

The Roles of the Queensland Herbarium and Its Collections

Rod J. F. Henderson¹, Gordon P. Guymer¹ and Paul I. Forster^{1,2}

¹Queensland Herbarium, Environmental Protection Agency, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia
(²e-mail: paul.forster@epa.qld.gov.au)

Abstract The roles of the Queensland Herbarium (BRI) and its collections are outlined together with a brief historical account of its founding and subsequent development to the present day. Established in 1855, the Queensland Herbarium now comprises in excess of 700,000 fully databased botanical specimens. The Queensland Herbarium was one of the first herbaria worldwide to database its collections starting in the 1970's. The Queensland Herbarium (BRI) is the centre for botanical research and information on Queensland flora and vegetation communities, and for plant biodiversity research in Queensland's Environmental Protection Agency (EPA). It is an integral part of the international network of herbaria, which facilitates research on the Queensland flora by national and international researchers. The Herbarium is the principal focus for documenting and monitoring Queensland's rare and threatened plants and plant communities, vegetation and regional ecosystem surveys, mapping and monitoring, plant names, plant distribution and identification, taxonomic and ecological research on plants and plant communities within the state.

Key words: Queensland Herbarium, BRI, Flora.

Introduction

The Queensland Herbarium (BRI) commenced in 1855, when Walter Hill was appointed Superintendent of the Botanic Gardens in Brisbane. The heart of the institution is the herbarium collection which contains more than 700,000 dried and/or liquid-preserved specimens. These specimens form the basis for scientific studies on the naming, distribution, identification and classification of plants, lichens, fungi and algae principally in Queensland but also Australia-wide, the western Pacific, Malesia and south-east Asia. This collection is the world's most comprehensive and hence most important one of tropical Australian plants and is estimated to have a replacement value exceeding \$A25 million. Approximately 30,000 specimens are on loan at any one time to botanists in some 150 scientific institutions world-wide. The label data from the specimens have been databased, thus allowing ready access to relevant information by land managers, consultants, researchers in various government departments and members of the general public.

Research at the Queensland Herbarium aims to document the plant biodiversity of the State. In the past twenty years, staff have described and formally named more than 13 genera and 800 plant species new to science, mainly in the annually published journal *Austrobaileya*; published the three-volume *Flora of South-eastern Queensland*; published many research papers in Australian and international journals; produced many vegetation reports and maps for 72% of the State (1.3 million km²); produced three editions of a census of Queensland native and naturalised plants; contributed taxonomic accounts to the *Flora of Australia* series; published books on

weeds, grasses, waterplants, sedges, rainforests and poisonous plants. Although much has been achieved, hundreds of Queensland plant, fungus, lichen and alga species remain to be formally described, while, no doubt, hundreds of others are yet to be discovered.

The Queensland Herbarium has a major program of surveying and mapping the vegetation communities and regional ecosystems of the State at 1:100,000 scale and providing detailed vegetation and regional ecosystem information both as hard copy and on the web. To date, over 72% of the State has been surveyed and mapped at the 1:100,000 scale. The program has received additional resources over recent years from the State and Natural Heritage Trust to survey and map the vegetation and regional ecosystems of the Brigalow Belt, the Desert Uplands and the Einasleigh Uplands bioregions of Queensland. The Herbarium has been producing high quality vegetation maps and information since the mid-1970s. The survey and mapping includes pre-clearing vegetation coverages, as well as remnant vegetation information for 1995, 1997, 1999 and 2001. Vegetation and regional ecosystem descriptions, statistics, ecology and detailed site data (Corveg database) have also been compiled and made available.

The Queensland Herbarium is also the authority responsible for providing plant names and botanical information relevant to the State including regional ecosystem maps and the conservation status of its rare and threatened species and plant communities. It provides a botanical information and advisory service to government departments, educational institutions, private enterprise organisations and the general public. Staff answer over 5,000 telephone, mail or personal enquiries from a diversity of sources each year. Consultants and commercial companies are charged for this service on a cost-recovery basis. The staff of the Queensland Herbarium in July 2005 numbered 67 comprised of 64 permanent, and three casual officers. Fifty-five of these were based in Toowong, Brisbane, four at the Mareeba office, one at the Mt Isa office, six at the Townsville office in north Queensland, and one at the Gladstone office in central Queensland.

