

Bryophytes of the Royal Botanic Gardens, Government House and the Domain, Sydney

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Abstract

H.P. Ramsay, R.G. Coveny, E.A. Brown & A.K. Brooks. (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney NSW, Australia 2000), 1993. *Bryophytes of the Royal Botanic Gardens, Government House and the Domain, Sydney*. *Cunninghamia* 3(1): 215–229. More than 90 species of bryophytes (70 mosses, 24 hepatics and one anthocerot) have been collected in the Royal Botanic Gardens, Government House and the surrounding Domain, an area of 30 hectares, Sydney. Species present include some new records for New South Wales and one for Australia and include representatives of up to 25 families of mosses and 13 families of hepatics.

Introduction

The Royal Botanic Gardens, Sydney lies on the foreshores of Port Jackson (Sydney Harbour) at Farm Cove (Fig. 1). Although bryophytes have been studied at the National Herbarium of New South Wales, in the Royal Botanic Gardens, Sydney since the late nineteenth century, few specimens are annotated as having been collected there and no species list has been published for the Royal Botanic Gardens, Government House or the Domain. The site occupied by the Royal Botanic Gardens has been cultivated for agriculture and horticulture since the earliest days of European settlement which began in Australia on this site, in January 1788 (Gilbert 1986).

Watercolours of adjacent Sydney Cove by William Bradley in 1788 (Bradley 1786–1792) show relatively dense stands of trees above a rocky foreshore, but with grassy understorey, behind the shoreline. The original vegetation behind the mudflats consisted of eucalypt woodland, 'brushwood' and a variety of smaller plants, occurring on exposed rocky outcrops and in the more sheltered fern gullies of the creek beds, while near the salt water the vegetation included Swamp Oak, *Casuarina glauca*, Port Jackson Fig, *Ficus rubiginosa*, and teatrees. Several species of eucalypt as well as Turpentine, *Syncarpia glomulifera* and Smooth-Barked Angophora, *Angophora costata* were present (Wilson 1986).

The underlying bedrock is sandstone and soils are sandy and shallow with some rocky outcrops. Reclamation of low lying land on the foreshores of the Harbour and building of the sea wall enabled the area of land available for cultivation and recreation to be increased from the original small farm area. Soils have since been modified by supplementation with other soils, fertilisers and mulching.

At present the Royal Botanic Gardens and Domain occupy an area of 30 hectares with the Domain parkland acting as an insulator from the Central Business District and its high-rise buildings (Johnson in Wilson 1986). By 1986 all that remained of the original vegetation were some gnarled trees of *Angophora costata*, *Ficus rubiginosa*, *Casuarina glauca* and a few specimens of *Eucalyptus pilularis*, *E. tereticornis*, *E. resinifera*, *Glochidion ferdinandi* and *Rapanaea variabilis* that are clearly descended from ones that were on the site (Wilson 1986, L.A.S. Johnson pers. comm.).

History of bryophyte collections and bryology at the National Herbarium of New South Wales (NSW)

Attached to and forming an integral part of the Royal Botanic Gardens complex are the administrative, research and educational services. The Brown Building houses the National Herbarium of New South Wales, referred to by its acronym NSW. Among the large array of plant specimens held is an extensive collection of Australian bryophytes, one of the largest in Australia (Ramsay & Seur 1990).

The earliest bryophyte specimens collected in New South Wales and held in the National Herbarium date back to the 1880's. Three prominent figures, Thomas Whitelegge, William Forsyth and William Walter Watts, whose specimens form the basis of the Australian collections at NSW, contributed significantly to knowledge of bryophytes in Australia, particularly New South Wales.

Thomas Whitelegge (1850–1927)

Thomas Whitelegge (1850–1927), born in Stockport, Cheshire, England, arrived in Sydney in early 1883 and was appointed to the Australian Museum, being in charge of Invertebrates from 1883–1908 (Obituary 1927). He also had an interest in ferns and mosses and in 1884 began to gather information on the mosses of New South Wales primarily in Sydney, Gosford, Moss Vale and Blue Mountains. At the urgent request of Dr. V.F. Brotherus in Helsinki, who was preparing the volumes on mosses for Engler & Prantl's *Die Natürlichen Pflanzenfamilien*, Whitelegge secured nearly 100 species in 1890–91. In 1892 he compiled a list, revised by Brotherus, of some 300 New South Wales species (Watts & Whitelegge 1902) but this was not published. In 1898 Whitelegge met W.W. Watts and they jointly presented a list of some 500 species for publication by the Linnean Society of New South Wales. Later the manuscript was withdrawn in favour of a broader list (Census) covering Australia. This was published in their joint names in 1902 and 1905, and dealt with the acrocarpous mosses [the pleurocarpous species were published later after their deaths (Burgess 1932, 1935)]. Whitelegge's position at the Australian Museum in the early 1900s prevented him from continuing research on mosses and he handed over this activity to Watts.

William Forsyth (1864–1910)

In the 1890s Joseph Henry Maiden, Director of the Sydney Botanic Gardens, encouraged bryophyte collecting and made sure they were included in the collections of the National Herbarium of New South Wales. He delegated William Forsyth to concentrate on bryophytes during general field excursions.

