



Botany and science at Adelaide's Botanic Gardens since the founding of the State Herbarium

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Abstract: Historically, science at Adelaide's Botanic Gardens has generally been taken to equate with the work of the State Herbarium of South Australia, from the time it was founded in 1954. But as gradual progress was made towards ensuring the viability of the Herbarium and its work in developing knowledge of South Australia's wild flora, other areas of investigation were also being pursued at the Botanic Gardens. These included techniques for propagating plants (especially Australian species new to horticulture), germination studies and investigation of diseases in ornamental plants. A capability in plant pathology was developed with the appointment of a Senior Research Officer in ornamental horticulture. With increasing emphasis on reliable and current identification of the plants growing in the Garden collections and displays, a Herbarium of Cultivated Plants was established, and in time qualified staff were appointed. These early developments led to several decades of gradually expanding and diversifying botanical and scientific activity, complementing that of the State Herbarium, though generally on a much smaller scale. An overview of the principal lines of investigation that waxed and waned over that period to the present, as the organisation evolved in response to local, national and global influences, is presented. Current and future trends in scientific programs are considered and a selected bibliography is provided.

Keywords: Botanic gardens, science, history, horticultural taxonomy, conservation biology, plant pathology, seed biology

Introduction

In a program of revitalising and diversifying the activities of Adelaide's Botanic Garden on his appointment as Director in 1948, Noel Lothian saw the re-establishment of a botanical and horticultural library and, more particularly, of a herbarium, as key elements in securing a scientific role for the institution (Bonython & Lothian 1950). Books were repatriated from the State Library to the Botanic Garden and an active program of acquisition of new titles, both books and journals, was commenced. With support from representatives of relevant organisations such as the University of Adelaide, the Waite Agricultural Research Institute and the South Australian Museum, a proposal for the establishment of the first State Herbarium formally funded by the South Australian Government was developed. In making their case, the Board and Director observed (Bonython & Lothian 1953):

Since the death of J.M. Black (who was considered as the unofficial State Botanist) no one central clearing house for botanical matters has been available to local, interstate and overseas botanists relating to South Australian material [...]

The fledgling State Herbarium was eventually established at the Botanic Garden at the end of 1954,

with the relocation and consolidation of herbarium collections from various institutions (Bonython & Lothian 1955a, b). Soon after, a scientifically qualified Keeper with expertise in plant systematics was appointed (Bonython & Lothian 1956) and the State Herbarium became the focal point for scientific activity at the Botanic Garden. As its viability and effectiveness as a centre for study of South Australia's wild flora gradually progressed and with knowledge of the State's flora still undergoing relatively rapid development, its outlook in scope of work and professional links were inevitably external rather than internal. Since that time and even until quite recently (e.g. Aitken 2006: 70–71) scientific research within the broader organisation has often been equated more or less entirely with the activities of the State Herbarium. Lothian, however, had a keen appreciation of the value of a sound knowledge-base in underpinning the horticultural and educational roles of the Garden and also developed the organisation's technical and scientific capacity in other areas. These related more directly to the garden plantings, such as in plant disease and garden plant identification (e.g. see Peters & Lothian 1967, 1971), giving rise to a complementary program of science-related activity. While information is available on the history and development of Adelaide Botanic Garden generally (see especially Aitken 2006) and also more specifically of the State Herbarium as a part of the

broader organisation (Kraehenbuehl 1986; Robertson 1986; Barker & Barker 2005), information on the progress and achievements of the parallel program of scientific activity at the Garden has yet to be brought together. This paper seeks to present a brief overview.

The Botanic Garden's first hundred years

When Noel Lothian became Director in 1948, the Adelaide Botanic Garden had been languishing for two decades or more, with the economic constraints resulting from the Great Depression and World War II a major factor. The scope of activities at the Garden was largely limited to presenting landscaped garden and floricultural displays for community enjoyment (Aitken 2006). But that was not always the case.

The first Director, George Francis, was botanically and horticulturally trained at Loddiges Nursery in London and had some years of botanical experience in Britain extending to authorship of several semi-popular botanical works (Francis 1835, 1837, 1839, 1840). He saw the role of the new Botanic Garden as twofold: providing a pleasant refuge for the citizens of the young colony and providing a place where new food, fodder and other plants of potential economic importance, particularly introduced but also native, could be trialled to help establish and improve the productivity of the colony (Robertson 1986). He was instrumental in the formation of an Acclimatisation Society of Adelaide, with which close ties were maintained by the Garden. While Francis sourced and introduced new species and varieties of fruit, crop, fodder and ornamental garden plants and used the Garden to display these, he is also known to have made a particular effort to obtain seed of many wild species. With the latter he established botanically informative displays, in part arranged systematically. Similar roles were common for colonial botanic gardens being established elsewhere in Australia and indeed around the globe and often a colonial botanist responsible for advancing knowledge of the native flora was appointed. Though this was not a particular emphasis in Adelaide during these earliest years of the Garden's existence, the managing committee did at times fund naturalists and others to make collections of native plants from remote areas such as the River Murray region, Kangaroo Island and the northern interior (Lamshed 1955: 35). The praise from Ferdinand Mueller, Government Botanist of Victoria and leading Australian botanist, of the botanical value of these collections was described by Lamshed (1955: 35) as

[...] almost the first public testimony to the value of the Garden as a scientific institution.