Herbarium and Staff

The history of the Queensland Herbarium, as an institution, dates from 1855, four years before Queensland became a separate Australian colony. In many respects it has a similar history to other major herbaria in Australia (Orchard, 1999), many of which were established in the British colonial period and given the tasks of documenting the local flora and its uses as well as the introduction of economic plants. 2005 marks the 150th celebration of the establishment of the institution which has grown from an initial staff of one botanist to over 60 botanists and associate staff today.

Walter Hill was appointed Superintendent of the Botanic Gardens at what is now known as Gardens Point in central Brisbane (Everist, 1982). At separation in 1859, Hill was appointed Colonial Botanist as well as Director of the Brisbane Botanic Gardens, positions he held until his retirement in 1881. Hill was interested primarily in the introduction of economic plants such as sugarcane and fruit trees but he also collected native plants from many parts of the State. However, he was unable to establish a working herbarium of specimens in Brisbane due to the poor state of the Gardens' buildings and lack of time due to the demands of his other Gardens' activities. He therefore sent most of the plant specimens he obtained to Sir William Hooker and later Sir Joseph Hooker for the herbarium of the Royal Botanic Gardens, Kew, London, England, or to Baron Ferdinand von Mueller for the herbarium of the Royal Botanic Gardens in Melbourne, Victoria. Hill's books, however, were transferred to the Queensland Museum on his retirement and later became the nucleus of the present Queensland Herbarium library.

Frederick Manson Bailey succeeded Hill as Colonial Botanist in 1881 (White, 1950; Everist, 1982). At the time of his appointment, Bailey already had a high reputation as a botanist, was Keeper of the herbarium at the Queensland Museum and was Acting Curator of the Museum as well, then situated in William Street, Brisbane. He held these positions concurrently till 1882. His collection of plant specimens and others of the herbarium of the Queensland Museum, formally established by the Queensland Government in 1874, formed the foundation of the present Queensland Herbarium plant collection. During the ensuing 34 years, this collection was added to assiduously by Bailey and his associates by personal collection over a large part of the State, by correspondence with farmers, graziers and amateur botanists in various parts of the country and by exchange with overseas institutions (Blake, 1954).

One particularly valuable collection sent in 1882 to Bailey by Sir Joseph Hooker, then Director of the Royal Botanic Gardens at Kew, was a partial set of the Australian plant specimens collected by Robert Brown, the Scottish surgeon/botanist who circumnavigated Australia with Matthew Flinders in HMS *Investigator* during the period 1801–1803, and who studied the flora of south eastern Australia till 1805. Later, Bailey received from the British Museum in London a selection of duplicate specimens collected by Sir Joseph Banks and Dr Daniel Solander in New Zealand and eastern Australia in 1769–1770 when they accompanied Captain Cook on his voyage of discovery in HMS *Endeavour*. In 1887, Bailey was transferred from the Queensland Museum to the newly established Department of Agriculture, later to become the Department of Agriculture and Stock (and still later the Department of Primary Industries, DPI), joining the Under Secretary (Mr P. McLean) and the Clerk (Mr E.G. Scriven) as the third permanent member of the staff of that Department. He and the herbarium specimens and books, however, stayed at the Queensland Museum until 1889. Bailey remained Colonial Botanist until his death in 1915. A decision to retire him and abolish the position in 1902 following Federation and the setting up of Queensland as a separate State, was reversed under pressure from an outspoken public and Bailey's flat refusal to stop work, whether he was paid or not. During his term of office, Bailey produced his *Synopsis of the Queensland Flora* (1883) and its three supplements, the *Queensland Flora* (in 6 volumes, 1899–1902) and the *Comprehensive Catalogue of Queensland Plants* (1913), as well as many other scientific and popular works. On his death in 1915, F.M. Bailey was succeeded in his role for a short time by his son, John Frederick Bailey, who was then Curator of the Brisbane Botanic Gardens, at Gardens Point (Everist, 1982). This is where the Queensland Herbarium was then situated. John Bailey, in replacing his father, was appointed as Government Botanist. On leaving Brisbane early in 1917 to take charge of the Adelaide Botanic Garden, he was succeeded as Government Botanist shortly afterwards by his nephew, Cyril Tenison White, who had been assisting his grandfather F.M. Bailey for several years.

