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The Bryoflora of the Vestfold Hills and Ingrid Christensen Coast, Antarctica

R.D. Seppelt

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THE BRYOFLORA OF THE VESTFOLD HILLS AND INGRID CHRISTENSEN COAST, ANTARCTICA

by

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ABSTRACT

The bryoflora of the Vestfold Hills and Ingrid Christensen Coast includes six moss species and one hepatic. Moss species represented in the flora are Grimmia antarctici, Grimmia lawiana, Ceratodon purpureus, Sarconeurum glaciale, Bryum algens, Bryum argenteum. The one hepatic Cephaloziella exiliflora, from the Larsemann Hills, represents the most southerly record of an hepatic. A discussion of the Antarctic distribution and taxonomic problems associated with the recognition of individual species is included. All species are illustrated.

1. INTRODUCTION

The Antarctic Botanical Zone has been defined in a variety of ways by different authors (Pickard and Seppelt 1984), but is here considered to be confined to those regions generally south of the Antarctic Divergence, the circumpolar boundary between the prevailing easterly continental winds and the westerly oceanic winds. The Antarctic Convergence, the northern limit of the Antarctic Cold Front, that is, the interface between antarctic and temperate air masses, has often been used to delimit the antarctic and the subantarctic regions. The Convergence is also an oceanographic boundary between the warmer, lighter, temperate waters and the colder, denser, antarctic water. Reasons for accepting the Divergence as the northern limit of the Antarctic Botanical Zone are discussed in Pickard and Seppelt (1984).

The Antarctic Botanical Zone is unique in possessing a flora that is almost entirely composed of cryptogams. Most of the land mass of Antarctica is covered by permanent ice and snow. Plant life, excluding the snow algae, is therefore restricted to the available exposed coastal and inland outcrops, nunataks and mountain ranges which amount to less than 5% of the 14 million km^2 of the antarctic land mass.

The bryophyte flora of Antarctica is known to consist of between 70 and 80 moss species and 10 hepatic species. Much revisionary taxonomic work and controlled environment growth studies are necessary before the number of moss species, particularly in the Continental Antarctic zone, will be clarified (Seppelt 1983a; Seppelt and Selkirk, in press).

Mosses have been reported from as far south as 84°42'S (Wise and Gressitt 1965). The majority of species are found in the Maritime Antarctic region, which includes the South Orkney Islands, South Shetland Islands, Palmer Archipelago, and the west coast of the Antarctic Peninsula. All these areas have a fairly oceanic climate with at least one month in summer with mean air temperature above freezing point at sea level and mean monthly winter temperatures rarely below -10°C. Summer precipitation, with some falling as rain, is higher in the Maritime Antarctic than in the Continental Antarctic zone where the summer temperatures generally do not exceed freezing point (except along the northerly coastal fringe) and where air temperatures in winter fall well below -20°C. The favourability of climatic conditions in the Maritime Antarctic is manifest in the abundance of species and the formation of extensive peat banks in some areas (Smith 1979; Fenton 1980, 1982).

Compared to the Maritime Antarctic the moss flora of Continental Antarctic zone is impoverished. Six genera of mosses have been confirmed - *Bryum* (the largest, and in which there is the greatest taxonomic confusion), *Ceratodon*, *Grimmia*, *Plagiothecium* (one aquatic record), *Pottia*, and *Sarconeurum*. *Sarconeurum* includes the most southerly moss record and was formerly considered an endemic genus. It has now been reported from Patagonia and southern South America (Greene 1975; Matteri 1982). Both terrestrial and aquatic species have been described in the genus *Bryum*. Phenotypic plasticity, particularly in response to environmental stresses, and the lack of sporophytes, makes this genus difficult taxonomically.

While numerous species have been reported there is only one authentic record of a fruiting *Bryum* from continental Antarctica (Filson and Willis 1975) and this can be referred to the widespread *Bryum algens*, a species that is known to produce capsules in abundance along the western side of the Palmer Peninsula in the Maritime Antarctic. The only other fruiting mosses reported from Continental Antarctica are Pottia heimii (Nakanishi 1977, as Bryum antarcticum; Kanda 1981) and an unpublished record determined, possibly by Dixon or Watts, as Grimmia trichophylla, collected by the Australasian Antarctic Expedition in Terre Adelie in 1912 (specimen in the Tasmanian Herbarium, HO).

The distribution of plant life in continental Antarctica is limited by the availability of suitable ice-free niches on coastal outcrops and inland nunataks and mountain ranges. Availability of liquid water for growth during the summer months is a major factor determining local plant distribution and abundance (Matsuda 1963, 1968; Rudolph 1966; Boyd et al. 1966; Gannutz 1967; Gressit 1967; Schofield and Rudolph 1969; Greene and Longton 1970; Lamb 1970; Kobayashi 1974; Nakanishi 1977; Shimizu 1977; Yamanaka and Sato 1977; Seppelt and Ashton 1978; Ando 1979). The distribution of moss and lichen communities is closely related to the pattern of snow drifts which, in turn, are governed by the prevailing wind direction. Wind also affects the local distribution of plants by the abrasive effects of mobile snow and ice particles and sand grains. Drier, wind-exposed sites tend to be occupied by lichens or small cushion-forming mosses (Longton 1967; Schofield and Rudolph 1969; Lindsay 1971; Smith 1972; Allison and Smith 1973; Nakanishi 1977). In coastal areas wind-borne salt spray may have a marked effect on plant distribution (Matsuda 1968; Nakanishi 1977; Seppelt and Ashton 1978; Broady 1982). Low temperatures in summer have also been considered an important factor determining the dominance of cryptogamic species in antarctic vegetation (Horikawa and Ando 1967; Longton and Holdgate 1967; Greene and Longton 1970; Lamb 1970; Rudolph 1971).

In Continental Antarctic localities colonies of Penguins and other sea birds may provide considerable input of plant nutrients via vomitus and excreta (Allen et al. 1967; Schofield and Rudolph 1969; Schofield and Ahmadjian 1972; Nakanishi 1977). While some lichens (species of Buellia, Caloplaca, Lecanora, Physcia, Xanthoria, Candelariella) and the nitrophilous green alga Prasiola crispa are abundant near many bird colonies or nest sites, bryophytes do not appear to favour ornithogenic substrates (Schofield and Ahmadjian 1972) although Nakanishi (1977) noted in the Ongul Islands region ornithocoprophilous communities of the Bryum argenteum - B. inconnexum sociation, Bryum inconnexum sociation, and the Bryum antarcticum - B. inconnexum sociation. Gross morphology of mosses may, in fact, be affected by the type of nitrogen source (Schofield and Ahmadjian 1972), such that some subspecies and possibly even species may be attributable to ecotypes induced by the type of nitrogen source in the habitat. Algal nitrogen fixation may also have some importance for abundance of mosses in some habitats (Yamanaka and Sato 1977).

The vegetation of Continental Antarctica has been described in general terms by Rudolph (1963). The first attempt to classify the vegetation of the continent was that of Longton (1973), based on the classification derived for the Maritime Antarctic by Holdgate (1964) and Gimingham and Smith (1970). In the Continental Antarctic zone there is a restricted diversity of both bryophyte species and life form types. Bryophyte vegetation is limited to the short moss turf and cushion subformation (Longton 1973; Nakanishi 1977; Seppelt and Ashton 1978; Longton 1979), contrasting markedly with the range of life forms found in the Maritime Antarctic zone (Holdgate 1964; Longton 1967; Gimingham and Smith 1970; Lindsay 1971; Smith 1972; Allison and Smith 1973; Smith and Corner 1973; Smith and Gimingham 1976; Longton and Holdgate 1979). Bryophyte vegetation is best developed on sandy and gravelly substrates where abundant moisture is available during the summer growth period as snow drifts melt and lakes overflow.

The dominant mosses may vary between sites both locally and from different geographical regions. Rudolph (1963) and Longton (1973) reported Bryum antarcticum - B. argenteum and Sarconeurum glaciale sociations from Cape Hallet and McMurdo station respectively. Matsuda (1968) and Nakanishi (1976) reported Bryum inconnexum, Ceratodon purpureus, C. purpureus - B. inconnexum, Bryum argenteum - B. inconnexum, Bryum antarcticum - B. inconnexum and Desmatodon sp. - B. inconnexum sociations from the vicinity of Syowa Station. Seppelt and Ashton (1978) included a Bryum algens - Grimmia lawiana sociation and several moss - lichen, lichen - moss sociations as well as a Prasiola crispa - Bryum algens sociation from the Mawson station area.

It is probable that some of the diversity shown in the Bryum - dominated vegetation results from differing taxonomic interpretations of the species. Kanda (1981), in a study of the Desmatodon species and Bryum antarcticum reported from the Syowa station area, referred the Desmatodon to Pottia austro-georgica and reduced Bryum antarcticum to synonymy of Pottia heimii.