In further recognition, a specimen collected on northern Eyre Peninsula and sent by Francis to Melbourne was used by Mueller in naming the new species *Hakea francisiana* F.Muell. after Francis (Mueller 1858). Francis actively acquired books and

literature on botany and horticulture, forming the basis of a library which would be added to as the Garden developed. He produced the first catalogue of the plantings he had established in the new botanic garden, listing 2,800 species (Francis 1859). It is evident that experimentation and the development of plant-related knowledge was an important part of the Garden's activity from its early beginnings.

Succeeding Francis as Director in 1865, Richard Schomburgk brought both botanical and horticultural training and expertise to the role. After travelling to British Guiana on an expedition led by his brother Robert from 1840 to 1844 and publishing an account of their travels – including natural history (Schomburgk 1847–1848) – he emigrated from Prussia to South Australia where he established a farm near the town of Gawler (Aitken 2006: 72). Not long before his appointment, the degree of Doctor of Philosophy had been conferred on him by the German Academy of Science in recognition of his work in botany and natural history (Aitken 2006). The stage seemed set for a continuing and potentially expanding emphasis on science and botany as part of the Garden's role. With the State experiencing a strong and growing economy over several decades, Schomburgk was able to develop the Garden significantly, continuing a focus on economic botany as well as on ornamental and informative displays. Schomburgk published a new catalogue of the significantly increased plantings in the Garden after only five years (Schomburgk 1871), by which time almost 6,000 species were being grown. He built a Museum of Economic Botany, opened in 1881, with displays of wood samples and plant products, but also with provision of space for a herbarium, which grew to a considerable number of specimens over succeeding years (Robertson 1986: 127). He contributed many articles to learned societies in Australia and overseas, especially in horticulture and economic botany, communicated regularly with Mueller in Victoria (Robertson 1986: 123) and received public acknowledgement from George Bentham, author of the *Flora Australiensis*, for sending almost complete sets of specimens from the collections of recent explorers of Central Australia (Bentham 1877). With the garden plantings still expanding during the 1870's, Schomburgk published a further catalogue listing 8,500 species (Schomburgk 1878).

Around this time, a chair in Natural Sciences was created at the newly established University of Adelaide. The appointment of the energetic Professor Ralf Tate to this position readily provided a focal point for expertise on the development of knowledge of the native flora. Whatever possibility there might have been of the Botanic Garden developing a strengthened capacity in study of the native flora, this appointment seems to have shifted the focus for such activity away from the Garden. Perhaps at least partly for this reason, Schomburgk's efforts in furthering plant knowledge were from this time directed almost exclusively at the introduction and trialling of plants of economic

importance. Trial beds were set aside in the garden for testing the new varieties which included strains of rust-resistant wheat and other cereals such as millet and sorghum, fodder plants, almonds and even native *Acacia* species for use in tanning (Lamshed 1955: 52).

When Maurice Holtze succeeded Schomburgk as Director in 1891, he continued and expanded the Garden's role of trialling the introduction of new economic crops, while also maintaining its public botanical and horticultural plantings. Early in his tenure he extended the Library and established a training school in horticulture for youths so that they could join the Garden staff, or seek employment in private gardens as qualified workers (Lamshed 1955: 70, 71). Holtze argued successfully for funds to establish an experimental and type orchard at Mylor in the Adelaide Hills, but after only a few years its role was eclipsed by the establishment of a Government Orchard at nearby Blackwood and soon after an Adelaide Demonstration Orchard adjacent to the Botanic Garden on Hackney Road, neither under the Garden's authority. With the State facing economic difficulties from the mid 1890's – leading to successively reduced annual financial grants from the Government (Lamshed 1955) – it seems events were conspiring to limit the opportunities for the Garden to engage in any scientific or experimental roles. Lamshed (1955: 71) writes:

[...] in 1900 the Director reported that because of the financial position, the efficiency of the institution had been gravely affected and the staff so much reduced that it was impossible to keep the Garden in a creditable condition. Buildings, paths, fences, the water service, library and the scientific sections had suffered 'far more than what was readily allowable.'

As the years progressed there was a consolidation of botanical study as well as a growing herbarium at the steadily developing University of Adelaide, where T.G.B. Osborne was appointed the first Professor of Botany, Vegetable Pathology and Parasitology in 1912. The independent botanist John McConnell Black devoted his time and energy to documenting the native and weedy plants of the State and emerged as the leading authority on the (wild) flora of South Australia. Through his work he had brought together an extensive private herbarium. These factors, together with ongoing economic constraints, especially during the Depression and war years, and perhaps the inclinations of successive Directors John Frederick Bailey (1917–1932) and Harold Greaves (1932–1947), led to a narrowing of the scope of activities at the Garden, with an emphasis on maintaining the perennial plantings, enriched by the provision of attractive floricultural displays. Aitken (2006: 144), writes:

Botany was not Greaves' strong suit. For pragmatic reasons he transferred the Botanic Garden's fine library collection during 1933 to the Public Library of South Australia, retaining just a skeleton of references. Funds were not available to maintain

or significantly upgrade the collection, and its safekeeping within another dedicated government department seemed the best means to care for this important resource. The move, however, did not send out strong signals about the role of research with the Botanic Garden.

