Gardenwise

The Magazine of the Singapore Botanic Gardens · Volume 53 · August 2019 · ISSN 0129-1688

Gardenwise

Volume 53 · August 2019

Articles

Regular Features

Cover
Papilionanthe Singapore Golden Jubilee, one of numerous orchid hybrids created by David Lim. It was named in 2015 in celebration of Singapore's 50th birthday. *(Photo credit: David Lim)*

Editors
Ada Davis, Nigel P. Taylor

Production Managers
Ada Davis, Christina Soh

Design
Photoplates Pte Ltd

Singapore Botanic Gardens
1 Cluny Road, Singapore 259569
National Parks Board

nparks_sbg_visitor_services@nparks.gov.sg
www.sbg.org.sg
www.nparks.gov.sg

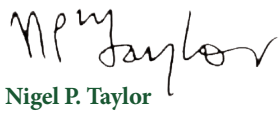
Opposite page
Ang Wee Foong, Centre Director of the Gardens' Seed Bank, sharing about the process of seed banking with Mr Desmond Lee, Minister for Social and Family Development and Second Minister for National Development.

Group Direction

2019, the Botanic Gardens' 160th anniversary year, is proving to be every bit as special as we hoped. In late April and early May our staff were involved with other NParks divisions in mounting the first modern competitive horticultural show in conjunction with the launch of Lakeside Garden at Jurong Lake Gardens and under the banner of the Singapore Garden Festival (SGF). This, in a sense, is the continuation of a tradition begun in 1862, when the Agri-Horticultural Society that originally founded the Gardens held its first flower show at the Esplanade. On 13 July we launched our annual nine-day Heritage Festival with the opening of the Gardens' Seed Bank, a major milestone in our history, a significant contribution towards the *ex situ* conservation of genetic diversity of Singapore's and the Southeast Asian flora, and an educational facility open to the public. Later this year we will be opening the 8-hectare Gallop extension, with its Forest Discovery Centre, gallery of botanical art and OCBC Arboretum, a further *ex situ* conservation programme for this key Southeast Asian family of forest trees, the Dipterocarpaceae, comprising some 200 species from the region. And 2019 will conclude with the opening of enhancements at the National Orchid Garden and associated SGF Orchid Show, both much anticipated. Another redevelopment reported on in this issue of *Gardenwise* (pp. 10–15) is that of the Potting Yard, an historic but vital behind-the-scenes facility supporting our scientific research.

We open this issue, however, with a celebration of the life of one of the Gardens' greatest horticulturists, David Lim Hock Lye or Uncle David as we all knew him, who passed away suddenly last December (a brief notice about his passing was published in our last issue). David's exceptional skill at breeding new orchid hybrids has left an important legacy for the Gardens and they continue to be favourites for naming in honour of visiting heads of state. Orchids, as naturally occurring species, also feature amongst our ongoing conservation efforts, focused on the reintroduction and reinforcement *in situ* of these rare examples of Singapore's flora (pp. 26–27). Members of the Pea family, Fabaceae, feature in contrasting ways – first as poisons not to be trifled with, though many are edible if prepared correctly, and second, the surprisingly versatile colours of the Blue Pea, which is often used as a food colourant (pp. 19–21 & 34–35). We also continue to look at the genus *Dracaena*, including various kinds of dragon trees (pp. 16–18), both local and exotic, while our now regular instalments on the fungus kingdom this time focuses on the fascinating relationships between these non-plants and termites (pp. 32–33). Our first Director, Henry Ridley, gets a further mention for his correspondence and meeting with the great Italian botanist Beccari (pp. 24–25). Ridley was perhaps the most important contributor to our SING Herbarium, whose collections and purpose are explained in 'From the Taxonomy Corner' (pp. 28–30).

In the eight years I have been experiencing Singapore's weather, its behaviour seems to have become increasingly unpredictable, with a greater frequency (whether perceived or imagined) of violent storms and extended droughts. While these may give our arborists and horticulturists more challenges, they can also bring much appreciated flowering events, as reported on pp. 38–39. Drought also affects the water levels in our lakes, as we saw earlier this year with the Eco-Lake. I wonder how many can remember what its predecessor looked like in the 1980s, when the Bukit Timah Core was first opened to visitors (see rear cover)?



Nigel P. Taylor
Group Director
Singapore Botanic Gardens

The life and legacy of David Lim Hock Lye, venerated orchid breeder and polymath

David Lim holding *Aranda* Lee Kuan Yew (*Arachnis hookeriana* × *Vanda* Golden Moon) in the National Orchid Garden in 2015. *(Photo credit: NParks)*

David Lim: early life and a budding orchid hobby

David Lim was born on 26 October 1945 in Singapore and grew up in the Telok Kurau area. At the age of 20, David started his first job at a shipping company. It was during that period that he met, and would later marry, Ame Han at a soya bean stall near a record store where she worked. David and Ame went on to have two children, Jerome and Casandra, and three grandchildren, Javier, Michelle and Juliette Lim.

When David was growing up, his mother used to grow floribunda roses. Having developed a love for these plants, he decided to try his hand at growing roses. He started importing hybrid tea roses from New Zealand and the United Kingdom but found that they were not suitable for the weather in Singapore. In 1961, David's schoolmate made a trip to Kuching, Sarawak, and posted 10 bare-rooted orchids back to David. Although some plants from that batch died, one finally flowered and enchanted David with its scent. The orchid turned out to be a *Phalaenopsis bellina*. That was the moment David fell in love with orchids and although his career path ahead sometimes led him on a tangent[1], he finally found his way back home.

Over the course of his career, he would come to know people like George Alphonso and Ang Gek Choo, and would even exchange plants and pollen with them. When he first started growing orchids, he had no knowledge on the subject at all and the books that he read contained information on growing only temperate plants – there were no books written by growers in tropical countries. David had to start from scratch, kill a few plants, succeed or fail at times, and learn a great deal from more experienced growers. He started learning a lot when he became a close friend of Syed Yusof Alsagoff and joined the Orchid Society of South East Asia (OSSEA) in the early 1970s. Between the 1970s and 80s, David served as a committee member for the Society and a member of the editorial board of the *Malayan Orchid Review*, a journal published by OSSEA. David became an orchid show judge in 1978 and continued to serve as a judge to the end. Being an active member of OSSEA, David would attend monthly meetings with his family, and in his later years, with his grandchildren. Ame would contribute regularly to the afternoon tea associated with each meeting.

Credit goes to Mr Alsagoff for sparking David's interest in orchid breeding. David was so immersed in his hobby that he even tried his hand at *in vitro* seed germination – he used empty milk bottles made of

[1] David has been an electrician, a shipping clerk, the owner of a lighterage and stevedore firm, an air-conditioning company and even a satay stall at Raffles Hotel!

***Spathoglottis* Monira Iqbal (*Spathoglottis* Rolita × *Spa. kimballiana*) was registered by David in 2011. David began experimenting with hybridising *Spathoglottis* while he had his farm, David Lim Orchids.**

glass to contain the nutrient media required for germination. However, he had a problem with a high rate of contamination. He then made friends at the Singapore Botanic Gardens and learned the finer details of the aseptic germination technique. He bought a pressure cooker for sterilising his media and equipment and built a chamber for aseptic work using a fish tank, silicone glue and a plastic sheet. The contamination rate of his cultures then dropped dramatically. He finally got himself a laminar flow hood when he started his own orchid nursery in 1983.

During these early years, David won six High Commendation Certificates (HCC's) between 1975 and 1982, the first of which was for *Phalaenopsis valentinii* 'Casandra Lim' in 1975, and one Award of Botanical Merit (ABM) for *Phal. amboinensis* 'Jerome Lim' in 1981.

David registered his first hybrid, *Phalaenopsis* David Lim, in 1974. The hybrid's originator was Syed Yusof Alsagoff.

David Lim Orchids, 1983–1996

As his orchid collection continued to grow, David decided to open his own farm in the Seletar area, which he named David Lim Orchids. The farm was a two-hectare plot of land with a 15-year lease. Being a polymath, David also bred Shetland Sheepdogs at his farm and grew a wide collection of roses, hibiscus and tropical fruit trees.

His orchid hybrid registration record took off in 1984 when he registered 11 hybrids within that year. Some notable ones were *Phalaenopsis* Ame Lim, *Phal.* Casandra Lim and *Phal.* Jerome Lim, along with *Phal.* Amber Delite for which he won the Eric Holttum Gold Medal Award in 1987.

In 1986, he registered another five hybrids, amongst them *Phal.* Peggy Tan. Between 1983 and 1996, David registered and/or originated a total of 90 hybrids. This was a period when David would push himself in experimenting with hybridising a wide range of orchid genera including *Dendrobium*, *Spathoglottis*, and those of the *Cattleya* and *Vanda* alliances.

David's first *Trichocentrum* hybrid, *Trichocentrum* Jerome Lim, was registered in 1991. This was also the year he originated his first *Dendrobium* hybrid, *Den*. Ngo Ding Neo; his first registered *Dendrobium* hybrid was *Den*. Stripes Delite, in 1984. In 1993, David originated and registered his first of only two *Pararenanthera* hybrids that he would ever produce, *Pararenanthera* Wendy Ngo. His first *Spathoglottis* hybrids were registered in 1994, amongst them *Spa*. Garden City

and *Spa*. Seletar Park. David's first and only *Rhyncholaeliocattleya* hybrid, *Rlc*. Adeline Chan Yimfong, was also registered in 1994. The following year, David registered the only *Parastylis* hybrid that he would produce, *Parastylis* Seletar Jewel. His only *Paraphalaenopsis* hybrid, *Pps.* Vanessa Martin, was registered in 1996.

David won many awards for his orchids, including HCC's for *Phalaenopsis* Sweet Memory 'Ame Lim' in 1990, *Phal*. Teo Tee Teong 'David Lim' and *Dendrobium* John Crane 'Star Sapphire' in 1991, *Vascostylis* Blue Haze 'Shavin' in 1992 and *Phal*. Seletar Tiger 'Hot Chocolate' in 1994. He also won the Vivian Bath Challenge Cup for Best Local Species for his *Phal. violacea* and the John Lam Challenge Cup for Best Foreign Hybrid for his *Phal*. Lanzac (both exhibited by Ame Lim) at the 1987 Singapore Orchid Show.

Sadly, the lease on David's farm land came to an end and he decided to wind up his business.

Mandai Orchid Gardens, 1996–2008

Following the closure of his farm, David joined Mandai Orchid Gardens (MOG; now closed also) as its General Manager, overseeing 10 hectares of landscaped orchid gardens. During this period, he worked closely with Amy Ede, the adoptive daughter of John Laycock, one of the founding members of the Malayan Orchid Society in 1928, now known as the Orchid Society of South East Asia. John Laycock set up MOG in 1951 and Amy's involvement with the garden began in 1953 when she married John Ede. They would take over management of MOG, under the company Singapore Orchids Pte Ltd, from 1960 until its sale to Heah Hock Heng in 2003. MOG finally shuttered in 2011, on the expiration of its land lease. MOG possessed many important heritage orchid hybrids which would have been lost if not for David's intervention before he left MOG and in his next job as Manager at the National Orchid Garden (NOG) at the Singapore Botanic Gardens. Says Dr Emrys Chew (past Editor of the *Malayan Orchid Review*, past Committee Member of OSSEA, and orchid hobbyist and breeder), who referred to David as 'MOG's conservator-in-chief', 'Before he left Mandai, in his last days as Manager, he had already started selecting and selling to me, Ah Hong (Neo Tuan Hong), J.B. Tay and Toh Garden, some of the best plants from MOG. I bought *Papilionanda* John Ede and *Sealara* David Marshall at reasonable clearance prices, and more were acquired by the others because we were the ones he could trust to value these old plants. The very best he acquired for NOG via his successor at MOG, Hedrick Kwan.'

David was awarded an Award of Merit (AM) for his *Phalaenopsis* Amber Delite 'Benjamin' in 1987 and again for his *Dendrobium* Toh Garden 'Ame Lim' in 2005. During the Singapore Orchid Show in 2006, he won the following cups: (i) Koh Cheng Kiang Challenge Cup for Best Terete *Vanda*, for his Vanda (now *Papilionanthe*) Miss Joaquim 'Douglas'; (ii) Tan Hoon Siang Challenge Cup for best Vanda Tan Chay Yan or similar, for his Vanda (now *Papilionanda*) Tan Chin Tuan; and (iii) Yeoh Bok Choon Challenge Cup for Best *Arachnis* Species, for his *Vandachnis* Woo Cheng Ee.