Longton (1982) noted that community structure varied between sites. At McMurdo station Bryum argenteum and Sarconeurum glaciale typically formed widely scattered short, compact turves amongst stones or with the colony surfaces flush with the surrounding substrate. Other species formed small cushions, sometimes giving complete cover over several square meters in favourable sites. Bryum inconnexum cushions in the vicinity of Syowa station attained depths of 5-9 cm (Matsuda 1968). At Mawson station Bryum turves are generally less than 5 cm in depth (Seppelt and Ashton 1978) but in the most sheltered habitats may reach depths of 10-15 cm, but the base of the turves was then generally much broken and degraded. In the vicinity of the former Wilkes station and near the adjacent presently occupied Casey station extensive moss and lichen fields occur. Turves of Grimmia antarctici, Ceratodon minutifolius (sensu Horikawa and Ando 1963) and Bryum algens are generally 30-60 mm in depth. In most favourable habitats the extensive Bryum turves may reach 150-200 mm in depth with the greatest depth so far noted being in excess of 300 mm in Bryum algens growing in a melt seepage runnel amongst moraine and sand. In the less extensive moss fields in the Vestfold Hills most colonies of Bryum and Grimmia are from 20-50 mm in depth.

Bryophyte vegetation in the Vestfold Hills is distributed generally over the easterly inland region. In the westerly or seaward half of the oasis, localities formerly inundated by the sea, bryophytes have been found only at a few isolated sites. Much of the western half of the oasis is covered by extensive sand and moraine deposits. There are few suitable habitats with sufficient freshwater supply and a stable substrate to permit extensive colonisation by bryophytes.

Figure 1 shows the location of the Vestfold Hills and the geographic features of the Ingrid Christensen Coast.

The distribution of collection records of all moss species in the Vestfold Hills is summarised in Figure 2. Not all the grid squares of the oasis have been collected and the absence of species records, at least in the eastern half, reflects in part those areas which have or have not been visited. The general absence of bryophytes from the western localities reflects the true distribution of the species.

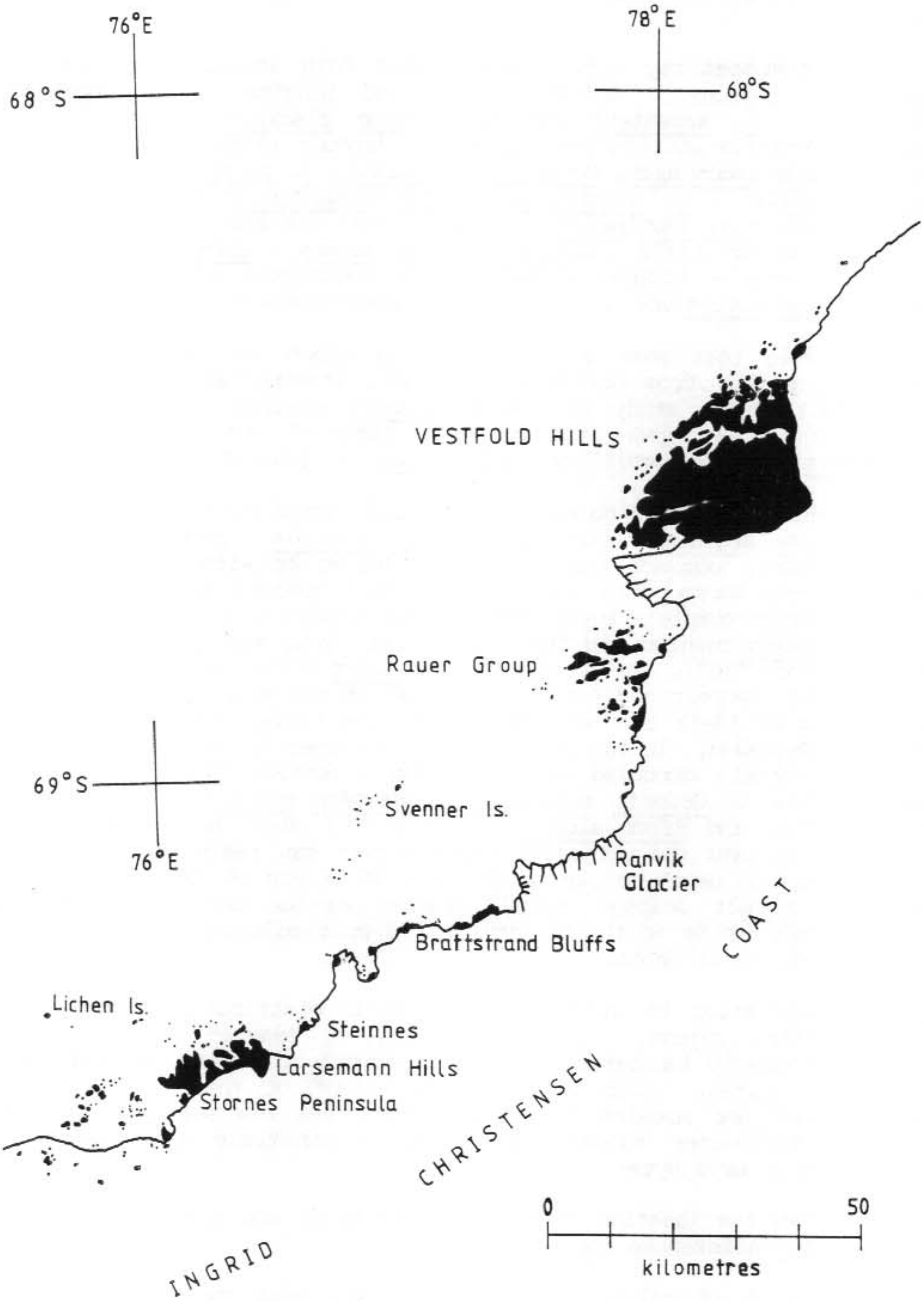

Figure 1. Ingrid Christensen Coast, Antarctica.

In the following treatment of the species which have been found an attempt has been made to discuss the Antarctic distribution and some of the taxonomic problems associated with the recognition of individual species. Illustrations of the species are provided to clarify the identification and indicate the author's taxonomic interpretations. It is evident that much needs to be done, with additional field observations and collections by specialists and extensive laboratory culture experiments, before there can be a definitive essay on the taxonomy and relationships of the Antarctic bryophyte flora.

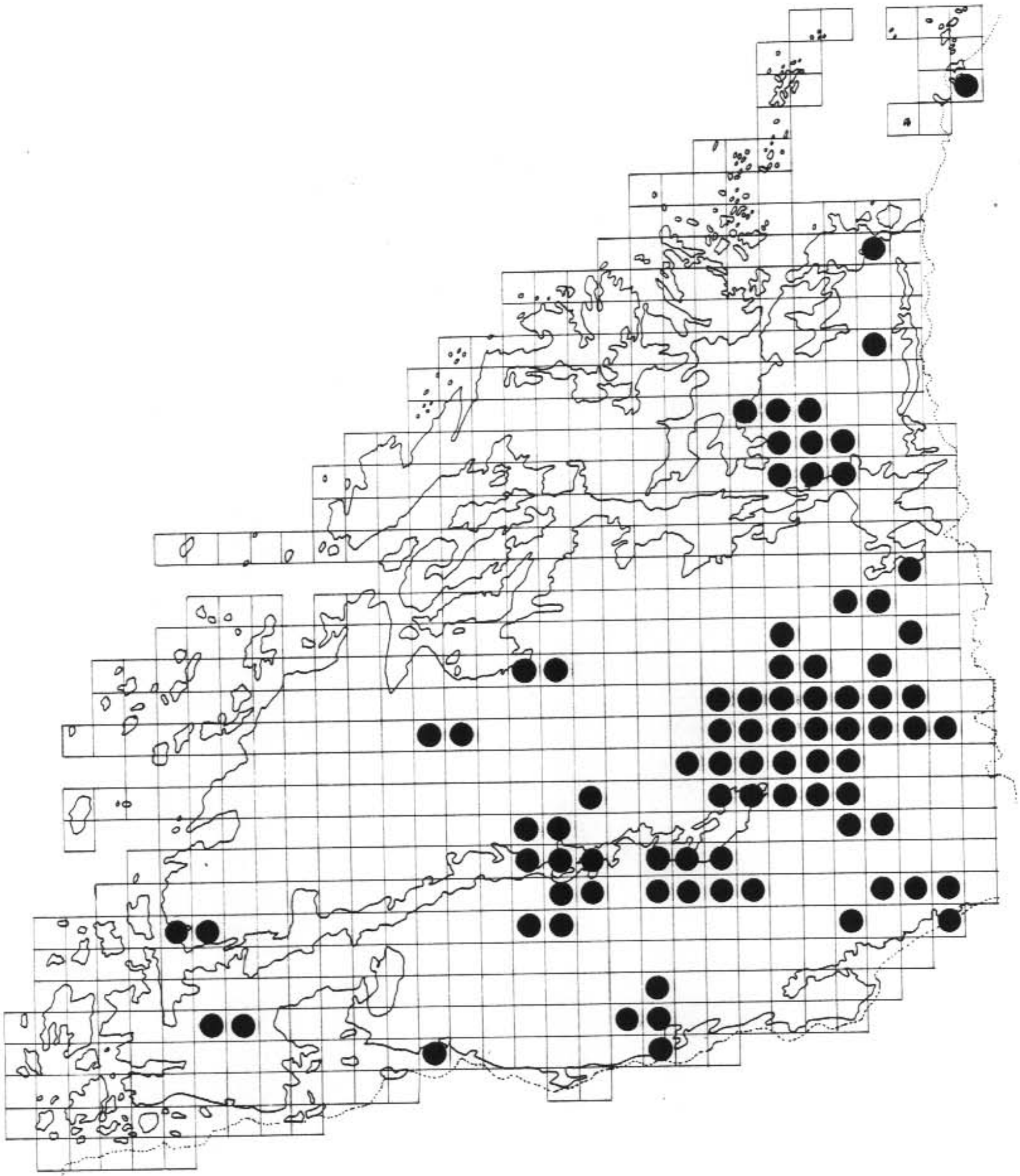

Figure 2. Distribution of collections of all moss species. Not all grid squares have been visited.