William Forsyth, born near Crieff, Perthshire, Scotland, came from a farming background. In 1886 he became overseer for Centennial Park, Sydney and from 1898 he added to this responsibility for collecting and maintaining bryophytes in the National Herbarium of New South Wales at the urging of Maiden. His enthusiasm for the task resulted in the addition of some 1200 specimens in just two years. He was Curator of Bryophytes from 1898 to 1903 adding many new Australian species during field trips on his own or with Maiden, W.F. Blakely and others to many areas of New South Wales.

His publication *Contribution to a knowledge of the moss flora of N.S.W.* (Forsyth 1899), recorded 61 species of which 43 were new to the colony and 26 were from Port Jackson. In 1900 he added collections from Richmond and Tweed Rivers, New England, Germanton (now Holbrook) and Tumbarumba. He also began an exchange program with overseas bryologists on whom he depended for identifications, in particular Brotherus in Helsinki.

W.W. Watts (1856–1920)

The Rev. William Walter Watts was born in Devon, England. Because of ill health he was sent by his church to Australia in 1887 (Brisbane and later northern New South Wales) to recuperate. He moved to Sydney in 1895. His major collections were made whilst he was minister of the Presbyterian Church in Ballina, far North Coast of New South Wales, and many collections were made at outlying timber camps at a time when the Big Scrub was being cut to open up the land for farming (Ramsay 1980).

In 1909 it was arranged that — "Rev. W.W. Watts and myself [Mr. A.E. Goddard the then curator] shall enter into a complete and detailed examination of the mosses during 1909 from the standpoint of external morphology and histology so that the greatest possible use and value may accrue from the collection in the herbarium." (Sydney Botanic Gardens Annual Report 1909). However, Goddard left for South Africa in 1909 and Watts became Honorary Curator of Cryptogams (1909–1916) until he moved to Victoria. In 1911 the Whitelegge collections, including mosses and lichens, purchased from Goddard, were added to the Herbarium. The collections of W. Forsyth and W.W. Watts (more than 12,000 specimens) were incorporated after their deaths.

Apart from his contributions to bryology in terms of specimens collected, it was Watts' publications with Brotherus and Stephani (17 in all) (Ramsay 1980), that brought the attention of the world to Australian, particularly New South Wales and Queensland taxa (e.g. Brotherus & Watts 1912, 1915, Stephani & Watts 1914 etc). Some 167 new moss species and more than 70 hepatics were named based on Watts' collections.

Study site and collections

Specimens of bryophytes (mosses, hepatics and anthocerotes) were collected in areas of the Royal Botanic Gardens, Government House and Domain over a period of over two years from 1989 to early 1991. This proved to be a particularly good period for bryophyte growth and development as Sydney had above-average rains during much of the time of the study. The majority of collections were made by R.G. Coveny, E.A. Brown and A. Brooks, with some assistance from R. Makinson & J. Wood. Identifications are based on published information in floras, checklists and monographs (Catchside 1980; Catchside & Frahm 1985; Crum 1991; Frahm 1985, 1987; Scott 1985; Scott & Bradshaw 1986; Scott & Stone 1976; Touw & Falter-van den Haak 1989. All specimens have been lodged at NSW as vouchers for future studies. An appendix, providing a complete list of identification numbers for the vouchers, will be deposited in the library at NSW.

The areas investigated were the Royal Botanic Gardens (RBG), Government House gardens and the Domain (Fig. 1). The names for sections of the Botanic Gardens (Palace, Upper, Middle and Lower) are indicated on Fig. 1 by number and used here for convenience to describe the features of the areas.

1. The Palace Garden — bounded by Macquarie Street and the Cahill Expressway and south of the Conservatorium of Music — includes various garden beds, the Rose Garden, stone walls, lawns and paths. A sunken garden, the Memorial Garden to Pioneers (Men and Women), is located in this area.
2. The Upper Garden — trees, lawns, garden beds, stone paths and walls lie adjacent to this but are separated from the Palace Garden by the Nursery behind the Pyramid and the Arc glasshouses of the Tropical Centre. The eastern border is on Mrs Macquaries Road where the Anderson, Brown and Cunningham buildings are located.