For 33 years, until his untimely death in 1950, C.T. White filled this position with great distinction (Blake, 1952; Everist, 1982). White was an energetic field botanist and plant collector with the capacity to inspire enthusiasm in other people. He pursued a vigorous policy of expansion in the Herbarium by conducting or organising collecting expeditions in Australia, New Guinea, the Solomon Islands, the New Hebrides (now Vanuatu) and New Caledonia, and by exchange with overseas institutions. White continued and expanded Bailey's work on economic botany, including study of native fodder plants, poisonous plants and weeds. He was the first Queensland botanist to be appointed to the position of Australian Botanical Liaison Officer, The Herbarium, Royal Botanic Gardens, Kew, England, in 1939, a position still filled by Australian botanists on an annual basis to this day.

In 1930, Charles E. Hubbard, then a young grass specialist from Kew, spent a year in

Queensland on exchange with William D. Francis, White's assistant, who spent the year working at Kew. Hubbard's influence on Queensland botany was tremendous. His enthusiasm for grasses was infectious. Largely as a result of his work and example, the grass collection of the Queensland Herbarium was enriched enormously and future grass specialists such as Stanley T. Blake were guided into this field of work.

William Francis succeeded White as Government Botanist in 1950 and held office until his retirement in 1954 (Everist, 1982). He had already published the authoritative work *Australian Rainforest Trees* and was particularly interested in poisonous plants. Francis began his career as a farmer in the Kin Kin area of south-eastern Queensland where, after return from World War 1 in 1918, his interest in the identity of rainforest plants developed while helping clear land for dairy farming. He joined the staff of the Queensland Herbarium in 1919.

Francis was followed in the position of Government Botanist by Selwyn (Sel) L. Everist who was appointed to it in 1954. In 1971, this position was redesignated Director of Botany Branch and The Queensland Herbarium, a position Everist held till his retirement in 1976. He had joined the Queensland Public Service in 1929 as a cadet clerk, gaining his Bachelor of Science degree from the University of Queensland in 1936. In the following year he was appointed botanist at Blackall where he studied the degradation of drought-affected Mitchell grass pastures. After return from a four-year stint as a Meteorological Officer with the Royal Australian Air Force during World War 2, he spent many years studying plants/stock interactions. This resulted in production of several important agricultural reference books on fodder trees and stock poisoning culminating in his *Poisonous Plants of Australia* in 1974, with a second edition in 1981. Everist also investigated methods of control of brigalow (*Acacia harpophylla*) scrub. He began this work in 1939 and it became the basis of later investigations by Robert W. Johnson, the results of which were used in commercial control of brigalow in the Fitzroy River Basin Brigalow Land Development Scheme and other areas. As a result of his work on poisonous plants, trees edible for stock, native pastures and weeds, Selwyn Everist gained an honorary doctorate from the University of Queensland for his contributions to primary industries in Queensland. During his time, the Government changed the name of the Department from the Department of Agriculture and Stock to the Department of Primary Industries (DPI).

Robert (Bob) W. Johnson took over as Director of Botany Branch and The Queensland Herbarium, DPI, in mid-1976. He had previously spent many years in Botany Branch investigating clearing and control of brigalow, especially while stationed as Officer-in-Charge at the DPI Brigalow Research Station near Theodore in central Queensland.