2. CONSPECTUS OF THE SPECIES

HEPATICAE

CEPHALOZIELLACEAE

Cephaloziella exiliflora (Tayl.) Steph.

MUSCI

GRIMMIACEAE

Grimmia antarctici Card.

Grimmia lawiana Willis

DITRICHACEAE

Ceratodon purpureus (Hedw.) Brid.

POTTIACEAE

Sarconeurum glaciale (C. Muell.) Card. et Bryhn

BRYACEAE

Bryum algens Card.

Bryum argenteum Hedw.

EXCLUDED SPECIES

Bryum korotkevicziae Savich-Lyubitskaya et Smirnova

= *Bryum algens* Card.

2.1 CEPHALOZIELLACEAE

2.1.1 Cephaloziella exiliflora (Tayl.) Steph.

> Plants very small, forming dense tufts of small turfs, stems dark green, usually deeply pigmented with reddish-purple, filiform, to 10 mm or longer, the branches intertwined; leaves distant or barely overlapping, the apex broadly bilobed, the lobe apices more or less acute, occasionally obtuse or rounded, the three rows of leaves all alike in shape, the ventral row slightly smaller.

Hepatics are poorly represented amongst the Antarctic terrestrial flora. Steere (1961) and Corte (1962) reported only 6 species from the antarctic continent and fringing islands. The number of species now known to occur on some of the islands is considerably greater. For example, Hassel de Menendez (1977) reported 59 hepatic species from South Georgia. However, the number of hepatics on the Antarctic Peninsula is severely limited.

One species of hepatic, determined only as a Cephaloziella species, has previously been reported from Continental Antarctica (Steere 1965). This species, from the Knox Coast in the vicinity of the now abandoned Wilkes station, has been found by the author to be widespread on the peninsulas in the vicinity of the Australian Casey station and Wilkes, as well as from Haupt Nunataks to the south of these peninsulas (Seppelt 1983b). I have also reported its occurrence from the Larsemann Hills (69°26'S, 76°00'E) (Seppelt 1983b). Although not yet found amongst collections from the Vestfold Hills its presence is likely.

Ochyra et al. (1982) reported a chromosome number of n = 18 (16 + 2m) for material collected on King George Island, South Shetland Islands. They also referred all Antarctic collections of C. varians (Gottsche) Steph., from the Antarctic Peninsula and adjacent islands to the north to C. exiliflora, which is widely distributed in the subantarctic region and in southern parts of Australia and New Zealand. Material of C. varians from the Antarctic Peninsula and adjacent areas that the author has studied appears vegetatively to be only a larger form of the Antarctic C. exiliflora. Until fertile material is found the absolute identity must remain somewhat tenuous.

Stem segments, leaves and stem sections are illustrated in Figure 3.

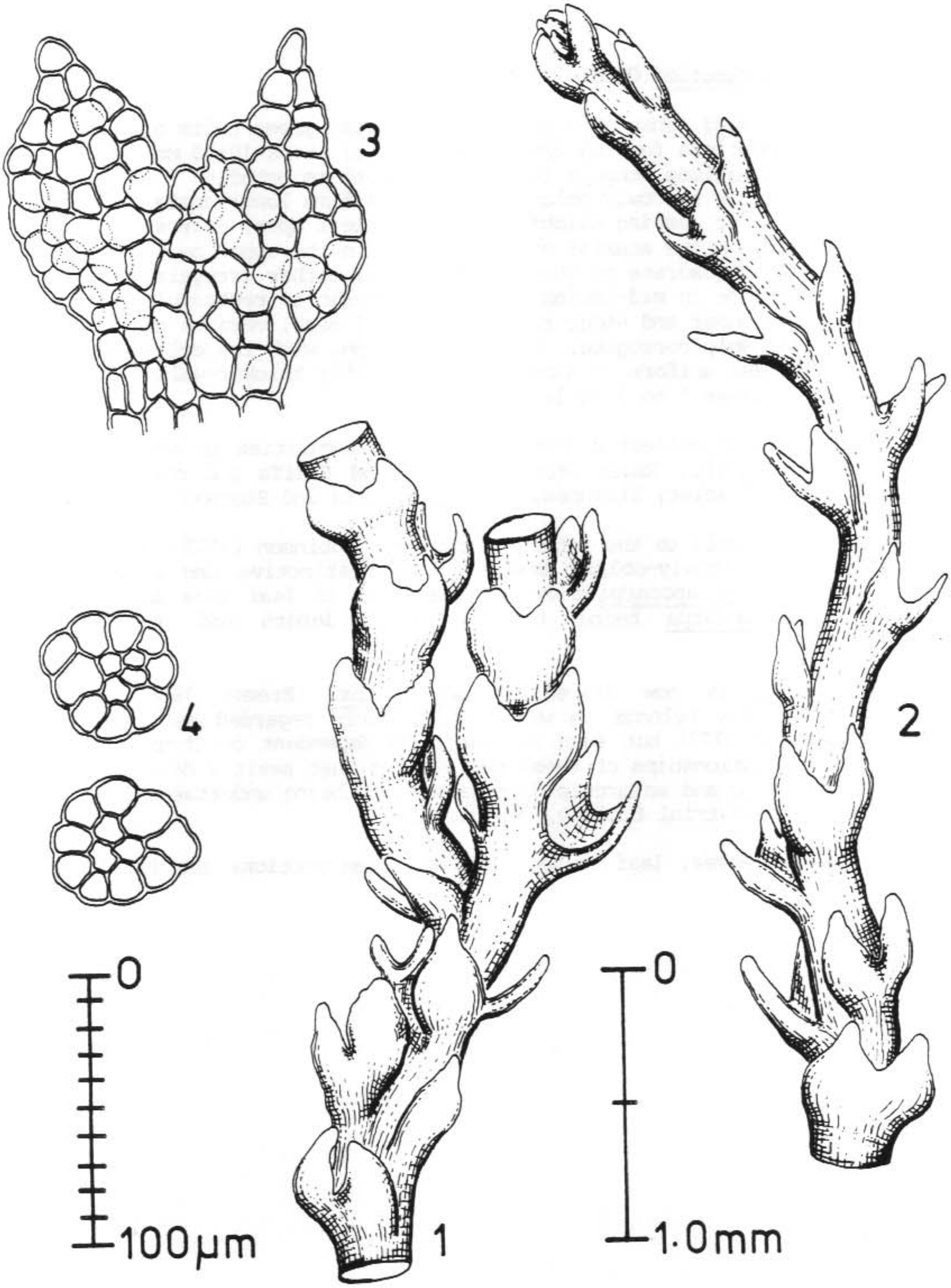

Figure 3. Cephaloziella exiliflora (Gottsche) Steph. 3.1, 3.2: stem segments. 3.3: lateral leaf. 3.4: stem sections. (From Seppelt 9446). Scale = 1.0 mm for stems; = 100 µm for leaf and sections.

2.2 GRIMMIACEAE

2.2.1 Grimmia antarctici Card.

Plants forming dense dark green to yellowish-green tufts or turfs, sometimes forming extensive patches; stems 10-50 mm in length, sometimes longer; leaves lanceolate to broadly lanceolate or narrowly oblong, to about 1.5 mm long; costa percurrent or ceasing slightly below the leaf apex, scarcely protruding on the abaxial surface; cells in the upper part of the leaf subquadrate to short-rectangular, rather irregular in length, those in mid-lamina short-rectangular to rectangular becoming longer and wider towards the leaf base, margins of cells variably corrugate. Stem, in section, with the cells more or less uniform in size, with a slightly thicker-walled cortical layer 1 to 2 cells thick.

The species has been collected from a number of localities in the eastern half of the Vestfold Hills, Rauer Group, Brattstrand Bluffs and outcrops between there and Ranvik Glacier, Steinnes, Larsemann Hills and Stornes Peninsula.

The species is endemic to the antarctic region. Robinson (1972) considered the small, crowded, narrowly-oblong leaves to be distinctive and separated this species from Grimmia apocarpa Hedw. on the basis of leaf size and shape, the leaves of G. apocarpa being 1.5-2.0 mm in length and usually ovate-lanceolate.

Grimmia apocarpa is now placed in Schistidium (Bremer 1980). Grimmia antarctici similarly belongs in what was formerly regarded as a subgenus of Grimmia (Robinson 1972) but such placement is dependent on characters of the capsule. The relationships of these two species must await a detailed revision of the subantarctic and antarctic Grimmia species being undertaken by B.G. Bell (Institute of Terrestrial Ecology, Penicuik).