Further information on the decline in scientific activity and influence of the Garden is provided by Robertson (1986: 128), writing of Constance Eardley, then Systematic Botanist at the Waite Agricultural Research Institute:

She [Con Eardley] had the full co-operation of Greaves, Director at the Botanic Garden (1932–1947), who assisted her with horticultural enquiries and gave her access to the herbarium amassed by Schomburgk. However, over the years the Schomburgk Herbarium had deteriorated due to lack of proper curation, and in 1940 the specimens that could be salvaged were given to the University for safe-keeping and transferred to the Department of Botany.

These were the circumstances that existed when Noel Lothian (Fig. 1) became Director in 1948, as the State emerged from the post-war years.

The Lothian era

Influenced among other things by two years' experience as a student at the Royal Botanic Gardens Kew, during which time he visited other botanic gardens in Britain and also Europe – all with their rich history of horticulture combined with botanical science – Lothian approached his new role with a broadly-based perspective. His time in establishing a certificate course in horticulture in New Zealand also seems to have had an important bearing on his outlook. He immediately embarked on an innovative program of diversification, in which horticultural experimentation, education, and a role in developing knowledge on the native flora complemented re-invigoration of the garden plantings. He re-established the Garden's botanical and horticultural library, began actively building up its holdings and negotiated staff support. He engaged technical staff, upgraded exhibits in the Museum of Economic Botany and acquired herbarium specimens of South Australian and other plants, in time partly from collecting expeditions he led into often remote parts of the State (e.g. Bonython & Lothian 1950; Finnis & Lothian 1959; an example presented in Fig. 2). These forays were in part to collect seed and other propagating material of native plants; he was actively promoting their wider use in ornamental horticulture. By 1954 he had succeeded in establishing the first State Herbarium for South Australia, with a small but growing staff complement, as a part of the Botanic Gardens organisation (Bonython & Lothian 1955a, b, 1956).



Fig. 1. L to R: Maintenance Worker Roy Haskett, Technical Assistant Ron Hill and Director Noel Lothian, summit of Mt Woodroffe, Musgrave Ranges, S.A. during collecting expedition, June 1958. Photo: Botanic Gardens and State Herbarium.

