Two Centuries of Botanical Exploration along the *Botanists Way*, Northern Blue Mountains, N.S.W: a Regional Botanical History that Reflects National Trends

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The *Botanists Way* is a promotional concept developed by the Blue Mountains Botanic Garden at Mt Tomah for interpretation displays associated with the adjacent Greater Blue Mountains World Heritage Area (GBMWHA). It is based on 19th century botanical exploration of areas between Kurrajong and Bell, northwest of Sydney, generally associated with Bells Line of Road, and focussed particularly on the botanists George Caley and Allan Cunningham and their connections with Mt Tomah.

Based on a broader assessment of the area's botanical history, the concept is here expanded to cover the route from Richmond to Lithgow (about 80 km) including both Bells Line of Road and Chifley Road, and extending north to the Newnes Plateau. The historical attraction of botanists and collectors to the area is explored chronologically from 1804 up to the present, and themes suitable for visitor education are recognised. Though the *Botanists Way* is focused on a relatively limited geographic area, the general sequence of scientific activities described - initial exploratory collecting; 19th century Gentlemen Naturalists (and lady illustrators); learned societies and publications; 20th century publicly-supported research institutions and the beginnings of ecology, and since the 1960s, professional conservation research and management - were also happening nationally elsewhere. The broader view of the *Botanists Way* concept is considered to provide a valuable basis for expanded visitor interpretation of science and conservation in and around the Greater Blue Mountains World Heritage Area, botany being a significant element of nature tourism.

Funding for public-good science through largely government funded institutions is a relatively recent development. It has been particularly influential in the last 50 years (i.e. essentially in the lifetimes of current researchers). However, despite recognition of its obvious successes, public-good science should not necessarily be assumed to be a permanent feature of our culture, and remains vulnerable to political climate.

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INTRODUCTION

But it is a form of romance to trace too close a parallel between a long lifetime and events belonging to local and national history, Most people exist with only the occasional peripheral thought they, personally, are part of an age or an epoch.
Ronald Blythe (1979)

The inscription of the Greater Blue Mountains World Heritage Area (GBMWHA) on the World Heritage List in 2000 has led to a demand for information not only on its biodiversity, but also on its scientific history, and particularly its botanical exploration and discovery. These stories provide background for interpreting the flora and vegetation in displays and exhibitions such as at Blue Mountains Cultural Centre at Katoomba, and for guides and

FIGURE 1 The route of the Botanists Way from Richmond to Lithgow along Bells Line of Road, a distance of about 80 km. The Newnes Plateau is immediately north of Clarence. (Source: Google maps).

tourist leaders, as well as the general public. The *Botanists Way* is a particular promotion by the Blue Mountains Botanic Garden at Mount Tomah to celebrate the botanical exploration of the Bells Line of Road and Chifley Road between Kurrajong and Lithgow (Figure 1). It has featured in its exhibitions and is shown on the maps of the Greater Blue Mountains Drive (DECC 2008), a series of routes traversing the GBMWHA.

In Australia the story of botany weaves in and out of the national history. During the 1950s N.S.W. primary school social studies classes devoted considerable energy to the discovery of the Australian continent and exploration of the interior. This included reference to the part that botanists and scientists played: a brief mention of William Dampier - though better known as a buccaneer, he collected the first documented Australian plant specimens (now at Oxford University) and described vegetation at Shark Bay in Western Australia in 1699 (Groves 2017); then of course James Cook's visit to Botany Bay in 1770 and the plant collections made by Joseph Banks and Daniel Solander that stunned the scientific world. Banks' later recommendations to the British Government were instrumental in the founding of the convict settlement of Botany Bay in 1788. Later he also selected, and largely funded, a series of botanists including George Caley, Robert Brown and Allan Cunningham. So influential was he in the development of the early colony of New South Wales that the 1821 Inscription Plaque at Botany Bay described him as *Maecenas of his time* (an influential arts patron under Roman emperor Augustus), and a later Australian botanist, Joseph Maiden, was convinced that he should be regarded as the *Father of Australia* (Maiden 1909).

Allan Cunningham was one of the intrepid explorers of the interior, and as well as collecting plants (this was not generally emphasized in classrooms) he discovered Pandoras Pass (northeast of Coolah) and the Darling Downs in southeast Queensland – neither meant much to N.S.W. students at the time. Botany appears to have then disappeared from Australian history, both in its impact on events and its significance in the N.S.W. primary school curriculum.

That is, until the late 1960s when the need for better general education led to an increasing interest in the natural world, particularly its biodiversity (a holistic term first used in 1985). At the same time establishment of the N.S.W. National Parks and Wildlife Service (in 1967), nature-focussed

conservation of natural areas, and the funding of science in institutions such as botanic gardens by the Whitlam Government's Australian Biological Resources Study (ABRS), gave new impetus to botanical research nationally.

The *Botanists Way* promotion concentrates mainly on early botanical history and exploration and was developed in 2008, focusing particularly on the early 19th century botanist/collectors George Caley and Allan Cunningham, and their collecting excursions from Richmond to Mt Banks and Mt Tomah. However the area's botanical history is much richer than presented in tourist promotion: the route of the Bells Line of Road and Chifley Road (its continuation from Bell into Lithgow) has many more historical botanical associations. George Caley is certainly important from the Mt Tomah point of view, but his fellow botanist Robert Brown played a bigger role in describing the Australian flora. At the other end of historical time is the discovery of the Wollemi Pine in 1994 (to the north of this route) and the inscription of the Greater Blue Mountains on the World Heritage List in 2000. Many botanists and botanical collectors have been involved; there is not space to describe fully all their contributions but further biographical details for most can be obtained from various websites (e.g. the Australian Dictionary of Biography). A chronological summary of people historically associated with the *Botanists Way* is provided in the appendix.

This account takes the geographical corridor of the *Botanists Way*, and expands some of its other important connections with botanical history, research, exploration, conservation biology and wildlife management. The major trends in the science world at the time are treated chronologically. Similar events to those described for the *Botanist Way* were also occurring elsewhere in Australia; the story is therefore a good example of how regional botanical history has unfolded to provide the diverse individual components that make up our current level of national knowledge.

THE *BOTANISTS WAY*: from Richmond to Lithgow along Bells Line Of Road

Bells Line of Road is a major connecting route providing an alternative to the Great Western Highway to cross the Blue Mountains. From Richmond (at the Hawkesbury River bridge) on the north western outskirts of Sydney, the road passes through Kurrajong, Bilpin and Mt Tomah to Bell, in the upper Blue Mountains, whence the route continues to Lithgow as Chifley Road (this road was only continued to Lithgow during World War II). The distance from Richmond to Lithgow is about 80 km. The route from Richmond to Bell and into Hartley Vale was pioneered by 19-year old Archibald Bell in 1823 and was later used as a stock route. Elevation along the route ranges from near sea-level at Richmond to about 1000 m at Bell. The area is partly within both the Central Coast and Central Tablelands Botanical Subdivisions. The *Botanists Way* is currently interpreted by the Blue Mountains Botanic Garden as the Bells Line of Road from Kurrajong to Mt Tomah, but is marked on the Greater Blue Mountains Drive maps (DECC 2008) to include the Chifley Road. URL http://www.greaterbluemountainsdrive.com.au/the-drive-in-detail/themed-touring-routes/botanists-way

Early botanical exploration along the *Botanists Way*: the influence of Sir Joseph Banks

Although **Sir Joseph Banks** (1743-1820), botanist, science patron and president of the Royal Society in London for 41 years, came no closer to the Blue Mountains than Botany Bay, he is a figure of international scientific standing. It is fitting that a major geographical feature on the *Botanists Way,* Mt Banks, was named in his honour. He had a significant influence on the selection of Botany Bay for the penal colony. His influence on the administration continued through selection of the first governors, but his personal scientific interests were promoted through his employment and patronage of naturalists, in particular George Caley, Robert Brown, and Allan Cunningham (O'Brian 1987).

George Caley was employed by Banks as a natural history collector and arrived in Sydney in 1800. For nearly 10 years he worked out of Parramatta and took a particular interest in eucalypts, noting species hybridization, and in Aboriginal plant use. His attempt to cross the Blue Mountains in November 1804 (with convict assistants but no aboriginal guides) took him from Richmond, through Kurrajong, across Burralow Swamp and then the rugged country along the northern side of the Grose Valley, which he called *The Devil's Wilderness* (his route is much further south of the current Bells Line of Road), to Mount Tomah (his *Fern Tree Hill*), and Mt Banks (which he named after his employer). Alan Andrews (1984) transcribed and annotated Caley's account of this journey and his descriptions of some of the plants. He was the first naturalist to journey into this part of the Blue Mountains, and some of his observations deserve highlighting.