A stem segment, leaves, leaf cells, leaf and stem sections are illustrated in Figure 4.

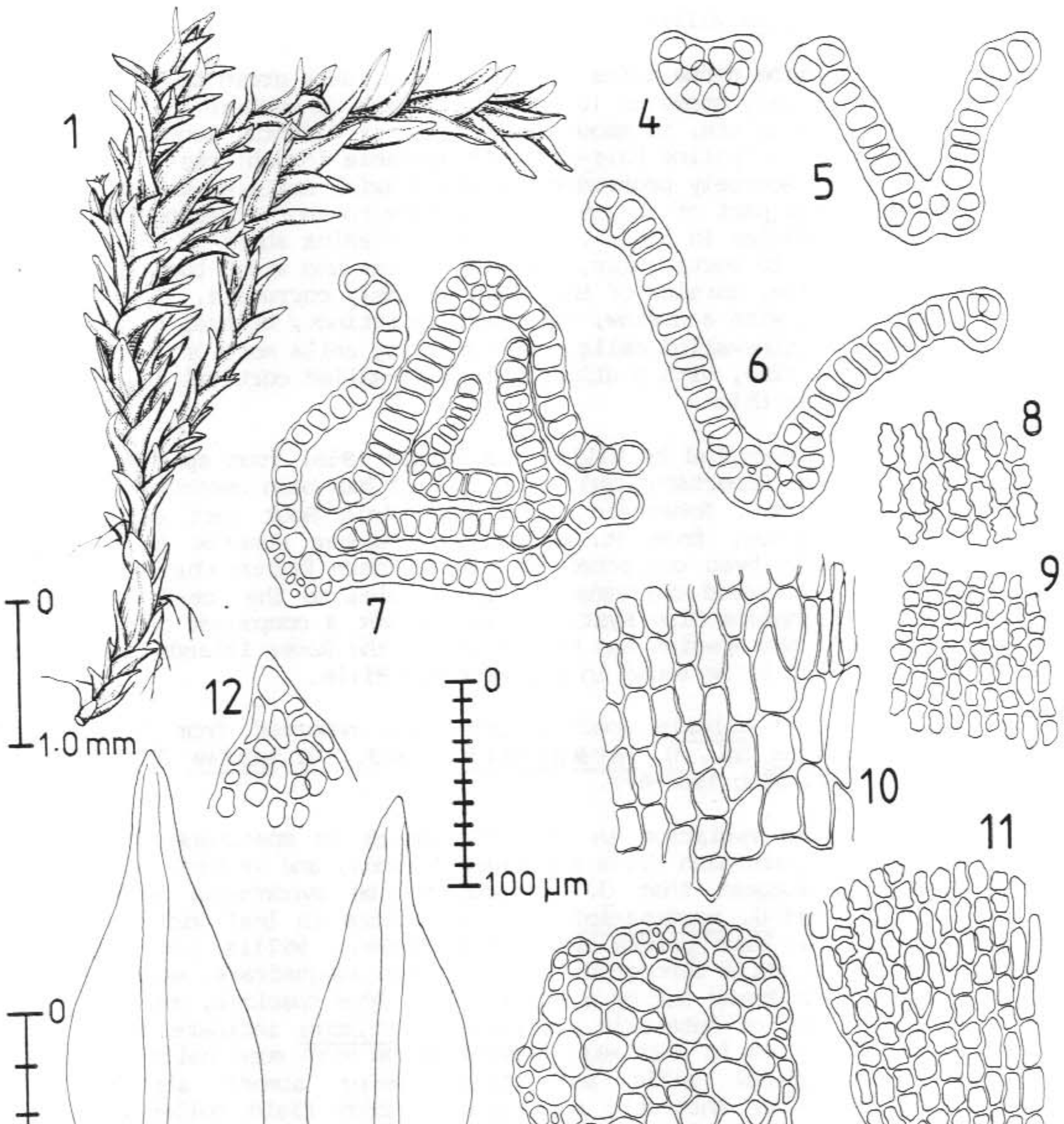

Figure 4. Grimmia antarctici Card. 4.1: Stem segment. 4.2, 4.3: mid-stem leaves. 4.4 to 4.7: leaf sections. 4.8, 4.9: cells from mid-lamina of leaf. 4.10: cells from near base of leaf. 4.11: cells from margin in lower part of leaf. 4.12: apex of leaf. 4.13: stem section. Scale = 1.0 mm for stems; = 0.5 mm for leaves; = 100 µm for cells and sections. (From Seppelt 5911, 11311, MEL 1012058).

2.2.2 Grimmia lawiana Willis in Filson

> Plants forming dense tufts or small turfs, dark green to brownish-green, stems to 10 mm high; leaves lanceolate to broadly lanceolate, to about 1.5 mm long or slightly longer, tapering to a hyaline hair-point of variable length; costa excurrent, scarcely protruding on the abaxial surface; cells in the upper part of the leaf subquadrate to short-rectangular, rather irregular in length, those in mid-lamina short-rectangular to rectangular, becoming longer and wider towards the leaf base, margins of the cells variably corrugate. Stem, in section, with a narrow, sometimes indistinct, central strand of small, thin-walled cells, the remaining cells more or less uniform in size, with a slightly thicker-walled cortical layer 1 to 2 cells thick.

This species was described by Willis (in Filson 1966) from specimens gathered at Ring Rocks, Mac. Robertson Land. The species has been recorded from several localities within Mac. Robertson Land, from Field Rock just east of Mawson station to Cape Bruce, from Mt. Henderson, Fischer Nunatak and the Masson Range. It has also been collected in the southern Prince Charles Mountains. Nakanishi (1977) extended the range of the species to the ice-free areas near Syowa station, Kronprins Olav Kyst. While not yet a component of the Vestfold Hills collections the species has been found in the Rauer Islands and Larsemann Hills and is likely to be found in the Vestfold Hills.

Several hair-pointed Grimmia species have been reported from the antarctic region: G. donniana Sm., G. nordenskioldii Card., G. grisea Card., and G. trichophylla Grev. (Kuc 1968-69).

There is sufficient variation in leaf characters in specimens of G. lawiana colleted from the Larsemann Hills and Rauer Islands, and in Mac. Robertson Land collections, to suggest that G. lawiana may be synonymous with at least G. trichophylla and G. nordenskioldii. Variations in leaf width and length, and length of the hair points are considerable. Willis (in Filson 1966) indicated that the cells throughout the leaf were subquadrate, with non-sinuose walls. This is not borne out by a study of the Type specimen, and observations the author has made on Antarctic specimens of Grimmia indicate that there is considerable variation in cell wall ornamentation with some cells having quite corrugate longitudinal walls and others being almost straight sided. Observations of other Antarctic moss species from field collections and in laboratory culture (Nakanishi 1979; Longton 1981; Kaspar et al 1982; Seppelt 1983a; Seppelt and Selkirk in press) have illustrate the inherent variability of mosses under Antarctic environment conditions.

The only fruiting record of Grimmia sepcies from continental Antarctica is a speciment determined, presumably by either Watts or Dixon, as G. trichophylla from the Australasian Antarctic Expedition of 1911-14. The specimen is in the Tasmanian Herbarium (HO) and is indistinguishable, at least in vegetative characteristics, from G. lawiana. A stem segment, leaves, leaf cells, leaf and stem sections of G. lawiana are illustrated in Figure 5.