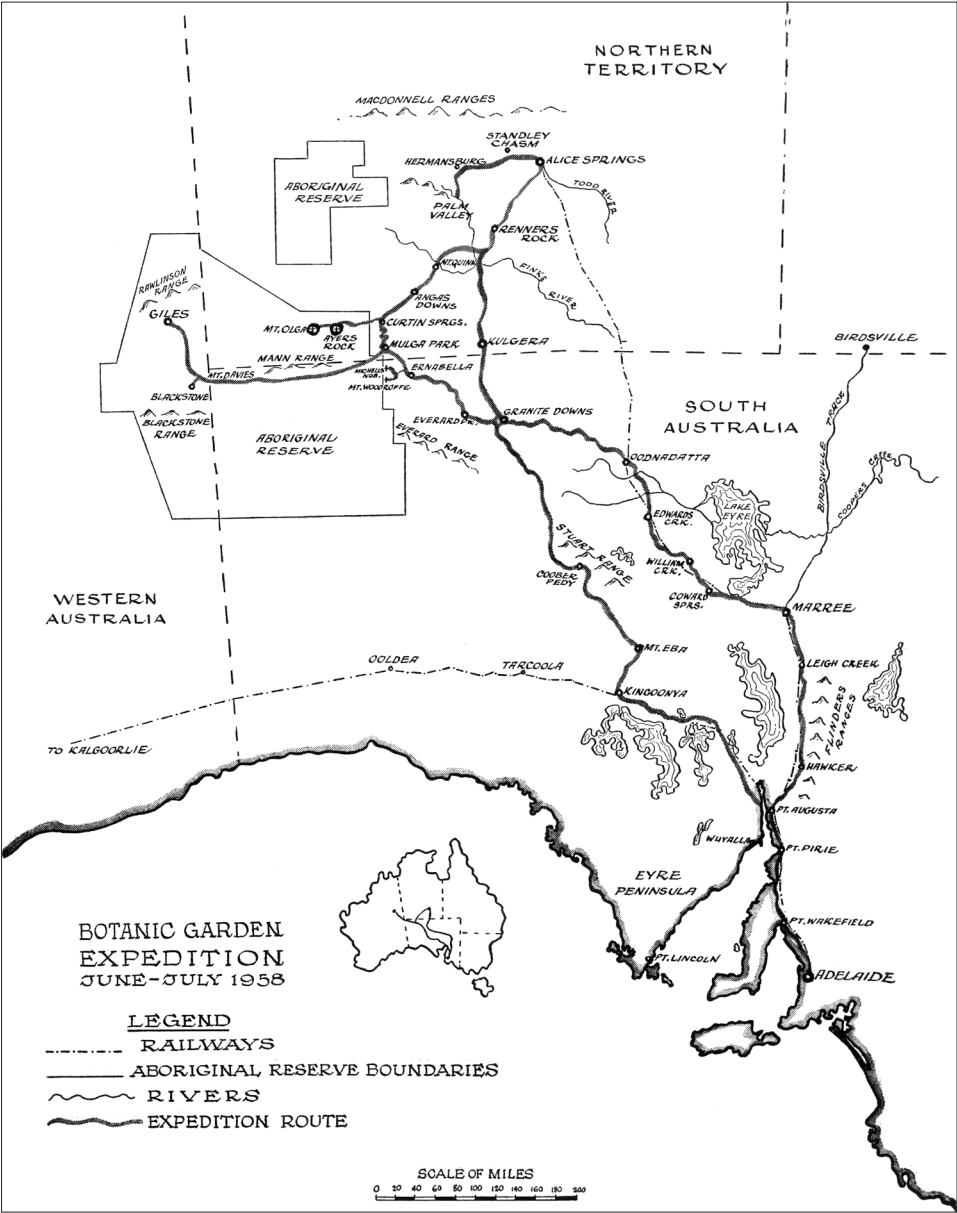


Fig. 2. The 1958 botanical collecting expedition assessing native Australian plants suitable for horticulture (from Finnis & Lothian 1959).



Fig. 3. Tony Whitehill, Tree Advisory Officer 1966–1998, at the Hawker Trial Plantation in 1993. Photo: Botanic Gardens and State Herbarium.

Technical positions to support the garden plantings were created for the first time in 1949/50. By 1952/53 the annual report was referring to a “Technical Department” (Bonython & Lothian 1953):

This now gives two full-time senior technical assistants [in addition to the Technical Officer] and already this arrangement is having its effect by more rapid checking of plants growing in the Garden as well as the determination and identification of plant material, and enquiries by the general public, private organisations and other outside bodies.

Lothian promoted horticultural investigations in a variety of areas, such as techniques for propagating plants (especially Australian species new to horticulture), germination studies, experimentation with mist propagation and propagation media, together with investigation of diseases in ornamental plants (e.g. Bonython & Lothian 1955b: 14; Finnis & Lothian 1960: 18). These were the first steps towards development of a set of scientific and botanical activities of the Botanic Gardens complementary to those of the Herbarium. With elements of an early citizen science initiative, Lothian pioneered connections with regional communities, establishing a series of experimental tree plantations to trial species suitable for use on farms, himself liaising with landowners and councils. Initially

he travelled by train with a knapsack full of seedlings to sites chosen for their proximity to railway stations, with plantations established at Giles Corner near Tarlee (1949) and Lameroo (1953); plantations at Kulpara (1955), Stansbury (1956) and Meningie (1963) followed (see Peters & Lothian 1967: 10–13). Lothian contributed articles to a wide range of horticultural and natural history journals, and continued to do so throughout his 32 years as Director (e.g. Lothian 1956, 1957a–d, 1958a, b, 1959a, b, 1961, 1962, 1963, 1969a, b, 1973, 1978, 1979 & 1980).

In time a substantial Technical and Advisory Section evolved, initially consisting of a technical officer and a technical assistant, later several technical officers led by a senior technical officer. Together they managed plant records, provided advice to the public and produced a series of information leaflets on a variety of horticultural and related subjects. This included a widely used booklet on harmful plants resulting from joint work by Senior Technical Officer Don Francis with medical practitioner Ron Southcott (Francis & Southcott 1967). Under Francis and later Thekla Reichstein (Fig. 4), who held the position for 21 years, staff also contributed articles to horticultural journals (e.g. Christensen 1982, 1993; Christensen & McAlister 1981; Hill 1959) and numerous similar articles over several years (Holiday & Hill 1969; Reichstein 1983; Swinbourne 1968, 1969a, b, 1970, 1986). Tree Advisory Officer for 32 years from 1966 until 1998, Tony Whitehill (Fig. 3) advised local government throughout South Australia on tree planting and management and took on responsibility for the network of rural experimental tree plantations as well as technical communications (e.g. Whitehill 1974). In the early 1980's Whitehill, with then Assistant Director Ed McAlister, expanded the tree plantation network to include sites at Cleve, Hawker, Mount Gambier and Quorn (Bridgland & Morley 1984: 9). As Superintendent from 1965 and then as Assistant Director from 1972, botanist Rex Kuchel contributed to the botanical and applied botanical literature (e.g. Bury *et al.* 1973; Kuchel & Kenny 1969; Kuchel 1973a, b, 1976; Francis & Kuchel 1976) and later became especially active in forensic botany, contributing to the discipline of forensic science (see Scott Young & Lothian 1978: 9) and its literature (e.g. Kuchel 1972).

A capability in plant pathology was established with the appointment of a Senior Research Officer, Ornamental Horticulture in 1969. The new appointee, Elaine Davison (see Davison 1969; Davison & Francki 1969; Crowley *et al.* 1969; Davison *et al.* 2020; Fig. 5) established a laboratory, tested for the occurrence of viruses in the orchid collection using electron microscopy and investigated unexplained plant deaths (especially Proteaceae) at the then new Wittunga Botanic Garden. She immediately proved the value of the position when she made the first detection of the occurrence in South Australia of the introduced root-rot fungus *Phytophthora cinnamomi*, already known from the Jarrah forests of Western Australia (Davison 1970a, b, 1972). Succeeding



Fig. 4. Thekla Reichstein, Senior Technical Officer 1982–2003. Photo: Botanic Gardens and State Herbarium.