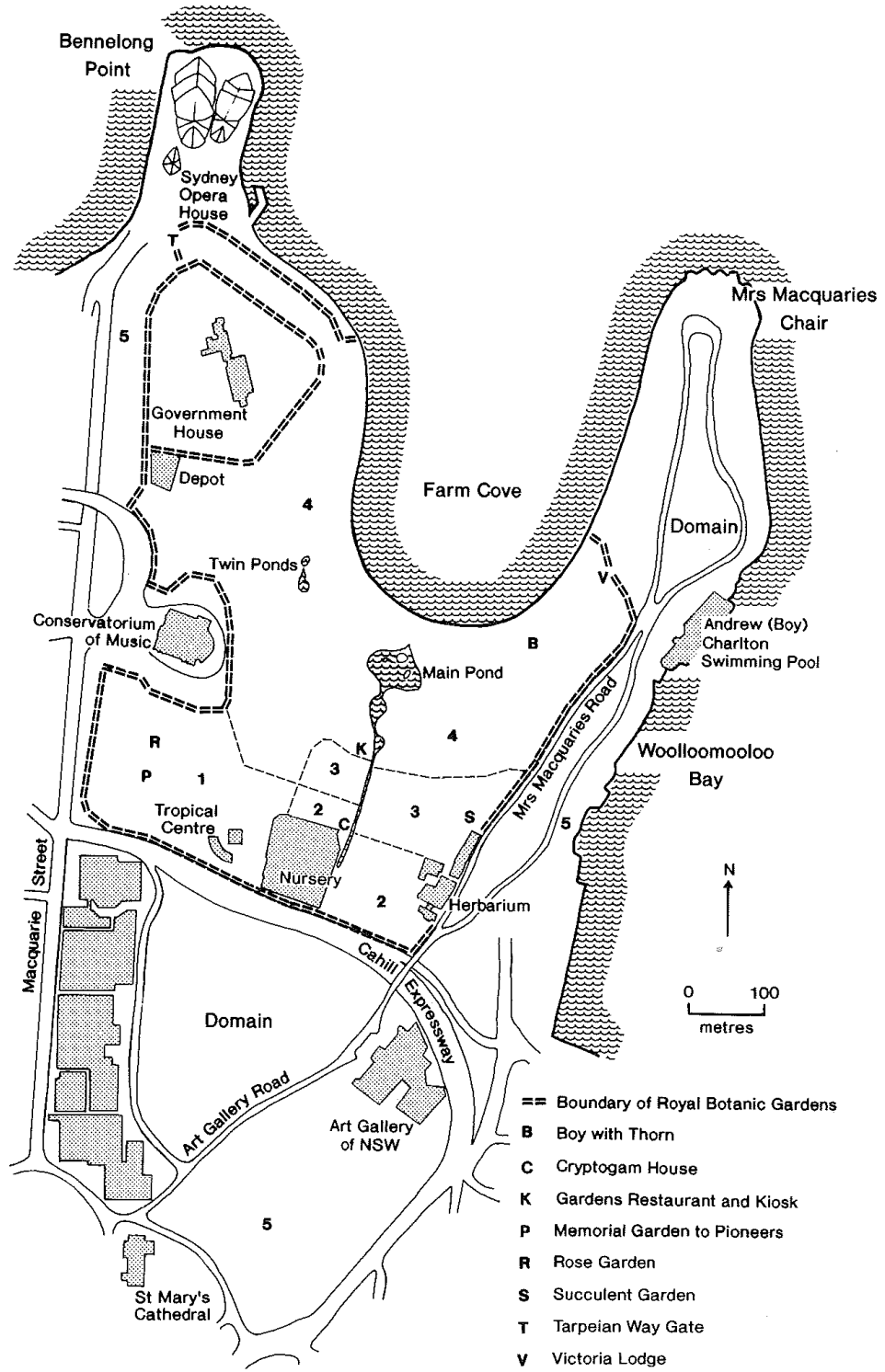


Figure 1. Map of the Royal Botanic Gardens Sydney, the Domain and adjacent areas showing the main collection sites referred to. 1. The Palace Garden. 2. The Upper Garden. 3. The Middle Garden. 4. The Lower Garden. 5. The Domain. Modified from 1990 general map published by the Royal Botanic Gardens, Sydney.

3. The Middle Garden — includes a succulent garden on Mrs Macquaries Road, a large brick-walled creek (known as Botanic Gardens Creek), part of a palm grove to the west, scattered large trees and formal gardens.

4. The Lower Garden — adjacent to Farm Cove and extending from Mrs Macquarie's Road to the Opera House; in the centre Botanic Gardens Creek feeds into the Main Pond, the Gardens Restaurant being above the ponds. Large trees, garden beds, paths and sandstone outcrops occur in this area. The Boy with Thorn statue and Tarpeian Way Gate are also in this area.

5. The Domain — extends both south of the Cahill Expressway, opposite and beside the Art Gallery, then north of the Expressway along Mrs Macquaries Road and Woolloomooloo Bay and past the Andrew Charlton Pool to Mrs Macquaries Chair. Also included is a narrow strip between the Gardens and Macquarie Street towards the Opera House.

The habitats of particular significance for bryophytes in the Royal Botanic Gardens include the brick and stone-walled Botanic Gardens Creek, Twin Ponds and island near the Gardens Restaurant, grounds outside the Tropical Centre glasshouses, potting shed and nursery glasshouses, paths and lawns, sandstone walls and stairs, large sandstone outcrops and old cut rock-faces in the Domain, near Mrs Macquaries Chair and near the Opera House, and the bark of trees.

Bryophytes present in the Royal Botanic Gardens, Government House and the Domain, Sydney.

We present here annotated species lists for 1.) Mosses and 2.) Hepatics and Anthocerotales, with expanded notes on mosses not described in detail in Scott & Stone (1976) or Catcheside (1980), and hepatics not mentioned in Scott (1985). Distribution notes for mosses refer to Ramsay (1984) where previous records are given for the Central Coast of New South Wales (CC), in which the Royal Botanic Gardens lie. As there are no details for the distribution of hepatics within New South Wales we referred to Scott (1985) for records of species present in New South Wales.