In 2006, during his time at MOG, David made a cross between *Papilionanthe* Miss Joaquim and *Vanchoanthe* Alexander Choo Weiwen. The seeds were germinated at MOG and the seedlings remained there. When MOG was winding up its business, many of its orchids were sold off, and amongst them were the seedlings of David's cross. The hybrid found its way to Toh Garden, and it was from there that Dr Emrys Chew obtained a top cutting which he brought to OSSEA's monthly meeting for display when it flowered, in the hope that someone at the meeting might be able to identify it. David immediately recognised his hybrid and informed Emrys of the identity of its parents. He also requested for the right to name the hybrid, which Emrys acceded to. David named this hybrid *Vanchoanthe* Michelle Lim, after his then 5-year old granddaughter, and registered the hybrid in 2012. *Vanchoanthe* Michelle Lim has been dubbed the blue *Papilionanthe* Miss Joaquim, referencing the former hybrid's remarkable likeness in form to the latter and additionally, its attractive and prized blue colouration.

Singapore Botanic Gardens, 2008–2018

David commenced work at the National Orchid Garden (NOG) in 2008. Over the decade spent at NOG, David produced many orchid hybrids through the Gardens' Orchid Breeding Programme. These orchids were named for visiting heads-of-state, dignitaries, organisations, and also to commemorate important events. David remains listed as the originator of some of those hybrids including *Papilionanda* Ban Ki-moon Yoo Soon-taek (2012), *Dendrobium* UNESCO (2014), *Papilionanda* David Cameron (2015), *Papilionanthe* Singapore Golden Jubilee (2015), *Papilionanda* Khaw Boon Wan (2015), *Den*. Barack and Michelle Obama (2016), *Papilionanda* Aung San Suu Kyi (2016) and *Den*. Francois Hollande (2017). David is perhaps best known by Singaporeans for his hybrid, *Aranda* Lee Kuan Yew, named in honour of Singapore's founding Prime Minister, when he passed away in 2015. It was a proud moment for David as he made the cross in 2007, only for it to flower for the first time, just in time to be named and presented to Singapore's Prime Minister, Mr Lee Hsien Loong and his family. The hybrid was displayed at Parliament House and various community sites where Singaporeans went to pay their respects to Mr Lee in the week leading up to his funeral.

At NOG, David continued to develop on his attempts at producing blue orchids, after achieving considerable success with *Vanchoanthe* Michelle Lim. Further experiments with other genera

(Left) ***Papilionanda*** **Ban Ki-moon Yoo Soon-taek (*Papilionanda* Mamo × *Vanda* Robert's Delight), and (right)** ***Dendrobium*** **UNESCO (*Dendrobium* Eleanor Chan × *Den.* Genting Blue).**

(Left and right) ***Papilionanthe*** **Singapore Golden Jubilee (*Papilionanthe* Snowdon × *Ple.* Pojo).**

(Left and right) *Aranda* Lee Kuan Yew was named for the nation's founding Prime Minister in 2015; it was displayed at the Gardens' tribute site set up for Singaporeans to pay their respects to Mr Lee following his passing.

***Vanchoanthe* Michelle Lim (*Papilionanthe* Miss Joaquim × *Vanchoanthe* Alexander Choo Weiwen)**

would produce *Papilionanda* Chinlili, named for Chin Li Li, a colleague who works at SBG's Micropropagation Laboratory, and registered in 2013.

David produced the world's first *Arundina* hybrid in 2011 which flowered a mere one year after its seeds were sown in the Micropropagation Lab. This hybrid was named *Arundina* Singapore Botanic Gardens. Further efforts to breed a blue *Arundina* produced intermediates, one of which David registered as *Arundina* Naomi Sivanandan in 2013, for this author's daughter.

David was awarded an AM in 2013 for his *Dendrobium* Margaret Thatcher 'Iron Lady' and received a Master Hybridiser award for this hybrid at the Singapore Orchid Ball in the same year. This same hybrid won David his second Eric Holttum Gold Medal Award in 2014.

(Left) *Arundina* Singapore Botanic Gardens, the world's first *Arundina* hybrid. David created it by crossing two *Arundina* species, (top right) *Arundina graminifolia* and (bottom right) *Ar. caespitosa*.

David produced his first *Aranda* hybrid, *Aranda* Abdul Halim Mu'adzam Shah, which was registered by the Singapore Botanic Gardens in 2014. He would create two more *Aranda* hybrids while at NOG, the iconic *Aranda* Lee Kuan Yew, and *Aranda* Super Red.

Throughout his orchid hybridising career, he had a penchant for using species orchids as one or both parents. He believed that this would produce more robust hybrids which would better withstand the growing conditions in Singapore.

David never shied away from using modern techniques to better understand his orchids. He worked closely with the Molecular Biology Laboratory at the Gardens to confirm the parentage of hybrids, the identity of species and the chromosome numbers of some of his stud plants. I had many a conversation with him which would start with him gently asking, 'Doctor, have you sequenced the DNA yet?'.

David and I co-authored several articles. I recall many a time when I would sit with him and essentially interview him to get information for an article. Such collaboration resulted in eight articles published between 2012 and 2016, on topics covering *Arundina* Singapore Botanic Gardens, *Vanchoanthe* Michelle Lim, breeding blue orchids, *Aranda* breeding, and also on genera such as *Dracula* and *Papilionanthe*.

Remembering David Lim

"Uncle David was loved by all and remains fondly remembered. He lived by his beliefs that one should "listen more and talk less" and "do unto others as you would have them do unto you". He was indeed a man of action and few words.

His hobbies included photography, teddy bear making, beading, but most of all, botany!" *– Lim family*

"Uncle David was an orchid expert par excellence. He has raised the standard of orchidology in Singapore through his extensive knowledge on orchid species and hybrids, and deep expertise in breeding. He was committed to establishing the Singapore Botanic Gardens as the centre of orchid breeding in the region. He helped the Gardens to build a valuable orchid germplasm for breeding and display. This included the *Aranda* Lee Kuan Yew, a breakthrough for *Aranda* in having green and yellow with large size flowers. He believed that the Gardens could compete with the very best in the region, and led the way by helping the Gardens to win eight Challenge Cups in the Singapore Orchid Show 2016. He was a mentor to many staff and colleagues, and has helped to groom a young team of orchid growers and breeders. He was a passionate and wonderful man, who has left an indelible mark on the orchid world."
– Kenneth Er, CEO of National Parks Board

"As a fellow member of OSSEA with David, I became acquainted with David and his wife, Ame. I admired his orchid hybridisation work, and when the opportunity arose, engaged him as a member of the Orchid Team in the Singapore Botanic Gardens.

David contributed greatly in curating and adding to the orchid collection of the Gardens, and became noted for his hybrids that were named in honour of the Gardens' VIPs.

David's passing was a tragic loss, not only to the orchid world, but personally as a good friend. His gentle manner and generous nature had endeared him to his colleagues, and his passing grieved us all. His memory will endure through his beautiful legacy of orchid hybrids that he left for all to enjoy. I join his friends in extending our affection and sympathies to his wife and family."
– Dr Kiat W. Tan, Founding CEO of Gardens by the Bay, first CEO of National Parks Board and past Director of Singapore Botanic Gardens

"I have known David for almost as long as I have been a member of OSSEA, which means nearly 40 years. For the longest time, I have noted and appreciated his endearing helpfulness, his wisdom and humility. In the "old days" when OSSEA had to participate in shows which stretched out for long hours over quite a few days – and our Volunteer Brigade had not yet existed – we had to rely on old stalwarts like David to help guard the exhibits, though fortunately we didn't have anything to sell. One particular show held in the 1980s at Takashimaya Square remained in my memory. It was David and Ame roaring up in their motorcycle every day, parking in the basement of the shopping centre and, without any fuss, stationed themselves by the showy orchid plants. It was quite typical of David and Ame to give of their valuable time, in their usual quiet way.

What also stood out was his quiet sense of humour, delivered in the most unique and hilariously deadpanned way. Once, he mentioned that during a time spent training officers in a Laotian botanic garden, he had to shower every morning in cold 9°C water. He only discovered the hot water switch many days later, when he was about to leave! When he was given a packet of food for lunch whilst out in the fields, he searched about for cutlery, only to discover his companions using their hands to eat. Often it's not what he said but the way he said it that was insanely funny. One cannot help but feel that embedded in his mild and soft-spoken manner, there lurked a deeply philosophical and all-knowing, impassioned and compassionate man. A man who touched everyone who has met him, and who brought out the best in each of us." *– Peggy Tan, past President of OSSEA*

"I came to know David during the 1970s because of our mutual interest in *Phalaenopsis*. David and I also shared an interest in koi, and David helped to design a koi pond for me. In 1978, we authored a paper entitled 'Three Popular Malaysian *Phalaenopsis* Species' that was published in *Orchids*, a publication that I edited for OSSEA to mark its Golden Anniversary. David collected many local species, among them *Phalaenopsis amboinensis* which he used to produce his award-winning Phals. David was a true professional and man of many talents." *– Dr Teoh Eng Soon, Gynaecologist, and past President of OSSEA*

David Lim in Hawaii, in search of a pure *Papilionanthe tricuspidata*. He had asked this author to sequence the DNA of a supposed *Ple. tricuspidata* prior to this trip which turned out to be a hybrid. Unfortunately, this plant that he is pictured holding was sequenced on his return to Singapore and turned out to be a hybrid too.

The legacy of David Lim

In all, David's orchid growing journey spanned a productive 57 years. He is the fourth[2] most prolific orchid breeder in Singapore, having been listed as the originator and/or registrant of 156 hybrids, winning the Tan Hoon Siang Master Hybridiser award in 2003, the Eric Holttum Gold Medal Awards in 1987 and 2014, and accruing a total of three Awards of Merit, one Award of Botanical Merit and 11 High Commendation Certificates. He is listed as the originator of a total of 61 *Phalaenopsis* hybrids making him a pioneer of novelty *Phalaenopsis* hybridising in Singapore. He originated 42 *Dendrobium* hybrids, along with 25 other *Vanda* alliance hybrids, excluding *Phalaenopsis*. He has contributed multiple orchid-related articles to various publications including the *Malayan Orchid Review* and *Gardenwise*.

David's love for his family, friends and colleagues is evident in the number of hybrids he named after them, such as *Phalaenopsis* Ame Lim (wife), *Phal.* Casandra Lim (daughter), *Phal.* Jerome Lim (son), *Trichocentrum* Jerome Lim (son), *Phal.* Princess Michelle (granddaughter), *Vanchoanthe* Michelle Lim (granddaughter), *Phal.* How Yee Peng (friend), *Phal.* Peggy Tan (friend), *Arundina* Naomi Sivanandan (this author's daughter), *Dendrobium* Simon Tan (colleague), *Papilionanda* Chinlili (colleague) and *Vanchoanthe* Ng-Yang Cheng Noi (colleague).

David, or Uncle David as many would refer to him, was a mentor, colleague and friend to me. I remain in awe of his willingness to embrace new things, his curiosity and his many talents. I miss his gentle and nurturing nature, kindness and goodness. Above all, I am grateful to have known him.

The last hybrid that he originated and registered on the 29th of October 2018 was *Papilionanthe* Seletar Stardusts, perhaps rather aptly named for he passed away on the 13th of December 2018, rising up to join the stars that watch over us in the night.

'If you love a flower that lives on a star, it is sweet to look at the sky at night. All the stars are a-bloom with flowers.' – *Antoine de Saint-Exupéry, The Little Prince*

Gillian Khew
Conservation and Molecular Biology

All photos by David Lim, unless otherwise stated

Acknowledgements
Special thanks go to Ada Davis for pulling up past media reports, Dr Emrys Chew for salient background information and a comprehensive list of David's hybrids, Peggy Tan for trawling through past issues of *Malayan Orchid Review* to compile a list of David's awards and Jerome Lim for information on the Lims' family life. Thank you also to all who have contributed to the quotes included in this article.

[2] Behind the Singapore Botanic Gardens with 627 hybrids, S.Y. Alsagoff with 281 and Singapore Orchids with 266.