Fig. 5. Elaine Davison, Senior Research Officer (Plant Pathology), 1969–1970. Photo: Peter Davison.

Davison in 1971, Tek Chin Lee (Fig. 6) eventually worked for 30 years as the Garden's broadly-based plant pathologist and laboratory scientist. During his sustained incumbency, Lee continued the *Phytophthora* work, assaying soil samples to detect the presence of the root rot fungus both in garden plants and as an invasive pathogen of native vegetation over many years (e.g. Lee & Wicks 1977) and provided a unique service identifying and documenting a wide range of pathogens detected in plants in ornamental horticulture in the State (e.g. Lee *et al.* 1979; Bishop & Lee 1980; Lee & Schoell 1979). Over time his plant pathology and tissue culture laboratory also provided key expertise and facilities for

investigations, for the most part in collaboration with scientists from the then Department of Agriculture, on the micro-propagation of virus-free grapevines and apricots, *Phytophthora* resistance screening in almonds and cherries (Scott *et al.* 1992; Wicks & Lee 1982a–c, 1985, 1986) and fungicide evaluation in grapevines and other horticultural crops (Lee & Wicks 1982a, b; Wicks *et al.* 1983, 1987). Tissue culture work included micro-propagation of ornamental dwarf forms of *Eucalyptus* species, a salt-tolerant 'green variant' of *Eucalyptus largiflorens*, *Pyrus calleryana* rootstock and the then rare ornamental cultivar *Clivia miniata* 'Aurea', with much of this work reported in detail in successive annual reports

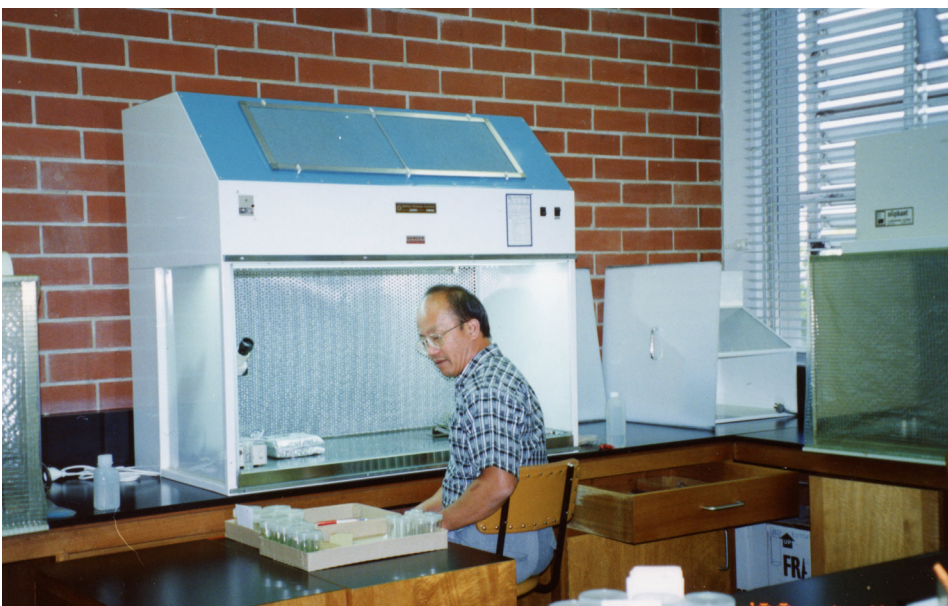


Fig. 6. Tek Chin Lee, Senior Research Officer, 1971–2001. Photo: Botanic Gardens and State Herbarium.

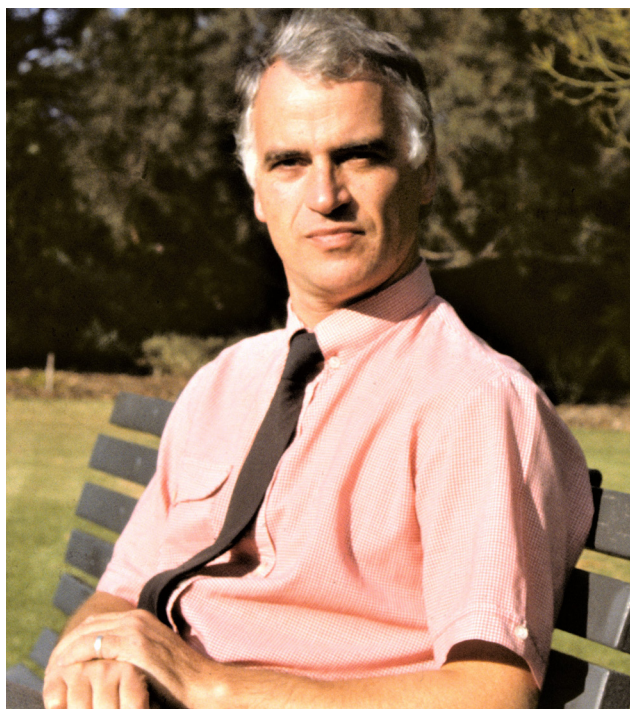


Fig. 7. Brian Morley, Horticultural Botanist, 1975–1978. Photo: Botanic Gardens and State Herbarium.

of the Botanic Gardens Board (e.g. Berry & Lothian 1973; Scott Young & Lothian 1980; Laurie & Morley 1993, 1994). With changing priorities, laboratory facilities and skills were increasingly being redirected to the emerging nature conservation role being adopted widely by Botanic Gardens (e.g. Lee & Jusaitis 2000). Plant pathology work was discontinued when Lee retired in 2001.