Species previously collected in the Gardens include *Fabronia australis* as *F. tayloriana* by W.W. Watts in 1910 and 1914; *F. scottiae* by W. Forsyth in 1899, W.W. Watts in 1899 and 1910; Lovegrove in 1901 and E. Cheel in 1901; *F. brachyphylla* by W. Forsyth in 1900; *Vesicularia* sp. on pots in fernhouse. The only previous hepatic specimen in NSW from the Royal Botanic Gardens is *Lunularia cruciata* (L.) Dumort. collected by A.N. Rodd in 1964 near the glasshouses.

1. Annotated species list of mosses of the Royal Botanic Gardens (RBG), Government House and the Domain.

+ not previously reported for Central Coast (CC) in New South Wales (Ramsay 1984). If a species has been collected only once or twice previously Ramsay has noted this.

++ new record for N.S.W.

Sphagnaceae

Sphagnum cristatum Hampe. Present in pots with insectivorous plants in the potting shed — probably brought in for soil improvement. Naturally occurring in soak areas.

Archidiaceae

Archidium watsii (Broth.) Stone [syn. *Splachnobryum watsii* Broth. fide Stone 1984: 153-157.]. Domain near Mrs Macquaries Point, on sandstone rock near retaining wall.

This species was originally known only from two specimens, collected at Watsons Bay and Parsley Bay 1899 (Watts 2450, 2479) Sydney but has now been reported from Queensland by Stone (1984). It is the first species of *Archidium* confirmed for N.S.W.

Dawsoniaceae

Dawsonia polytrichoides R. Br. Brought in with plant material in nursery pot although this species does occur in wet forested valleys in the region.

Fissidentaceae

Fissidens dietrichiae C. Muell. On wall of Botanic Gardens Creek. This name is listed in error as a synonym for *F. crassipes* Wils. ex B.S.G. for New South Wales in Ramsay (1984). *F. crassipes* has not been found in Australia (Stone pers. comm.). Previously recorded from fewer than three collections for CC.

Fissidens leptocladus C. Muell ex Rodw. On moist brickwork of Botanic Gardens Creek, on brickwork and soil on hillside near the Opera House, near the Government House Depot, and in Domain overlooking Woolloomooloo Bay. Known from fewer than three collections in CC.

Fissidens linearis Brid. var. *linearis* [fide Stone 1991: 403-405; syn. *F. humilis* Dix. & Watts and syn. *F. aeruginosus* Hook. f. & Wils. var. *arcuatulus* Stone fide Stone 1990: 245-260]. Botanic Gardens Creek, Domain near Andrew Charlton Pool, on earth bank among rocks on Mrs Macquaries Point. Common species of wet earth banks.

Fissidens oblongifolius Hook. f. & Wils. On sandstone rocks between the Brown and Cunningham Buildings.

Fissidens perangustus Broth. On soil in Pioneer Memorial Garden in RBG and Domain overlooking Woolloomooloo Bay. Listed by Watts & Whitelegge (1902) for New South Wales but not confirmed in Ramsay (1984, p. 513)

Fissidens pungens C. Muell. & Hampe. Common in various areas, floor of large drain, on small island near Kiosk, soil near Pyramid glasshouses, steps near Government House, between the large pond and Gardens Restaurant. Common on soil.

Fissidens semilimbatus C. Muell. & Hampe [listed as a synonym of *F. taylorii* C. Muell. in Ramsay (1984) and Scott & Stone (1976) but now considered a separate species (Stone pers. comm.)]. On spillway of Botanic Gardens Creek, on brickwork near the Cryptogam House, Domain on moist sandstone rock. Common in CC area.

Fissidens rigidulus Hook. f. & Wils. subsp. *rigidulus*. An aquatic species found here only on brickwork of Botanic Gardens Creek below water level. Confined to running water, known from fewer than three collections from CC.

Ditrichaceae

Ceratodon purpureus (Hedw.) Brid. subsp. *convolutus* (Reichdt) J.S. Burley [fide Burley & Pritchard 1990: 17-76]. Collected on brickwork in Domain, near Conservatorium and Government House on soil and in soil in cracks near Botanic Gardens Creek. A cosmopolitan species, commonly occurring as coloniser of disturbed soil.

Ditrichum difficile (Dub.) Fleisch. In soil on sandstone cliff overlooking the Opera House. Frequently found on earth banks.

Dicranaceae

Campylopus bicolor (F. Muell.) Wils. var. *bicolor*. On soil outside Herbarium buildings and on rock in Domain near Mrs Macquaries Chair.

Campylopus clavatus Hook. f. & Wils. On pots in nursery. Generally common on rocks.

Campylopus incrassatus C. Muell. On soil cracks on wooden bridge over Botanic Gardens Creek. Recorded as *C. flavo-viridis* Dus. [fide Catcheside & Frahm 1985: 363] = *C. incrassatus* [fide Frahm 1987: 715].

Campylopus introflexus (Hedw.) Brid. Young plants in crevices of bark on *Brachychiton rupestre* with *Tortula pagorum* and lichen, sandstone rocks and near Andrew Charlton Pool in Domain. Lacking the usual hyaline apex but clearly *C. introflexus* from leaf sections. Common coloniser of rocks.