Refurbishment of the Potting Yard for horticulture and botanical research

Display and interpretation of botanical collections, often for research and conservation purposes, is an important feature that distinguishes many botanical gardens from well-manicured parks. However, caring for the plants in such collections is a different ball game than working with those that are readily available in nurseries. Unlike ornamentals that have been trialled by commercial growers to determine how to achieve optimum growth, there is no cultivation manual for many plants in botanical collections. Keeping them alive requires experimentation based on knowledge of their native habitats, excellent horticultural skills, and appropriate facilities where light, temperature and humidity can be controlled.

For over 130 years, the Gardens' staff have nurtured living collections at the Potting Yard. Tucked into an inconspicuous corner of Tanglin Core, away from visitor circulation routes, the Potting Yard was originally built in 1882–1884 by then-superintendent Nathaniel Cantley. It began as a one-acre nursery to supply plants for the Gardens and trees for city parks and forest reserves. An iconic street tree introduced at that time was the Rain Tree (*Samanea saman*) from tropical America. It was first raised from seed in the Potting Yard in 1882 and is now found along many roads in Singapore and around the region.

Even in its early days the Potting Yard contained numerous structures with specific purposes, such as propagation houses, shade houses, an orchid house and glass-covered buildings to shelter plants from the rain. It was used as the Gardens' main nursery prior to the development of other nurseries and remains indispensable to Gardens' staff in our daily operations.

The orchid house in the late 1800s. This structure was built near the entrance to the Potting Yard and is an example of what the Gardens' early shade houses looked like. *(Courtesy of Michele Rodda)*

In the late 1980s, two small cool houses, each about 50 m^2, were built on the Potting Yard premises. Made of concrete walls with a polycarbonate roof and fitted with several air-conditioning units, these houses originally accommodated plants from high altitudes and temperate climates. They were later used to propagate and grow high elevation orchids for display in the Cool House at the National Orchid Garden. From the early 2000s, staff from the herbarium were using the cool houses to grow orchids for taxonomic study. These collections were the source of numerous new species described by the Gardens' researchers.

In 1998, a new building was added to the Potting Yard for the School of Horticulture. (This had evolved from an earlier School of Ornamental Horticulture that was established in 1972 at Burkill Hall and tasked primarily with the advancement of horticulture in Singapore.) When the School of Horticulture was discontinued in the early 2000s, this building was renovated to provide additional classrooms for training programmes to be run by the Gardens' Training and Certification Branch. Starting in 2007, the classrooms and outdoor space of the Potting Yard were used for courses conducted by NParks' Centre of Urban Greenery and Ecology (CUGE).

Refurbishment of the Potting Yard

Over the course of the Potting Yard's long history, buildings were added and/or re-built to meet changing needs. Thus, none of the original structures still remain. Despite these

(Top and bottom) Glass-covered greenhouses used for growing cacti and other succulent plants. These photos were taken in 1958 by Humphrey Burkill, then-director of the Gardens.
(Courtesy of Singapore Botanic Gardens Archives)

improvements, it became apparent that the capacity of the Potting Yard was unable to support the Gardens' rapidly growing needs. Hence, it underwent a much needed refurbishment between 2016 and 2018.

Given the Potting Yard's location within the inscribed boundary of Singapore's first UNESCO World Heritage Site and its proximity to the Gardens' Rain Forest, all enhancements were carried out in a sensitive and meticulous manner. A key consideration was to maintain the original footprint of the Potting Yard and to preserve the site's existing topography, ensuring that minimal earthwork was required. The buildings were designed with lightweight structures that required smaller foundations and pre-fabricated components, which significantly reduced the level of noise and dust during construction. The low visibility that has been characteristic of the Potting Yard since the 1880s has also been retained by keeping the height of the new facilities similar to that of the pre-existing buildings.

The refurbished Potting Yard has three cool houses, two large nursery sheds, other horticultural and storage facilities, and office space for staff. The office is outfitted with perimeter glass façades and skylights to allow natural light in, which improves the indoor working environment. Energy-efficient air conditioning systems were incorporated into both the office and cool houses to ensure efficiency without compromising performance, reliability and sustainability. An important new feature of the cool houses is the intelligent Building Management System (BMS), which controls the cooling and misting systems. The BMS mimics the environmental conditions required by plants collected from high elevations to flourish and can achieve the low night-time temperatures that induce many of them to flower.

Collections for research and conservation

The plants grown in the Potting Yard often come from exchanges with botanical gardens in the region and far away, such as the Royal Botanic Gardens, Kew, or are collected by Gardens' staff while on expeditions around Southeast Asia. Some of these plants are propagated and shared with other gardens, and many are planted around the Gardens where they grow to maturity and eventually flower. In fact, our archives contain a number of historical illustrations of such flowering specimens, some of which were described as species new to science.

These priceless collections are now housed in the new nursery sheds and cool houses. They contain various plant groups that are targeted under the Gardens' active research areas. Gingers have been on the Gardens' research radar since the 1890s and it is therefore not surprising that they remain our largest collection, supplemented with members of several other related monocot families like Asparagaceae or Hanguanaceae. Other remarkable plants in our collections are a number of climbing and epiphytic

Orchidantha maxillarioides **was one of the many species described as new to science and introduced to the Singapore Botanic Gardens by Henry Ridley, who presumably first cultivated it in the Potting Yard. It was then introduced to Kew Gardens, and from there to various other gardens of the world. (Top left) A botanical illustration of** ***Orchidantha maxillarioides*** **from the Gardens' Archives, and (top right and bottom) recent photographs taken of the species.** *(Photo credits: Jana Leong-*Škorničková*)*

Gardens' staff at the School of Horticulture in 1998 (top right image, from left to right: Nashita Mustafa, Seri Hayuni binte Hadi and Janice Yau). *(Courtesy of Janice Yau)*

(Top and bottom) The School of Horticulture and surroundings in the early 2000s. *(Courtesy of Janice Yau)*

One of the new cool houses in the Potting Yard. *(Photo credit: Jana Leong-Škorničková)*

One of the new nursery sheds. *(Photo credit: Jana Leong-Škorničková)*

Botanical collections growing in one of the new facilities at the Potting Yard.
(Photo credit: Jana Leong-Škorničková)

Apocynaceae, including genera that are well-known in horticulture such as *Hoya* and *Dischidia*. Although most of the plants in these collections are being grown for research projects, many of the species are also propagated for planting into the Gardens' landscapes. Gingers that come from the Potting Yard are not just displayed within the Ginger Garden and Heliconia Walk, but in the National Orchid Garden, Jacob Ballas Children's Garden, the Marsh, Healing, and Foliage Gardens, along Saraca Stream, and in many more places.

Another very important aspect of the Potting Yard is its function in propagating plants for conservation purposes. Many of the species grown there are Critically Endangered in the wild, and in a few cases, are presumed to be extinct in Singapore. The Potting Yard's facilities enable us to propagate these plants for future reintroduction into suitable habitats, so that they can be enjoyed by future generations and remain part of Singapore's living natural heritage.

The refurbishment of the Potting Yard has not only conserved an important part of the Gardens' history, but will go a long way towards facilitating our research and conservation efforts well into the future. It contributes to the Gardens' Outstanding Universal Values as a World Heritage Site by providing novel, interesting plants to constantly refresh the Gardens' landscapes and by supporting the research required to maintain it as a centre for plant research in Southeast Asia.

Jana Leong-Škorničková
Michele Rodda
Herbarium, Research and Conservation

Tan Siew Tin
Facilities Management

Gingers under cultivation in one of the new nursery sheds.
(Photo credit: Jana Leong-Škorničková)

Native *Dracaena* in Singapore – Part 2, Maingay's Dracaena

Dracaenas are sometimes referred to as 'dragon trees' in allusion to the magnificent Dragon Tree, *Dracaena draco*, which is native to northern Africa and the Canary Islands. In Singapore, this name would ill suit the genus as most of our native dracaenas are small shrubs or even herbs, at most treelets. There are some spectacular exceptions, however! In the surviving primary forests one can still come across a few thick trunks of *Dracaena maingayi*, or Maingay's Dracaena.

Dracaena maingayi is one of a great many species named after Alexander Carroll Maingay (1836–1869). Maingay was an extremely active collector of plants in Peninsular Malaysia and Singapore, though he was not a naturalist by profession. He was a British surgeon who came to manage prisons in present-day Malaysia and Myanmar, and in fact, was killed at a young age during a prison riot. In past centuries, botany was an integral part of becoming a doctor, not least because so many medicines were derived from plants, which explains why Maingay and so many other medical men in the past were plant collectors. Maingay collected a massive amount of plant specimens during his time in the region, and these were sent to Europe. There, numerous new species were described, a large number of which were posthumously named after Maingay. *Dracaena maingayi*, like many of the other species collected by Maingay, was named by Joseph Hooker in his *Flora of British India* (1892).

***Dracaena maingayi* at Bukit Timah Nature Reserve.**

A tree-like habit is rare in monocotyledonous plants (commonly referred to as 'monocots', these are plants with one seed-leaf, or cotyledon, such as grasses and lilies). However, any word other than 'tree' would be a poor description of *Dracaena maingayi*. With a pale trunk (or trunks) reaching 10 to 15 m in height and up to 60 cm in diameter, Maingay's Dracaena easily competes with any of Singapore's rainforest trees. The upper part of the trunk is branched and produces a large leafy canopy. In comparison with bananas, large palms and pandans, *Dracanena maingayi* is, for us, the most obvious monocot in Singapore to deserve to be characterised as a canopy tree. Indeed, like dicotyledonous trees, its trunk has a secondary thickening that produces loose wood-like tissue. The branch ends are covered by narrowly elliptic dark green leaves which are 25 to 30 cm long, up to 7 to 8 cm wide and leathery in texture.

The thick trunk retains the remarkable ability of other dracaenas to regenerate. Just like the spiral branches of the Lucky Bamboo (*Dracaena braunii*), the trunk of Maingay's Dracaena, when cut, will start to sprout new shoots. Sadly, reshoots from cut trunks are all that remain of some mature plants in Singapore. Although the species is

found widely here, from offshore islands to all forested parts of the main island, the number of mature specimens is very low.

The inflorescences of Maingay's Dracaena are large (up to 60 cm long), branched and pyramidal in shape. The flowers are cream-white with short pedicels, and are arranged in clusters of about five. As in most *Dracaena* species, they open at dusk. The ripe berries are orange-red in colour and the size of a cherry. The seeds seem to germinate readily in Singapore, as seedlings are commonly encountered (much more so than mature specimens). The seedlings, by the size and shape of the leaves, greatly resemble young plants of *D. cantleyi* but the leaves are without the typical spots (see *Gardenwise* 52: 3–5). It takes several decades for seedlings to grow into full-sized trees.

The canopy of a mature tree at Bukit Timah Nature Reserve.

Encounter with the original Dragon Tree

'El Drago Milenario', the famous Dragon Tree of Icod de Los Vinos, Tenerife.

I recently had the opportunity to see another species of tree-like *Dracaena*, the original Dragon Tree, *D. draco*. Occurring in northern Africa and the Canary Islands (along with a few other closely related species), *D. draco* is one of the most widely known dracaenas in the world and surpasses even *D. maingayi* in size and splendor. It has cultural significance to indigenous people in the Canary Islands, and its red sap has been known in Europe since ancient times. While the Canaries have lost almost all of their natural forests, and the largest and oldest Dragon Trees venerated by the Islands' ancient Guanches have been gone for centuries, some large specimens survive to this day. The species is now common along the streets of the Canary Islands, as it is easy to grow from seed, and wild plants can still be found on near-vertical cliffs that are difficult to access.

The most famous living example of *Dracaena draco* is 'El Drago Milenario', an ancient giant in the village of Icod de Los Vinos in Tenerife. Centuries old or older, the tree probably pre-dates its current village setting, and recently the surrounding land has been converted to a small botanic garden (Parque del Draco) in honour of the tree. On a recent visit to the garden, I saw a lot of small seedlings but none that could compete with the massive tree which towers over them. By now it is not only the most famous *Dracaena* in the world, but it has a place among the most iconic trees anywhere.

Matti Niissalo

A young plantlet.

A fruiting branch. *(Photo credit: Zaki Jamil)*

A close-up of the fruit.

(Left) The trunk and (right) a close-up of the bark of Maingay's Draceana.