On the native currant, presumably *Leptomeria acida* - Nov 7 1804 The Devil's Wilderness - *As*

a substitute for water, we made use of the native Currant*, which we found to be in tolerable plenty in some places, upon the barren hilly ground, and which in great measure alleviated our thirst. Yet though the shrub was so common, the fruit might be said to be scarce, seemingly by being devoured by birds.*

First description of mallee eucalypts - Nov 13 1804 southwest of Mt Tomah - (*The ground down hill we found to be nakedish of trees, of a very barren nature, but in some places thickly covered with a bush like species of* Eucalyptus*, which much resembled young trees in growth.*

Similarities with Sydney vegetation - Nov 14 1804 Mt Charles - *We arrived at a barren piece of land, destitute of trees, and much like some places in the vicinity of Sydney, such as South Head etc*.

The contrast between the vegetation on barren sandstone and that on the Wianamatta Shale - 21 Nov 1804 returning near Little Wheeny Creek - *The first sight of forest land had great effects on our minds, which had the appearance of a paradise, in comparison to that which of late we had been accustomed to* [i.e. sandstone vegetation]. *As we came through the brush, on the lower part of the hills we noticed a deal of* Currijon *(a species of* Hibiscus*) in flower, which had a grand and beautiful appearance.* It is clear from this and Caley's separate description of *Currijon* (Appendix in Andrews 1984) that Caley's *Currijon* refers to the shrub/small tree *Hibiscus heterophyllus*, and not the well-known tree Kurrajong *Brachychiton populneus*, commonly associated with the placename Kurrajong. Both species could have provided fibre, which the Aboriginal word apparently refers to. Caley clearly indicates the abundance of *Hibiscus heterophyllus,* but he does not mention *Brachychiton*. Both species could have occurred in the Kurrajong area; both occur at the interesting botanical site at nearby Grose Vale (Benson 2012).

Caley's plant descriptions (Appendix in Andrews 1984) are difficult to identify to species now, but recent research indicates that, for example, his *Viola* from *The Devils Wilderness* area is a new and undescribed taxon (Louisa Murray pers. comm. 8/2/2018).

Robert Brown (1773-1858) was selected by Banks as naturalist to accompany Matthew Flinders on the *Investigator's* survey of the Australian coast (1801-1805) (the expedition also included the artists Ferdinand Bauer and William Westall). Vallance et al. (2001) transcribed Brown's journal of the expedition. During his time in Sydney Brown met with Caley, and in 1804-05 he explored the Richmond-Windsor area, then known as the Green Hills, and the Lower Grose River. From here he collected and described a small shrub *Epacris sparsa*, which was subsequently overlooked until the 1990s, when it was found in the Grose near the Vale of Avoca (Powell & James 1993), probably very near where Brown originally collected it. Brown returned to Britain to work on his material, later (1805) becoming Bank's librarian, and subsequently (1827) Keeper of the Botanical Department of the British Museum, when the collections were transferred there. He published descriptions of 3500-4000 Australian species.

The appointment of **Allan Cunningham** (1791-1839) as botanical collector for the Royal Botanic Gardens Kew was one of Banks' last significant contributions to Australian science. Cunningham, had Brown's acquaintance at Kew and after more than a year in Brazil, arrived in Sydney in 1816 with substantial botanical expertise. He collected locally around Parramatta and in April 1817 joined John Oxley exploring westward to Wellington and the Lachlan River. Over the next four years he sailed with Philip Parker King on coastal hydrographical surveys and collected widely in north-western Australia. Back in Sydney in 1822, he set out to collect specimens and explore the country between the Macquarie and Cudgegong Rivers, resulting in the discovery of Pandoras Pass through the Liverpool Range to the Liverpool Plains (though much better access across the range was soon found to the west). In 1827 he made a major exploratory journey north from the upper Hunter through the Gunnedah and Bingara areas to the Condamine River, a potentially rich pastoral area which he named the Darling Downs. He made many local trips around Sydney including to Mount Tomah in 1823 following Bell's survey line and described the rainforest and treeferns at Mt Tomah. His journals contain a wealth of botanical and landscape descriptions, as well as observations on ecology and early impacts of settlement. While extracts of Cunningham's writings are available (e.g. Lee 1925), his journals are yet to be fully transcribed and published, though this is being gradually done by various people (R.O. Makinson pers. comm.). See also Heward (1842)-obituary, McMinn (1970)-general biography and Orchard and Orchard (2015)-letters.

An awareness of Australian identity: the beginnings of formal scientific research

The second half of the 19th century brought the cessation of convict transportation, the wealth from the gold rushes, and an increasing population regarding Australia as its home. These led to the development of civic pride in the Australian colonies, particularly highlighted by the 100th anniversary of the Foundation

of the Colonies in 1888. The excitement of science and discovery in a new continent drove scientific research. From Melbourne the internationally recognized scientist Ferdinand Mueller (1825-1896) kept Australia in touch with world botany. The monumental *Flora Australiensis* by George Bentham, seven volumes published in London in 1863-1878, was made possible by the specimens collected by Banks, Caley, Brown, Cunningham, Mueller and many others. It provided the definitive resource for identifying Australian plants in Australia, but it also ended the era of needing to send specimens to Britain/ Europe for major work on Australian botany. There was now an increasing interest in local organisations and scientific institutions. Local networks of men with common interests developed. Colonial scientists formed the *Australasian Association for the Advancement of Science* in 1888.

Networks of learned men: opportunities provided by the Linnean Society of New South Wales

Natural history scientific institutions in 19th century Sydney were the Sydney Botanic Gardens (established in 1816), the Australian Museum (1827), the Technological Museum (1878) and University of Sydney (established in 1852, but the Botany Department was only established in 1913). These institutions were essentially storehouses for specimen collections overseen by a few professional scientists. The majority of scientific research in the 19th century was done by networks of educated and often influential enthusiasts, Gentleman Naturalists (Augee 2010), connected through learned scientific societies which provided opportunities for correspondence, meetings, field visits and publication of results (Fig. 2). Though modelled on those of London, they were not exclusive in their membership and catered for a wide variety of interests. The networks did include some 'lady' illustrators. Their illustrations which often disclose considerable understanding and original natural history observations, accompanied scientific papers but they were rarely included as authors. For those

FIGURE 2 Rather formally attired members of the Linnean Society pose for Henry King's camera during an excursion to the Nepean River, on Saturday, 29 September 1888.
Seated, from left: Henry Deane, Ernst Betche, J.H. Maiden (with plant press), John Brazier, Dr James C. Cox, Sir William Macleay. Standing, from left: Prof. W.J. Stephens, Frederick A. Skuse, Frank Meyrick de Meyrick, Joseph Fletcher. Many were authors of Linnean Society publications over the following decades. (Source: Henry King; State Library of New South Wales).

with natural history interests there was the Linnean Society of New South Wales (which accepted women as Associate Members from 1885 and as full members from 1909). Others were the Royal Society of New South Wales with primarily geological interests, and the Royal Zoological Society with a major interest in acclimatisation.

The Linnean Society of New South Wales was founded in 1874, to promote the "Cultivation and Study of the Science of Natural history in all its Branches", with the support and patronage of Sir William Macleay (major interest entomology) and supported by other leading Gentleman Naturalists including Sir William Macarthur (botany, horticulture). Robertson (1974) summarised the first hundred years of the Society, emphasising that '*One of the characteristics of natural history in the nineteenth century was that the work — including work of great distinction — was often carried out by people to whom it was more of a hobby than a profession…Macleay and the clergyman -geologist W. B. Clarke.* [In the early 20th century]- *the Reverend H. M. R. Rupp working on the orchids, Mr. G. A. Waterhouse " the butterfly man ", Mr. S. J. Copland the herpetologist who used to be the night crime reporter for the Sydney Morning Herald.* [and] *Mr. A. H. S. Lucas, Headmaster of Sydney Grammar School… the only person in Australia then to undertake a systematic investigation of our marine algae'.*

The Society also provided meeting rooms (most recently Science House) and important library resources up until their dispersal in the early 1980s (Martin 2015). However, the lasting value of these societies was, and is, their publications. The journals of the learned societies such as the *Journal and Proceedings of the Linnean Society of New South Wales* published much of the work of this period. In 1890, for example, 50 papers were published in Volume 5 of the *Proceedings*, the majority by Gentleman Naturalists, though seven were written by people who were professional biologists or had biological training (Augee 2010); a new trend in the "professionalism" of natural history studies was emerging.

