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The Waite Arboretum – Science, Trees and Technology

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Introduction

Nestled in the foothills of Adelaide, South Australia the Waite Arboretum comprises 28 hectares with 2,430 trees and shrubs representing over 1,040 taxa from around the world. The Arboretum was established in 1928 following a visionary bequest to the University of Adelaide by Peter Waite. In 1961, the decision was made not to water trees after establishment, so the Waite Arboretum demonstrates the performance of species on rainfall alone for up to 55 years and points the way to better species selection for our urban forests of the future.

This paper traces the establishment and development of the Waite Arboretum – its purposes, changing composition, collection policies and directions, special collections, expanding community outreach programs, and the use of current digital technology to make the information embodied in the collection accessible to the widest possible audience. The Waite Arboretum is part of Waite’s lasting legacy.

The Waite Bequest

Peter Waite (Figure 1) was born of humble origin at Pitcairn Farm near Kirkcaldy in Scotland in 1834. At the age of 25 he followed his two older brothers and migrated to South Australia, joining his brother James in the pastoral country. Despite setbacks of drought, rabbit plagues and economic downturns, through innovative and effective land management Waite became a very successful pastoralist and businessman. In 1877 Waite and his family took up residence at the 54-hectare Urrbrae estate which is probably unique in the Adelaide region as it has remained undivided since the original land grant in 1839 (Zeit 2014). Although they had eight children, as Peter and Matilda approached the age of 80 none was in a position to take over management of his properties and fortune.

Waite was of the view that with comparatively little scientific training, South Australian agriculturalists and pastoralist had placed wheat, wool, fruits and machinery in the highest estimation in the world, but that

We have now reached a point when it behoves us to call science to our aid to a greater extent than hitherto has been done, otherwise we cannot hope to keep in the forefront.¹

In 1913 Waite wrote to the Chancellor of the University of Adelaide informing him of his intention to offer his Urrbrae estate of 54 hectares to the University to advance its work in agriculture and allied fields.²

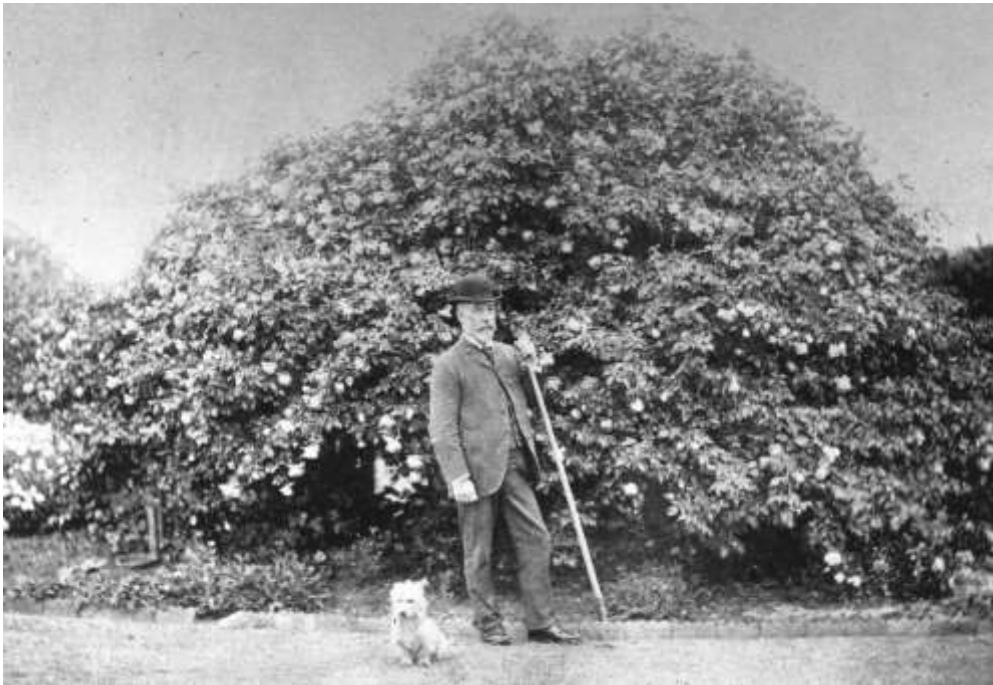


Figure 1: Peter Waite in his rose garden 1905. Source: *Our Pastoral Industry*

The Urrbrae estate was formally transferred to the University, subject to the life tenancy of Waite and of his wife, by an Indenture dated 29 January 1914. The Deed of Gift specified that the University shall hold the eastern half of the estate (27 hectares) together with the mansion house and other buildings for the purpose of teaching and study of agriculture, botany, zoology, veterinary science, entomology, horticulture, forestry and related fields, to better the development of the natural resources of the land by agriculture and husbandry, and that the western half (27 hectares) be held 'upon trust ... in perpetuity as a park or garden for the recreation and enjoyment of the public.'³ In 1915 Waite purchased the adjoining 21-hectare Claremont estate and 45-hectare Netherby estate and added them to his original gift the University. In doing so he observed that:

Seeing that the climate, rainfall and soil at Urrbrae are typical of large areas of our agricultural land, and of the agricultural land in other States, the results of the research work to be prosecuted there by the University may be safely relied upon by agriculturalists throughout Australia. ⁴

In addition, Waite transferred shares to create an endowment fund to establish and run the future institution. The total value of the Waite Endowment was determined to be £100,000. It was one of the most generous public benefactions in the history of South Australia (Zeitz 2014).