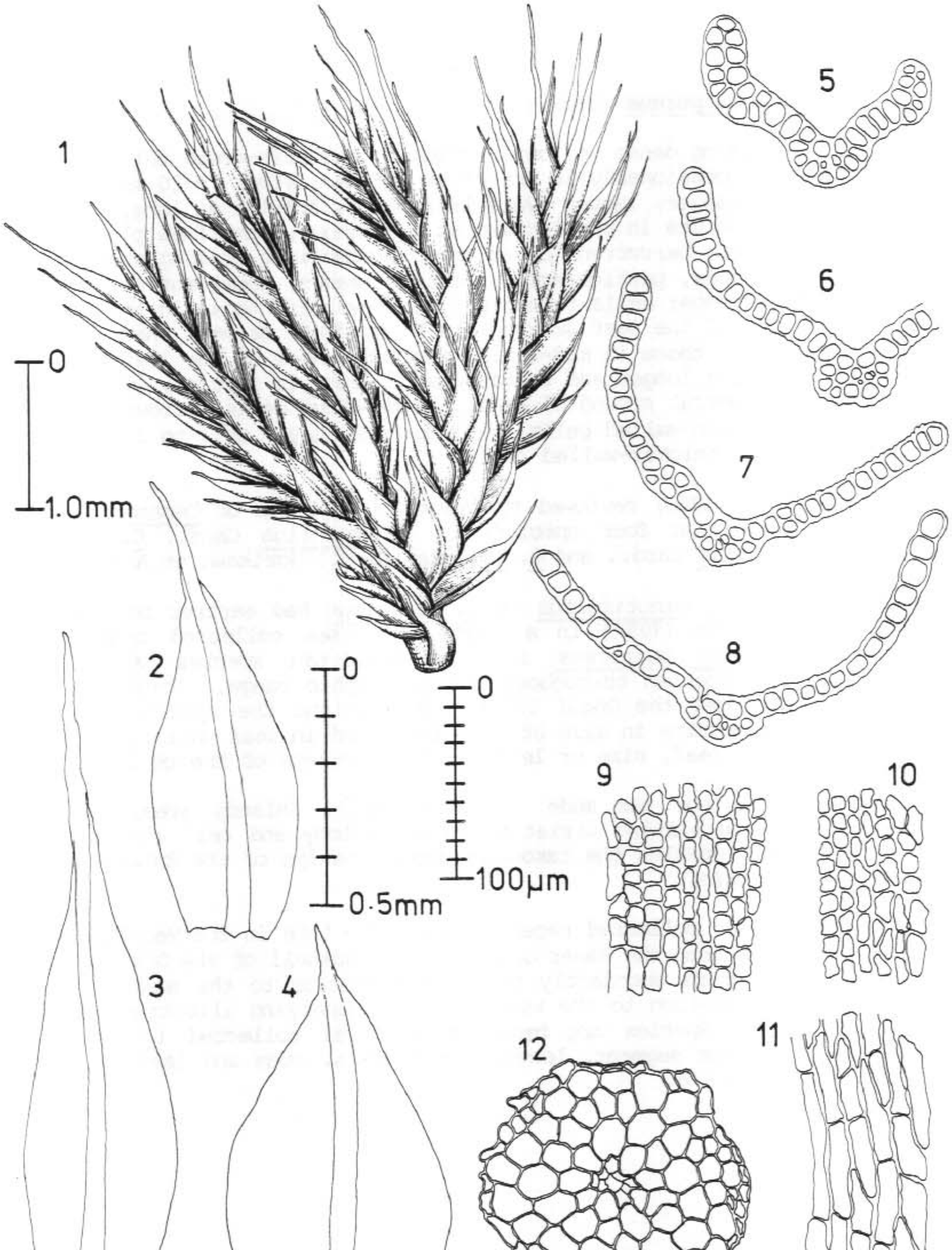

Figure 5. Grimmia lawiana Willis. 5.1: stem segment. 5.2 to 5.4: mid-stem leaves showing variation in morphology. 5.5 to 5.8: leaf sections. 5.9, 5.10: cells from mid-lamina of leaf. 5.11: cells from near base of leaf. 5.12: stem section. Scale = 1.0 mm for stem; = 0.5 mm for leaves; = 100 µm for cells and sections. (From Seppelt 8006, 9558).

2.3 DITRICHACEAE

2.3.1 Ceratodon purpureus (Hedw.) Brid.

Plants forming dense yellowish-green to brownish-green tufts or turfs, occasionally in extensive patches; stems 10-20 mm high, sometimes longer; leaves ovate-lanceolate, 0.8-1.5 mm long, margins revolute in part or almost throughout, sometimes plane, entire; costa percurrent or excurrent, sometimes ceasing shortly below the apex, particularly in obtuse leaves, prominent on the abaxial surface; cells relatively thick-walled, those in the upper part of the leaf subquadrate to quadrate or very short-rectangular, those in mid-lamina similar, those of the leaf base becoming longer and rectangular. Stem, in section, with a narrow central strand of small, thin-walled cells surrounded by larger thin-walled cells and a cortical layer of 1 to 2 rows of smaller, thicker-walled cells.

Horikawa and Ando (1963) reviewed the Antarctic species of Ceratodon described by Cardot, recognising four species; C. minutifolius Card., C. antarcticus Card., C. grossiretis Card., and C. validus (Card.) Horikawa et Ando.

The similarity of C. minutifolius to C. purpureus had earlier been recognised by Horikawa and Ando (1961) in a study of mosses collected from the Ongul Islands. Ceratodon purpureus is a cosmopolitan species which exhibits considerable polymorphism throughout its geographic range. Horikawa and Ando observed that amongst the Ongul Islands collections the specimens exhibited, "Extraordinary diversity in size of the plants and in leaf characteristics such as the form of the leaf, size or leaf cells, thickness of the cell wall."

Collections the author has made in the Windmill Islands area, Knox Coast, exhibit the same perplexing variation in morphology and cell characteristics. In the absence of capsules the taxonomic relationships of the Antarctic species must remain uncertain.

The species has been collected recently near Club Lake in the Vestfold Hills by V. Dhargalkar, and from the Rauer Group by G. Cracknell of the Oceanic Research Foundation. It occurs abundantly near Casey station to the east, and in the vicinity of Syowa station to the west. The accompanying illustrations and the description of the species are based on material collected in the Windmill Islands area. A stem segment, leaves, leaf cells, stem and leaf sections are illustrated in Figure 6.

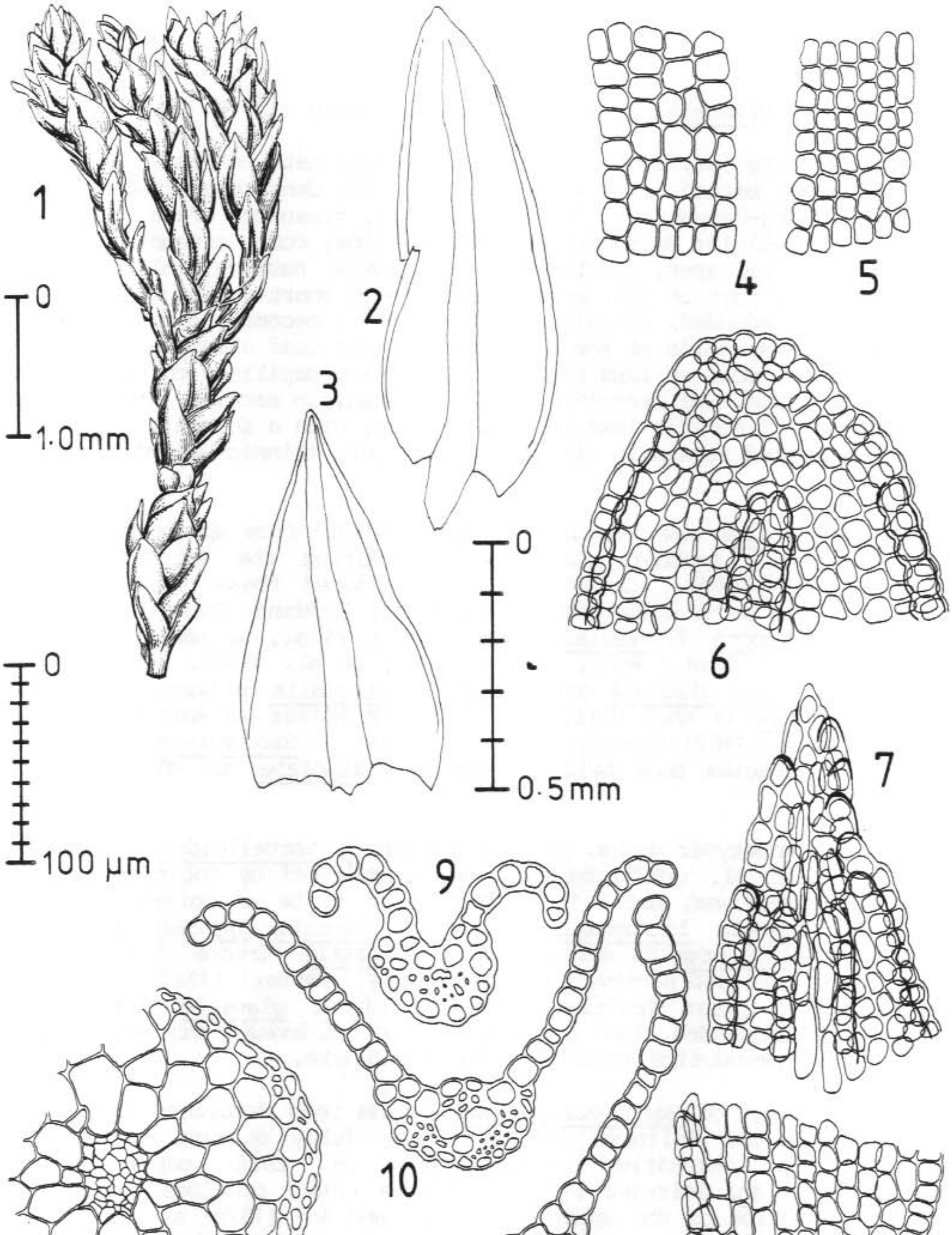

Figure 6. Ceratodon purpureus (Hedw.) Brid. 6.1: stem segment. 6.2, 6.3: mid-stem leaves. 6.4, 6.5: cells from mid-lamina of leaf. 6.6, 6.7: leaf apieces showing variation in morphology. 6.8: cells from leaf base. 6.9 to 6.11: leaf sections. 6.12: stem section. Scale = 1.0 mm for stems; = 0.5 mm for leaves; = 100 μm for cells and sections. (From Seppelt 5865, 5917, 13090, 13153, 13299).