The internal classification of *Dracaena* is very much unresolved, but despite its woody habit *D. maingayi* is not closely related to the northern African Dragon Tree. Occasionally *D. maingayi*, along with numerous other dracaenas, has even been included in a separate genus *Pleomele* due to differences in flowers, but it is now known that the flower characters don't describe real relationships in this group, and the genus *Pleomele* has not been commonly upheld in recent works.

Matti Niissalo
Molecular Biology Laboratory

Jana Leong-Škorničková
Herbarium

All photos by the authors unless otherwise indicated.

Toxic 'peas' – the dark side of the legumes

The Legume or Pea family (Leguminosae or Fabaceae) has close to 19,500 described species, and is one of the largest flowering plant families in the world. When we mention legumes, what comes to mind immediately would be the edible ones – Chickpeas (*Cicer arietinum*), Lentils (*Lens culinaris*), Mung Beans (*Vigna radiata*), Peas (*Pisum sativum*) and Peanuts (*Arachis hypogaea*). Then there are the trees and other plants that we are familiar with because they are a large part of the landscape in Singapore – the Rain Tree (*Samanea saman*), the Angsana (*Pterocarpus indicus*), the Yellow Flame (*Peltophorum pterocarpum*), the ubiquitous *Phanera kockiana*, and the flamboyant Peacock Flower (*Caesalpinia pulcherrima*). This large and diverse family provides us with both food and lovely ornamentals, so it may come as a surprise that many legumes produce some of the most lethal substances known to man.

***Abrus precatorius* (Rosary Pea). (Top) Seed pods with seeds attached, and (bottom left) a close-up of seeds showing the red and black aposematic colouration.** *(Photo credits: Lily Chen)*

Seemingly benign, the Saga tree (*Adenanthera pavonina*) is not as innocent as you might think. Its shiny red bead-like seeds are remarkably uniform in mass, about 0.25 grammes each, and have been used in times past for weighing gold and silver. These seeds, which are also popular as a symbol of love, are actually toxic. Their vivid red colour serves two purposes – first, to attract birds to help in their dispersal (the seeds have a thick seed coat that enables them to pass through the short gut of birds unharmed), and secondly, to warn other animals not to eat them, as red is an aposematic colour signalling danger.

In the animal kingdom, several colours or combinations of colours act as warnings to remind predators to stay away. Classic examples can be found in venomous snakes and poisonous frogs. In Singapore, the Blue Malayan Coral Snake (*Calliophis bivirgatus*), for example, is vivid red and blue, and the Banded Krait (*Bungarus fasciatus*) is banded white and black. In tropical America, many poison arrow frogs (family Dendrobatidae) are cobalt blue, or a mixture of red, black, blue and/or yellow. These colours signal the presence of deadly toxins or at least distastefulness and discourage attacks from potential predators. Such examples of aposematism are well known in animals, but many may not realise that a good number of plants rely on the same system as a passive defence mechanism against herbivory.

Abrus precatorius, or the Rosary Pea, is a highly attractive legume whose seeds display a classic aposematic colour combination, red and black. As its vernacular name

***Callerya atropurpurea* (Purple Milletia). (Left) A tree growing in the Singapore Botanic Gardens, and (top right) a close-up of the flowers.** *(Photo credits: Ho Boon Chuan)*

***Crotalaria retusa* (Rattleweed), an ornamental that is commonly planted for its bright yellow flowers.** *(Photo credit: Koh Sin Lan)*

suggests, its seeds have long been used to make rosaries, bracelets and other ornaments. They also contain abrin, one of the most lethal natural toxins known to man. Exposure to just 0.005–0.007 mcg of abrin per kg of body mass can result in death, making it more deadly than ricin, the toxin that comes from the seeds of the Castor Bean (*Ricinus communis*, Euphorbiaceae). Ingesting just one or two seeds of the Rosary Pea can be fatal for an adult, and even inhalation of the powdered, crushed seeds may be deadly.

Some leguminous species do not exhibit obvious warning colours but are just as toxic as the Castor Bean, Rosary Pea or Saga. For instance, the ordinary looking brown seeds of the Rattleweed (*Crotalaria retusa*) contain high concentrations of pyrrolizidine alkaloids (PAs), which are known to cause liver damage. Although people would not normally consume the seeds directly, honey can become contaminated with these alkaloids if pollen is gathered from PA producing plants. In Afghanistan, there was a case where cereal grains were contaminated with the small

***Derris* species native to Singapore, such as (top) *D. amoena* and (bottom) *D. trifoliata*, contain rotenone. This toxin was formerly used as a pesticide, and derived primarily from *D. elliptica*.**
(Photo credits: Ho Boon Chuan)

brown seeds from the Rattleweed, leading to acute poisoning and caused more than 1,600 fatalities. The PAs in *C. retusa* are apparently harmless for some insects such as the caterpillars of the Pea Blue (*Lampides boeticus*), a Lycaenid butterfly that feeds on the flower buds and seeds of this plant.

Many people may not realise it, but most of us regularly consume toxic legumes. Their dangerous toxins have simply been destroyed by cooking before they make it to the table. Red Kidney Beans (*Phaseolus vulgaris*), for instance, are poisonous when raw, but the toxins are destroyed during the cooking process, which includes soaking the beans overnight then simmering them for up to eight hours. Mature or dried seeds of the Hyacinth Bean or Lablab (*Lablab purpureus*) contain cyanogenic glycosides and must be boiled in at least two changes of water before they are safe for consumption. Similarly, Saga seeds, which are used as a famine food, are also toxic when raw. Cooking renders the seeds safe for consumption.

Another toxic legume that is commonly consumed is the Mang Kwang (*Pachyrhizus erosus*), also commonly known as Bangkuang, Yam Bean, or Shā Gé (沙葛). The roots are the only edible part of the plant, and these are used as an ingredient in local dishes such as *popiah* and *kueh pie tee*. The tuberous roots of this sprawling vine can weigh up to 20 kg when mature, and they can be eaten raw or cooked, but only after their poisonous outer layer has been peeled away. Consumption of any other part of the plant, especially the seeds, can be fatal depending on the amount ingested. The toxic cocktail present in Mang Kwang includes rotenone, which has been used as an insecticide. Several other legumes, such as Derris Vine (*Derris elliptica*) and Purple Millettia (*Callerya atropurpurea*), also contain rotenone and have been used by indigenous peoples for fish poison – the rotenone immobilises fish, making them easy to capture.

Large and diverse, the Legume family certainly harbours many surprises. In the next issue of *Gardenwise*, we will check out the role of legumes in myths and legends.

Ho Boon Chuan
Lily Chen
Herbarium

New to cultivation in Singapore

An attractive mistletoe cactus

Various species of the cactus genus *Rhipsalis*, which mostly lack spines and look very un-cactus-like, can be grown in Singapore, though many will not flower here as they need a cooler, dry resting period to stimulate flower production. An exception is *R. baccifera*, which is a truly tropical species and in fact the most naturally wide-ranging of all cacti. It is an epiphyte that occurs in humid forest in many areas of the Americas between the Tropics of Cancer and Capricorn, from Mexico and the Caribbean southwards to Bolivia and Brazil, but in ancient times it also managed to disperse across the Atlantic Ocean to the Old World, where it ranges through the humid parts of Africa and Madagascar, and has even jumped halfway across the Indian Ocean to Sri Lanka (strangely it is absent from India). Thus, it is the only cactus truly native outside of the Americas, though many other members of the family have been introduced by man to the drier parts of the Old World and are sometimes invasive weeds. The ability of *R. baccifera* to have travelled so far without the aid of man is thought to be due to its extremely sticky fruit pulp, the fruits being attractive to birds – in Singapore bulbuls sometimes steal the fruits on my plants. In cleaning their beaks after eating the fruit, the seeds can get stuck to birds' feathers or legs and thus be transported long distances – at least that is how it is assumed the plant managed to reach the Old World from its tropical American ancestral home, where the cactus family is otherwise endemic.

Given this, *Rhipsalis baccifera*, perhaps unsurprisingly, is a complex species and may even be biologically a species-complex, made up of distinct entities that cannot all interbreed (though some botanists, unlike zoologists, disagree that such breeding barriers should automatically delimit one species from another). The species exists in at least three different chromosome races, with either one, two or four sets of chromosomes, i.e. diploid, tetraploid or octoploid, yet this is not the only cause of its variability, as some of its subspecies share the same chromosome count but differ morphologically. In recent times, some of its former subspecies have been demonstrated to be distinct species on the basis of DNA gene-sequence studies, but today at least three are still treated as subspecies

***Rhipsalis baccifera* subsp. *erythrocarpa*.**
(Photo credit: Dr Nigel P. Taylor)

Close-up images of *R. baccifera* subsp. *erythrocarpa* taken with a microscope and showing: (top) a flower, and (bottom) a young fruit. *(Photo credit: Lim Weihao)*

distinct from the tropical American *R. baccifera* subspecies *baccifera*. One of these is the plant illustrated here, *R. baccifera* subsp. *erythrocarpa*, from the mountains of east Africa, on the slopes of Mt Kilimanjaro and Mt Kenya.

The epithet, *erythrocarpa*, means blood-red-fruited, but this is a little misleading. When fully ripe the fruits are almost white, but when they are still quite young and not yet properly expanded they are indeed dark red, turning to an attractive pink as they swell and begin to ripen, so that the plant often bears fruits ranging from red through pink to white at the same time. The diminutive flowers are also yellow and pinkish red when examined closely and in these respects the subspecies is readily distinguished from typical *Rhipsalis baccifera*, which has fruits and flowers that are white or greenish at all stages of their development. *R. baccifera* subsp. *erythrocarpa* also has flowers with five to seven petaloid perianth-segments, compared with four or five in typical *R. baccifera*, but these are so small that a magnifying glass may be needed! Another feature is that a few of its youngest new shoots, which are dark red in colour, bear bristly harmless spines at first, a juvenile character on a mature plant which can be termed neotenic (neoteny is the retention of juvenile characters in the adult). This tendency may reflect that it is a tetraploid race, since other polyploid subspecies of *R. baccifera* tend to exhibit it also, but not the diploid *R. baccifera* subsp. *baccifera* itself.

Rhipsalis baccifera is easy to grow in Singapore in a small hanging basket or suspended pot, so that its pendent stems can hang down freely. It takes full sun and survives with either a lot or less water, preferably from the rain, as long as the potting medium used is open, free-draining and never becomes water-logged. Under such conditions, many of its stems will produce abundant aerial roots, meaning that its propagation by cuttings is almost fool-proof. As in all other *R. baccifera* races, the flowers are self-compatible and automatically self-pollinate, so that every flower becomes an attractive fruit.