Figure 2: Aerial view (looking east) of the eastern part of Urrbrae estate. Urrbrae House and gardens are located on the right side of the photograph. The photograph was taken by Frank Hurley in December 1919. *Source:* Courtesy of Marion Wells

Peter and Matilda Waite died in 1922 and the University came into full possession of the estate (Figure 2) in early 1923. The Waite Campus of the University of Adelaide now comprises 200 hectares where more than 1,100 people work and study in 12 research organisations, centres and nodes. In addition to the University of Adelaide's School of Agriculture, Food and Wine, collocated organisations include the Australian Wine Research Institute, SA Research and Development Institute, CSIRO, Australian Plant Phenomics Facility, Australian Centre for Plant Functional Genomics, Food SA and ARC Centres of Excellence. This research and education precinct is the largest concentration of expertise in the southern hemisphere in the areas of plant biotechnology, cereal breeding, sustainable agriculture, wine, horticulture and land management [www.adelaide.edu.au/campuses/waite/].

Planning and establishment of the Waite Arboretum

On 26 March 1923 a committee of 12 members was appointed to make recommendations to the University Council on how best to give effect to the objectives of the Waite bequest (Gardner 1990a). The Deed of Gift had specified that the Council might set apart and enclose an area not exceeding 6 hectares of the western half of the estate for a sports ground for students of the University. The Committee's report, dated 19 May 1923, recommended unanimously that the public park take the form of an arboretum, to be designed and planted over a dozen years. From the outset the main purpose of the arboretum was 'to demonstrate the kinds of tree that may thrive in the State'.⁵ T. G. B. Osborn, Professor of Botany, offered to assist by finding seeds of rare or interesting species (Urrbrae Committee 1923).

Waite Arboretum is located at 34°59'S, 138°38'E at an altitude of 84-118 metres. It is virtually frost free with a mean rainfall (recorded 1925-99) of 622 millimetres mainly in winter, followed by a warm dry summer. The original vegetation of the site was open grassy woodland of Grey Box (*Eucalyptus microcarpa*), South Australian Blue Gum (*Eucalyptus leucoxylon*) and River Red Gum (*Eucalyptus camaldulensis*), but the land had been cleared for agriculture before planting of the Arboretum began and only a few original trees remain (Symon 1984).

Echoing Waite's assertion, H. Hugh Corbin, Department of Forestry, University of Adelaide, observed that 2,400,000 hectares of land in South Australia has a climate like that of Urrbrae from an arboricultural point of view. The Arboretum would therefore offer an exceptionally good opportunity for testing the adaptability of different species to local soil and climate, and thus its experimental value would be high (Corbin 1923). He prepared a list of 56 trees to plant which included exotics such as willows, elms, conifers, palms and figs and Australian species Silky Oak (*Grevillea robusta*), native pines (*Callitris spp.*), sheoaks (*Casuarina spp.* and *Allocasuarina spp.*), kauri (*Agathis spp.*) and *Araucaria spp.* Corbin recommended that the larger trees be spaced 20 m apart to give ample room to show the natural growth habit of each species. He also proposed that the trees be planted in numbered rows for ease of location, but that was not adopted.

With great energy and enthusiasm Professor Arnold E. V. Richardson, Foundation Director of the Waite Agricultural Research Institute (WARI) from 1924-38, planned and established the Arboretum, after consultation with many specialists including Mr J. F. Bailey, Director of the Adelaide Botanic Gardens; Mr F. J. Rae, Director of the Melbourne Botanic Gardens; Mr E. Julius, Conservator of Forests; Mr S. Griffiths, Government Town Planner; Mr G. Melville, Forest Department of South Australia; Mr G. Quinn, Chief Instructor of Horticulture; and Mr A. W. Pelzer, City Gardener (Richardson 1928b). The original layout designed by Richardson and Bailey (Figure 3) was a series of sweeping paths and circles of trees representing

different genera. However, over time as specimens have died and many new trees added to the collection the original layout is increasingly indiscernible.

Planting began in 1928 with a central avenue of 70 English Elm (*Ulmus procera*) framing a vista from the centre of the new Institute building to the sea – a feature which remains a dominant landscape element today.