During his time as Director, Bob Johnson oversaw the computerisation of label data from the specimens, an ambitious project conceived and commenced by Sel Everist in the early 1970's. This established the Queensland Herbarium as one of only two in the world at that time with this facility (Johnson, 1991). Dr Johnson also maintained a strong interest in improving the professional image of botanists. During his 14 years as Director, the three volume *Flora of South-eastern Queensland* was published as were a number of vegetation survey and mapping reports. The taxonomic journal *Austrobaileya* was launched in 1977 and continues today after 26 issues incorporating 4346 pages of text comprising 376 papers and notes with the description of 13 genera and over 800 species and infraspecific taxa. Bob Johnson retired in mid-1990 but continues as a research associate of the herbarium.

Following a review of DPI by the Queensland Government Public Sector Management Commission, Botany Branch was transferred administratively in August 1992 to the then Department of Environment and Heritage (DEH), as part of the Conservation Strategy Branch of that Depart-

ment. However, the institution remained intact but officially leaderless and without an official name while the structure of the enlarged DEH was considered. At this time, the title of the institution was unofficially shortened to The Queensland Herbarium only. It had been granted the internationally recognised acronym designation BRI by the International Association for Plant Taxonomy in the 1950's though the title Queensland Herbarium was first listed only in edition 6 of the international Index Herbariorum, in October 1974. It still retains that internationally recognised acronym even though the name Queensland Herbarium is currently not officially recognised.

The period of leadership uncertainty came to an end in January 1994 when Dr Gordon P. Guymer was appointed Chief Botanist to head what is now an institution of multifaceted activities. Its main role is guardianship of the collection, identification/naming and preservation of specimens of Queensland's plants, fungi, algae and lichens, survey and mapping of the vegetation of this State and studies on and identification of its rare and threatened plant species and plant communities. It also provides expert scientific and technical advice relevant to Queensland's plants and vegetation to multifarious clients. In 1996, with another change in State government, the Department's name was shortened to the Department of Environment (DoE), but this reverted to the Department of Environment and Heritage (DEH) briefly in 1998 with yet another change in State government. In December 1998, the new State government formally abandoned the departmental name Environment and Heritage and reorganised the department to set up the state Environmental Protection Agency (EPA) which includes the Queensland Parks and Wildlife Service (QPWS). The Queensland Herbarium's subsequent official name is the Biodiversity Sciences Unit of the EPA's Division of Environmental Sciences.

In the 125 years or so since the Herbarium was established, the number of plant specimens has grown to a total of more than 700,000. Most of these are from Queensland, although there are significant collections from New Guinea (over 80,000 specimens), elsewhere in Australia, the western Pacific, Malesia and south-east Asia. The collections represent original data that can never be replaced or gathered again, providing confirmable evidence for the existence of particular individual organisms and species at particular points in space and time.

Library

Walter Hill laid the foundation for the botanical library when, in 1860, he sent to Sir William Hooker, Director of the Royal Botanic Gardens, Kew, England, a sum of £100 provided by the Queensland government of the day for the purchase of books. For several years, Hooker and his successor, his son Sir Joseph Hooker, used this money wisely to purchase books for BRI, and many of the rare and valuable works now in the library were purchased by them. Many of these books are still in regular use here. Control of the library passed from BRI botanists' hands in the late 1960's when it became part of the DPI library and was managed full-time by DPI library staff. The library collection, however, remained physically with BRI as it is a resource indispensable for BRI functioning. This situation continued until BRI was transferred to DEH in 1992. At that time, whereas the library collection was transferred to DEH with the Queensland Herbarium, no library staff or position was transferred. It then became the responsibility of BRI to once again attend to library matters as best as could be done. Since then, with funds from various sources, a succession of part-time or temporary library staff attended to library matters until a permanent library technician position was created in 1999. All the while, the botanical library, begun over 140 years ago, has continued to grow and now contains approximately 8,500 mono-

graphs, 800 periodical titles, and a microfiche collection of rare botanical reference works and critical contents of historical European herbaria collections. The Queensland Herbarium Library is primarily a working resource centre for current staff and honorary associates.