Gloxinia perennis. *(Photo credit: Dr Nigel P. Taylor)*

Gloxinia perennis

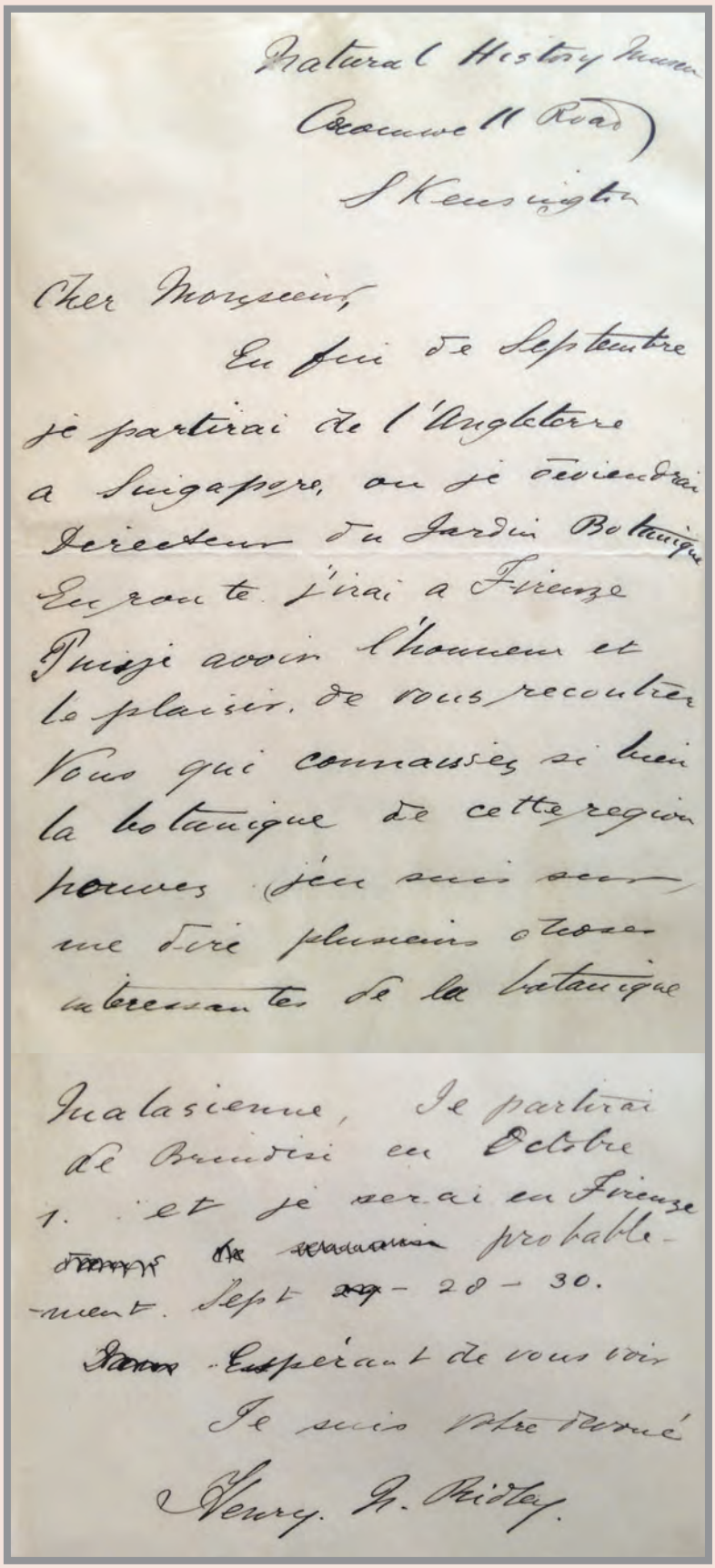
Some may question whether this attractive *Sinningia*-relative from the family Gesneriaceae is really 'new' to cultivation in Singapore, as it appears in the latest (3rd) edition of *1001 Garden Plants in Singapore*, on page 323. However, that introduction from the plant markets around Bangkok apparently did not establish, and the specimen illustrated here is a later introduction. It is a most beautiful plant that we hope will eventually thrive in Singapore, but it needs careful cultivation as it seems sensitive to excessive heat and sunlight, even though it comes from Central America and the Amazon region of Brazil.

Its habit is a little unusual amongst its family as it makes broad clumps of semi-sprawling stems a little less than 1 metre tall, arising from horizontally spreading rhizomes, and it could be described as a somewhat fleshy low shrub in character. I first saw it in a hotel garden in the town of Parapat, on the shore of Lake Toba, northern Sumatra, at more than 900 metres altitude. There it was in full flower, every one of its many stems being an inflorescence and giving the plant the superficial appearance of a huge clump of foxgloves, but with purplish flowers and opposite leaves. The delicate, shortly tubular flowers last about one week each before fading and are externally clothed in fine silky white hairs. The youngest leaves are a deep crimson-red, before turning a slightly yellowish green with darker toothed margins, while the sappy stems are mottled with red.

Though it may need a carefully selected site away from the full glare and heat of the sun, *Gloxinia perennis* does seem very easy to propagate, and cuttings of young shoots readily take root if immersed in a cup half-filled with water. The potting medium needs to be very well-drained open compost, since if not, the stems tend to rot and it should be watered sparingly, though not allowed to completely dry out. It may be best cultivated in a container until its suitability for the open ground has been properly assessed.

Nigel P. Taylor
Group Director

A meeting of two giants of botany – Beccari and Ridley


Natural History Museum
Cromwell Road
S Kensington

Cher Monsieur,

En fin de Septembre
je partirai de l'Angleterre
a Singapore, ou je deviendrai
Directeur du Jardin Botanique
En route j'irai a Firenze
Puisje avoir l'honneur et
le plaisir de vous rencontrer
Vous qui connaissez si bien
la botanique de cette region
nouvelles (j'en suis sure)
me dire plusieurs choses
interessantes de la botanique
Malasienne, Je partirai
de Brindisi en Octobre
1. et je serai en Firenze
probable-
ment. Sept - 28 - 30.
Espérant de vous voir
Je suis Votre Devué
Henry. N. Ridley.

A letter from Henry Ridley to Odoardo Beccari, sent from the Natural History Museum, Cromwell Road, S. Kensington. *(Courtesy of Beccari Archive, correspondence 15.3, Ridley, in the Science Library, Botany section, Florence University, all rights reserved)*

Transcription [with corrections]:

Cher Monsieur,

En fin de Septembre je partirai de l'Angleterre a [à] Singapore, ou [où] je deviendrai Directeur du Jardin Botanique. En route j'irai a [à] Firenze. Puisje [puis-je] avoir l'honneur et le plaisir de vous rencontrer [?]

Vous qui connaissez si bien la botanique de cette region [région] pouvez (j'en suis sure [sûr]) me dire plusieurs choses interessantes [intéressantes] de la botanique Malasienne [Malaisienne]. Je partirai de Brindisi en Octobre 1 et je serai en Firenze probablement Sept. 28 – 30.

Espérant de vous voir
Je suis votre devué [dévoué]
Henry N. Ridley

Translation:

Dear Sir,

At the end of September I will leave England and move to Singapore where I will become the Director of the Botanic Gardens. Along the way I will go to Firenze. May I have the honour to meet you?

You who know so well the botany of this region I am sure you will tell me many interesting things on Malesian botany. I will leave Brindisi on October 1 and I will be in Firenze probably Sept. 28–30.

Hoping to see you,
I am your devoted
Henry N. Ridley

The room in the Florence herbarium where Beccari's Malesian collections are preserved (in the middle cabinets). The historic herbarium of Philip Barker Webb is also kept here (along the walls). *(Photo credit: Michele Rodda)*

This short but interesting note is contained in the Beccari archives in Florence, Italy. It is not dated but was probably written in mid-1888, shortly before Henry Ridley (1855–1956) started on his first journey to Singapore, where he was to become Director of Gardens and Forests of the Straits Settlements. He was only 33 and had been working at the British Museum (Natural History) in London (now the Natural History Museum) at the time when he was offered and accepted the post. Unfortunately, Beccari's reply has been lost, but we do know that on his way to Singapore in 1888, Ridley did meet with Beccari in Florence.

Odoardo Beccari (1843–1920) was a famous Italian botanist who was an expert in Malesian flora and collected extensively in the region. He went on three expeditions to Malesia between 1865 and 1878, amassing about 16,000 botanical specimens. This would have been one of the largest collections of Malesian plants in the world at the time, and is a very significant one still today. En route to and between remote areas while on expedition in the region, Beccari made a few stops in Singapore, where he collected botanical specimens, in particular from present-day Woodlands.

Based on examinations of the Beccari archives in Florence and the Ridley archives in Kew, it is clear that Ridley and Beccari were in touch from as early as 1886 and continued to communicate with one another until at least 1911. Their discussions were mostly focused on the exchange and loan of specimens, in particular of palms, and sometimes of photographs – the same discussions that occur between botanists nowadays, just by using pen and paper rather than email! What is interesting is that Beccari and Ridley communicated almost exclusively in French, a language native to neither of them. Ridley wrote sporadically in English, but Beccari was likely not well versed in the language and French would have been a common language as it was still frequently used in scientific circles.

Unfortunately, we do not know what happened during that meeting between Beccari and Ridley in Florence, or what the young Ridley discussed with the much more experienced Beccari. It is imaginable though that they spoke in French and that they discussed Beccari's travels throughout Malesia, the exciting plants he documented, and the difficulties he had encountered in the field. It must have been exciting for Ridley to meet such an experienced botanist who had first-hand knowledge of Malesia's flora, which Ridley was soon to explore for himself. For Beccari, who was not to return to Asia, it may have been gratifying to meet somebody that would continue his legacy of botanical research in Malesia.

Michele Rodda
Herbarium

Laura Guglielmone
Herbarium
Department of Life Sciences and Systems Biology
University of Turin, Italy

Conservation of a Critically Endangered native orchid, *Callostylis pulchella*

Callostylis pulchella was presumed extinct in Singapore until relatively recently. It was first recorded here in 1890 by the Gardens' first Director, Henry Ridley, who found it at Sungei Buloh. In the same year, it was collected from Sungei Murai and Tuas by forest inspector J.S. Goodenough. Later, Ridley made collections from Pulau Tekong, Chan Chu Kang, Seletar and Kranji. In 1950, J. Sinclair, Curator of the Gardens' herbarium at the time, collected it from Pulau Pawai, and that was the last time it was recorded in Singapore for more than 60 years.

This rare orchid was rediscovered in 2012 in the Nee Soon Freshwater Swamp Forest, where it was found growing high up in the canopy of a tree along a stream. For another six years, this was the only known population in Singapore, but then, on 15 November 2018, it was found at the Bukit Timah Nature Reserve. It had been growing there on a branch about 25 m up a 30-m tall *Mangifera subsessilifolia* tree. The tree had fallen during a storm, leading to the discovery of the orchid.

Callostylis pulchella **on a fallen tree branch at Bukit Timah Nature Reserve in November 2018.**

An epiphyte, *Callostylis pulchella* has creeping rhizomes that usually cover large areas of tree branches. The rhizomes are thick and stiff, bearing short-stalked pseudobulbs spaced about 10 to 15 cm apart. The pseudobulbs are flattened and angular, club-shaped, and around 10 cm long and 2.5 cm across. They bear two to five oblong and bi-lobed leaves at the apex, each about 15 cm long and 3.5 cm wide, while the bases of the pseudobulbs are covered in dried sheaths.

The inflorescences are erect, covered in white woolly hairs, and produce many flowers that are close together and open one at a time. The floral bracts are light green while the flowers are variable in colour, ranging from cream to light orange-brown. They have a fleshy texture and are around 3 cm across. The sepals and petals are covered with hairs that are more dense on the outside than on the inside. The lip is fleshy and glossy with short yellow hairs, dark brown at the centre, and has a large callus that is divided into three ridges. The column is curved and around 7 mm long.

A flower of ***Callostylis pulchella*** **at Nee Soon Freshwater Swamp Forest.**

Outside of Singapore, *Callostylis pulchella* is distributed in Peninsular Malaysia, Thailand, Laos and Myanmar, as well as on the islands of Sulawesi, Sumatra, Borneo and Java. It is a lowland species that grows at elevations from sea level to above 1,000 metres, and has been found in mangroves, beach and damp forests along coastlines, and in damp inland forests.

The Gardens has been working with *Callostylis pulchella* as part of our orchid reintroduction programme since 2014, when it was collected from Nee Soon Freshwater Swamp Forest. We are glad to report that it has since been successfully propagated and reintroduced to several locations in Singapore, including Dairy Farm Nature Park, Pasir Ris Park, Sembawang Park, and Bukit Timah Nature Reserve, where it has been planted around the Visitor Centre. We have also collected material from the population discovered at Bukit Timah last year, which will be propagated for future reintroduction efforts.

***Callostylis pulchella* on a fallen tree branch at Bukit Timah Nature Reserve in November 2018.**

***Callostylis pulchella* in propagation at the National Orchid Garden.**

Yam Tim Wing
Peter Ang
Felicia Tay
Research and Conservation

Sunia Teo
Central Nature Reserve

All photos by Tim Yam

References

Lok, A.F.S.L., Ang, W.F. & Yeo, C.K. (2012). Rediscovery of *Callostylis pulchella* (Lindl.) S.C.Chen & Z.H. Tsi (Orchidaceae) in Singapore. *Nature in Singapore* 5: 205–209.

Seidenfaden, G. & Wood, J.J. (1992). *The Orchids of Peninsular Malaysia and Singapore*. Fredensborg: Olsen & Olsen.

Herbarium collections

All that we know about plant diversity in the world begins with botanists putting on their boots and venturing into the outdoors to observe and collect plants. These plants are processed into pressed and dried specimens and are deposited in a herbarium such as the one at the Singapore Botanic Gardens. Once in the herbarium, they are available for scientific study, particularly for taxonomic research to delimit, describe and map species. After the species are described, keys can be written to help users of plant information identify other collections. When species are mapped, these data can be used to assess the conservation needs of a species and to compare its distribution with other species for biogeographic studies. A single herbarium specimen captures a small element of the plant diversity of a particular place at a particular time, and a herbarium full of specimens with its associated data can tell a multitude of stories. The network of herbaria across the world has an estimated 350 million specimens between them and this depository of the world's plant diversity is available for researchers to better understand the plants around us and thereby provide the information for sustainable utilisation and conservation.