Consolidation and diversification

In 1975 Brian Morley (Fig. 7) became the first appointee to the new position of Horticultural Botanist, with responsibility for the Technical & Advisory Section and the separate Herbarium of Cultivated Plants, established by Lothian in 1966 to support the correct naming and documentation of the Garden plantings. In these last years before his retirement in 1980, Lothian harnessed the enthusiasm of new appointees Morley and John Jessop, Chief Botanist at the State Herbarium. Together with the support of the Board and funding from it, they established the *Journal of the Adelaide Botanic Gardens* to better facilitate the publication of the results of botanical and horticultural research (Scott Young 1976). The journal has recently been re-named 'Swainsona'.

As Horticultural Botanist, subsequently as Assistant Director and later as Director, Morley made contributions to the taxonomic and descriptive literature on cultivated plants (Byrne & Morley 1976; Morley 1976a–d, 1978a–d, 1979a, b, 1980a; Morley & Dutkiewicz 1977a–d, 1978; Morley & Chao 1977; Morley & Nelson 1979, 1995; Powell & Morley 1976)



Fig. 8. Ed McAlister, Horticultural Botanist, 1979–1981. Photo: Botanic Gardens and State Herbarium.

and botanic gardens and horticulture generally (Larson *et al.* 1987, 1989; Morley 1979c, 1980b, 1992, 1993a, b, 1995; Morley & Sandham 1993). Morley initiated, and with State Herbarium Senior Botanist Hellmut Toelken co-edited the collaborative work *Flowering Plants in Australia* (Morley & Toelken 1983), involving contributions from botanists around Australia and some internationally. It provided a beautifully illustrated account of the vascular plant families of Australia, with keys to genera.

Subsequent Horticultural Botanists included Ed McAlister (Fig. 8), Laurie Haegi (Fig. 9) and Trevor Christensen (Fig. 10), all later serving successively as Deputy Director. Each was involved in identification and recording of the living collections and seed index vouchers as well as various botanical projects on plants relevant to a greater or lesser degree to ornamental horticulture (R.M. Barker *et al.* 1996, 1999, 2000; W.R. Barker *et al.* 1999; Beale & Christensen 1999; Christensen 1991, 1996, 1999, 2000; Craven *et al.* 1995; Haegi 1982, 1983a, b, 1985, 1986, 1991a, b; Haegi & Barker 1985; Haegi & Dashorst 1985; Haegi & Symon 1984, 1986; Haegi *et al.* 1999; Imam *et al.* 1990, 1991; McAlister 1981, 1982, 1983, 1990; Purdie *et al.* 1982; Zdero *et al.* 1988). Continuing the Gardens' involvement with injurious plants (see above) each was appointed, successively, as Honorary Consultant to the Poisons Information Centre in the South Australian Department of Health (located at the Women's and Children's Hospital), and made contributions to knowledge in this field (Southcott & Haegi 1992; Sims *et al.* 1998, 1999). This culminated in provision, by Christensen, of the botanical component of an internationally recognised training course in clinical



Fig. 9. Laurie Haegi, Horticultural Botanist, 1982–1992. Photo first published in Strasburger (1988: 3).

toxinology for emergency medicine specialists (White 2013; International Society of Toxinology 2019, 2021).

Inaugural Nursery Supervisor at Wittunga Botanic Garden, Bruce Grivell, was an exceptional plantsman and propagator who developed an intimate knowledge of the extensive, species-rich plantings of South African *Ericas* at the Garden. Over many years in the role he saved a range of spontaneous hybrids and distinctive seedlings with superior horticultural potential. He propagated these from cuttings to ensure they were retained in the collections and used them to create much-admired spectacular displays in the *Erica* beds. Two such selections were not only distinctive, but were unusually floriferous, reliably propagated using protocols developed by Grivell, and had outstanding vase life. Following botanical determination and documentation by Haegi (see descriptions in Nelson & Small 2005) the cultivated varieties *Erica* 'Wittunga Satin' and *Erica* 'Wittunga Gem' were released under contract by Plant Growers Australia in 1991 and 1992 respectively (Anon. 1991; Nelson & Small 2005). They were registered with the International Cultivar Registration authority for Ericaceae in 2003 (Nelson & Sellers 2004) and were widely sold.