Campylopus pyriformis (Schultz) Brid. Domain near Andrew Charlton Pool, Mrs Macquaries Chair and on old cut sandstone cliff opposite the Opera House. Recorded as *C. pallidus* Hook. f. & Wils. from CC [synonyms *C. novae-valesiae* Broth., *C. woollsii* (C. Muell.) Par. fide Frahm 1987: 720; *C. pallidus* fide Corley & Frahm 1982: 187–190].

Dicnemoloma pallidum (Hook.) Wijk & Marg. On rock near the Brown Building. Common coloniser of sandstone rocks.

Trematodon suberectus Mitt. On soil on brick in nursery.

Leucobryaceae

++*Leucobryum aduncum* Dozy & Molk. On soil at base of *Ficus rubiginosa*. This species was identified by D.G. Catcheside. Although not previously reported from N.S.W. many specimens have probably been misidentified as *L. candidum*.

Pottiaceae

Barbula calycina Schwaegr. In lawn with other mosses below and east of Succulent Garden and wall, RBG. A common moss of disturbed soil.

Barbula unguiculata Hedw. On Boy with Thorn Statue, on moist soil in lawns in RBG. Common coloniser of soil.

Gymnostomum calcareum Nees & Hornsch. [= *G. aeruginosum* Sm. fide Zander 1977: 233–269, see note in Catcheside 1980: 187]. On moist old cut sandstone cliff overlooking the Opera House and on calcareous soil in the Domain. A calcareous moss suggesting that the sandstone rock surface possibly had a surface wash of cement dust or other calcareous material.

Pottia truncata (Hedw.) B.S.G. on soil in lawn – Domain, Government House and near the Tarpeian Way Gate. Common coloniser of soil.

Tortula muralis Hedw. On sandstone blocks near Government House, common on cement in brick walls, footpaths, stonework of Botanic Gardens Creek, near Andrew Charlton Pool in Domain and at Mrs Macquaries Point. Common on calcareous brickwork, and rocks.

Tortula pagorum (Milde) De Not. Common on bark of trees such as *Lophostemon confertus*, *Fraxinus chinensis*, *F. Xcanadensis*, *Populus* sp., *Ficus hillii*, *F. bengalensis*, *F. macrophylla*, *Schinus areira*, *Magnolia grandiflora*, on brickwork of Succulent Garden and cement steps of Rose Garden. Frequent epiphyte on rough-barked trees.

Tortula papillosa Wils. Uncommon in RBG, epiphytic on *Bauhinia patersoniana* in Gardens [tree since removed] and on tree in Government House Grounds. Known from fewer than three collections in CC.

Weissia controversa Hedw. var. *controversa* Hedw. Common on soil on brickwork in the Gardens, and near the Tarpeian Way Gate and Cryptogam House. Very common on soil.

+*Weissia controversa* Hedw. var. *gymnostoma* (Dix.) Sainsb. [Capsule was clearly gymnostomous] near Boy with Thorn Statue.

Ptychomitriaceae

Ptychomitrium australe (Hampe) Jaeg. Sandstone rock near Herbarium buildings and Government House. Recorded from fewer than three collections in CC.

Funariaceae

Funaria hygrometrica Hedw. On soil in Domain, on pots in glasshouse, old rose garden and in nursery garden bed near the Gardens Restaurant. Very common weed in pots in nurseries and as a coloniser of soil after fires.

Bryaceae

Bryum argenteum Hedw. Common on soil in footpaths and brick walls throughout the Gardens and Domain, cement in walls of Government House and in cracks of wall of Botanic Gardens Creek. Common on calcareous substrata particularly paths and walls.

Bryum billardierei Schwaegr. var. *billardierei*. On walls of Botanic Gardens Creek, soil and in crevices in rock wall near Andrew Charlton Pool. A common moss of damp soil.

Bryum capillare Hedw. Garden bed, on pots in nursery, wall of Botanic Gardens Creek, on soil and sandstone rock overhang in Domain.

Bryum ?chrysonuron C. Muell. Near swimming pool in Domain.

Bryum dichotomum Hedw. Common on soil and brickwork in RBG, pots in nursery, glasshouses, footpaths, sandstone rock near Brown Building, brickwork in Succulent Garden and sandstone rock near Conservatorium, on tree bases and sandstone blocks near Government House, on brickwork and sandstone rocks in the Domain and at Mrs Macquaries Chair. Common colonist of soil.

Bryum pachytheca C. Muell. Brickwork and wall in Pioneer Memorial Garden.

++*Bryum rubens* Mitt. Soil outside Pioneer Memorial Garden. No previous report of this moss for N.S.W. [some earlier collections included in the *B. erythrocarpum* complex may be this species. Refer to Catcheside 1980: 277]

Bryum ?sauteri B.S.G. On sandstone rock outside Brown Building. Another member of the *B. erythrocarpum* complex. Collected fewer than three times in CC.

+*Bryum subapiculatum* Hampe. Southern side of Botanic Gardens Creek, on soil in Domain near Mrs Macquaries Point.

Bryum subfasciculatum (Hampe) Mitt. Common in wet soaks in grass in RBG, on soil at base of trunk of *Brachychiton rupestre*, grass near Government House and with wet grass in Domain. Frequent on soil.