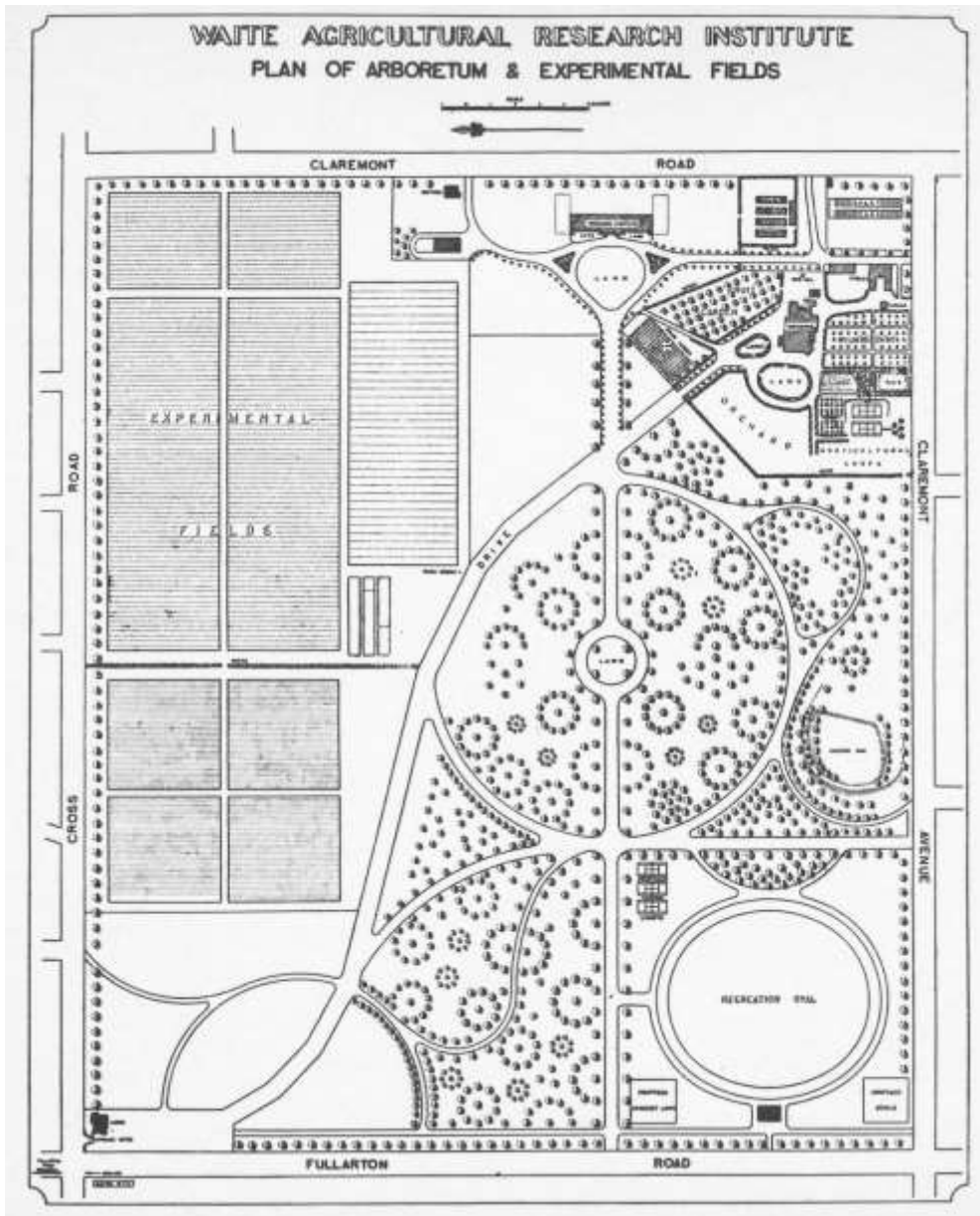


Figure 3: Plan of Arboretum c.1931

Initially two main plantings were envisaged with hardier Australian species on the higher eastern areas where the soil is shallow and the subsoil of a gravelly nature and exotic broad-leaved trees and conifers on the lower western areas of deeper soil (Richardson 1928b). The western soil type has been described as Urrbrae Fine Sandy Loam.⁶

Arrangement of the trees was to be on broad taxonomic grouping and to some extent continues to the present. Corbin (1923) considered that 'the scenic effect which may be produced by landscape forestry is not the object which is to be held in view but rather the economic and scientific value of the collection of trees and the data derivable from them'. In contrast Richardson (1927) stated: 'Though the main aim of the Arboretum will be educational it is not desirable to sacrifice the aesthetic aspect of the planting for mere systematic and formal arrangement of species.' He envisaged a third area of mixed natives and exotics, planted to give the greatest aesthetic effect, but this objective was not pursued.

Young trees were sourced from Adelaide and Melbourne Botanic Gardens, Adelaide City Council, New South Wales Forestry Commission, the Federal Capital Commission and horticultural institutions and nurseries in NSW, Victoria and SA including Nobelius and Hazelwood nurseries. There were multiple specimens of some common species. In addition, seed came from New Zealand and the Boyce Thompson Arboretum in Arizona (Richardson 1928c).

