed that some slow growing *Enteromorphas* which form prostrate basal systems may become reproductive before the upright is produced. This was a culture artifact in an essentially isomorphic life history.

Although *Blidingia* and *Kornmannia* have similar cell sizes, ultrastructurally their vegetative cells are not alike. It appears that *Blidingia* exhibits typical ulvacean cytology while *Kornmannia* does not. The pyrenoid of *Blidingia* is a type common to all ulvacean genera: *Ulva*, *Enteromorpha*, *Percursaria*, *Ulvaria* (HORI 1972, SWANSON and FLOYD 1978); in contrast, that of *Kornmannia* is unique. The organelle arrangement within *Blidingia* cells is also similar to that in *Ulva* (LØVLIE and BRÅTEN 1968, MICALEF and GAYRAL 1972, SWANSON and FLOYD 1978). The characteristic placement of mitochondria as a layer between the chloroplast and nucleus in *Kornmannia* has not been observed in any other Ulvaceae examined to date.

Ordinal:

Wide-cristaed mitochondria similar to those observed in *Kornmannia* are evident in electron micrographs included in several other ultrastructural studies on most algae in the orders Ulvales, Ulotrichales, and Acrosiphonales (e.g. MATTOX and STEWART 1973, LOKHORST and TRASK 1981, SLUIMAN *et al.* 1983), but not in the Cladophorales or siphonaceous algae (e.g. HIRAYAMA and HORI 1984, ROBERTS *et al.* 1984). MATTOX and STEWART (1973) suggested the transfer of *Pseudendoclonium* to the Ulvales based on several characters including its ulvacean pyrenoid and the appearance of its mitochondria. They were aware of the "folly" of comparing algae on the basis of mitocondrial ultrastructure, but there may now be some merit in considering all available EM data on ulvalean, ulotrichalean and acrosiphonalean algae to determine if they have sufficiently similar cytological features to form a more natural single group (Ulotrichales).

Kornmanniaceae fam. nov.

Sporophyton macroscopicum, laminaris, monostromatica et pertenuis. Cellulae parvae, pyrenoides sine vaginis amyli. Gametophyton minutum, pulvinatus, monoicum.

Sporophyte macroscopic, blade-like, monostromatic and thin. Cells small, pyrenoids without starch sheath. Gametophyte minute, cushion-shaped, monoecious.

GENUS TYP I: *Kornmannia* BLIDING 1968, p. 610.

Accepted species: *K. leptoderma* (KJELLMAN) BLIDING, 1968.

Synonyms: *Monostroma zostericola* TILDEN Amer. Algae 1900, #388.

Kornmannia zostericola (TILDEN) BLIDING 1968. p. 620.

Monostroma areolatum S & G 1920b.

Emended description of genus *Kornmannia*: Plants with thin, monostromatic blades; stipes tube-like, collar-like or absent; cells small; rhizoids present or not; pyrenoids lacking starch sheath. Heteromorphic alternation of generations or asexual; macroscopic bladed sporophyte usually product of a disc-sac ontogeny alternates with a microscopic crust-like monoecious gametophyte. Reproductive cells 3-5 μm long, without eyespot.

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ゴールデン, L.・コール, K. M.: ブリチッシュ コロンビア産の紅藻モツキヒトエ（モツキヒトエグサ科〔新称〕ヒビミドロ目）の研究

本研究は，ブリチッシュ コロンビア北部のトリプル島と南部のバンクーバー島産モツキヒトエの野生及び培養材料について，形態的特徴の分類学的信頼度を確めるために行われた。異った二種類のものが，野生での形態や個体発生，並びに宿主選好によって容易に区別されたが，培養では差異は認められなかった。両者は個体発生，形態及び細胞学からみて同種であった。ブリチッシュ コロンビア産の培養結果は日本，ノルウェーとドイツ産での報告と共通した。従って，*K. leptoderma* が唯一の北方域種であると結論され，*Monostroma areolatum* と *K. zostericola* は *K. leptoderma* (KJELLM.) BLIDING のシノニウムとし，属記載が修正された。さらに，新しい科として Kornmanniaceae が，独特の生活史と細胞学に基いて創設された。