An 18th century specimen of *Cucuma longa* (Turmeric) in the Linnaean Herbarium in London. *(Photo credit: Jana Leong-Škorničková)*

Botanists have been making herbarium specimens for hundreds of years. For example, the herbarium at the Università di Bologna in Italy was founded in 1570. The extensive collection of herbarium specimens used by Linnaeus to formulate his ideas for his seminal book *Species Plantarum*, published in 1753, is still extant and carefully looked after by the Linnean Society in London. The oldest specimens in the Singapore Botanic Gardens' Herbarium date from 1790 and come from India. Our herbarium has about 750,000 specimens, thousands of which were collected in the 19th century. These older specimens are vital to study for our understanding of what was present in Singapore at a time when the forest cover was more extensive. Collections of the same species in different localities and over time give us essential information on the variability of a species and the condition of habitats in different eras. Collections from urban areas must also be made so we can assess the total plant diversity in Singapore.

So what is a herbarium specimen? Quite simply it is a whole plant or part of a plant that is pressed flat and dried as quickly as possible before it can begin to rot or go mouldy. Once the plant is flat and dried it can be mounted onto a sheet, the label attached, and stored in the herbarium in a filing system that enables a researcher to find it quickly and efficiently. The size of these herbarium sheets varies between different herbaria but in the Gardens they are A3 size, 420 × 297 mm. A dried plant specimen preserves many of the features that the botanist needs

Preparing a specimen of *Ornithoboea* in Gesneriaceae for pressing in newspaper.
(Photo credit: Preecha Karaket)

The Singapore Botanic Gardens' Herbarium showing the specimens stored in boxes on shelves.
(Photo credit: Derek Liew)

to observe to decide on its identity, and potentially describe it as a new species if it was previously unknown. In some plant groups, dried plant specimens are best accompanied by pickled flowers and/or fruits as the three dimensional structure is not easily reconstituted from the dried material. This is particularly true in plant groups such as the orchids and gingers.

The most useful herbarium specimens are those that not only have a well-preserved plant with all of the parts most useful for scientific study, but ones that have well-written labels with extensive notes. The botanist needs the dried plant for scientific study but also needs more information than the plant itself provides. The whole plant can fit on the herbarium sheet if it is a small herb but a 50 m tall tree cannot be captured on a herbarium specimen. The twigs, leaves and flowers of many herbarium specimens do not tell the botanist enough about the habit of the plant (a tree, a shrub, or a climber?), its size, the colour and texture of its bark, whether it has latex, the scent of its flowers, the colour of its flowers (the colour fades on a dried specimen), and many other parameters and features that the scientist may find useful but are

International collaboration between David Middleton from the Gardens and Somran Suddee from the Forest Herbarium Bangkok to collect the fern *Tectaria tenerifrons*.
(Photo credit: Pramote Triboun)

A recent specimen of *Oldenlandia corymbosa*, now called *Hedyotis corymbosa*, to show a modern label and the importance of collections even from urban areas.

not captured on the specimen. The collector should ensure all of these data are on the label along with who collected it, the date it was collected and, extremely importantly, exactly where it was collected, including the vegetation type. A photograph of the living plant is also extremely valuable.

It was common in the past for a collector to simply write 'Singapore' on a label of a herbarium specimen. When almost everything was unknown and all was new and exotic to the European botanists who came to Singapore in the 19th century, they considered 'Singapore' to be enough information to distinguish it from collections from 'Malacca' or 'India'. Earlier collections from the 18th century could be even more vague and simply note they were from the 'East Indies'. For the botanist studying these specimens, considerable detective work is needed to find where they came from. Almost none of these early collectors considered that it was important to record the habitat where they made their collections; after all they were all from the 'jungle' so it didn't need to be said! After 200 years of research on the plants of Singapore and the many thousands of collections made in that period, however, we now know that Singapore has a range of habitats, each with its own assemblage of species, and consequently that when we collect specimens we need to be far more precise about the data we collect along with the specimens to make our collections more valuable for current and future generations.

Some of the world's herbarium specimens are already hundreds of years old. In order to reach such a great age and be available for research for many hundreds of years to come, the specimens need to be stored with great care and kept dry to prevent mould and free of insect pests that may find a herbarium specimen a ready meal. Curators of herbaria throughout the world have always struggled to ensure these conditions are met. Nowadays most herbaria institute an integrated pest control system. This involves preventing pests getting into the herbarium in the first place as well as making the environment hostile to pests if they should get in. In the Gardens' Herbarium, as in most herbaria, all incoming specimens are frozen to kill any insects that may be on them, and the herbarium is air-conditioned 24 hours per day to keep the humidity low. Low humidity prevents mould and also deters insects. In the Gardens' Herbarium, we also have special plastic boxes that provide a physical barrier against pests (see *Gardenwise* 50: 33–34).

The greater the density of collections from a particular area, the greater the chance that the true extent of its plant diversity is known. Singapore has a particularly large number of herbarium collections for its size, yet we still find species not previously known from the country and rediscover species that were thought to have become extinct in Singapore. In the next *Gardenwise* we will explore more of the ramifications of different collection densities across Southeast Asia.

David Middleton
Herbarium

International researchers on the Flora of Singapore project

Photo credit: Derek Liew

Ye Wen, from the South China Botanical Garden, is working on liverworts for the Flora of Singapore project. She was at the Singapore Herbarium (SING) from 19 September to 7 October 2018 and is contributing to the families Cephaloziellaceae, Calypogeiaceae, Solenostomaceae, Trichocoleaceae and Lejeuneaceae (*Cheilolejeunea*).

Photo credit: Derek Liew

Wei Yu-Mei is from the Guangxi Institute of Botany, China and has been focusing her research on the taxonomy and systematics of the genus *Lejeunea* and its related genera. She also has an interest in the general bryophyte diversity of Guangxi, China. Her contributions for the Flora of Singapore include the liverwort families Lepidoziaceae, Pseudolepicoleaceae and Lejeuneaceae (*Lejeunea*). Yu-Mei visited SING for the second time from 19 September to 19 October 2018, and collected about 200 liverwort specimens on this visit.

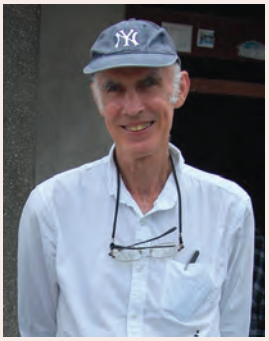


Photo courtesy of Andrew Henderson

Andrew Henderson is a curator at the New York Botanical Garden and also an adjunct professor at the City University of New York. Andrew was at SING working on *Calamus* and *Daemonorops* for the Flora of Singapore from 30 September to 13 October 2018. He is no stranger to SING though – in 2013, he was awarded the Singapore Botanic Gardens' Research Fellowship to study the genus *Calamus*.

Photo credit: Serena Lee

Ian Turner currently works as the Singapore botanical liaison officer at the Royal Botanic Gardens, Kew. He was at SING from 14 November to 12 December 2018 to work on the genera *Chassalia*, *Discospermum*, *Lasianthus*, *Mussaenda*, *Psychotria* and *Uncaria* in the Rubiaceae for the Flora of Singapore. Ian was previously a staff member at the Gardens and prior to that a lecturer at the National University of Singapore.

Photo credit: Serena Lee

Sumudu Rubasinghe is working on liverworts. She visited SING from 11 to 25 January 2019 and is a senior lecturer from the University of Peradeniya, Sri Lanka. She is contributing to the families Aneuraceae, Cyathodiaceae, Marchantiaceae, Ricciaceae and Wiesnerellaceae for the Flora of Singapore.

Photo credit: Ali Ibrahim

Joeri Sergej Strijk is a Dutch researcher currently working in China. Joeri is an associate professor in biodiversity genomics at Guangxi University, China and visited the Gardens from 13 February to 10 April 2019 to prepare the treatments of the Fagaceae and Monimiaceae for the Flora of Singapore, including illustrations for these families. Fagaceae is his favourite plant family and he is also developing the website AsianFagaceae.com, detailing over 700 species in Asia.

Photo credit: Ali Ibrahim

Padma Raj Gajurel is an associate professor from the North Eastern Regional Institute of Science and Technology, India. He was here from 3 to 19 March 2019. Whilst at SING, he gave a talk entitled '*Piper* L. (Piperaceae) in India: Diversity, Economic Potential and Conservation'. As some *Piper* species are difficult to delimit due to high variability, he spent some time in the field with staff from NParks to observe the species in Singapore.

Serena Lee
Herbarium

Fungus-termite partnerships

In this issue, we bring to light an example of a symbiotic relationship between termite farmers and their mushroom crop.

Termitomyces is a genus of gilled basidiomycetes predominantly from areas within and in proximity of the tropical belt, including parts of Southeast Asia and South America, as well as equatorial and southern Africa. There are a number of *Termitomyces* known to occur in Singapore, our pin-up species for this issue being *T. termitomycoides*.

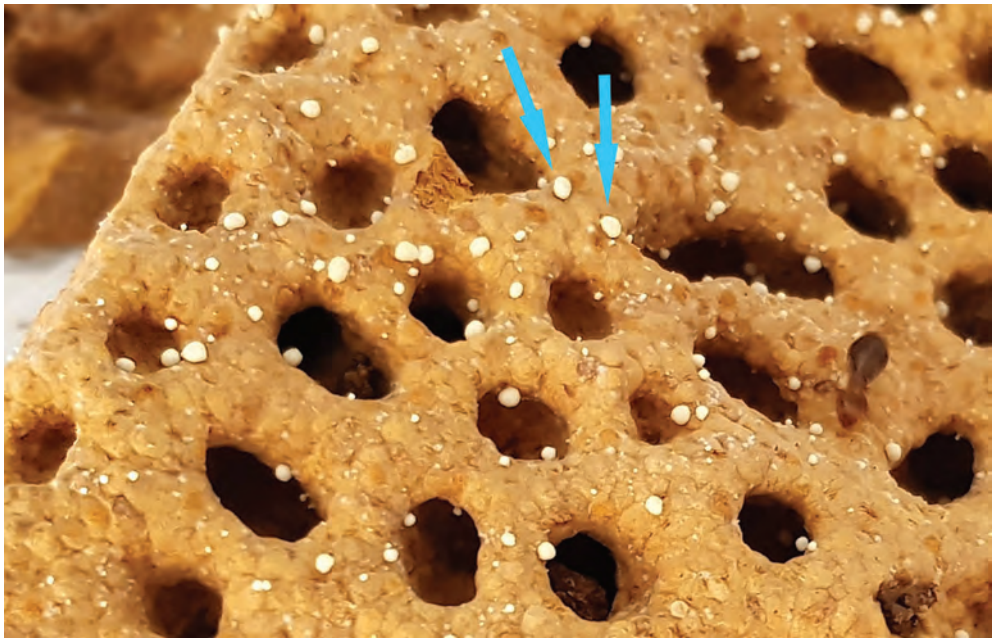
We recorded *Termitomyces termitomycoides* from a termite mound along the Green Corridor. The fruiting body of the fungus was found on the surface of the mound, and after digging down less than 4 cm, we encountered the fungal comb chamber. We also found the species in the Gardens, although in this case the mushrooms did not emerge from a termite mound but rather were growing on the surface of the soil. We were quite surprised to find the fungal comb 8 cm below the soil surface, which is deeper than we would have expected.