By 1930 some 1,020 trees had been planted representing 367 species in 180 genera and 67 families (WARI 1932). Articles in both *The News* and *The Advertiser* newspapers 22 April 1937 reported on a visit to the Arboretum by members of the Tree Planters' Association of South Australia and representatives of 23 District Councils (Figure 4). They were escorted by Richardson who stressed the importance of planting the right species of trees for South Australia and pointing to the success of trees from the Mediterranean region such as Canary Island Pine (*Pinus canariensis*), Cork Oak (*Quercus suber*), Algerian Oak (*Quercus canariensis*) and Stone Pine (*Pinus pinea*) and other dry climates, as well as some from moister climates such as the Jacaranda (*Jacaranda mimosifolia*) from Brazil and an array of trees from eastern Australia.



Figure 4: Visit to the Waite Arboretum by the Tree Planters Association and representatives of 23 District Councils. Source: *The Advertiser* 22 April 1937

Frederick A. Couzens Jnr grew up on the Urrbrae estate where his father was Peter Waite's head gardener. In 1928 Richardson put Couzens Jnr in charge of the newly established Arboretum at an annual salary of £203 17s (Richardson 1928a). Couzens was keen but untrained and there was a program of heavy staking and trunks were pruned to head height. During the next 38 years of his association, Couzens took particular interest in the eucalypts (*Eucalyptus*, *Corymbia* and *Angophora* spp.) and raised most of the specimens from seed, cuttings and grafts. It is due in large part to him that the Arboretum has its large collection of eucalypt species.

Development of the Arboretum

In the first three decades of the Waite Institute both the first and second Directors, Richardson, and Professor James A. Prescott (Director 1938-55), took a strong personal interest in the Arboretum and oversaw its development and policy directives. Richardson appointed Constance M. Eardley as the first taxonomic botanist at the Waite Institute with the position of Curator of Waite Herbarium and Waite Arboretum (1933-49). Eardley maintained the Arboretum records and published growth measurements for 20 trees (WARI 1936). Enid L. Robertson joined the staff of the Institute as Systematic Botanist in 1947 and succeeded Eardley as Curator of the Arboretum (1950-3). Frank M. Hilton was Systematic Botanist from 1953-5.



Figure 5: Waite Campus view looking east to the Adelaide hills 1976. The Waite Arboretum is in the centre.

David E. Symon joined the staff of the Waite Institute as an Agrostologist in 1951 and was appointed Systematic Botanist in 1956. In addition to teaching and research he paid considerable attention to the Arboretum (Figure 5) and had a much greater influence on its composition and documentation than previous curators. Symon retired in 1985 and in 1996 was awarded a D.Sc. for his published work on the Australasian Solanaceae (Nightshade Family). He represents the second phase of the development of the Arboretum as a directed botanical collection influenced by the concept of homoclimes. In 1961 a major policy change occurred with the decision to cease watering trees after their establishment (Gardner and Symon 2004). This established the Arboretum as a significant rain-fed collection, distinguishing it from most botanic gardens. By establishing overseas links for seed exchange he sourced material, often wild collected of known provenance, from homoclimes such as the eastern Mediterranean, California, South Africa and Chile. He added a large number of eucalypts to the collection and genera of interest to him such as pears (*Pyrus* spp.), oaks (*Quercus* spp.), sheoaks (*Casuarina* and *Allocasuarina* spp.), junipers (*Juniperus* spp), pistacios (*Pistacia* spp.), yuccas (*Yucca* spp.), brachychitons (*Brachychiton* spp.) and dragon trees (*Dracaena* spp.). He also initiated fortnightly recording of flowering and fruiting data of a number of species of interest, especially the eucalypts and pears, a task diligently performed over the next 12 years by his technical assistant Roy D. Pearce.

After the retirement of Symon the position of Systematic Botanist was discontinued. The Waite Herbarium, by then comprising over 52,000 numbered

sheets plus numerous miscellaneous collections and seed collections, was transferred to and integrated with the State Herbarium of South Australia. In 1986 a new half-time professional position was created for a botanist to manage and develop the Waite Arboretum and provide a taxonomic botany advisory service to staff and students. Dr Jennifer A. Gardner was appointed Curator of the Waite Arboretum with a high level of autonomy and continues to hold the position. Her curatorship represents the third phase of the development of the Arboretum as a working collection with a strong program of community engagement.

In 1990 Professor Harold W. Woolhouse, a distinguished UK academic who had pursued a career in developmental biology and physiological ecology, was appointed fifth Director of the Waite Institute. In his five years at the helm he was widely acknowledged for his dynamic and innovative leadership. As the first botanist to be appointed Director he took a very keen interest in the Waite Arboretum and implemented a number of changes in its management. One of these was to remove the resident sheep used to mow the grass. The sheep had also grazed the tree canopies within reach giving the trees a clipped rather than natural form and the compaction caused by hard hooves was detrimental to the trees. With the removal of the sheep, the trees redeveloped their natural form and internal fences and tree guards were removed which considerably enhanced public access and visual aspect.