HERBRECS (Specimen Label Information Database)

In 1971, Selwyn Everist had an automatic tape-punching typewriter installed in the Indooroopilly building to enable rapid production of herbarium specimen labels. While doing this, it also produced a computer-readable paper tape of this label information. The information on this paper tape was then transferred to magnetic tape and stored at the Queensland Treasury Department's Electronic Data Processing (EDP) Centre, now separate from Treasury Department and known as CITEC. This was the beginning of what has become the Queensland Herbarium's present-day HERBRECS database, an ever-increasing database of information relative to Queensland's plants, fungi, algae and lichens, their associations and where they occur (Fig. 1).

In 1982, the data from these magnetic tapes were transferred to a purpose-designed database on a computer located at the Department of Primary Industries' Indooroopilly complex. This allowed, for the first time, direct on-line queries of data relevant to specimens in the Queensland Herbarium collection.

In 1990, the database was converted to the ORACLE database management system. This allowed for even greater versatility in querying the data. This version of the HERBRECS database remained essentially unchanged until September 1994, though it had been moved physically through several different host computers, all administered by the Department of Primary Industries. By this time, the Queensland Herbarium had been transferred administratively to the Department of Environment and Heritage.

In late 1994, the database was transferred to an in-house computer system within the Indooroopilly building. In May 1998, the computer with the HERBRECS database, along with other sections of the Queensland Herbarium, was moved physically to the new herbarium building at the Brisbane Botanic Gardens Mt Coot-tha in Toowong where a new and bigger network for querying the data was set up. The database structure had received only minor enhancements since 1990 but in 2000, a project was commenced to upgrade HERBRECS. This included updating to a currently supported version of ORACLE, modifications to how locational information data are handled, and the inclusion of textual label information.

The latter has been aided by external funding from Australia's Virtual Herbarium project (<http://www.chah.gov.au/avh/>), which aims to pool herbarium specimen label information Australia wide and make it available on the Internet. This allows for capture of textual label information from existing herbarium records in the Queensland Herbarium collection related to plant groups of high national interest.

Housing of the Library and the Herbarium Collections

During its long history, the library of the Queensland Herbarium has been housed in six places and the herbarium collection in five. Walter Hill kept the books he acquired in his cottage at the gardens at the eastern end of George Street, Brisbane city. When Frederick Manson Bailey succeeded him as Colonial Botanist in 1881, the books were transferred into Bailey's care at the Queensland Museum which was then in William Street, Brisbane city, opposite the Queens Gardens. In 1889, Bailey moved physically from the Museum to the adjacent Department of Agricul-

collection and library remained in the City Botanic Gardens until mid-1968, when they were moved to a new building in the DPI Agricultural Research Laboratories complex at Indooroopilly. From April 1998, the collection and library were again moved, this time to the present site in the Brisbane Botanic Gardens Mt Coot-tha in Toowong.

The Botanic Museum and Herbarium ceased to have any official connection with the Brisbane Botanic Gardens in 1925, when responsibility for the gardens was transferred to the Brisbane City Council. The building they occupied, however, remained within the precincts of the gardens, although the land on which it stood was gazetted as a reserve separate from the Reserve for Botanic Gardens. It was demolished in 1972 to make way for the new QUT Conservatorium of Music building which was later incorporated into the QUT student services complex when the Conservatorium of Music moved to South Bank to become the Queensland Conservatorium of Music. The building at Indooroopilly used to house most of the Queensland Herbarium (BRI) collection was designed to serve various functions. On the ground floor were offices, an identification laboratory, preparations room, store rooms and library.