2.4 POTTIACEAE

2.4.1 Sarconeurum glaciale (C. Muell.) Card. et Bryhn

Plants forming low, loose or dense dull green mats, stems 2-6 mm high, matted below with a more or less dense tomentum; leaves oblong-lanceolate, 1-2 mm in length, flexuose, often with multicellular deciduous gemmiferous tips; costa extending beyond the leaf apex, prominent on the abaxial surface; cells of the upper part of the leaf subquadrate to short-rectangular, the corners rounded, densely papillose; cells becoming longer in mid-lamina; cells of the lower part of the leaf elongate rectangular, more or less hyaline and lacking papillae; costa, in section, lacking stereids adaxially; stem, in section, with the cells all more or less uniform in size, with a scarcely differentiated region in mid-stem of smaller, thinner-walled cells.

Sarconeurum antarcticum was described by Bryhn (1902) from specimens collected by Borchgrevink from southern Victoria Land during the British Antarctic Expedition of 1898-1900. Cardot (1907) considered these specimens to be identical with specimens collected by Hooker on Cockburn Island in 1843 and described as Didymodon ? glacialis Hook.f. et Wils., a name predated by Didymodon glacialis (Brid.) Wahl. (van der Wijk et al. 1962). Müller (1851) based his Leptotrichum glaciale on Didymodon ? glacialis of Hooker and Wilson. The epithet glaciale is thus validated by citing Müller as author (Greene et al. 1970). Cardot (1907) transferred the species to Sarconeurum, the correct citation of the species thus being Sarconeurum glaciale (C. Müll.) Card. et Bryhn.

Sarconeurum is a monotypic genus, another species S. tortelloides, described by Greene in Greene et al. (1970) having been transferred by Robinson (1972) to Tortella. The genus was, until 1975, considered to be an Antarctic endemic. However, with Tortula lithophila Dus., and Tortula pygmaea Dus., being transferred to Sarconeurum as synonyms of S. glaciale (Greene 1975) the range of the genus was extended northwards to Patagonia. Matteri (1982) reported the occurrence of the first fruiting specimens of S. glaciale from southern Patagonia. She concluded that the species was dioicous, and described and illustrated the reproductive structures and sporophyte.

Vegetative morphology of Sarconeurum glaciale has been described in detail by Savich-Lyubitskaya and Smirnova (1962). They fully discuss the Antarctic distribution and vegetative reproduction in this paper and in Savich-Lyubitskaya and Smirnova (1961). Greene (1967) provides a map of the Antarctic distribution of the species. Zander and Hoe (1979) studied material of S. glaciale and S. tortelloides together with other species of Pottiaceae having multistratose, propaguloid leaf apices and recognised S. tortelloides as Tortula fragilis var. tortelloides (Greene) Zander et Hoe. Sarconeurum is unlikely to be confused with any other Antarctic moss species. The highly papillose leaf cells and deciduous leaf apices are distinctive. Stem segments, leaf, leaf cells, leaf and stem sections are given in Figure 7.

In the Vestfold Hills the species is known from a number of scattered localities in the eastern half. Its distribution is undoubtedly more extensive as the species is easily overlooked. It has not yet been identified in collections elsewhere along the Ingrid Christensen Coast.

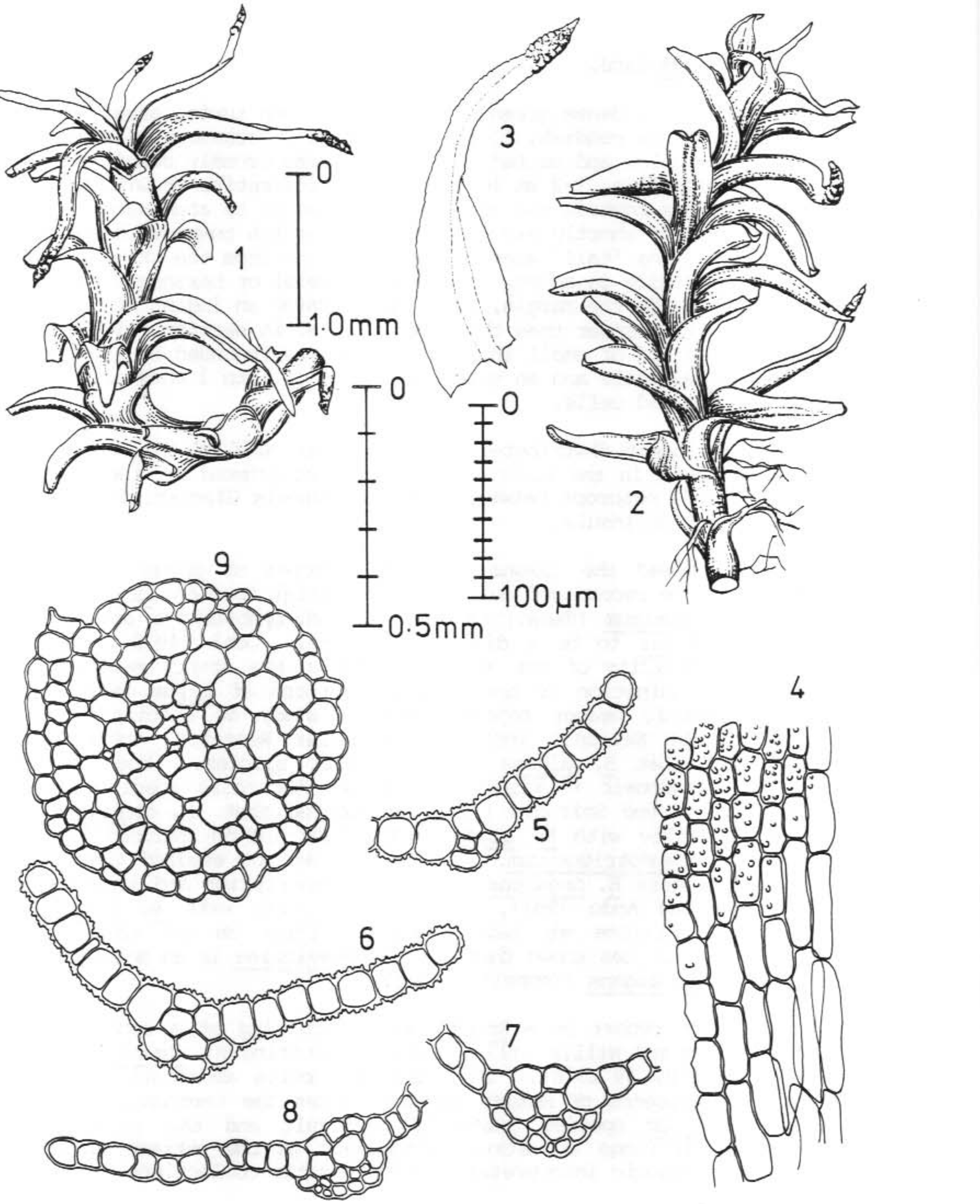

Figure 7. Sarconeurum glaciale (C.Muell.) Card. et Bryhn. 7.1, 7.2: stem segments. 7.3: Stem leaf with propaguliferous apex. 7.4: Cells from lower mid-lamina and basal portion of leaf. 7.5 to 7.8: Sections of leaf and costal region. 7.9: stem section. Scale = 1.0 mm for stems; = 0.5 mm for leaf; = 100 µm for cells and sections. (From Seppelt 8802).

2.5 BRYACEAE

2.5.1 Bryum algens Card.

Plants forming dense green to yellowish-green turfs, often extensive patches; stems reddish, 10-50 mm in length, occasionally longer, tomentose below and matted together; leaves broadly oblong-ovate to ovate-lanceolate, 1-2 mm in length, margins entire or with a few serrulations towards the apex, the apex acute to acuminate; costa percurrent to shortly excurrent, often reddish towards the base and forming a long 'tail' when the leaf is torn from the stem; lamina cells rather variable in shape, rhomboid-hexagonal or hexagonal, becoming longer towards the margin, sometimes forming an indistinct border, lower lamina cells longer than the upper. Stem, in section, with a broad central strand of small thin-walled cells surrounded by large thin-walled cells and an epidermal layer of 1 to 2 rows of smaller thicker-walled cells.

This species is widely distributed in the eastern half of the Vestfold Hills. It has also been found in the Rauer Group; the northernmost of the Svenner Islands, Brattstrand Bluff, outcrops between there and Ranvik Glacier, Steinnes, Larsemann Hills and Stornes Peninsula.

Ochi (1969) reviewed the taxonomy of the species of Bryum from the Antarctic Botanical Zone. He recognized only two terrestrial species, Bryum argenteum Hedw. and B. pseudotriquetrum (Hedw.) Gaertn. Savich-Lyubitskaya and Smirnova (1972) considered B. algens to be a distinct species. Ochi (1979) preferred not to comment on the validity of the species owing to the scanty material of the Type specimen. An examination of the many collections of Bryum made throughout the Australian Antarctic sector together with a study of specimens of B. pseudotriquetrum at the National Institute of Polar Research, Tokyo, supports the author's belief that B. algens is a distinct species. Much confusion still surrounds the taxonomic relationships of the Antarctic species. For example, Savich-Lyubitskaya and Smirnova (1972) considered that B. ongulense Horikawa et Ando was conspecific with B. algens while Ochi (1979) reduced this species to synonymy of B. pseudotriquetrum. The author has not studied the Types of these species but considers B. ongulense, from the description and illustrations of the Type (Horikawa and Ando 1961), to be conspecific with B. algens. However, environmental conditions may have a marked effect on the morphology of Bryum species. The author has shown that B. korotkevicziae is an aquatic morphotype of the terrestrial B. algens (Seppelt 1983a).