Under Woolhouse, for the first time, a budget was allocated for the Arboretum. The position of Curator of the Arboretum was increased to full-time with additional responsibilities of managing the conservation and restoration of Waite Conservation Reserve, and overseeing the redevelopment and management of the gardens of the Urrbrae House Historic Precinct. The 121 hectare Waite Conservation Reserve is the eastern hills of the Waite Campus and represents one of the most significant remnants in the Mount Lofty Ranges of Grey Box (*Eucalyptus microcarpa*) Grassy Woodland, a nationally threatened ecological community.

In 1993-4 a further five hectares were added to the Arboretum which enabled a rapid expansion of the eucalypt collection. Other collections which have been expanded or added over the last 30 years include oaks, pears, banksias, hakeas, palms, cycads, dragon trees and Australian citrus.

The Arboretum today

Roles of the Waite Arboretum

The Arboretum has four main purposes:

1. Experimental

From the outset, the main aim of the Waite Arboretum was to evaluate the performance of a wide range of species from around the world to assess their habits of growth and suitability to its soils and climate which is typical of a large part of settled south-eastern Australia. With the now long established policy of not watering after establishment, the Arboretum collection demonstrates performance for up to 55 years on rainfall alone and informs more sustainable species selection for our streets and amenity planting. The dissemination of this increasingly valuable information has been facilitated with the formation of Treenet (discussed below). Evaluation of trees takes decades and the protection afforded by the Waite Trust ensures that the Waite Arboretum can undertake such long-term testing into the future.

2. Research and education

Waite Arboretum is actively promoted as a resource for research across a range of fields. It has provided experimental material for research in plant physiology, phytochemistry, chemotaxonomy and reproductive biology of eucalypts and banksias and is a repository for material developed in plant breeding programs. Recent research conducted in the Arboretum by the University of Adelaide's Dr Katja Hogendoorn and her Ph.D. students involved the study of pollination and other aspects of native bee ecology.

The Arboretum is a valuable resource for education at all levels, fostering a connection with nature and promoting the study of the natural environment. The Arboretum is used by groups across the age spectrum from Nature Play and Outdoor Playgroups for pre-school children, primary and secondary school students, tertiary students undertaking practical sessions in plant taxonomy, garden design, soil science, entomology and horticulture, to retirees attending the University of the Third Age.

3. Ex situ conservation

Waite Arboretum is a repository for rare and endangered species. The International Union for the Conservation of Nature (IUCN) based at Cambridge University, England has been assessing the conservation status of species, subspecies, varieties and selected subpopulations on a global scale for the past 50 years and maintains the on-line IUCN Red List. Arboretum specimens representing 70 taxa are on the IUCN Red List with a status of Near Threatened or greater concern, with 25 taxa Endangered and two taxa Critically Endangered. Other Arboretum species are listed on the Australian Government Department of the

Environment's list of Threatened species and ecological communities [<http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>] The Arboretum provides seeds, cuttings and bud wood of rare specimens in the collection to botanic gardens and specialist nurseries for propagation.

4. Community asset and outreach programs

In keeping with the stipulation in Waite's bequest setting aside half of his estate as a park or garden for the recreation and enjoyment of the public, the Waite Arboretum is open every day of the year from dawn till dusk. It attracts a growing number of interstate and overseas visitors. Many local residents, staff and students of the campus walk through the Arboretum regularly, appreciating its beauty and tranquillity and holding it in great affection. The amenity and visitor experience has been enhanced with seats – many of them in memory of scientists who have worked at the Waite Institute, sculptures, interpretive signs, a labyrinth and recently the Waite Arboretum app for mobile devices.

There is a strong focus on raising public and professional awareness of the Arboretum. Community outreach programs include regular free guided walks and booked tours, participation in the Children's University program, and public presentations to community groups and at conferences.

Treenet

In 1995 Gardner presented a paper on the future species selection for urban street trees with suggestions from the Waite Arboretum at a Royal Australian Institute of Parks and Recreation seminar (Gardner 1995). The seminar was also attended by nurseryman David Lawry who had studied at the Waite Institute and understood the experimental value of the Arboretum collection. In 1997 Lawry proposed the formation of a cluster group of researchers, educators, landscape architects, urban planners, Local and State Governments, arborists, nursery and allied industries, and others with an interest in street trees. Together with Gardner he founded Treenet Inc. a not-for-profit research and educational organisation based at the Waite Arboretum. The organisation currently has 64 Institutional Members and annual symposia have been held since 2000 to showcase current research and share information. The pdfs of proceedings of every symposium are available free on line [<https://www.treenet.org/symposium/proceedings-archive/complete-symposium>] and videos of symposia including outdoor presentations are available on <http://treenetmedia.com/>.

One of the activities of Treenet, in collaboration with Local Governments, is to promote street tree trials based on species proven successful in the Arboretum or recently released cultivars established with best practice tree planting and maintenance techniques. However, many of the species in the Arboretum recommended for trialling are uncommon and not commercially available. It is a Catch-22 situation. Local Governments are willing to trial the recommended

species, but stock is difficult to obtain. Tree nurseries are reluctant to invest in propagating species for which there is no proven market.