Bryum torquescens Bruch ex De Not. On pots in nursery. (Previously published as *B. capillare* ssp. *torquescens* (De Not.) Kindb.)

Leptobryum pyriforme Hedw. Soil in pots in nursery, and in Depot near glasshouses, on sandstone overhang in Domain [plants of this species covered in rhizoidal gemmae were collected in Hyde Park in Central Sydney]. Common weed of pots in nurseries.

Orthodontium lineare Schwaegr. subsp. *sulcatum* (Hook. f. & Wils.) Meijer. On moist soil at Government House and twin ponds. More commonly found on burnt logs in forests.

Pohlia tenuifolia (Jaeg.) Broth. On soil with other mosses including *Barbula calycina* in RBG. Known from fewer than three collections in CC.

Aulacomniaceae

Aulacomnium palustre (Hedw.) Schwaegr. Found with *Dawsonia polytrichoides* and with *Bryum billardierei* on pots in potting shed. The presence of pseudopodia bearing leaf-like gemmae is characteristic. As all previous New South Wales reports are from the North Coast and Southern Tablelands, this is most likely an introduction from elsewhere.

Bartramiaceae

+*Philonotis ?austrofalcata* Broth. & Watts. The only previous locality in New South Wales is Yarrangobilly in the Southern Tablelands (ST). This may be an introduction to CC.

Philonotis dicranellacea (C. Muell.) Watts & Whitel. On moist sandstone rocks near Govt. House, on sandstone rocks on earth embankment in Domain and near Andrew Charlton Pool.

Philonotis tenuis (Tayl.) Reichdt. On pots in nursery, glasshouses with *Funaria hygrometrica*, brick wall in Royal Botanic Gardens, on damp soil below hanging rock and on sandstone rocks near Andrew Charlton Pool in Domain. Common in seepage areas or under rocks.

Fabroniaceae

Fabronia australis Hook. Epiphytic on trees, e.g. trunk of Rosaceous tree, southern side of trunk of *Pyrus calleryana*, on *Ficus macrophylla*, on base of trunk of *Macrozamia communis* in RBG and in Government House gardens. Collected fewer than three times in CC.

Fabronia ?brachyphylla C. Muell. Rose garden near Conservatorium, on base trunk of *Glochidion ferdinandi* and on trunk of *Diospyros digyna*.

Fabronia scottiae C. Muell. Stem of Rosaceous tree, base of *Olea europaea* subsp. *europaea*, trunk of *Ficus macrophylla*, base of trunk of *Macrozamia communis* in Royal Botanic Gardens and on wall near Andrew Charlton Pool in Domain.

Racopilaceae

Racopilum cuspidigerum (Schwaegr.) Aongst. var. *cuspidigerum* Common on pots in nursery, on stonework of Botanic Gardens Creek, on brickwork near nursery, on sandstone near Brown Building, on grass beneath *Liquidambar* and other trees, on brickwork and floor of Cryptogam house, near glasshouses, near Opera House gate, on soil near ponds and on rockface near Andrew Charlton Pool in Domain. Common coloniser of soil.

Ptychomniaceae

Hampeella pallens (Lac.) Fleisch. On bark of the palm *Jubaea chilensis* in garden bed in Royal Botanic Gardens. Mostly found in wet forests as an epiphyte.

Lembophyllaceae

Camptochaete gracilis (Hook. f. & Wils.) Par. [= *Fallaciella gracilis* (Hook f. & Wils.) Crum fide Crum 1991: 313-322]. On trunk of *Ceratonia siliqua* in garden bed between Government House and the Twin Ponds. Occurs mainly in wet forests on rocks.

Hypopterygiaceae

Hypopterygium rotulatum (Hedw.) Brid. On moist sandstone rock near Opera House Gate. Mostly found on wet rocks in valleys and forests.

Thuidiaceae

Thuidium sparsum (Hook. f. & Wils.) Jaeg. Brickwork of Botanic Gardens Creek, brick wall of Pioneer Memorial Garden with *Tortula muralis*, *Bryum dichotomum*, *Fissidens pungens*, *Lunularia cruciata*, Opera House Gate, Government House grounds and on soil and stone walls in the Domain. Common species on rocks and soil in CC. [previously reported as *T. furfurosum* e.g. Scott & Stone (1976) fide Touw & Falter-van den Haak 1989: 1-57]

Leskeaceae

Pseudoleskeopsis imbricata (Hook. f. & Wils.) Ther. [*Pseudoleskea imbricata* (Hook. f. & Wils.) Broth.]. Sandstone rock wall and sandstone outcrop in Domain near Mrs Macquaries Chair. Known to occur on calcareous substrates. The calcareous nature of this moss suggests that the sandstone rocks had some calcareous material on the surface.

Amblystegiaceae

+*Amblystegium serpens* (Hedw.) B.S.G. Stone walls of Botanic Gardens Creek. New generic record for CC.

Brachytheciaceae

Brachythecium rutabulum (Hedw.) B.S.G. Glasshouses in Nursery.

Eurhynchium muricatulum (Hook. f. & Wils.) Jaeg. Sandstone rocks outside laboratory in Brown Building. Recorded from fewer than three specimens in CC.