Based in Richmond, the **Reverend** Dr William Woolls (1814-1893), a Church of England clergyman and a knowledgeable botanical Gentleman Naturalist, published papers on both native and exotic plant species, particularly for Parramatta and western Sydney (Woolls 1867) (see biography by Thompson 1986). He sent specimens to botanist Ferdinand Mueller in Melbourne and on meeting young botanist **Louisa Atkinson** (1834-1872) who was living with her mother at *Fernhurst* at Kurrajong in the 1860s, introduced her to William Macleay and encouraged her to correspond with Mueller. She published articles in the *Sydney Morning Herald* on the flora of the Kurrajong area, particularly ferns, and planned an illustrated fern guide, but died too young to finish it (Lawson 1995). *I wish you had known Louisa Atkinson*, Woolls wrote to his botanist-engineer friend Henry Deane fourteen years after her death (Gilbert 1980). In the 1880s Woolls gave botanical lessons to a young mining surveyor Richard H. Cambage (1859–1928) who made plant collections for him. Cambage later authored papers on geological influences on vegetation and the routes of the early explorers in the *Journal and Proceedings of the Royal Society of N.S.W*.

The lush rainforests on the isolated basalt soils at Mt Wilson and Mt Tomah that had attracted Caley and Cunningham now attracted others. Woolls published (1887) *A glance at the flora of Mount Wilson,* Prosper N. Trebeck published a list of Mount Wilson ferns (Trebeck 1886), and in 1899 teacher Alexander G. Hamilton published notes on the Mt Wilson vegetation and climate, and listed the flora, combining his list with those of Trebeck, Joseph Maiden, and local residents Jesse Gregson and J.D. Cox. (Hamilton 1899). The botanical works of all these people were published in the *Proceedings of the Linnean Society of N.S.W.*

Gardeners at Mount Wilson

The rich red soil of the basalt-capped mountains also provided attractive sites for country houses, with extensive gardens set in surrounds of tree fern-filled forest (Fig. 3). The nearby railway station of Bell (opened in 1875 as Mt Wilson station) made Mount Wilson accessible. In 1880 **Jesse Gregson** (1837-1919) (Superintendent of the Australian Agricultural Company) constructed a holiday property *Yengo* at Mt Wilson, and developed gardens with assistance from Sydney Botanic Gardens director Charles Moore. Later, as his interest in botany developed, he sent specimens to botanist Joseph Maiden, Moore's successor. A friendship developed and Maiden accompanied Gregson on collecting excursions. An unpublished list of lichens collected at Mt Wilson by Jesse Gregson (Gregson 1902-3) (46 species determined by Edwin Cheel) is probably the first documentation of the non-vascular flora of the area. The fern *Blechnum gregsonii* was named for him by moss expert Reverend William Watts (Fig. 4). His son **Edward Jesse Gregson** (1882-1955) continued to live at *Yengo* and collect specimens (which were later given to the University of New England) and

FIG. 3 Cathedral of Ferns Mt Wilson; early 20th century post-card promoting the rich basalt vegetation as a tourist experience. (Source: Mt Wilson and Mt Irvine Historical Society)

published a paper on the eucalypts of Mt Wilson and Mt Irvine (Gregson 1952). The botanical contribution of the Gregsons was recognised in the naming of *Eucalyptus gregsoniana* in 1973 by another Sydney Botanic Gardens Director L.A.S. Johnson who had been accompanied in the field by Edward Gregson.

Other Mt Wilson retreats were J.D. Cox's *Balangra* (now *Sefton Hall*) and *Nooroo*, purchased in 1918 by George Valder, previously principal of Hawkesbury Agricultural College and later Undersecretary of the N.S.W. Department of Agriculture (he was Maiden's superior in the Public Service). His son continued to improve the historic garden, and the expertise of grandson **Peter Valder**, a Sydney University botanist and mycologist, made *Nooroo* an important collection of exotic, not least Chinese, plantings.

Commercial horticulture has also been important along the Bells Line of Road with orchards on the shale soils at Kurrajong and Bilpin, and nurseries on Mt Tomah, one of which the Brunet family donated in 1972 to become Mt Tomah (now Blue Mountains) Botanic Garden.

An example of the new professionals

In 1890 the Linnean Society included only a few professionals; notably J.H. Maiden (Curator of the Sydney Technological Museum), T. W. Edgeworth David (N.S.W. Department of Mines), W.A. Haswell (professor of biology Sydney University), and Baron F. von Mueller (National Herbarium of Victoria), but their number and influence was beginning to increase (Augee 2010). In 1891 Hawkesbury Agricultural College (HAC) was established at Richmond and began to employ trained science teachers, providing a base for science outside Sydney, often closer to interesting field study sites. **Charles Tucker Musson** (1856-1928) (Fig. 5) was a significant member of the Hawkesbury Agricultural College staff from its beginning until 1919, being, amongst other duties, Science Master and Lecturer in Botany and Entomology (see Lister 2017). Musson's career exemplifies the type of work being done in science and education at the time by a network of educated (mainly) men. Compared with the early 19th century exploration, this period has been generally overlooked; much of the progress at this time was made possible through the personal connections between the scientists through meetings and correspondence.

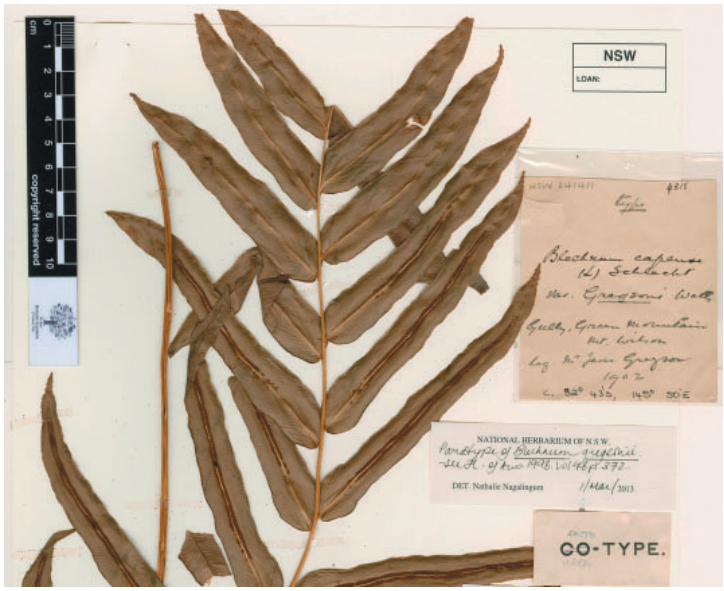

FIGURE 4 Type specimen of the fern *Blechnum gregsonii* (originally *Blechnum capense* var *gregsoni*) collected from Gully, Green Mountain, Mt Wilson by Mr Jesse Gregson in 1902. (Source: National Herbarium of NSW).

Charles Musson had broad interests in science and education, and a wide circle of friends and correspondents. He published his own botanical research on dioecy in the small lily *Wurmbea dioica,* and with his Hawkesbury colleague **Walter Mervyn Carne** researched adventitious roots on *Melaleuca linariifolia.* He worked on eucalypts and lignotubers with Joseph Fletcher (another teacher/scientist). **Joseph J. Fletcher** (~1850-1926) Councillor of the Linnean Society of N.S.W. from 1885 to 1919 and noted for his zoological research, maintained an interest in sandstone flora, in particular eucalypt and wattle seedling development. Fletcher had given a short account of the occurrence of what he believed were natural *Grevillea* hybrids amongst wild populations in the Blue Mountains to the Linnean Society in 1913, and in 1927, following Fletcher's death, Musson was asked by Fletcher's wife