Another major activity of Treenet is the Avenues of Honour 1915-2015 project which is a national initiative to honour with a tree, the memory of each of the 102,000 Australians who has died while on military service [<http://www.avenuesofhonour.org/>] The project was conceived and is driven by Lawry. Treenet works with communities across Australia to support efforts to document, preserve and restore Avenues and establish new ones. New Avenues of Honour are being established in Adelaide, selecting species of proven success in the Waite Arboretum for example the Smooth-barked Apple or Sydney Red Gum (*Angophora costata*).

Major Arboretum collections

1. Eucalypt Collection

Three main areas of the Waite Arboretum have been planted with eucalypts. The north-west Arboretum was established in 1949 primarily for large species. Another collection of mainly mallees was established in 1955 in what was Peter Waite's orchard close to Urrbrae House. When a third eucalypt planting was established in 1993-4 volunteers grew and planted specimens from seed collected in the wild by Dr Dean Nicolle. The Arboretum eucalypt collection (*Angophora*, *Corymbia* and *Eucalyptus*) now comprises 890 specimens representing 360 taxa.

An imposing avenue of Sugar Gums (*Eucalyptus cladocalyx*) was planted in 1877 by Waite and lined the sweeping driveway from the Gate House to his residence. These trees can be seen in the 1919 aerial view (Figure 2). Only 13 of these trees remain and some are in decline. However one very majestic specimen which has a height of 32.5 metres and a trunk diameter of 2.09 metres at 1.3 metres above the ground has a State significance listing on the National Trust of Australia's Trust Trees [www.trusttrees.org.au/] and features as one of Australia's remarkable trees (Allen and Baker 2009).

In the northwest Arboretum are six remnant Grey Box (*Eucalyptus microcarpa*) four of which, judging by their size, are thought to pre-date European settlement. The site of the Waite Arboretum was formerly within an extensive area of Grey Box woodland, referred to as the Black Forest by early European settlers, probably a reference to the dark trunks of the Grey Box (Kraehenbuehl 1996). In 1998, a project commenced to conserve and enhance the indigenous native species and reinstate some of the original Black Forest understorey plants such as Hop Bush (*Dodonaea viscosa*), Round-leaved Wattle (*Acacia acinacea*), Golden Wattle (*Acacia pycnantha*) and Native Lilac (*Hardenbergia violacea*). The Adelaide Plains have been mostly cleared of native vegetation so remnants such as this section of the Arboretum are of high conservation significance (Crompton 1998). An action plan prepared by Crompton recommended minimum disturbance weed removal,

leaving the remnant native grasses to set seed before summer mowing, and gradual reintroduction of some of the native forbs and shrubs from seed collected in the Waite Conservation Reserve then propagated and planted in small stands to facilitate management. Over the years, thanks to the dedicated efforts of a small band of volunteers, the native grasses and new plantings have self-sown and visitors can gain an appreciation of some of the understorey of the original Black Forest. Throughout the rest of the Arboretum efforts are also being made to gradually replace exotic grasses and broad-leaved forbs with native grasses such as Wallaby-grass (*Austrodanthonia* species) and Windmill Grass (*Chloris truncata*) which have a low fuel load.

Eucalyptus 'Urrbrae Gem' (*E. erythronema* x *stricklandii*) was a chance hybrid discovered at the Waite Arboretum in 1936 by Couzens. The original tree is still extant. It is an attractive small tree with white bark, glossy green leaves and spectacular dense red blossoms. Progeny were widely distributed but proved to be disappointing with poor form and low vigour making propagation by seed unsuitable. Research at the Waite Institute to develop ornamental eucalypts was initiated by Professor Margaret Sedgley who worked at the Waite Institute 1985-2005. She was the driving force behind the University's horticultural research efforts at that time, and developed and commercialised three *Banksia* cultivars - 'Waite Orange', 'Waite Crimson' and 'Waite Flame'.

The current Ornamental Eucalypt Development Program at the Waite is led by Principal Researcher Dr Kate Delaporte who has established in-ground trials of over 20 new hybrid lines, some of which have been planted in the Waite Arboretum. Two of Delaporte's named *Eucalyptus* cultivars are commercially available - 'Nullarbor Rose' and 'Nullarbor Lime'.

2. Oak Collection

The Waite Arboretum Oak Collection comprises 116 specimens representing 60 taxa. The best performing species from the Mediterranean are Cork Oak (*Quercus suber*), Algerian or Canary Oak (*Q. canariensis*), Kermes Oak (*Q. coccifera* subsp. *calliprinos*), Holly or Holm Oak (*Q. ilex*) and Tabor or Vallonea Oak (*Q. ithaburensis*). Those from California are California Field or Coast Live Oak (*Q. agrifolia*), Canyon Oak (*Q. chrysolepis*), Blue Oak (*Q. douglasii*), Engelmann Oak (*Q. engelmannii*) which is on the IUCN Red List, Valley Oak (*Q. lobata*), and Interior Live Oak (*Q. wislizenii*). The 12 Californian species in the collection were introduced by Professor Prescott in collaboration with Professor Lindsey Pryor who supervised the development of the Australian National Botanic Garden in Canberra between 1945 and 1958. The soil scientist Prescott and the botanist Pryor shared an interest in homoclimes.