For many years there was a continuation of the tradition established by Morley and Toelken of joint projects between Herbarium and Gardens staff (Morley & Toelken 1983). Examples include the preparation of a handbook on the identification and control of garden weeds (Whibley & Christensen 1982, 1991) and investigation of the origins and global spread of species in the thornapple genus *Datura* (Symon & Haegi 1991a, b). An extensive taxonomic review

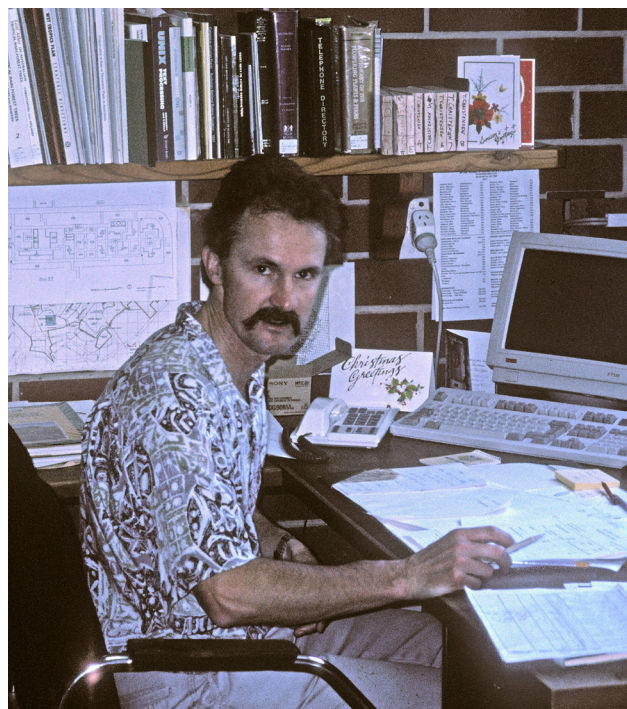


Fig. 10. Trevor Christensen, Horticultural Botanist, 1993–1999. Photo: Botanic Gardens and State Herbarium.

of the endemic Australian genus *Hakea* by Haegi in partnership with State Herbarium botanists Robyn and Bill Barker, was assisted greatly by the extensive living collection of the species in this horticulturally interesting genus held at Wittunga Botanic Garden. The completed treatment, covering 150 species, including 30 new species and subspecies, was published in the *Flora of Australia* (R.M. Barker *et al.* 1999; W.R. Barker *et al.* 1999; Haegi *et al.* 1999).

Documenting the Plantings

During this period there was a major focus on updating and providing greater access to the information of the plantings in the organisation's now three botanic gardens: Adelaide, Mount Lofty and Wittunga at Blackwood. This involved collection and lodgement of herbarium specimens, checking of identifications in botanical and horticultural literature and on-ground censuses. Following his appointment, Lothian had quickly allocated resources towards preparation of the first catalogue of plants for the Adelaide garden in 77 years (since Schomburgk's second catalogue of 1878). It was published as part of the Garden's Centenary Volume (Lothian 1955). A census of the Adelaide Botanic Garden plantings was again conducted in 1970 and a typescript listing for internal use was prepared in 1972. In the mid 1980's priority was given to updating documentation of the plantings at the smallest of the gardens, Wittunga, (opened to the public in 1975), leading to publication of its first catalogue (Haegi & Morley 1986). Transition from a card-based system for recording plantings to a new computerised database followed; commercially available collections-based

software allowing the final structure to be designed in-house was employed. The new catalogue for the Adelaide Botanic Garden was the first published for 33 years, the first produced digitally and the first using a newly adopted garden bed system giving significantly improved reliability for locating plants on-site (Haegi & Morley 1988). In time, garden-bed-based systems were devised for the other gardens, the information on their plantings was added to the database and the first catalogue for Mount Lofty Botanic Garden, opened to the public in 1977, was published (Haegi & Morley 1991). Following a comprehensive on-ground census that extended to many previously excluded plants existing from the time when Wittunga was a private garden, an updated Wittunga catalogue was produced from the living collections database and published as a second edition (Christensen & Morley 1995). Since then an updated combined catalogue for all three gardens, indicating garden occurrence but not garden bed location, has been completed (Sandham & Kellermann 2010).

In the early 1990's a reference collection of cultivated plants, with specimens stored in plastic sleeves in folders, was established by Haegi for greater ease of use by not only technical and gardening staff but also by public enquirers. This enabled the several thousand specimens in the Herbarium of Cultivated Plants to be incorporated into the State Herbarium, providing multiple benefits in co-location with existing global collections, ready accessibility to visiting specialists and inclusion in a range of routine curatorial actions. However, in the last two decades, perhaps strangely for a botanical collections institution, the Gardens has been unable to sustain a dedicated professional capability in horticultural taxonomy, presumably with resultant challenges in maintaining scientific currency in the botanical documentation of the plantings.