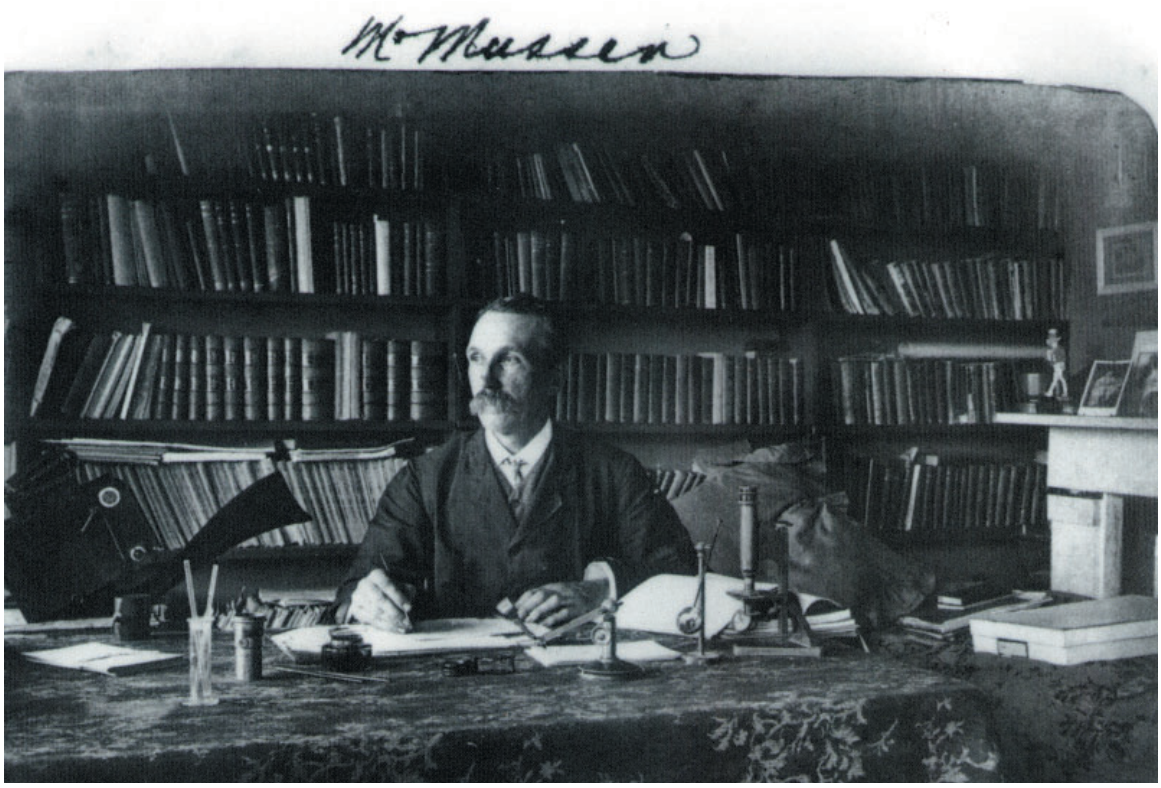

FIGURE 5 Charles Musson at his desk at Hawkesbury Agricultural College Richmond. Note the white herbarium boxes with black metal label holders on the right – these were still in use at the National Herbarium of N.S.W. until replaced with plastic boxes in 1982. (Source: Peter Lister).

Emma if he could do something with her husband's notes. Musson incorporated his own field observations and the resulting publication (Musson and Fletcher 1927) established that *Grevillea gaudichaudii* (as originally described by botanist Robert Brown in 1830), was actually a hybrid of *Grevillea acanthifolia* X *Grevillea laurifolia*. The characteristic plants of the hybrid growing to the present day on the edges of swamps on the Newnes Plateau, in intermediate microhabitats between the swamp inhabited by *Grevillea acanthifolia* and the dry woodland with *Grevillea laurifolia,* are always of interest to botanical enthusiasts (and reminds professional botanists that even Robert Brown, 'Jupiter botanicus' as he was described in his lifetime (Mabberley 1985) could make mistakes), though Brown would not have seen the plants in the field.

Near the end of his life Musson wrote a series of articles intended for a proposed *Introduction to the botany of N.S.W*. These, subsequently collected together in the HAC library and now reprinted (Lister 2017), provide an insight into botanical thinking of his time. Although the loss of species associated with land clearing was deplored, there was no consideration given to the idea of protecting areas for wildlife conservation. That was left to the bushwalking and conservation activists of the next generation.

The networks of the Linnean Society of N.S.W. and other learned societies allowed members with scientific interests, such as Charles Musson, to collaborate across disciplines: in botany, microbiology, pathology and zoology as well as history and education. Musson's colleagues for example also included Charles Hedley (on molluscs) and Sir John B. Cleland (pathologist and microbiologist). They also enabled valuable collaborations between amateur naturalists and professionals, but later as public institutions became more formal and professional, the role of the amateur became less important.

Walter Mervyn Carne, Musson's successor at HAC, was interested in the impact of geology on the distribution of species and plant communities. His attention was drawn to an interesting area of vegetation on limestone near Kurrajong (Carne 1910). Plant species lists for that site have been recorded on a number of subsequent visits documenting changes (Benson 2012). Currently (2019) the site is potentially threatened by the proposed Castlereagh Connection motorway corridor route from Castlereagh to Bells Line of Road at Kurrajong. At about the same time W.M. Carne's father **Joseph Carne** published his extensive geological surveys of the volcanic sites of the western Blue Mountains (Carne 1908). He was commemorated in the 1970s by the renaming of the eastern branch of the Wolgan River on the Newnes Plateau as Carne Creek.

The 20th century- national focus, public service science and herbaria

Most Australian capital cities set up botanic gardens early in their history, but for most of the 19th century these were mainly involved in importing seed and material of (exotic) overseas species and distributing or growing/acclimatising these, as well as sending Australian plant material overseas (especially for European gardens). Research on the Australian flora was mainly confined to sending Australian specimens to overseas herbaria. At the Sydney Botanic Garden, director Charles Moore (Director from 1848 to 1896), *in view of rendering the Public Herbarium of indigenous plants as complete as possible* travelled along Bells line of Road as far as *Mt Thomar* (sic), to collect *flowering plants and seeds* (according to Wilson 2004). He published *A Census of the Plants of New South Wales* (1884) and a *Handbook of the Flora of New South Wales* (with Ernst Betche in1893), but the next director **Joseph Henry Maiden** (1859-1925) found *a very poor herbarium* (Wilson 2004). Maiden established local collections and serious research programs and could be regarded as the first publicly-funded professional botanical research scientist in N.S.W. He had developed his botanical interests at the N.S.W. Technological Museum (later the Museum of Applied Arts and Sciences and then the Powerhouse Museum) (Gilbert 2001) where, inter alia, he used the collections to write *The Useful Native Plants of Australia* (Maiden 1889) (Fig. 6). A proud tradition of botanical research concentrated on essential oils was continued at the MAAS until the 1980s when the plant collections were transferred to the National Herbarium of NSW. In 1901, following his appointment as Director of the Sydney Botanic Gardens, Maiden opened a new Botanical Museum and National Herbarium building (known as the National Herbarium of New South Wales) in the Sydney Gardens. (As part of the 1970s injection of funding into science, this building was replaced by a new larger herbarium building in 1982, but the herbarium is now to be relocated from central Sydney out to the Australian Botanic Garden at Mount Annan in 2022).

From the end of the 19th century, enquirers sent plant specimens to the Sydney Gardens for identification, and for adding to the National Herbarium of N.S.W. institutional collections. A strong culture of public service science developed, enhanced by the Herbarium's position as part of the

FIGURE 6 *Actinotus helianthi* illustration from Maiden's 1895 Flowering Plants and Ferns. Such lavish colour illustrations, made possible with departmental funding, were not to be readily achieved again until the digital era. (Source: author)

N.S.W. Department of Agriculture, which already had a strong role in promoting science for general public good. Maiden (who remained as Director from 1896-1924) was also responsible for a serious program of extensive botanical research and collecting. He called for a botanical survey of N.S.W. and sent out collecting staff and received specimens from correspondents all over N.S.W., as well as collecting widely himself in N.S.W. and other States. He had wide research interests, particularly in eucalypts, which took him all around the state, and in the history of botany in Australia. He had many contacts through the Linnean and Royal Societies of NSW and nationally through the *Australian and New Zealand Association for the Advancement of Science* (ANZAAS), and he published extensively in local journals, for example, with R.H. Cambage (Maiden and Cambage (1905).

Botanical collecting using access from the Western Railway Line and Bells Line of Road continued into the 20th century, extending onto the sandstone of the Newnes Plateau north of Lithgow where a number of endemic plant species and vegetation communities occur. In 1906 **Henry Deane**, railway engineer and botanist, and a Linnean Society colleague of Maiden, while working on the Wolgan Valley shale railway found and described the now threatened *Boronia deanei* in swamps near Clarence on the Newnes Plateau. Deane published a number of papers on eucalypts with Maiden and was president of the Linnean Society in 1896.

Botanists from the National Herbarium of N.S.W. contributing further to the exploration of the Newnes Plateau area in the early 20th century included Joseph Maiden (eucalypts, history) and **William F. Blakely (**1875-1941) (collecting Fabaceae such as *Pultenaea*, and the endemic *Leptospermum blakelyi*) (Fig. 7). Later, **Ernest Constable** (1903-1986) explored the area after his appointment as botanical collector in 1946. Access was generally along the by-then disused old Wolgan Valley shale railway, or the Old Bells Road. The Great Depression and its aftermath in the 1930s and World War II led to reduced funding for public institutions which limited activity to herbarium specimen-based research.