3. Pear Collection

From the mid 1960s Symon assembled the Waite Arboretum Pear Collection which now comprises 91 specimens representing 30 taxa. Much of Symon's material

was wild collected. He recognised that ornamental pears (*Pyrus* spp.) were much more drought tolerant, disease resistant and better suited to Adelaide's climate than other deciduous genera commonly planted for their showy spring blossom. An outstanding success was Callery Pear (*P. calleryana*) which is now widely planted as a street tree in Adelaide and Wild Pear (*P. pyraster*). Symon made a fine selection of Callery Pear which he dubbed 'Lynington' and a unique hybrid of *P. calleryana* x *P. amygdaliformis* which he named 'Prescott'. Two Arboretum species, *P. tadshikistanica* from Tajikistan and *P. korshinski* from Kyrgyzstan, Tajikistan and Uzbekistan, are listed on the IUCN Red List as Critically Endangered in the wild. Budwood and cuttings have been provided to the Botanic Gardens of Adelaide for propagation and distribution.

4. Dragon Tree Collection

Arborescent Dragon Trees (*Dracaena* spp.) are represented in the Waite Arboretum with 31 specimens representing five species and one subspecies. *Dracaena draco*, both the Canary Islands and Cape Verde Islands forms, are common in cultivation (Figure 6). The other species from Socotra (Yemen), Somalia, Oman, Saudi Arabia, Egypt and Sudan are uncommon, but all the Arboretum species are listed in the IUCN Red List, three with Vulnerable and two with Endangered status.



Figure 6: Measuring the iconic *Dracaena draco* Waite Arboretum Tree #467, November 2002. Source: Jennifer Gardner

5. Pine Collection

The Waite Arboretum Pine Collection of 77 specimens represents 13 taxa. Best performing species are Calabrian or Turkish Pine (*Pinus brutia*), Canary Island Pine

(*P. canariensis*), Aleppo Pine (*P. halepensis*), Digger Pine (*P. sabiniana*) and Torrey Pine (*P. torreyana*) which is on the IUCN Red List as 'Endangered' in the wild.

6. Palm and Cycad Collection

Palms were included in the earliest plantings of the collection which now comprises 235 specimens in 95 taxa. Of the earliest plantings the most impressive specimen is the Chilean Wine Palm (*Jubaea chilensis*). In 1994 Gardner initiated a project to landscape the open channel connecting the Waite Campus bore to the Arboretum dam to more resemble a meandering watercourse with ponds and native aquatic vegetation. The Palm and Cycad Society of South Australia became involved in planting the verges. That partnership has continued over 20 years as the Society still donates, plants and tends an expanding collection of palms and cycad species, many of which are not commercially available.

Recognition

In 1986, the International Dendrology Society (IDS) awarded the Waite Arboretum its bronze plaque in recognition of the importance of the collection, in particular the outstanding eucalypt collection (Figure 7). There has been only one other such award by the Society in Australia. The Society aims to promote the study and cultivation of woody plants and observe and conserve those which are rare and endangered.



Figure 7: Unveiling of International Dendrology Society bronze plaque in the Waite Arboretum on 14 September 1987. (From left) TR Noel Lothian (Australian Vice-President, IDS), the Hon. Kim Mayes (South Australian Minister for Agriculture), Professor James Quirk (Director Waite Institute), Dr Jennifer Gardner (Curator Waite Arboretum) and Dr David Symon (past Curator). *Source:* University of Adelaide – Coach House Collection

Documentation of the Waite Arboretum collection – opening the digital door

From the outset, details of each Arboretum specimen were recorded on index cards including individual tree number, scientific and common names, family, distribution, source of material, and for many specimens, flowering, fruiting and other observations. In 1986 Gardner developed the first electronic catalogue. The entire catalogue could then be readily updated, searched, sorted or exported as a spreadsheet which was subsequently made available to the public on the Arboretum website. In 1990 Gardner developed the first electronic map of the Arboretum. A tape measure was used to determine the extent of each canopy and the relative position of each specimen in relation to a grid of existing taps. The data was plotted using what was then new technology, Computer Aided Drawing (CAD) software. The catalogue and map were published as a booklet (Gardner 1990b). The CAD map was updated annually for the next ten years by which time the software was outdated and a new map was required.

In 2014 Gardner and Marian McDuie produced a digital geo-referenced map which could be kept current as trees were removed and new specimens were planted and grew. An aerial image to 10 cm resolution was obtained by a fly over in a small aircraft. This level of detail allowed trees and other features to be accurately digitised to provide a comprehensive dataset of the current Arboretum collection as well as infrastructure such as gates, fences, roads, paths and seats. Using the aerial image as a backdrop and overlaying it with the rasterised CAD drawing allowed the canopies to be 'visually' adjusted to match the current canopy extent of every specimen. The spatial dataset was then joined with the tree catalogue. The merged data was then in a format to develop an app that would allow any user with a smart device to easily locate a specific tree or call up the label information of every specimen within a 20 metre radius. Labelling trees is a costly and on-going challenge as names change and labels are lost or become obscured by the growing canopy. The app makes the current label information available at the tap of a finger.