+*Kindbergia praelonga* (Hedw.) Ochyra [formerly *Eurhynchium praelongum* (Hedw.) B.S.G. fide Ochyra 1982: 54]. On stone walls of Botanic Gardens Creek and on soil on island near Gardens Restaurant. No report in Ramsay (1984) for N.S.W. but there is a recent record for Sydney by Downing (1989: 6).

Plagiotheciaceae

Rhynchostegium patulum Jaeg. On moist soil in Domain. Previously collected from the area around Port Jackson, Sydney.

Rhynchostegium tenuifolium Hedw. Moist soil with *Racopilum* on island near Gardens Restaurant. This species occurs on logs and soil.

Sematophyllaceae

Sematophyllum homomallum (Hampe) Broth. On stone walls of Botanic Gardens Creek, epiphytic at base of *Eucalyptus saligna* with *Tortula pagorum*, occasionally on trunk of of rough barked trees e.g. *Jubaea* sp., *Rothmannia globosa* also with *T. pagorum*.

+*Sematophyllum contiguum* (Mitt.) Mitt. Wall of Botanic Gardens Creek, rock in Domain.

Sematophyllum aciculium (Broth. ex Dix.) Dix. Glasshouses near Nursery, in Domain and at Mrs Macquaries Point. Reported from Port Jackson, Sydney.

Hypnaceae

Isopterygium ?minutirameum (C. Muell.) Jaeg. On soil near Depot.

?*Isopterygium albescens* (Hook.) Jaeg. In moist crevices of sandstone rock in Domain toward Mrs Macquaries Point.

In addition there are a number of undetermined sterile pleurocarpous moss species possibly from the families Hookeriaceae and Brachytheciaceae.

2. Annotated species list of hepatics and anthocerototes of the Royal Botanic Gardens, Government House and Domain.

+ not previously recorded for N.S.W.

++ not previously recorded from Australia

Anthocerototes

Anthoceros cf. *punctatus* L. On moist soil outside Ranger's cottage (Victoria Lodge) and on soil (now dug over) near Andrew Charlton Pool in Domain.

Hepatics

Aneuraceae

+*Riccardia bliklika* Hewson. On treefern fibre in orchid glasshouse in Nursery. A Queensland species probably brought in from there.

Riccardia ?macdonaldiana Hewson. Male plants only, on sandstone rock outside laboratory in Brown Building. A Queensland species probably brought in from there.

Pallavaciniaceae

+*Pallavicinia lyellii* (Hook.) Carruth. On stone walls of Botanic Gardens Creek, moist soil near Gardens Restaurant. Not recorded for N.S.W. by Scott (1985) or Scott & Bradshaw (1986).

Metzgeriaceae

Metzgeria decipiens (Mass.) Schiffner & Gottsche. On trunk of tree fern *Cyathea leichhardtiana* near Gardens Restaurant. Recorded as a common epiphyte in wet forest in N.S.W. Probably brought in on the *Cyathea* trunk.

Aytoniaceae

Asterella drummondii (Hook. f. & Tayl.) R.M. Schuster. In pot in nursery. Common on soil crusts.

Marchantiaceae

Lunularia cruciata (L.) Dumort. On stone walls of Botanic Gardens Creek, brickwork in Pioneer Memorial Garden, on soil and stonework of steps overlooking Woolloomooloo Bay in the Domain. Common on soil in the Sydney area and throughout N.S.W.

Marchantia polymorpha L. On soil in pots in nursery in RBG. A common weed of glasshouses in N.S.W.

Ricciaceae

Riccia asprella Carring. & Pears. Outside Government House on black loamy soil.

Riccia bifurca Hoffm. Outside Government house on black loamy soil. Occurs on damp loamy soils often under grass in N.S.W.

Riccia cartilaginosa Stephani. Outside Government House on black sandy loam and on moist sandy soil at edge of sandstone rocks in Domain. Found on wet soil in forest clearings in N.S.W.

Riccia aff. *spongiosula* Na Thalang. Outside Government House on black loamy soil.

Occurs in dry, hot regions of N.S.W.

[Note: all the *Riccia* species, which tend to occur in drier areas, may have been brought in as spores with soil].

++Choncoleaceae

++*Choncolea doellingeri* (Nees) Grolle. On bark of various phorophytes, e.g. *Olea europa* subsp. *africana*, *Eucalyptus saligna*, *Pinus roxburghii*, *Quercus cerris*, *Jubaea chilensis*, *Beilschmiedia elliptica* and the trunk of *Macrozamia communis*, on bark of *Ficus macrophylla* and *F. hillii* in the Domain, outside Government House on bark of *Harpephyllum caffrum* and *Eucalyptus robusta*. This is the first record of this family, genus and species from Australia. *Choncolea* is a native of Brazil, the lowlands of subtropical South America and of subtropical Florida. This species is thriving and is found throughout the RBG. It also occurs in adjacent areas having been collected near St Mary's Cathedral but has not been found on the northern shores of Sydney Harbour. This species may have arrived as a propagule and become naturalised here.

Lepidoziaceae

Kurzia hippurioides (Hook. f. & Tayl.) Grolle. In crevice below moist sandstone rock overhang in the Domain.

Lepidozia laevifolia (Hook. f. & Tayl.) Taylor ex Gottsche et Nees & Lindenb.). On rotting log in rainforest area of RBG.