Plant Biology Research

When, in 1986, the Gardens assumed responsibility from National Parks and Wildlife South Australia for the Black Hill Native Flora Centre, a new era of scientific work commenced. Over a period of 12 years this work took place under the leadership of Manfred Jusaitis (Fig. 11), who succeeded the existing officer-in-charge, Richard Williams, in 1988. Under the modified name of the Black Hill Flora Centre, work proceeded on a diversity of projects including the introduction of selected native Australian species into horticulture – notably the Sturt Desert Pea, *Swainsona formosa*, as a cut flower (Jusaitis 1994, 1997a; Jusaitis & Schmerl 1993; Symon & Jusaitis 2007) – but also other species such as Fire Daisy, *Ixodia* (Bennell & Jusaitis 1989; Bennell *et al.* 1991), and Quandong, *Santalum* (Loveys & Jusaitis 1994). Attention was also given to the use of tissue culture to establish plants of rare and endangered South Australian species in cultivation, in part for re-introduction purposes (Jusaitis 1991, 1992a–c, 1993a). Threatened and endangered species targeted for this



Fig. 11. Manfred Jusaitis, Senior Scientist, Black Hill Flora Centre, 1988–2000, then Senior Conservation Biologist until 2014. Photo: State Library of South Australia B 75111/28 Messenger Press photo collection.

work included those in the genera *Acacia*, *Brachyscome*, *Haloragis*, *Nicotiana*, *Olearia*, *Phebalium*, *Pterostylis* and *Thryptomene* (Jusaitis 1993b, 1995; Jusaitis & O'Connor 1999; Jusaitis & Sorensen 1993, 1994; Lee & Jusaitis 2000; Sorensen & Jusaitis 1995a, b). There was also some early work in site rehabilitation (Jusaitis & Pillman 1992, 1995, 1997; Pillman & Jusaitis 1992, 1997). As biodiversity conservation became a higher priority for State and Commonwealth governments, the Gardens were well positioned for some years to capitalise on the funding opportunities that eventuated, seeing a diversification into translocation work, the preparation and implementation of recovery plans for threatened species and even weed management for conservation outcomes (Atkins *et al.* 1997; Davies 1997; Jusaitis 1997b, 1998, 2005; Jusaitis *et al.* 1998, 2003; Jusaitis & Adams 2002, 2005a, b; Jusaitis & Freebairn 2010; Jusaitis & Polomka 2008; Jusaitis & Sorensen 1998; Petit *et al.* 2009). With changing government priorities resulting in significantly reduced funding, several aspects of this work have, in recent years, largely come to a close perhaps with the exception of the area of threatened species recovery. When the Botanic Gardens vacated the Black Hill research facility in 2000, these lines of research continued for a further 13 years at the Hackney Road laboratories.

The new Millennium

Early in the 21st century, the Botanic Gardens gained a new director in Stephen Forbes, who, with a botanical background, placed continued importance on science



Fig. 12. Seed Conservation Centre volunteer Peter Hunt capturing images of seeds with photo-microscope. Photo: Botanic Gardens and State Herbarium.

within the organisation (Dawkins & Forbes 2003), while also promoting an influential role at a broader level (Forbes 2011, 2012). A new direction was emerging for Botanic Gardens on a global scale: a strategic role in nature conservation, in part through long-term germplasm storage of wild species. In Adelaide, building on the skills base of Lee and of Jusaitis and his team, together with their well-established laboratories, the Gardens entered a funding agreement with Millennium Seed Bank of the Royal Botanic Gardens, Kew. Under the auspices of Botanic Gardens Conservation International and its grand vision, the Global Strategy for Plant Conservation, the South Australian Seed Conservation Centre was established (Dawkins & Forbes 2003). Since 2003, initially under the leadership of Phil Ainslie and more recently through the untiring efforts of Jenny Guerin and Dan Duval, the Centre has been building up a seedbank of South Australian native species, with a priority on threatened species (Fig. 12). It has secured material of almost half of the State's species in the seedbank and nearly 70% of threatened species (SASCC 2021). Working with industry and other funding partners, the Centre has been pursuing several lines of research in seed biology and threatened species re-introduction (Adkins *et al.* 2005; Ainsley *et al.* 2008; Ainsley & Jones 2010; Ainsley & Lee 2010; Aleman *et al.* 2011; Dowling & Jusaitis 2012; Guerin *et al.* 2010, 2013; Pound *et al.* 2009, 2014; Te *et al.* 2009).

Looking to the Future

What of the future? There have been four main streams of scientific work in the Botanic Gardens over the last 60 years:

- Plant Pathology
- Plant Systematics (with an emphasis on cultivated plant groups)
- Plant Biology and Conservation Biology
- Seed Conservation Biology.

Each of the first three proved to have a life of around 30 years, with different starting and end points. Their co-occurrence for a period of 15 years from 1986 until 2001 probably marked the time of greatest diversity in scientific activity since the founding of the Botanic Gardens. Paralleling earlier phases in the history of the gardens, leaner economic times and changing priorities have seen a significant narrowing in the range of science activity over the last decade or so. But the Seed Conservation Centre has sustained a robust thread of quality scientific output, good focus, relevance to long-term biodiversity conservation aims, expertise for which there is likely to be ongoing demand, a diversity of funding partners, national and international cooperation and a clearly stated strategic direction. The nature of the work, of necessity, involves a constructive link utilising the resources and expertise of the State Herbarium. We might be assured that these are the characteristics that will help ensure science remains a key element in and perhaps once again diversifies in the activities of the Botanic Gardens.

Postscript

Since this paper was first presented for the State Herbarium 60th Anniversary seminar series and then largely completed for publication, the work of the Seed Conservation Centre has developed under the leadership of subsequent Directors. Lucy Sutherland, who succeeded Stephen Forbes in 2016, forged closer organisational ties for the Centre with the State Herbarium, the two entities being placed together under a Science and Conservation group. These arrangements continue under the leadership of the current Director Michael Harvey.

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