Fully expanded fruiting bodies of *T. termitomycoides* at the Gardens.
(Photo credit: Bazilah Ibrahim)

The term 'fungal comb' is a bit of a misnomer. It is not made from the fungus itself, but rather from the primary faeces (mylospheres) of termite workers, excreted after ingestion, short mastication and concentration of plant material. The mylospheres are built into a framework and maintained by the termites (if you look closely at one of these fungal combs, you can see the patted down poop!). The fungus gets inoculated into this framework by the termites, which carry asexual spores of the fungus in their gut. The fungus spreads vegetatively through the growth of hyphal mycelial strands, producing small white nodules on

Developing fruiting bodies of *Termitomyces termitomycoides* in the bud stage. These were found on a termite mound along the Green Corridor. *(Photo credit: Chan Wai Yeng)*

A fungal comb just under the surface of a termite mound along the Green Corridor.
(Photo credit: Serena Lee)



Small white nodules that are vegetative and produced by the fungus grow on the fungal comb and are harvested by termites for food. *(Photo credit: Serena Lee)*

***Macrotermes carbonarius*. The largest termites are major soldiers, the mid-sized ones are minor soldiers and the smallest are the worker termites.** *(Photo credit: Serena Lee)*

the surface of the fungal comb. As the fungus grows, it degrades the cellulose and lignin in the framework material, turning it into food for the termites. In this way, the fungus is monoclonal throughout the mound, and the older comb material, which has been made more nutritious by the fungus, is consumed by the termites, supplying them with fungal spores for inoculation into new framework material and continuous asexual propagation of the fungus. When climatic conditions are suitable, the fungus will form reproductive fruiting bodies (mushrooms) at the surface of the soil, and this is how it will spread its spores further away for mating with other compatible strains. Research has found that fungal combs also have the ability to maintain specific humidity levels within termite mounds.

It is believed that agriculture has evolved independently in three different insect orders, and we know that the ancestors of *Termitomyces* were farmed by the ancestors of *Macrotermes*. The putative farmer of our *T. termitomycoides* is the termite species *M. carbonarius*. Despite the bad name that termites get for destroying buildings and property, only some species are capable of infesting homes. Most termites, like *M. carbonarius,* are forest dwelling species that contribute to the breakdown of forest debris.

Termitomyces are identified by their umbonate mushroom caps and solid stipe, and most species have a well developed pseudorhiza and hyphae without clamps (a microscopic feature). As far as we know, all *Termitomyces*, or at least all of those known from this region, are prized edibles.

Fun fact: Termites are in the order Blattodea, making them more closely related to cockroaches than they are to ants!

Serena Lee
Herbarium

Chan Wai Yeng
Creator of the fungi-philic facebook community Mushroom Spotters (Singapore)

Appreciating the colours of the Butterfly Pea's flowers

The legumes that most people are familiar with are known for their edible immature fruit pods that are eaten as a vegetable, or mature, dried seeds that are consumed as pulses. In contrast, the Butterfly Pea is a leguminous species best known locally for its flowers, which are edible and a source of blue dye. Botanically known as *Clitoria ternatea*, the Butterfly Pea is also called the Blue Pea, and Bunga Telang in Malay.

Traditionally used to colour local Peranakan, Malay and Thai desserts, the flowers of the Butterfly Pea have become popular in more recent years for dyeing a much wider range of food and beverages. Fresh flowers are commonly added to salads and used to adorn cakes. Their popularity in food and beverages can be attributed to their unique, brilliant blue colour which also makes them a natural alternative to chemical food colouring.

The blue flowers of the Butterfly Pea yield an edible food dye. In Singapore, their signature blue colour can be seen in local Peranakan glutinous rice cakes.

There are mauve, light blue and white flowered forms of the Butterfly Pea. The blue flowered form is the most cultivated, probably favoured for its use in the kitchen. The blue colour of the flowers is due to compounds called ternatins, which are anthocyanins (members of the flavonoid group of secondary metabolites produced by plants). The presence or absence of anthocyanins, as well as their different acylation patterns, are responsible for the different flower colours seen in the Butterfly Pea. Anthocyanins can also be found in other plant foods, such as grapes, black carrots, red cabbage, purple corn and blackcurrant. In plants, anthocyanins play a role in reproduction by helping to attract pollinators and seed dispersers. These pigments have antioxidant properties and provide protection against abiotic and biotic stresses experienced by a plant. They are also likely responsible for a range of human health benefits attributed to the Butterfly Pea.

A unique property of anthocyanins is that their colour can change with pH (the acidity or alkalinity of a solution), and this occurs due to structural changes of the anthocyanin molecule. Butterfly pea dye is most stable in acidic pH – it is blue at a pH of 7 and changes to violet at a pH of 4. This change can be observed when one adds lime juice to a butterfly pea drink (easily found in Thai restaurants). In alkaline solutions the dye becomes green at a pH of 8 and yellow at a pH of 11. Butterfly pea dye is used as a natural pH indicator and is readily available in the tropics. Hence, local children can use it as a substitute for the more commonly used dye obtained from red cabbage leaves to learn about acid-base chemistry concepts at home.

The Butterfly Pea grows as a perennial in the tropics and is most commonly propagated from seeds. However, the seeds can be difficult to germinate and an acid treatment can help to boost germination rate. It is a climbing vine and requires a vertical support such as a trellis for it to grow on; it can also be planted in a large flower pot topped with a teepee frame. Alternatively, the Butterfly Pea can be cultivated as a small shrub through regular pruning. It requires direct sunlight for at least six hours daily to promote robust growth and profuse flowering. It should be grown in a medium that retains moisture but also drains well.

The leaves of this legume often attract spider mites, and an infestation can be identified by the appearance of numerous small yellow spots on the leaves. Such infestations are best dealt with by repeated applications of summer oil. Thrips

There are two types of blue Butterfly Pea flowers, one with single petals (centre right) and another with double petals (centre left). The flowers can be blue, light blue or mauve (top left and right). There is also a white flower form that does not contain any anthocyanins in the petals.

The blue dye extracted from Butterfly Pea flowers contains anthocyanins and can be used as a pH indicator. (Left to right) The dye turns pink in highly acidic solutions (tile stain remover containing hydrochloric acid, pH 1) and is violet in a weak acid solution (vinegar, pH 4). It is blue at neutral pH 7 (centre). As the solution gets more alkaline, the dye turns green at pH 8 (baking soda solution which contains sodium bicarbonate) and yellow in a strongly basic solution (drain cleaner, pH 11).

are another common pest of the Butterfly Pea, and can be treated with an organic pesticide called spinosad. This pesticide can also prevent infestations of leaf-rolling caterpillars that attack its leaves during the rainy season. Occasionally, plants may show mottled leaves that may be caused by a virus. Viral diseases are not treatable and infected plants should be promptly removed to prevent or reduce their spread.

A prolific bloomer that produces flowers all year round, the Butterfly Pea is a great plant that can be grown at home. Not only are its highly decorative flowers useful as a source of natural food dye, the plant helps to add nitrogen to the soil, making it especially beneficial to growers of edible plants.

Wilson Wong
Horticulture and Operations

All photos by Dr Wilson Wong

Sharing with the community

There is nothing more rewarding than giving back and making a difference in the lives of others. Quoting Mahatma Gandhi, 'The best way to find yourself is to lose yourself in the service of others'. Those of us in the Education Branch are very fortunate to have the opportunity to do just that, almost on a daily basis.

The Children's Cancer Foundation (CCF) provides children with cancer and their families much needed support in their battle against this life threatening disease. Children with cancer will experience disruptions to their education due to medical treatments, side-effects of medication and hospitalisation. To help improve the quality of life of children with cancer in some small way, the team from the Gardens' Education Branch conducts regular talks and craft sessions through CCF's learning centre, the Place for Academic Learning and Support (PALs).

Since April 2016, we have visited CCF to connect children with nature through interactive talks on various topics. The inaugural session was on dragonflies and damselflies, and for our most recent session, the fifth conducted so far, we delved into 'The Secret World of Pollinators'. A group of 11 children attended this session on 6 March 2019, when we shared on the importance of pollination and the pollinators that can be found in our midst. The children were impressed by the diversity of butterflies, birds and bees that can be found in Singapore.

Armed with an impressive collection of flowers and figs from the Gardens, our team set out to 'bring the outdoors in' for our young audience. We were rewarded by the children's enthusiastic responses as they studied specimens under magnifying glasses. They were extremely fascinated by the relationship between the fig and its pollinator, the fig wasp. One child noted that

A child examining the structure of a hibiscus flower. *(Photo credit: Children's Cancer Foundation)*

Children putting together a button badge bearing the illustration of a pollinator of their choice. *(Photo credit: Children's Cancer Foundation)*

Dr Hanin Hussain, lecturer from the National Institute of Education, opening the symposium on 'Fostering Outdoor Learning and Play' at Jacob Ballas Children's Garden. *(Photo credit: Janice Yau)*

Ms Nur Syuhada Limat sharing on the design principles used in NParks' nature playgardens. *(Photo credit: Janice Yau)*

figs are 'not vegetarian' as male wasps, which are born blind and wingless, die within the figs after hatching and fertilising female wasps. The session concluded with a hands-on craft activity with the children assembling a flower with a bee pollinator attached. They also had the opportunity to put together a button badge with an illustration of a pollinator of their choice.

In another sharing opportunity with a different segment of the community, we hosted and participated in a symposium entitled 'Fostering outdoor learning and play' at Jacob Ballas Children's Garden on 28 March 2019. More than 25 leaders and educators in the early childhood sector attended the symposium, which was organised by the National Institute of Education (NIE) and supported by the Early Childhood Development Agency (ECDA).

Dr Hanin Hussain from NIE kick-started the day with a pre-symposium dialogue session about topics related to biophilia and outdoor play. Biophilia, or the innate emotional connection that humans have with nature, is fostered in children by allowing them to play in outdoor areas set in nature, where they have an opportunity to explore and interact with elements in the natural world.

Following the dialogue session, Ms Nur Syuhada Limat from NParks' Design team gave a talk on 'Supporting Children's Biophilia through the Design of NParks' Play Areas', and then the Gardens' Education team led the participants on a tour which focused on 'Outdoor Play at Jacob Ballas Children's Garden'. To conclude the afternoon, participants reflected on and shared what they had learnt, and were invited to visit the Nature Playgarden at HortPark following the symposium.

Through sharing our passion with the community, the Gardens' Education Branch hopes to plant seeds that will develop into a genuine love of nature in every child.

'If you truly love nature, you will find beauty everywhere.' – *Vincent Van Gogh*

Janice Yau
Winnie Wong
Tan Hui Min
Steffi Loe
Education Branch

Heat wave and flowers…

Lovely pale blue-violet inflorescences covering the handsome Mengkulat tree in the Bukit Timah Core.

A close-up of the pretty blue-violet flowers of the Mengkulat.

Visitors were recently treated to a visual spectacle of flowering plants in every corner of the Gardens. A phenomenon commonly observed among plants in the tropics, this had come as the result of a prolonged heat wave and very humid weather in the early part of the year followed by intermittent rain. Highlighted here are two of the many species that stood out during the flowering period, when their striking blooms would have made a stroll in the Gardens worthwhile despite the scorching sun and humid weather!

Teijsmanniodendron pteropodum

Even at a distance, visitors would have spotted the explosion of purplish pink flowers on this large tree about 20 m tall near the Foliage Garden and Bougainvillea collection. A soft breeze brushing against the flowers would have treated passers-by to their delicate rose-like fragrance. Known commonly by the Malays as the Mengkulat, the tree's scientific name is *Teijsmanniodendron pteropodum* – a botanical tongue twister!

Teijsmanniodendron pteropodum belongs to the Mint family (Lamiaceae). The genus is named after Johannes Elias Teijsmann, who was Curator of the Buitenzorg Botanic Gardens (now Bogor) from 1831 to 1869. The species' epithet, *pteropodum*, is Latin for 'winged feet', in reference to its winged petioles. It is a large tree that can reach up to 32 m in height, and its leaves are compound with three to seven leaflets.

The Mengkulat occurs in Thailand, Peninsular Malaysia, Sumatra, Borneo and the Philippines. It is normally found in primary and secondary forests, including heath forest, and often along riverbanks or in freshwater swamps. It grows in clayey or sandy soils and sometimes on basalt or limestone.

The inflorescences of this handsome tree normally occur in panicles from 0.2 to 1 m long and have pale greenish pink stalks. The corolla of the short tubular flowers is a lovely pale blue-violet hue;

The small fragrant white flowers of the Pelong.

The fruit of the Pelong.

the central lobe is a darker shade of blue-violet and has a brownish striated throat. The ripe fruit of the Mengkulat is a conspicuous, thick woody brown drupe containing a single seed.

The wood of the Mengkulat is used for general purposes such as house construction, interior work, light framing, telegraph poles, mouldings, boxes and crates, and also as fuel. This attractive tree is reportedly used medicinally to treat intestinal ailments, and also has good potential as an ornamental given the profusion of flowers it can produce.