Geocalycaceae

Chiloscyphus novae-zelandiae (Lehm. & Lindenb.) Engel & Schust. Near Pyramid glass-house at base of fern *Angiopteris erecta*. Generally found on fallen logs in N.S.W. forests.

Chiloscyphus semiteres (Lehm.) Lehm. & Lindenb. [syn. *Lophocolea semiteres*]. On brickwork of Botanic Gardens Creek, base of the fern *Todea barbara* and the palm *Livistona* sp. outside Gardens Restaurant, brickwork of Cryptogam House, outside Government House and on moist sandstone steps and moist soil at edge of sandstone rocks in the Domain. Common as an epiphyte or on fallen logs in forests in N.S.W.

Chiloscyphus sp. Stonework of Botanic Gardens Creek.

Frullaniaceae

Frullania monocera (Hook. f. & Tayl.) Taylor ex Gottsche, Nees & Lindenb. On bark of *Quercus cerris* (tree since removed) in RBG.

Frullania pentapleura Tayl. On bark of various phorophytes e.g. *Fraxinus*, *Quercus*, *Jubaea chilensis* and *Rothmannia globosa*, outside Government House on *Quercus palustris*. Occurs as an epiphyte or on rocks in N.S.W.

Frullania ?probosciphora Tayl. On bark of *Brachychiton rupestre* near statue of Boy with Thorn (Lower Garden).

Codoniaceae

Fossombronia caespitiformis De Not. ex Rabenh. On moist ground amongst mosses below sandstone rocks at edge of Mrs Macquaries Road in the Domain. Common in Eastern mainland Australia including N.S.W..

Fossombronia sp. Sterile material only, unable to be identified to species without spores. On pot in nursery, growing amongst mosses and *Riccia cartilaginosa* at base of sandstone rocks in Domain.

Lejeuneaceae

+*Cololejeunea ?minutissima* (Sm.) Schiffn. On bark of *Liquidambar* near Twin Ponds, bark of *Rothmania globosa* and a rough-barked tree in garden beds near walled section of Botanic Gardens Creek.

Lopholejeunea sp. In glasshouse amongst mosses at base of orchid stems (*Dendrobium* sp.) in pot and tree fern fibre amongst mosses.

Conclusions

The Royal Botanic Gardens provided an interesting site for study of bryophytes, as the area has been subject to disturbance since settlement. The species present include some native locally and possibly continuously present since early settlement days, as well as opportunistic forms that have invaded by dispersed diaspores, and some species imported on soil or with plants.

In this study 95 species of bryophytes (70 mosses, 24 hepatics and one anthocerot) were collected. A wide range of families is represented: 24–25 families of mosses of which 12 are acrocarpous and 12 pleurocarpous; 13 families of hepatics of which 6 are thallose and 7 leafy. The genera with most species are *Bryum* (10 species), *Fissidens* (8), *Campylopus* (5), *Fabronia* (3), *Tortula* (3), *Chiloscyphus* (4), *Riccia* (4).

Taxa present can be grouped according to their life strategies and/or habitat preferences.

1. Colonising opportunistic species mainly on soil include *Bryum dichotomum*, *Ceratodon purpureus*, *Ditrichum difficile*, *Fissidens* spp., *Funaria hygrometrica*, *Racomitrium cuspidigerum*, *Weissia controversa*, *Riccia* spp.,
2. Epiphytic species common in the gardens are *Fabronia* spp., *Tortula pagorum*, *Frullania* sp.
3. Mosses most commonly found on calcareous substrata are *Bryum argenteum*, *Gymnostomum calcareum*, *Pseudoleskea imbricata*, *Tortula muralis*.
4. Colonisers of rocks include *Campylopus* spp., *Dicnemoloma pallidum*, *Ptychomitrium australe*.
5. Aquatic species present are *Fissidens rigidulus*, *Sphagnum cristatum*.

A new record for Australia is the liverwort *Chonecolea doellingeri* (Nees) Grolle (identified by R. Grolle) and a new moss record for New South Wales is *Leucobryum aduncum* Dozy & Molk. (identified by D.G. Catcheside; many specimens which may be this have probably been identified erroneously as *L. candidum*). Species present in other regions of N.S.W. but not previously reported for the Central Coast (Ramsay 1984) include *Amblystegium serpens*, *Bryum rubens*, *B. subapiculatum*, *Kindbergia praelonga*, *Philonotis ?austro-falcata*, *Sematophyllum contiguuum*, *Weissia controversa* var. *gymnostoma*. Some species listed as having only one or two collections in CC by Ramsay (1984) include *Fabronia australis*, *Fissidens leptocladus*, *F. rigidulus*, *Tortula papillosa*, *Ptychomitrium australe*. Hepatics not listed for New South Wales by Scott (1985) include *Pallavicinia lyellii*, *Riccardia bliklika*, *R. macdonaldiana*, *Cololejeunea minutissima*.

Species most likely to have been introduced to Australia rather than being native here are *Kindbergia praelonga* (Hedw.) Ochyra (formerly *Eurhynchium praelongum* (Hedw.) B.S.G.), *Leptobryum pyriforme* Hedw. and *Chonecolea doellingeri* (Nees) Grolle.

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