On that floor, the day-to-day work of identification was carried out using references in the library and a reference set of Queensland's plant specimens stored in cupboards lining the corridor opposite the laboratory. Incoming plant specimens for the BRI collection were dried, mounted and labelled then sterilised, at first by fumigation with methyl bromide but later by a less-dangerous freezing procedure, before being filed in an alphabetical systematic order in the herbarium. The library occupied a considerable portion of the space on this floor. On the upper floor was the main herbarium with a storage capacity of about 350,000 specimens and six research rooms including the Chief Botanist's office. Only the main herbarium room in this building was air-conditioned and that was maintained at 21 °C and 50% relative humidity. Specimens were stored in brown-paper folders on steel shelving in mobile units, which closed up to reduce non-functional passage space and to prevent accidental damage to the material. This building quickly became too small to cope with the demands for storage and work-space for ever-increasing botanical and ecological work being undertaken in the institution. In 1987, an annexe building was constructed on an available site close-by to the main herbarium building and to it was transferred the BRI collection of exotic, lower plant, fern and sedge specimens totalling some 220,000 sheets. In 1994, a demountable building was erected in the eastern car-parking area of the main herbarium building and some staff transferred to it to undertake work on their various projects. This later became home for BRI's Geographical Information System section. In 1997, with funds from the Commonwealth Government for vegetation survey and mapping projects in Queensland, the dis-used DPI Seed Store at Indooroopilly was refurbished for working space for the various vegetation-mapping teams and other staff.

In 1997, work commenced on construction of a new, fully air-conditioned building in Toowong to house the Queensland Herbarium, its collection, library and staff. Construction of this building was completed in March 1998 and over the following months, transfer of all components of the Queensland Herbarium to it was effected. The building at Toowong occupies a 50-year leased parcel of Brisbane City Council land in the Brisbane Botanic Gardens Mt Coot-tha. The total floor area of this building is 3500 square metres that compares with 900 square metres available in the Indooroopilly main herbarium building or the total of 1200 square metres eventually occupied by the Queensland Herbarium at the Indooroopilly site. The collection floor area is two and a half times larger than that available for the collection at the Indooroopilly site allowing for accommodation of up to one million plant specimens in a phylogenetic systematic order in specifically designed, distinctively coloured plastic boxes housed in mostly free-standing storage

units. The non-vascular plant, alga, lichen and fungus specimens, in packets or boxes, and specimens of ferns and conifers and allies in folders, are housed in adjacent compact units. Quarantine of the collection from insect infestations is maintained by treatment of incoming material by freezing, suitable low humidity levels, and regular inspections of material. Facilities additional to the increased herbarium storage areas, staff work rooms, library and administration areas at the Toowong site include a molecular/systematics laboratory, a plant ecology laboratory, a geographic information system laboratory, a public client work area for plant identification and the F.M. Bailey Conference Room.

Summary of the Modern Roles of the Queensland Herbarium and Its Collections

The Queensland Herbarium and its staff aim to improve botanical and vegetation knowledge and information, and deliver this to support decision-making and management by government, the community and industry for a sustainable future. Discover, research and document plant, fungus, lichen and alga species and vegetation communities. Ensure clients are provided with accurate, appropriate and timely information in accessible forms. Enhance and maintain the State's principal herbarium collections, vegetation maps and databases. Develop further regional, national and international cooperative partnerships.

References

- Blake, S. T., 1952. Cyril Tenison White, 1890–1950. *Proc. Roy. Soc. Queensland*, **62**: 35–48.
- Blake, S. T., 1954. Some pioneers in plant exploration and classification. *Proc. Roy. Soc. Queensland*, **66**: 1–19.
- Everist, S. L., 1982. History of the Queensland Herbarium and botanical library, 1855 to 1976. *Austrobaileya*, **1**: 429–445.
- Johnson, R. W., 1991. HERBRECS—the Queensland Herbarium records system—its development and use. *Taxon* **40**: 285–300.
- Orchard, A. E., 1999. A history of systematic botany in Australia. In A.E. Orchard (ed.), *Flora of Australia*, 2nd ed. Vol. 1, pp. 11–103, ABRS/CSIRO Australia, Melbourne.
- White, C. T., 1950. F. M. Bailey: his life and work. *Proc. Roy. Soc. Queensland*, **61**: 105–114.