A later enthusiastic local plant collector was **Keith Ingram (**1912-2002), school teacher and later local resident of Mt Tomah and then Richmond, who amassed a considerable personal herbarium

FIGURE 7 W. F. Blakely, Botanist and Eucalyptologist, botanised on the Newnes Plateau in the 1930s and discovered *Leptospermum blakelyi* near Lithgow. (Source: National Herbarium of NSW).

collection of plant species (37 000 specimens later donated to the National Herbarium of N.S.W.). He collected widely across all states and territories and is honoured by the naming of *Acacia ingramii* and *Bertya ingramii* from the Northern Tablelands and *Zieria ingramii* from near Dubbo in the Central Western Slopes. His interest in rare plants included unsuccessful searches along Bells Line of Road between Bell and Mt Tomah for *Asterolasia buxifolia* (previously only known from an 1835 specimen labelled *Bell's Road Blue Mountains*) (Keith Ingram and P.G. Wilson, pers. comm. 2000). The species was subsequently rediscovered in Hyde Park Reserve at Hartley by R.O. Makinson (Makinson and Benson in prep. 2019).

University of Sydney contributions to botanical research: Mt Wilson and the first ecological studies

At the University of Sydney **Professor Abercrombie Anstruther Lawson** (1870-1927) (Fig. 8), foundation professor of botany from 1913 to 1927 and member of the Linnean Societies of both London and N.S.W., emphasized the importance of field excursions as a teaching technique. He established a teaching herbarium named in honour of botanist John Ray (1627-1705) and provided his own collections as well as specimens collected during various research enterprises (Rayner and Quinnell 2016). Among the holdings there are a number of significant historical collections including about 1500 specimens collected by R.H. Cambage (some of which are likely to have been collected during his time with Woolls), and a set of A.H.S. Lucas' algal collection.

In April 1916, Professor Lawson privately purchased land at Mt Wilson (about 60 acres) from George Valder senior. This aroused his enthusiasm for the diversity of vegetation at Mt Wilson and its outstanding contrasts of geology and vegetation. He formally introduced the newly developing discipline of ecology into the teaching programme and encouraged his staff and the Sydney University Botanical Society (i.e. botany students) to undertake field studies at Mt Wilson. Members of the Botany Department came to Mt Wilson and stayed at *Dennarque* (or *Wildflower Hall* as it was called at that time) and *Campanella*, another guest house, and carried out extensive plant surveys (Mt Wilson and Mt Irvine Historical Society 2006). In the first of three papers Brough et al. (1924) wrote that *the study of Plant Ecology has developed rapidly overseas (in Britain, United States and on the Continent) but little has been carried out so far in N.S.W. despite the innumerable fascinating and important problems awaiting solutions*. A considerable body of material from the surveys was published in three papers in the *Journal and Proceedings of the Linnean Society of N.S.W.* (Brough, McLuckie and Petrie 1924; Petrie 1925; McLuckie and Petrie 1926). Patrick Brough and John McLuckie were lecturers and

FIGURE 8 Professor Abercrombie Lawson, instigator of Sydney University's landmark ecological studies at Mt Wilson, dressed ready for fieldwork. (Source: Sydney University).

Arthur Petrie was a recent graduate whose father had been Linnean Society Macleay Research Fellow. The publications include descriptions of the vegetation on the basalt and sandstone, fire impacts and exotic roadside weeds (Fig. 9). These studies were the first ecological studies to be carried out in N.S.W., the first to look seriously at fire as an ecological issue, and probably the first ecological study of any kind to have been carried out in Australia. Specimens collected by the Mt Wilson researchers held at the John Ray Herbarium (R.Carolin pers comm. 2019), together with Lawson's lantern slides from the Macleay Museum (Rayner and Quinnell 2016) which include a slide of a tree fern *Cyathea australis* that looks to be taken at Mt Wilson, are significant items for the history of ecology in N.S.W.

The John Ray Herbarium also holds collections by its sometime curator and assistant to Lawson, Obed Evans, and by Noel Beadle, who were both major contributors to the first edition of the classic *Flora of the Sydney Region*, (Beadle, Evans and Carolin 1963). This publication made comprehensive botanical field identification accessible for the first time, and has been a major impetus for conservation, particularly in its subsequent revised editions.

Sydney University advances descriptive ecology and botanical education in the 1930s

Lawson died in 1927, but by the early 1930s descriptive ecology was considered a serious university subject. Ecological work begun by him was continued through a series of major studies throughout the state by students, many of whom were women. These studies included the coastal sand dunes of Myall Lakes by Rutherford Robertson in 1934, rainforest and eucalypt forest at Barrington Tops by Lilian Fraser and Joyce Vickery in 1936-37, and the Bulli-Illawarra escarpment vegetation by Consett Davis in 1938.

Eric Ashby at Sydney University 1938-1946

Eric Ashby, later Lord Ashby (1904-1992) and master of Clare College and vice-chancellor of Cambridge University, was appointed professor of botany at Sydney University in 1938 when only 33. Born in Essex and having held lectureships at Imperial College London, Chicago and Bristol, the charismatic Ashby imbued his students with the philosophy of science and rigorous scientific methods. He was enthusiastic about Australian plants and how research could address poor land management practices. He continued Lawson's work and under his influence, Ilma Pidgeon researched sandstone and shale vegetation in the Sydney area from 1937 to 1941 and disturbed plant associations, particularly on mined and overgrazed areas around Broken Hill in western N.S.W. The Mt Wilson researchers Patrick Brough and John McLuckie developed a botany teaching resource known then as '*A key to some of the plants of the Sydney Region'*, later expanded and published by Noel Beadle, Obed Evans and Roger Carolin, with substantial assistance from the National Herbarium of N.S.W., as *Handbook of the Vascular Plants of the Sydney District and Blue Mountains* (Beadle, Evans and Carolin 1963). Subsequently, revised editions have become the classic Sydney plant identification handbook *Flora of the Sydney Region* (Beadle et al. 1972 to Pellow et al. 2009).

Ashby supported education at all levels. As noted in his foreword to Gladys Carey's (1941) *Botany by observation - a textbook for Australian schools* Ashby believed the whole purpose of teaching botany at school was defeated if it didn't give children an appreciation and enthusiasm for their own environment. This he considered to be common sense not narrow provincialism (King 2015). John McLuckie went on to write a botany text relevant to Australia and New Zealand (McLuckie and McKee 1954).

Post World War II – baby boomers, public science and the discovery of biodiversity, and that it is threatened

By the mid 20th century research had passed almost completely from the Gentlemen Naturalists to professionals associated with research institutions, though these had limited funding during the previous two decades dominated by the Great Depression and World War II. Linnean Society of N.S.W. publications in 1950 included only two authors who did not have an institutional affiliation as indicated by their addresses (Augee 2010).

The 1970s brought an increasing interest in the Australian flora by the baby boomer generation (i.e. those born between 1945 and 1960) and increased resources for biological research and publicly funded science. The Australian Biological Resources Study (ABRS) set up by the Whitlam Labor Government provided resources to public institutions across Australia including the National Herbarium of N.S.W. for systematic flora studies, and later for vegetation survey and mapping. Comprehensive identification publications such as the *Flora of Australia* were begun, while the establishment in 1968 of the N.S.W. National Parks and Wildlife Service recognised the need to protect and manage land for nature conservation.

FIGURE 9 Plate from the Sydney University ecological study of Mt Wilson published in 1924 in the Proceedings of the Linnean Society of N.S.W. showing contrasting aspects of the rainforest and eucalypt forest. Though limited by the poor photographic reproduction of the time these are some of the earliest photos to specifically illustrate ecological issues. (Source: Linnean Society of NSW).