The Waite Arboretum app has proved to be a very useful management tool. It enables researchers and professionals such as arborists, landscape architects and urban planners to readily locate a species of interest. Visitors can learn about the wildlife and discover other features as well as follow a series of themed walks. Using digital technology connects to and appeals to children who are all adept at using tablets and smart phones for learning and play, thus fostering a connection to the Arboretum in the next generations who will hopefully become its supporters, champions and custodians.

Support for the Arboretum

The Friends of the Waite Arboretum Inc. was founded in 1994 with aims to foster interest in the care and use of the Waite Arboretum, and to raise funds for its development and promotion. The association has continued to the present with fairly steady membership of about 130. Since its foundation the Friends organisation has contributed over \$178,000 to the Arboretum for a variety of projects including professional arboricultural work and interpretive signage.

In 1997 there was a proposal to alienate a section of the Arboretum for the construction of a new Netherby Kindergarten. The Friends played a pivotal role in marshalling opposition to the proposal and protecting the Arboretum from encroachment. During World War II the Commonwealth used its powers to construct some supposedly temporary huts for military use in the Arboretum, in contravention of the Waite Trust which preserved the land as a public park. In the immediate post-war years a couple of the huts were removed but the University Council, at a time of building shortages, agreed to lease the remaining structure to the local community to accommodate a kindergarten while a permanent site was sought. The Netherby Kindergarten was established in 1946 and despite determined efforts of Waite Directors James Melville and Professor James P. Quirk to terminate the lease, the University Council was reluctant to do so partly because they did not want to antagonise the staff and influential local residents who sent their children there and partly because they saw no harm in the kindergarten remaining in the Arboretum (Zeit 2014). All this changed in 1997 with the proposal by the South Australian Education Department to build a new kindergarten on the site to replace the unsatisfactory dilapidated structure. To enable this development, the South Australian Parliament passed *The Netherby Kindergarten (Variation of the Waite Trust) Act 1997* indemnifying the University against being sued for breach of the Waite Trust. The Friends were concerned that the proposed new building would be the thin end of the wedge and that more than the building footprint would be needed for safe off-street parking leading to further encroachment. Moreover, the precedent would be set for future buildings on Arboretum land (student residential accommodation had already been suggested but dismissed). An alliance was formed with the Netherby Heritage Action group and the National Trust of South Australia who were concerned about the proposed removal of six significant trees. Support was also forthcoming from Martin Hamilton-Smith MP, Member for Waite. Other organisations were enlisted to join the campaign and in 1999 a public rally was held at which a number of prominent people spoke against the proposal to a gathering of 400 people. By 2000 the campaign had been successful and another more suitable site for the kindergarten was found on the Waite Campus on land donated by Waite but not subject to the restrictions of the Waite Trust. Not content to rest while the enabling Act remained, Hamilton-Smith put forward a Private Member's Bill, *Netherby Kindergarten (Variation of Waite Trust) Act Repeal Bill 2000* and new

legislation was enacted on 22 March 2001 to repeal the 1997 Act. The threat to the Arboretum was over for the foreseeable future.

In addition to the invaluable support of the Friends of the Waite Arboretum in raising funds for and public awareness of the Arboretum, the Arboretum has benefitted from private donations, competitive grants, sponsorship-in-kind, professional advice and countless hours of volunteer effort by organisations and individuals who appreciate the value of the Arboretum and want to see it continue in perpetuity for research, education and the enjoyment of the public as Waite intended.

Conclusion

Peter Waite understood the value of science and enthusiastically embraced new technology. His generous bequest to the University of Adelaide has resulted in the Waite Research Institute – an internationally renowned facility doing leading research and delivering world class teaching.

Waite also had the generosity and foresight to leave a portion of his estate in perpetuity for a park or garden for the enjoyment of the public. This has resulted in the Waite Arboretum, a significant scientific collection of trees that can be explored and its embodied information accessed worldwide with digital technology. Waite left a much loved and enduring living legacy.

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Notes

- 1 Peter Waite, Letter to Honourable A.H. Peake, Premier of South Australia, 3 October 1913, in Edgeloe 1984.
- 2 Peter Waite, Letter to Sir Samuel Way, Chancellor of the University of Adelaide, 3 October 1913.
- 3 Indenture between Peter Waite and The University of Adelaide, 29 January 1914.

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- 4 Peter Waite, Letter to the Chancellor, 21 May 1915, in Edgeloe 1984.
 - 5 G. J. R. Murray, Letter to the Chancellor to the Hon. Sir Henry Barwell, Premier of South Australia, 7th August 1923.
 - 6 Urrbrae Fine Sandy Loam has been described as ~73% fine sand and silt pH 5.7-5.9 (0–35 centimetres), 65% clay pH 6.6 (35-75 centimetres), and ~70% clay and silt pH 7- 8.6 (75–175 centimetres) (Litchfield 1951)

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