Pentaspadon motleyi

Covered in blooms during the flowering period, a small clump of medium sized trees along Cluny Road would have attracted the attention of drivers and pedestrians alike. On balmy days, visitors strolling past the trees would have been rewarded with the fresh, subtle scent of their flowers. This tree is commonly known in Malay as the Pelong or Pelajau. Its generic name, *Pentaspadon*, is derived from the Greek *pente*, meaning 'five', and *spadon*, meaning 'eunuch', referring to its five sterile stamens. Its species' epithet, *motleyi*, honours James Motley, a 19th century English naturalist who had lived, worked and died in Borneo.

The Pelong tree belongs to the Mango or Cashew family (Anacardiaceae). It is naturally distributed in lowland forests from Sumatra to New Guinea and the Solomon Islands, including Peninsular Malaysia. This tree is usually deciduous and occurs naturally in low-lying, undulating land, especially near streams and in seasonal swamp forests. In its natural habitat, the Pelong is a fairly large tree, reaching up to 36 m in height and the trunk to 80 cm in diameter at breast height. It produces a spreading buttress and graceful, feathery crown.

Pelong trees can be found in a few different places in the Gardens. The trees next to Cluny Road were planted in 2005, and are now around 10 m tall with greyish straight boles and pinkish inner bark. If wounded, the trunk of this species can exude a whitish sap. According to literature, an oil extracted from the trunk, called *minyak plang* in Peninsular Malaysia and *minyak pelanjau* in Borneo, is used to treat skin eruptions.

The leaves of the Pelong are clustered at the end of the branches. They range from 10 to 30 cm long, are compound with seven to nine leaflets, and when young, are pinkish in colour. The flowers are arranged in dense, branched clusters known as panicles and have purplish red stalks. Each fragrant flower is small and star-shaped, about 4 mm wide, and composed of five white to cream-coloured petals with rounded tips. The fruit of the Pelong is a fleshy drupe with an almond-shaped kernel (seed) inside. It is edible and can be eaten fresh or roasted; in Borneo, the seed is sold in local markets.

The Pelong is harvested from the wild mainly for local use as food, medicine and a source of wood. The wood is traded as *pelajau* timber and is fairly hard and heavy with moderate durability. It is suitable for interior finishings, such as flooring, panelling and mouldings, and for making artefacts.

Nura Abdul Karim
Library, Training and External Relations

All photos by Dr Nura Abdul Karim

Pictorial Guide to the Flora of Tasik Chini
FRIM Special Publication No. 22

Tasik Chini is the second largest natural freshwater lake in Peninsular Malaysia and is located in the Pekan district of the state of Pahang. In addition to wetlands, the 901-ha Tasik Chini Biosphere Reserve also contains adjacent dryland forests. This Biosphere Reserve is one of more than 650 sites across 122 countries under UNESCO's Man and Biosphere Programme, which aims to establish a scientific basis to improve relationships between people and the environment.

The *Pictorial Guide to the Flora of Tasik Chini* gives an introduction to the morphology, ecology, distribution and uses of select plants within the Biosphere Reserve, and provides a user-friendly means to identify them. The introductory chapter provides an excellent introduction to the overall plant ecology of Tasik Chini, with a page devoted to each of six microhabitat types: open water, *rassau* swamp, reed bed, freshwater swamp forest, riparian forest, and lowland dipterocarp forest. Of special note is that the authors discuss the major anthropogenic activities that have had an impact on the plant ecology. This includes a dam along Sungei Chini and the use of fire by the local aboriginal people.

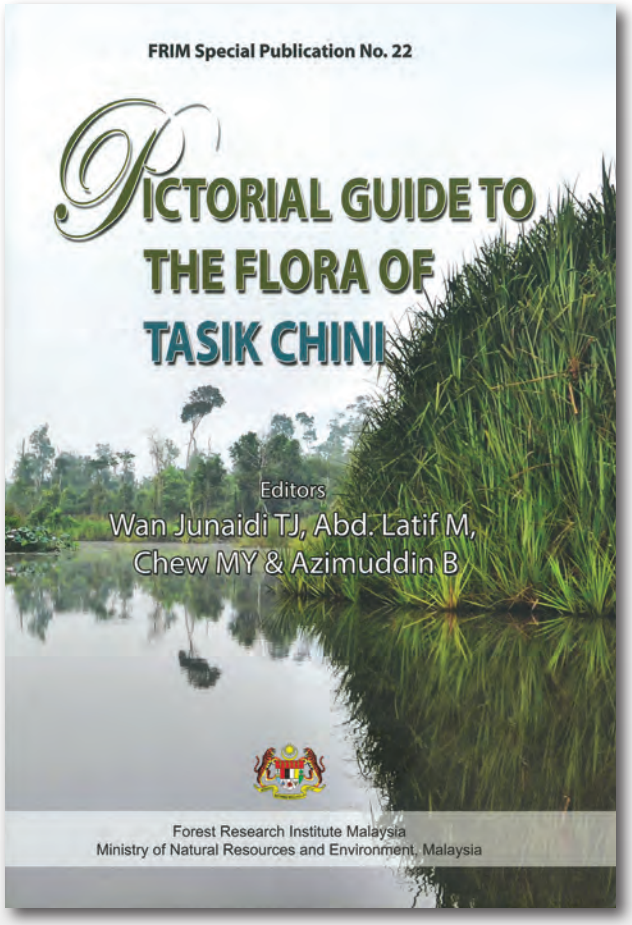
Following the introduction are three chapters treating aquatic and semi-aquatic plants, freshwater swamp forest and riparian forest plants, and lowland forest trees. Each of these chapters begins with a plant checklist indicating uses and conservation status. This is followed by one-page information factsheets for select species, including photographs and notes covering morphology, ecology and uses. Global distribution is also presented in brief, with more detailed distribution and habitat information given for the species in Peninsular Malaysia.

The book has a strong emphasis on ethnobotanical uses of the plants found in Tasik Chini, especially in traditional medicine. In the chapter on lowland forests, the emphasis on uses shifts to timber. The lowland forest in the Tasik Chini Biodiversity Reserve is dominated by dipterocarps, and there is an arboretum at the entrance of the nearby Lake Chini Resort, which is also introduced in the *Pictorial Guide to the Flora of Tasik Chini*. At the arboretum itself, a total of 140 trees, belonging to 34 families, 61 genera and 92 species, are labeled for visitors.

For those who would like to read further about the information in the book, there is an extensive reference list. A glossary is provided so that the general public can understand the technical terms used in the book, and an index to the scientific names is also included.

This well-illustrated, user-friendly publication is a valuable addition to the literature on plant ecology in Peninsular Malaysia. It is also a useful book for visitors to Tasik Chini, and can serve as a reference resource to the managers of Tasik Chini Biosphere Reserve and its environs.

S.K. Ganesan
Herbarium



Edited by Wan Junaidi T.J., Abd. Latif M., Chew M.Y. and Azimuddin B.

Published in 2018 by Forest Research Institute of Malaysia, Ministry of Natural Resources and Environment Malaysia.

17.6 × 25 cm, hard cover, xv+140 pp.

ISBN 978-967-2149-21-7

Price RM 85.00 (approximately S$28.00)

January–June 2019

(Left) His Excellency Andrej Babiš, Prime Minister of the Czech Republic, and Dr Leong Chee Chiew, Deputy CEO of NParks, during the naming of *Dendrobium* Andrej Babiš (right) on 15 January 2019.

Mr Amandyk Batalov, Governor of Almaty Region, Republic of Kazakhstan

Dr Anders Lindström, Curator, Nong Nooch Tropical Garden, Pattaya, Thailand

HE Andrej Babiš, Prime Minister of the Czech Republic

Dr Bill McDonald, Queensland Herbarium, Australia

Dr Bruce Maslin, Western Australia Herbarium, Australia

HE Carlos Raul Vasquez Corrales, Ambassador of Peru to Singapore

Dr Carmen Puglisi, Royal Botanic Gardens, Kew, United Kingdom

Dr Charan Leeratiwong, Prince of Songkla University, Thailand

Ms Choi Deokje, Director, Forest Greenery Section, Pyeongtaek City, Republic of Korea

Dr Daniele Cicuzza, Universiti Brunei Darussalam

Mr Dermot Molloy, Horticulturist, Royal Botanic Gardens Victoria, Melbourne, Australia

Mr Desmond Lee, Minister for Social and Family Development and Second Minister for National Development, Singapore

Dr Elliot Gardner, The Morton Arboretum, United States of America

Mr Ethan Cheah, Forest Research Institute Malaysia

HE Fatma Varank, Deputy Minister of Environment and Urbanisation of the Republic of Turkey, and delegation

Ms Hannah Wilson, Royal Botanic Garden Edinburgh, United Kingdom

HE Jacek Czaputowicz, Minister of Foreign Affairs of the Republic of Poland, and delegation

HE James Sinclair, Ambassador of Chile to Singapore

Mr Jiratthi Satthaphorn, Prince of Songkla University, Thailand

Dr Joeri S. Strijk, Alliance for Conservation Tree Genomics and Associate Professor at Guangxi University, China

Ms Kim Rabbidge, Australian Association of Friends of Botanic Gardens

Mr Lim Teck Lee, Deputy Principal, and delegation from ITE College East, Singapore, and Roma Street Parkland and South Bank Parklands, Australia

HRH Princess Maha Chakri Siridhorn and delegation from the Royal Thai Embassy

Dr Mark Hughes, Royal Botanic Garden Edinburgh, United Kingdom

Dr Padma Raj Gajurel, North Eastern Regional Institute of Science and Technology (NERIST), India

Mr Pantamith Rattanakrajang, Mahidol University, Thailand

Dr Peter van Welzen, Naturalis Biodiversity Center, Leiden, The Netherlands

Mr Phongsakorn Kochaiphat, Mahidol University, Thailand

Dr Rogier de Kok, London, United Kingdom

Prof. Rouben Aroutiounian, Yerevan State University, and **Dr Sahak Vardanyan**, Institute of Botany after A. Takhtajyan and Yerevan Botanical Garden, National Academy of Sciences, Republic of Armenia

Dr Sahut Chantanaorrapint, Prince of Songkla University, Thailand

Dr Sara Oldfield, Global Trees Campaign, United Kingdom

HE Scott Wightman, British High Commissioner to Singapore, and **Ms Nicola Hewett**, Climate Change and Energy Attache, British High Commission

Dr Sumudu Rubasinghe, University of Peradeniya, Sri Lanka

Ms Susana Guerrero, Naturalis Biodiversity Center, Leiden, The Netherlands

Dr Tamara Fleming, Director, Longwood Gardens Fellows Program, United States of America

Mr Tanatkrit Trongdechakraiwut, Prince of Songkla University, Thailand

Ms Thetyu New, Myanmar Floriculturist Association

Dr Wayt Thomas, New York Botanical Garden, United States of America

Mr Wisnu H. Ardi, Bogor Botanic Gardens, Indonesia

Mr Zacky Ezedin, University of Minnesota, United States of America

From Third Lake to Eco-Lake

Third Lake in 1988. At the time, the land occupied by the lake was separated from the rest of the Gardens by Cluny Road.

The land that Eco-Lake occupies was part of the Economic Gardens from the late 1870s until the 1920s, when it was annexed by the government. When 15 ha of this land was returned to the Gardens in the 1980s, a 'Third Lake' (after Swan Lake and Symphony Lake) was acquired along with it. The lake had been built to the specifications of the Drainage Department to serve as part of the water catchment and flood control scheme for the area. Its sides were very steep and the water level fluctuated up to 3 m at various times during the year, and thus it was not suitable for growing a diversity of aquatic plants.

With the completion of flood control measures in the area in the 1980s, the Third Lake was no longer required as a catchment. So in 1990, Jun-ichi Inada, the Gardens' landscape architect at the time, was asked to reconfigure the lake so that it could provide freshwater habitat for biodiversity. When completed in 1993, the lake had natural contours and an extended shoreline to support a variety of plants, insects, birds and other animals. Called 'Eco-Lake' after its reconfiguration, it is the largest lake (by surface area) in the Gardens today.

Eco Lake in 2000. Today, this lake supports a variety of local biodiversity and is also home to a family of Black Swans native to Western Australia.

Christina Soh
Library