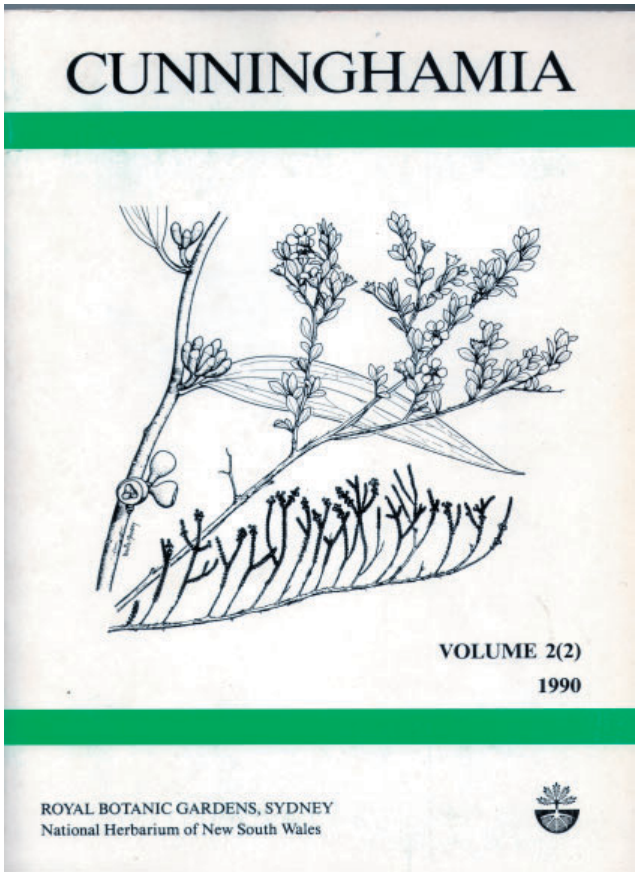

FIGURE 10 Journals produced by the National Herbarium of N.S.W. in response to the scientific discoveries of the mid to late 20th century were the *Contributions* (later to become *Telopea*) and *Cunninghamia*: a journal of plant ecology for Eastern Australia. *Cunninghamia* was launched at the 1981 International Botanical Congress in Sydney. The 1990 cover (*Cunninghamia* vol 2 no 2) illustrated three rare plants from the Newnes Plateau– *Eucalyptus gregsoniana* (left), *Leptospermum blakelyi* (centre) and an unusual prostrate form of *Micromyrtus sessilis* (lower). (Source: National Herbarium of NSW).

The Rare or Threatened Australian Plants listing (ROTAP) was established to draw attention to the vulnerability of rare or threatened species (Leigh, Briggs and Hartley 1981), to be followed by the N.S.W. *Threatened Species Conservation Act* in 1995 (now replaced by the current N.S.W. *Biodiversity Conservation Act 2016*).

New and more specialised national biological societies were established, including the Ecological Society of Australia and the Australian Systematic Botany Society, with their own national publishing outlets. These and the journals published by CSIRO led to fewer publications from the old state-based and broader learned societies. The house journals of institutions also increased their publications and readership output, including *Telopea: a journal of plant systematics* and *Cunninghamia: a journal of plant ecology for eastern Australia* from the National Herbarium of N.S.W., and various technical reports and monographs from the Australian Museum (Fig. 10).

With money for trained staff and field work, and four-wheel drive vehicles allowing access to more difficult areas, there was an increase in plant collecting, description and ecology. Interesting plant collection sites from earlier in the century were now revisited and explored further. The Newnes State Forest had been the site of a number of earlier collections by Gregson (unusual mallee eucalypts), Deane (*Boronia deanei* – Fig.11) and Blakely (*Leptospermum* and *Dillwynia* species). Access to the area now known as the Newnes Plateau was along the old Bells Line of Road, and the old Wolgan Valley railway route and various forestry tracks.

FIGURE 11 *Boronia deanei,* first collected by Henry Deane in 1906 near Clarence, was not subsequently seen until 1978, when its rediscovery during vegetation survey work was greeted enthusiastically by Botanic Gardens ecology assistant Helen Bryant. At that time scientific publications were still limited to black and white illustrations. *Boronia deanei* is now endangered as a result of longwall coalmining causing drying out of its restricted swamp habitat, (Source: author).

Collecting trips and research projects were undertaken by a number of botanists from the National Herbarium of N.S.W. including Lawrence Johnson (mallee eucalypts, Proteaceae), Tony Rodd (rainforest and general collecting), Peter Hind (general collecting, rare plants) Peter Weston (*Persoonia* systematics) and Doug Benson (vegetation mapping (Benson and Keith 1990); rare plants and environmental impact assessment).

Peter Hind, for example, spent considerable time collecting on the Newnes Plateau, much of it in his own time. In describing *Prostanthera hindii* (Hind was a joint collector of the type material), Conn (1997) stated that '*the specific epithet acknowledges the considerable contribution that Mr Peter Hind (NSW) has made to our understanding of the flora of Australia, and in particular of the Newnes Plateau of the Wollemi National Park*.' Similarly, Weston and Johnson (1997) named *Persoonia hindii* for Peter Hind '*who first collected this species*.'

The 1970s also brought major environmental threats to the area. Proposals by the N.S.W. Electricity Commission in 1978 to dam the Colo River and construct a power station at Birds Rock on the Newnes Plateau were met with fierce public opposition. One benefit was that newly required environmental impact surveys provided some basic data on the poorly known area. The threatened dam was stopped by the declaration of Wollemi National Park in 1979, but the power station proposal was replaced by the proposed Birds Rock Colliery with associated coal washery and a rail link to the main western railway line (Birds Rock Colliery 1981a,b). Botanical surveys of the proposed site by the Royal Botanic Gardens Sydney highlighted the importance of the Newnes Plateau shrub swamps, some of which were directly impacted by the colliery infrastructure and rail line (D. Benson appendices in Birds Rock Colliery 1981a,b). A public inquiry approved the colliery development but subsequently changing economic conditions prevented its establishment. Coal mining under the Newnes Plateau is now being done by longwall mine extraction from collieries on the margins of the plateau, and is now threatening the swamps through water loss by subsidence impacts (Benson and Baird 2012).

Interest in biodiversity of small, delicate and rare organisms in the late 20th century led to work on bryophytes and fungi, particularly by Macquarie University School of Biological Sciences; e.g. bryophytes of Mt Tomah (Ramsay et al. 1990); bryophytes at Mt Wilson, Mt Banks and Mt Tomah (Downing et al. 2007); fungi at Mt Wilson (Alec Wood and the Sydney Fungal Studies Group). Interest in swamps has led to a number of pollen studies at Mountain Lagoon and Newnes Plateau (e.g. Robbie and Martin 2007), and exploration of fire histories, e.g. at Gooches Crater (Black, Mooney and Attenbrow 2008).

Geomorphology studies by Macquarie University have included one on landform erosion associated with lyrebirds at Calcined Knoll at Bell (Adamson, Selkirk and Mitchell 1983) and studies on the Newnes Plateau, including recognition of Last Glacial maximum sand dunes with implications for past climates (Hesse et al. 2003) and unusual heath/geomorphology relations (Wilkinson and Humphreys 2006). Since 2000 increasing attention has been directed to the geological diversity and importance of the sandstone pagoda country of the Newnes Plateau (Washington and Wray 2011), currently proposed for National Heritage Listing (Washington and Wray 2015).

The Wollemi Pine and World Heritage Listing

The ongoing contribution of enthusiast bushwalkers and their exploration of hitherto inaccessible country resulted in the exciting discovery of the Wollemi Pine *Wollemia nobilis* in 1994. The discovery received wide international attention. *Wollemia* is a genus of coniferous tree in the family Araucariaceae known only through fossil records until the living species *Wollemia nobilis* was discovered in a remote series of narrow, steep-sided sandstone gorges in a wilderness area of Wollemi National Park, north of Bells Line of Road. The discoverer, David Noble, a National Parks field officer with adventurous bushwalking and rock climbing abilities, and good botanical knowledge, quickly recognised the trees as unusual and worthy of further investigation. Generating considerable research interest, the species was described jointly by N.S.W. National Parks and Royal Botanic Gardens botanists and named to honour both its discoverer and the tree's stature (Jones et al. 1995).

The Greater Blue Mountains including Wollemi and Blue Mountains National Parks, was inscribed on the World Heritage list in 2000 for its outstanding biodiversity, particularly in terms of the richness of eucalypt diversity (almost 100 species – Hager and Benson 2010). About 1 million hectares are now protected in the Greater Blue Mountains World Heritage Area. This happened after decades of public pressure (Colley and Gold (2004), but the listing was dependent on the strong scientific case for its success. The extensive body of research publications and biodiversity collection data relating to Bells Line

of Road and the Newnes Plateau area (highlighted by the Wollemi Pine in the Wollemi National Park farther north) provided a substantial part of the case for listing the Greater Blue Mountains as a World Heritage Area. The assessment report by botanist Teresa James (1994) included chapters on sclerophyll ecosystems by James and Phillip Kodela, and on rainforests by Gwen Harden.