There is only one report of a Bryum species fruiting at a continental Antarctic locality. Filson and Willis (1975) reported fruiting B. algens from Fold Island, Kemp Land (67°18'S, 59°23'E). This species fruits abundantly on the Antarctic Peninsula. The absence of mature capsules makes the taxonomic interpretation of the Antarctic Bryum species generally difficult and the vegetative variation induced by a wide range of micro-environments in the extreme Antarctic climate compounds the taxonomic interpretation of Antarctic collections.

Considerable confusion has centered around the identity of B. antarcticum Hook.f. et Wils. Kanda (1981) considered this species to be referable to Pottia heimii (Hedw.) Feurnr. There are many specimens in the collections the author has made which do not appear to be referable to B. algens, B. pseudotriquetrum or B. argenteum and which are not Pottia heimii. However, Nakanishi (1979), Kaspar et al. (1982) and Seppelt (1983a) have all shown the potential for morphological variation in Antarctic species to be very high. Ochi (1979) summarised the taxonomic problems as follows, "The plants are sterile in almost every case; they are very variable in stature, as are stems in length, thickness, foliation, branching etc.; the leaves vary in size, shape, serrulation and revolution of the margin, length and thickness of the costa, differentiation of the border, etc." Experimental studies such as those of Longton (1981) and more recently of Seppelt and Selkirk (in press) will be critical in evaluating the taxonomic variability and interrelationships of the Antarctic species.

Stem segments, leaves, leaf cells, stem and leaf sections of B. algens are illustrated in Figure 8.

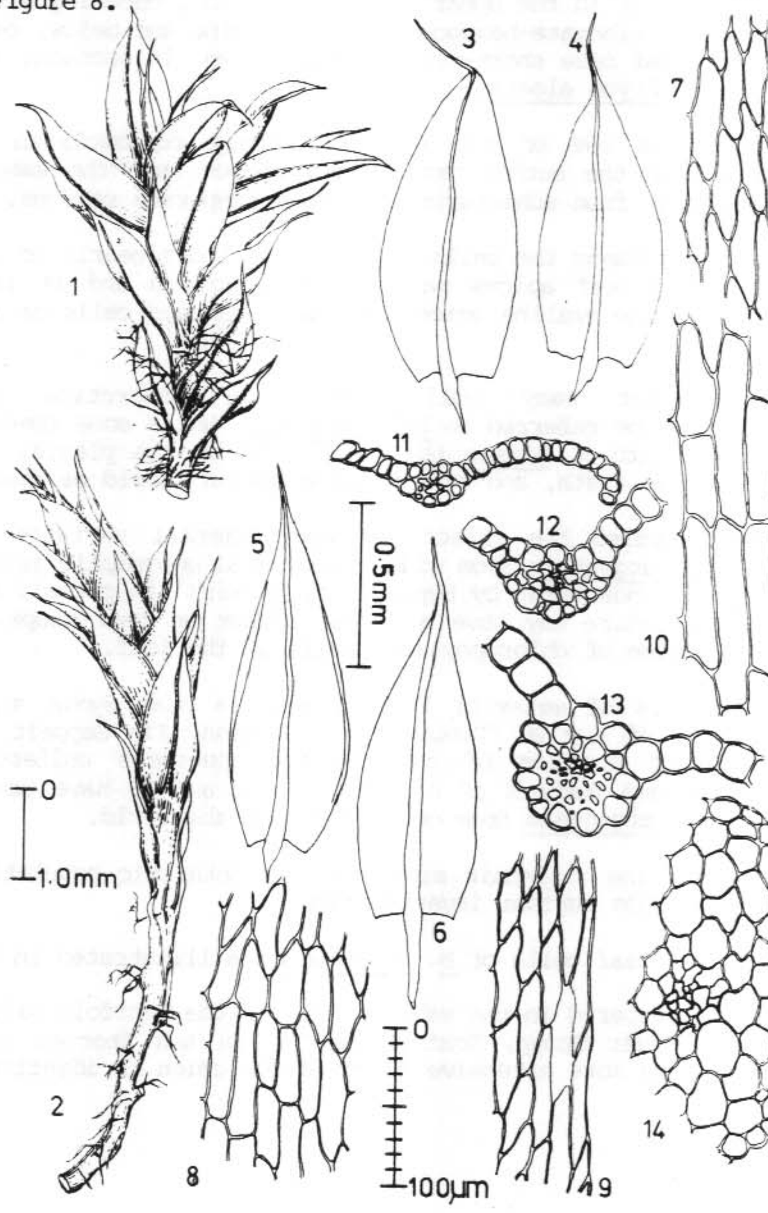

Figure 8. Bryum algens Card. 8.1, 8.2: stem segments. 8.3 to 8.6: mid-stem leaves. 8.7, 8.8: cells from mid-lamina of leaf. 8.9: cells from margin of leaf in mid-lamina region. 8.10: cells from near base of leaf. 8.11 to 8.13: costal sections. 8.14: section of part of the stem. Scale = 1.0 mm for stems; = 0.5 mm for leaves; = 100 µm for cells and sections. (From Seppelt 5923, 8326, 8415, 9277).

2.5.2 Bryum argenteum Hedw.

Plants forming low dense yellowish-brown to dark brownish-green turfs, stems reddish, mostly to about 10 mm or sometimes slightly longer, matted below with a more or less dense tomentum; leaves broadly ovate, apiculate to filiform-acuminate, 0.5-1.0 mm long, margins entire; costa reddish towards the base, rather variable in length, ceasing below the apex; lamina cells rhomboidal and mostly hyaline in the upper part of the leaf, becoming elongate-rhomboid to elongate-hexagonal in mid-lamina and below, cells near the leaf base short-rectangular. Stem, in section, similar to that of Bryum algens.

Bryum argenteum is one of the very few truly cosmopolitan moss species. Antarctic specimens the author has studied do not have the same silvery-green colour of specimens from subantarctic or more temperate regions.

In many of the specimens the cells are chlorophyllous nearly to the apex of the leaves. Often the leaf apices may be partly eroded and it is difficult to ascertain whether the hyaline apices represent damaged cells or achlorophyllous cells.

It is possible that many collections from Antarctica determined as B. antarcticum may be referred to B. argenteum. While some specimens appear to grade confusedly into B. algens the small size of the plants, leaf shape and size, length of the costa, and hyaline upper cells should be distinctive.

Longton (1981) studied the effects of environmental variation on growth of populations of B. argenteum from widely separated geographic areas. Additional studies have been undertaken by Seppelt and Selkirk (in press), who have showed that growth temperature may have a marked affect on leaf shape, costa length, and the distribution of chlorophyllous cells in the leaf.

Cytological studies of material from Antarctica near Syowa station showed a chromosome number of n = 20 (Tatuno 1963). Ramsay (in Seppelt and Selkirk in press) established a value of n = 10 for specimens collected near Casey station. Chromosome numbers of n = 10, 11, 12 and 13 have been obtained for populations of B. argenteum from other parts of the world.

As with B. algens the taxonomic status of the Antarctic populations determined as B. argenteum needs further investigation.

Stems, leaves and leaf cells of B. argenteum are illustrated in Figure 9.

The species is scattered in the eastern half of the Vestfold Hills. It is also known from the Rauer Group, Brattstrand Bluffs and Stornes Peninsula. Its distribution may be more extensive owing to confusion in identification.