Unfortunately, much of the Newnes Plateau, a key destination of the *Botanists Way*, was not included in that listing (as it was, and remains, part of Newnes State Forest rather than national park), and significant vegetation (montane swamps and mires, and rare species) remains threatened, particularly by subsidence from longwall coal mining. By 2017 several important listed swamps had been impacted by subsidence, evident in piezometer data and visible in dying vegetation and lack of groundwater, and unlikely to recover (Young 2017). Since the first plans to mine the area in the 1980s a vigorous community-based campaign for protection of the Gardens of Stone Stage 2, covering much of this area has been waged by conservation groups, particularly the Colong Foundation, and the final outcome for the long-term management of the area is still in doubt in 2019. Future decisions on its conservation and management will be an important part of the ongoing Botanists Way story.

DISCUSSION

Evaluation of the *Botanists Way*

Is the botanical history of the area promoted as the *Botanists Way* unique? Did botanical exploration happen similarly along other geographical corridors radiating from Sydney? What about the Western Road (now Great Western Highway) across the Blue Mountains, or the roads to the Illawarra (Princes Highway) or to Goulburn (Hume Highway), or the road to the coast north of Newcastle (Pacific Highway)? At this stage no similar case has been made for any of these areas. Perhaps the geology along the Bells Line of Road was important - the ridge is relatively narrow with few easy deviations except for the basalt-capped mountains. Early botanical visitors were attracted to the rainforest vegetation, the easily accessible shale areas around Kurrajong, and later the basalt caps of Mt Tomah and Mt Wilson with their red soils, rainforests and ferns. These mounts are not as prominent or easily accessible from the Western Road, though similar basalt country does occur in the Southern Highlands (Mittagong to Robertson). These areas were attractive places, in a cool climate, and the wealthy in Sydney set up country retreats with attractive European-style gardens, yet overlooking the rugged Australian sandstone country beyond. As a result the Bells Line of Road may have attracted a higher proportion of botanically interested people, with the time to explore, collect plants seriously and correspond with experts. Because of its relative inaccessibility generally needing four-wheel drive access, the Newnes Plateau with its interesting plant species and the highest altitude sandstone landscape in the Blue Mountains attracted botanical interest later than the Western Road at Katoomba or Blackheath.

The *Botanists Way* route is now mostly through national parks (Blue Mountains and Wollemi) and its natural landscape is relatively little disturbed. It has not been heavily overlaid by development, unlike the Western Road which, though passing through national park, carries the history and impacts of the first crossing of the Blue Mountains (the Bicentenary was celebrated in 2013), the development of the Blue Mountains towns, the building of the railway to the interior, and the subsequent impacts of tourism and recreation. Bells Line of Road has been primarily a narrow transport corridor, but there are likely to be further impacts in the near future. Currently (2019) the proposed Castlereagh Connection motorway corridor route from Castlereagh to Bells Line of Road at Kurrajong potentially threatens significant remnant rainforest vegetation at Grose Vale, and future motorway upgrading along Bells Line of Road is likely to impact World Heritage listed vegetation and impose a substantial barrier on north-south faunal migration and movement. An increase in wildlife road-kills is likely to result from increased traffic in the short term, while widening of the road will reduce genetic connectivity in the longer term unless provision is made for faunal crossings.

The Way forward

As originally promoted by the Blue Mountains Botanic Garden, the *Botanists Way* concept referred to a relatively narrow geographical corridor between Kurrajong and Mt Tomah. However, the rich biodiversity of the surrounding area and its associated botanical history as discussed above justify expanding the concept to include reference to the Newnes Plateau (Glow-worm Tunnel Road), as well as Chifley Road west to Lithgow (although that road was only completed to Lithgow during World War II). At the eastern end botanical connections can be extended to Richmond and Windsor.

The historical reach of the concept should also be expanded. The original focus on the early 19th century botanists should be enlarged to include the late 19th

century scientific connections, and the importance of the Linnean Society of N.S.W. publications, as well as 20th century botanical exploration and ecological research, the funding of public-good science, and the impact that this has had on conservation biology research and nature conservation in the present time.

There is a growing demand for 'nature tourism', and biodiversity and landscape research should underpin responses. 'Nature tourism' was important in the late 19th century, it is not something new, even if it was in relative decline for much of the 20th century. The natural landscape elements along the *Botanists Way* that attracted botanical interest over nearly two centuries, and the use of botany to explore and interpret the environment, can be successful from a range of perspectives, not only the plants and sites themselves, but to explain the science of systematic biology and the underlying basis of evolution. Interpretation can also be enriched by highlighting the (still surviving) use of Latin in the modern world, and the often obscure meanings of the Greek and Latin derived plant names, or the persons honoured (e.g. see Table 1). Botanical art and biography are important cultural history elements (e.g. Louisa Atkinson's illustrations). Authenticity accentuated through tangible connections to plants and places can stimulate and enrich educational and visitor experiences. Such demands have led to the recent development of university studies bringing together botanical art and history such as at the University of Newcastle's School of Creative Industries.

All this provides a rich palette of interconnecting material for organisations interested in landscape and biodiversity interpretation, such as the Blue Mountains Botanic Garden, National Parks and Wildlife Service, the Greater Blue Mountains World Heritage Area, the National Trust of Australia, Western Sydney University, Blue Mountains City Council and Hawkesbury City Council. The area provides considerable scope for both botanical scientific research and biographical studies. Note the recent interest in Hassans Walls Reserve, Lithgow, its history (Painter 2017) and its botany (Lollback et al. 2014), the latter a cooperative project with serious enthusiast naturalists, a photographer and a professional plant collector. Botanical exploration continues.

Future Ways for Botanical Research

Though the *Botanists Way* of this story is focused on a limited geographic area, similar scientific activities and trends (the initial colonial botanical exploration, the later 19th century Gentlemen Naturalists and learned societies, leading to the 20th century publicly-supported research institutions and professional conservation management) were also happening interstate, largely paralleled in and around Melbourne, Brisbane, Perth, etc. It is important to recognise that public-good science in largely government-funded institutions, is a relatively recent development that has been particularly successful and influential in the last 50 years (i.e. essentially in the lifetimes of current researchers). Despite recognition of its obvious successes it is not necessarily a permanent feature of our culture and remains vulnerable to the prevailing political climate. The interest in biodiversity, the recognition of threats such as rainforest clearing and urban expansion, and the need for better conservation measures generated public attention at all levels in the 1960s and 70s. Robertson (1974) related higher levels of science teaching in schools to an increased community awareness in science at that time.

However, the subsequent achievement of major conservation aims in the 1980s and 90s (such as cessation of rainforest logging in N.S.W., the formalisation of wilderness areas, and legislation for environmental protection and threatened species) are mainly dependent on public funding for on-going governance and management. Enactment of legislation may have given the public assurances that environmental and conservation issues are now being appropriately dealt with, but this is not necessarily the case. Decreased public attention provides opportunities to reduce funding commitments and weaken protection legislation (indeed we have retreated a long way from the high point of the 1990s). Publicity for big issues such as climate change also draws attention away from local conservation funding needs.

The 21st century is bringing further changes. While the formal professionalism and support for publicly-funded biological science has reduced the need for inputs from amateur naturalists and enthusiasts (i.e. the equivalent of the Gentleman Naturalist), such people (often professionals in related fields) still exist and make important contributions, for example, in the exploration of remote areas (the discovery of new species such as the Wollemi Pine stands out), or by observations on ecology and geographic ranges of small, generally economically unimportant and less studied taxa such as bryophytes, fungi, lichens and invertebrate taxa. Opportunistic research by enthusiasts can draw attention to and kickstart

Table 1 (next page). Plant species and landscape features honouring or discovered by botanists associated with the Botanists Way. All species are found in the Botanist Way area except *Acacia carneorum*.