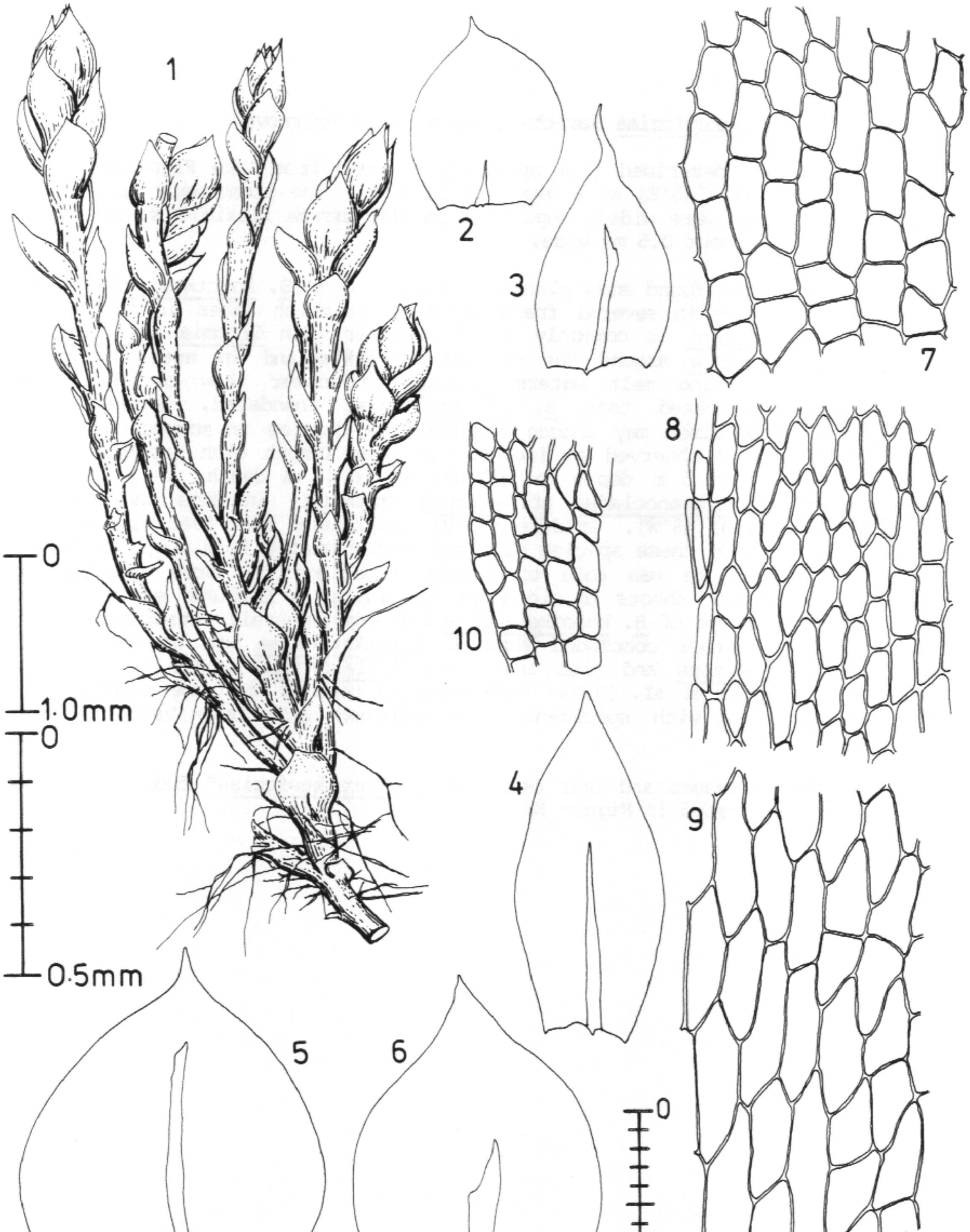

Figure 9. Bryum argenteum Hedw. 9.1: stem segment. 9.2 to 9.6: mid-stem leaves showing variation in morphology and costal length. 9.7, 9.8: cells from mid-lamina of leaf. 9.9: cells from lower mid-lamina. 9.10: marginal cells near base of leaf. Scale = 1.0 mm for stems; = 0.5 mm for leaves; = 100 µm for cells. (From Shimizu 74 det. Ochi; Seppelt 8087, 14074).

2.6 EXCLUDED SPECIES

2.6.1 Bryum korotkevicziae Savich-Lyubitskaya et Smirnova

This species was described from specimens dredged from Lake Figurnoye, Bunger Hills (66°18'S, 100°45'E) at a depth of 33-36 m. The stems were up to 300 mm long. The leaves were widely separated on the narrow flexible stems and from 1-2 mm long and about 0.5 mm wide.

In 1978 the author found moss plants attributable to B. korotkevicziae growing amongst algal mats in several fresh water to brackish lakes in the Vestfold Hills. Bryum algens is commonly found together with Grimmia antarctici and Sarconeurum glaciale around the margins of lakes and in areas subject to inundation by rising melt waters during the summer thaw period. Field observations indicated that B. algens, when inundated, became rapidly etiolated. Submerison may induce considerable changes in morphology. Light and Heywood (1973) observed an increase in stem length with increased depth, from 100-200 mm at 5 m depth to 300-400 mm at 10 m depth, in a Calliergon sarmentosum and Drepanocladus cf. aduncus community in Moss Lake on Signy Island (60°43'S, 45°48'W). Priddle (1979) established that leaf size and shape of aquatic forms of these species differed significantly from their terrestrial counterparts, and he was able to induce a variety of forms in Calliergon ranging from robust shoots to microphyllous and even leafless stems. From a study of the Isotype of B. korotkevicziae and experimentally etiolated stems of B. algens the author concluded that B. korotkevicziae was no more than an ecotype of B. algens and also that var. hollerbachii should be considered similarly. Kaspar et al. (1982) independently reached the same conclusion for B. korotkevicziae with specimens they examined from Lake Vanda (77°32'S, 161°35'E).

A stem segment, leaves and leaf cells of "B. korotkevicziae" from the Vestfold Hills are illustrated in Figure 10.

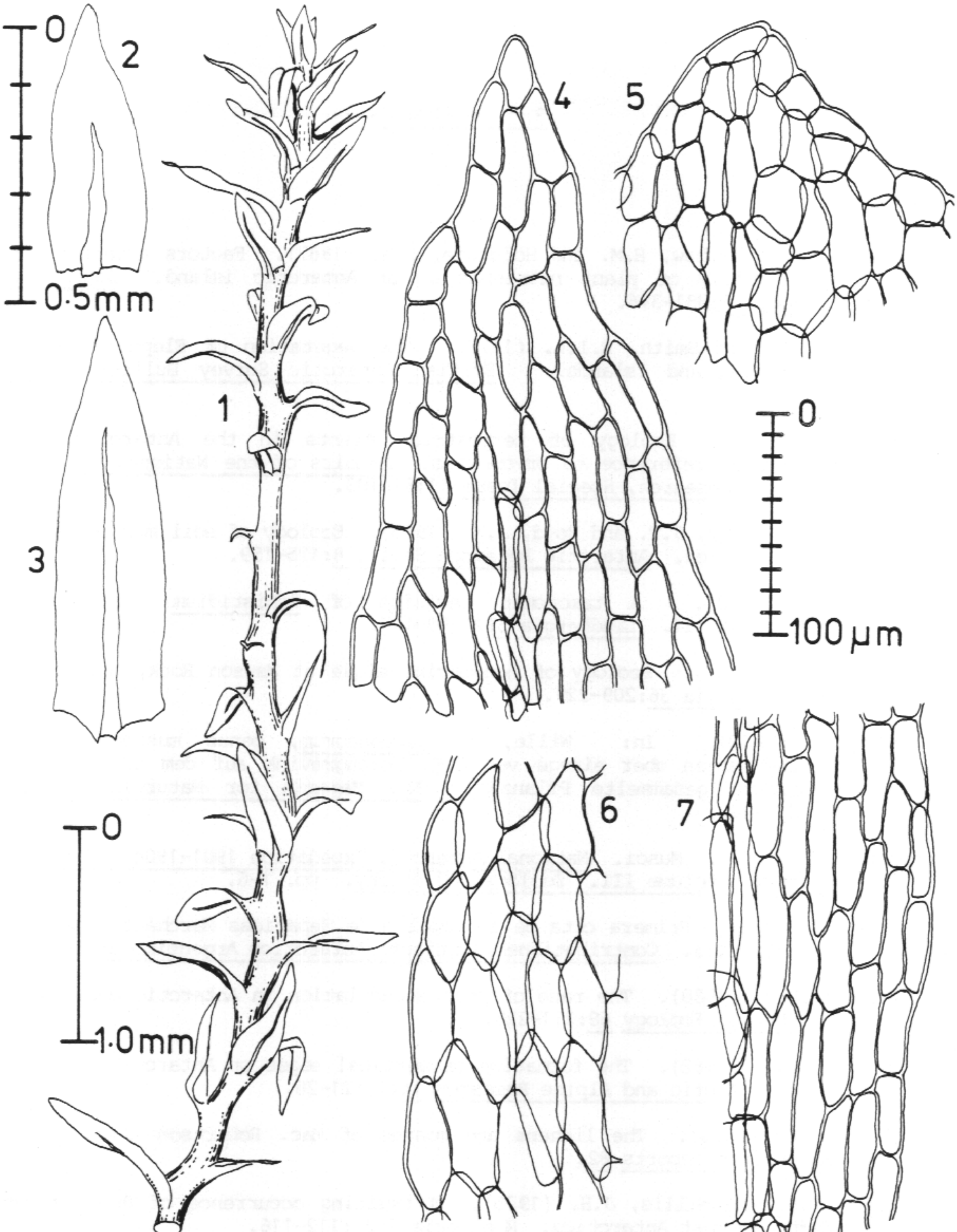

Figure 10. *Bryum korotkevicziae* Savich-Lyubitskaya et Smirnova (= *Bryum algens* morphotype). 10.1: stem segment. 10.2, 10.3: stem leaves. 10.4, 10.5: cells of the leaf apex. 10.6: marginal cells in mid-lamina of the leaf. 10.7: cells from costa to margin in lower mid-lamina. Scale = 1.0 mm for stem; = 0.5 mm .for leaves; = 100 μm for cells. (From un-numbered material collected from algal mats in Lake Druzhby, Vestfold Hills).

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