Plant species	**Name**	**Notes**
Acacia carneorum Maiden	Joseph Carne and Walter Mervyn Carne	Western N.S.W. shrub species honouring both the Carnes. The Latin ending is genitive plural meaning *of the Carnes*
Acacia maidenii F. Muell.	Joseph Henry Maiden	Large wattle of forest environments
Alania endlicheri Kunth	Allan Cunningham	Small, cliff-dwelling lily essentially confined to the higher Blue Mountains
Atkinsonia ligustrina (Cunn. ex F. Muell.) F. Muell.	Caroline Louisa Atkinson	Interesting shrub mistletoe that parasitises the roots of other plants
Blechnum gregsonii (Watts) Tind.	Jesse Gregson	Cool rainforest fern
Boronia deanei Maiden and Betche	Henry Deane	Rare Newnes Plateau swamp shrub found by Deane
Dictymia brownii	Robert Brown	Epiphytic rainforest fern
Eucalyptus baeuerlenii F. Muell.	Wilhelm Baeuerlen	Small tree on cliff ledges, Upper Blue Mountains
Eucalyptus bensonii L.A.S. Johnson and K.D. Hill	Douglas Benson	Rare mallee from northern Wollemi found by Benson
Eucalyptus cunninghamii G. Don	Allan Cunningham	Rare mallee, Mt Banks
Eucalyptus deanei Maiden	Henry Deane	Tall tree on shale caps and in deep sandstone gorges.
Eucalyptus gregsoniana L.A.S. Johnson and Blaxell	Jesse Gregson and Edward Gregson	Rare Newnes Plateau mallee from honouring the Gregsons
Hakea constablei L.A.S Johnson	Ernest Constable	A prickly shrub in the Mt Wilson-Bell area found by Constable
Isopogon fletcheri F.Muell.	Joseph Fletcher	Rare shrub confined to wet cliffs near Blackheath
Kunzea cambagei Maiden and Betche	Richard H Cambage (1859–1928)	Rare Mt Werong shrub recently reported from the Newnes Plateau
Leptospermum blakelyi Joy Thomps.	William Faris Blakely	Rare Newnes Plateau shrub found by Blakely
Persoonia hindii P.H.Weston and L.A.S. Johnson	Peter Hind	Rare Newnes plateau shrub found by Peter Hind
Viola caleyana G. Don	George Caley	Wet sites, Blue Mtns
Wollemia nobilis Hill Jones	David Noble	Very restricted conifer found in 1994 by Noble
Woollsia pungens (Cav.) F. Muell.	William Woolls	Common shrub in heath / open forest; monotypic genus
Landscape connections		
Browns Ridge	Robert Brown	Grose Vale
Carne Creek	Joseph Carne	Newnes Plateau
du Faurs Rocks	Ecleston Du Faur	Mt Wilson
Mount Banks	Sir Joseph Banks	Upper Grose valley
Mount Caley	George Caley	Upper Grose valley

fields of research on taxa not previously considered mainstream by funding bodies. Enthusiasts can also provide much needed public interest and public support, and is currently being seen in the Citizen Science movement. The potential here was recognised by Robertson in 1974 *...I am glad that I have lived long enough to realise that we need people like Clarke, Waterhouse, Lucas, Copland and others. The reason for the paucity of knowledge of biology and geology in district details in this country, compared with such knowledge in Britain, is that such people are so thin on the ground. The ordinary member here, with his notes and publications, has an important role to play in the establishment of this kind of science.*

The cuts to public-good science in the last decade have been associated with the promotion of the virtues of Citizen Science, often to disguise holes in professional staff. Citizen Science has and will continue to have a major role, but scientists and citizens should be equal partners, rather than the citizens being cheap data-collecting options for a dwindling number of professionals.

The formal publication of a scientific paper with its considered ideas and conclusions, based on an acknowledged body of available data, together with formal review by scientific peers, and long-term availability, remains the bedrock of scientific progress in the biological sciences. Issues in knowledge dissemination through the electronic media include substantial charges for publications and the use of citation indices to evaluate researchers (favouring international over local publications). Opportunities to reduce costs may cause publicly-funded institutions to reduce their role in the science publication process (as they have reduced their role in supporting technical libraries), leaving biodiversity researchers (particularly those doing local biodiversity projects) with limited outlets for peer-reviewed formal publication. The last few years has also seen implementation of policies in publicly-funded institutions that increase dependence on short term grant funding, and often involve reductions in permanent long term employment of scientists and loss of institutional memory. Science is a slow and careful process that builds on the progress of past workers, as the history of the Botanists Way shows.

Particularly on local or regional biodiversity and conservation issues, freely accessible scientific publication needs continued support from scientific societies such as the Ecological Society of Australia and the old learned societies as Martin (2015) indicates for the Linnean Society (though often now with reduced and aging memberships). It cannot be assumed that the huge advances in scientific knowledge relating to biodiversity that have been achieved in the last 60 years (i.e. essentially in the lifetimes of current researchers) will necessarily continue.

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APPENDIX. A chronological listing of the main events associated with the Botanists Way and some of the associated people, their lifespans, roles and areas of interest.

	Name	Lifespan	Role	Area of interest
Colonial botanists sent by Sir Joseph Banks (1743-1820)				
	George Caley	1770-1829	naturalist collector	Richmond to Mt Banks (1804)
	Robert Brown	1773-1858	botanist	Lower Grose River
	Allan Cunningham	1791-1839	botanist, explorer	Followed Hoddle's survey west to Mt Tomah (1823)
19th Century local botanists				
	William W Woolls	1814-1893	Clergyman, school master, botanist	Richmond to Mt Wilson
	Caroline Louisa Waring Atkinson (later Mrs Calvert)	1834-1872	botanist, botanical artist	Kurrajong
Collectors and correspondents, the scientific societies particularly the Linnean Society of N.S.W.				
	Eccleston Du Faur	1832-1915	Lands Dept officer	Grose Valley, Mt Wilson
	Wilhelm Baeuerlen	1845-1917	collector	Grose Valley (1899)
	Jesse Gregson	1837-1919	correspondent	Mt Wilson
	Henry Deane	1847-1924	railway engineer, botanist	Newnes Plateau
	Joseph James Fletcher	1850-1926	teacher, zoologist, botanical collector	collected at Kurrajong (1886)
	Richard Hind Cambage	1859-1928	mining engineer, botanist	botanical history and collecting
	Charles Tucker Musson	1856-1928	botany lecturer Hawkesbury Agricultural College	education, botany
	Walter Mervyn Carne	1885-1952	botany lecturer, Hawkesbury Agricultural College	Grose Vale limestone vegetation
	Edward Gregson	1882-1955	correspondent	Mt Wilson
Nationally focussed botanical research begins				
	Joseph Henry Maiden	1859-1925	botanist, Director, Sydney Botanic Gardens	Kurrajong to Mt Tomah (1890s)

	William Faris Blakely	1875-1941	Botanist, Sydney Botanic Gardens	Upper Blue Mtns, Newnes Plateau
The first significant plant ecology studies in N.S.W. 1920-1925 and continued botanical research				
	Abercrombie Anstruther Lawson	1870-1927	Foundation Professor of Botany, Sydney University	Mt Wilson
	Patrick Brough	1885-?	botany lecturer, Sydney University	Mt Wilson
	John McLuckie	1895-1956	ecologist, botanist, Sydney University	Mt Wilson
	Arthur H.K. Petrie	1904-1942	science graduate Sydney University, later plant physiologist	Mt Wilson
	Eric Ashby	1904-1992	Professor of Botany, Sydney University1938-46	Ecology, education
Post World War II activity				
	Ernest Constable	1903-1986	collector, Royal Botanic Gardens Sydney	Mount Tomah area (1950 to 1967)
	Lawrence A.S. Johnson	1925-1997	botanist, Director Royal Botanic Gardens Sydney	upper Blue Mtns, Newnes Plateau
The 1970s, conservation and science expands				
	Keith Ingram	1912-2002	teacher, plant collector	Mt Tomah
	Donald F. Blaxell	current	botanist, Royal Botanic Gardens Sydney	upper Blue Mtns
	Peter Valder	current	botanist, Sydney University	gardens, Mt Wilson
	Anthony N. Rodd	current	botanist, Royal Botanic Gardens Sydney	upper Blue Mtns
	Douglas Benson	current	plant ecologist, mapping, swamps Royal Botanic Gardens Sydney	upper Blue Mtns, Newnes Plateau swamps
	Peter Hind	current	collector Royal Botanic Gardens Sydney	Newnes Plateau
	Peter H. Weston	current	botanist, Royal Botanic Gardens Sydney	upper Blue Mtns
	Alison Downing	current	botanist Macquarie uni	Mt Wilson ferns and bryophytes
	Patricia Selkirk	current	botanist Macquarie uni	Mt Wilson ferns and bryophytes

The Wollemi Pine discovery and description 1995				
	David Noble	current	bushwalker, ranger	discovered *Wollemia*
	Wyn Jones	current	scientist, ranger	described *Wollemia*
	Jan Allen	current	Blue Mtns Botanic Garden	described *Wollemia*
	Kenneth D. Hill	1948-2010	taxonomist, Royal Botanic Gardens Sydney	described *Wollemia*
Listing of the Greater Blue Mountains World Heritage Area 2000				
	Teresa James	current	botanist, Royal Botanic Gardens Sydney	World Heritage submission
	Phillip Kodela	current	botanist, Royal Botanic Gardens Sydney	World Heritage submission
	Tim Hager	current	botanist, NPand WS	World Heritage submission