Gardenwise

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Articles

Regular Features

Cover
Participants of the 18th Flora of Thailand Conference at the Singapore Botanic Gardens. The conference was held both physically and online, allowing participants to also join virtually.
(Photo credit: Derek Liew)

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Message from the Director

In August, the Singapore Botanic Gardens signed an MOU with the National Arboretum Canberra and Wellington Botanic Garden. In the back row are the witnesses, from left to right: Mr Yap Him Hoo, Deputy CEO of NParks; Ms Indranee Rajah, Minister in the Prime Minister's Office, Second Minister for Finance and Second Minister for National Development; Mr Andrew Barr MLA, Australian Capital Territory Chief Minister; and H.E. Ms Jo Tyndall, New Zealand High Commissioner to Singapore. In the front row are the signatories, from left to right: Dr Tan Puay Yok, Group Director of the Gardens; Mr Scott Saddler AM, Executive Branch Manager, National Arboretum Canberra and Stromlo Forest Park; and Mr David Sole, Manager, Wellington Botanic Garden, Wellington City Council.

The past six months have been a very hectic but fulfilling period for the Gardens!

After a two-year postponement, the Gardens hosted the 18th Flora of Thailand Conference from 18 to 22 July 2022 (see pages 39–41). The Gardens' botanists have been involved in the Flora of Thailand for many years now, but for the first time since the Flora of Thailand project started in 1970, the Gardens had the honour of organising and staging the conference here in Singapore. A greater honour that the opening session was hosted by Singapore's Minister for National Development, Mr Desmond Lee, and the conference was opened by Her Royal Highness Princess Maha Chakri Sirindhorn of Thailand.

After a four-year break, the Gardens successfully staged the Singapore Garden Festival (SGF) 2022 from 30 July to 9 August. What is very special about this edition of SGF is that for the first time in its history, it was held in two completely new venues. The first was in the Gardens, which reprises the Gardens' historical role in staging the first flower shows in Singapore in its grounds. In fact, the earliest documented garden show was held in the Gardens in 1884. The second location was Orchard Road, right in the heart of Singapore's shopping and lifestyle destination, with key international show components anchored at Ngee Ann City and Ion Orchard. The experimental format was deliberate – as we planned for SGF with uncertainties imposed by the COVID-19 pandemic, it was necessary to ensure that the different components were adequately spaced for visitor management, but yet be able to maintain the thematic and spatial coherence of the show. Although this was a smaller show than previous editions, feedback and reviews have been positive. Look out for the feature article on SGF in the next edition of *Gardenwise*.

SGF 2022 was scheduled to coincide with the World Cities Summit (WCS) 2022, an international platform organised by Singapore for leaders in the public sector, academia and practice to share, discuss and exchange ideas on the future of cities. Not only did SGF 2022 benefit from visits from overseas participants of WCS, the Gardens' team also created a landscape centrepiece in the WCS event venue, showcasing not only what visitors could see more of in SGF, but also the rich talent and artistry of our landscape designers.

The Gardens' Heritage Festival was also held in conjunction with SGF 2022. The Festival this year saw 39 events and programmes organised over a two-week period. The most attended event must be the concert on 7 August 2022 with a performance by the very popular Thai group Fivera. Organised by the VIVA Foundation for Children with Cancer, more than 5,000 visitors were treated to a repertoire of popular classic operatic arias and renditions of universally popular hit songs from the movies and West End show tunes.

The Gardens has enjoyed a rewarding relationship with the National Arboretum Canberra (NAC) through an MOU that we signed with NAC in 2017. We were very happy to renew this working relationship during an MOU signing ceremony held in the Gardens on 12 August 2022. For this MOU, we were also very glad that NAC had suggested to include the Wellington Botanic Garden in a tripartite agreement. The MOU was witnessed by Ms Indranee Rajah, Minister in the Prime Minister's Office, Second Minister for Finance and Second Minister for National Development, Singapore; Mr Andrew Barr MLA, Australian Capital Territory Chief Minister; Her Excellency Ms Jo Tyndall, New Zealand High Commissioner to Singapore; and representatives of the respective institutions. The Gardens looks forward to working closely with our partners to fulfil our respective missions.

Over the last six months, the Gardens also increased its VIP orchids, with three new orchids named after visiting dignitaries to Singapore: *Dendrobium* Kishida Fumio, named in honour of His Excellency Kishida Fumio, Prime Minister of Japan on 11 June 2022; *Papilionanda* Oyun-Erdene Luvsannamsrai, named in honour of His Excellency Oyun-Erdene Luvsannamsrai, Prime Minister of Mongolia on 8 July 2022; and *Dendrobium* Ibrahim Zarith, named in honour of His Majesty Sultan Ibrahim Ibni Almarhum Sultan Iskandar, Sultan and Sovereign Ruler of the State and Territories of Johor Darul Ta'zim, and Her Majesty Raja Zarith Sofiah Binti Almarhum Sultan Idris Shah, Permaisuri of Johor, on 20 July 2022.

In September 2022, the Gardens will announce at the 7th Global Botanic Garden Congress in Melbourne that the 8th Congress will be held in Singapore in 2024, in partnership with Botanic Gardens Conservational International. The Gardens put up a strong proposal to secure the hosting rights, and we look forward to welcoming international participants to attend what will be an exciting and rewarding conference in Singapore.

As I reflect on these past and impending activities, it is clear that the Gardens has maintained a strong network of international partnerships, and with that, a strong international profile. To date, the Gardens and NParks have 33 MOUs with international and local partners, and through our research, education, outreach, shows and events, we continue to engage even more international partners and visitors. This has been built upon a foundation of professional relationships by staff and the goodwill that has been grown over many years. We cherish our international network and reputation, and will continue to leverage this toward fulfilling our mission to connect people and plants.

Tan Puay Yok
Group Director
Singapore Botanic Gardens

Edible legume flowers in Asia

Members of the Legume family (Fabaceae) are vital components of many staple diets across the world, and the parts that we most commonly utilise are the seeds or pulses, sprouts and the unripe pods. While most of us would have consumed foods prepared from all of these categories, there is one part of legume plants that many of us are less familiar with eating – the flowers.

The most well-known example of a legume flower used in the cuisine of our region is perhaps the Butterfly Pea or Blue Pea (*Clitorea ternatea*), which produces a blue pigment that is extracted for use in many Peranakan and Malay confectioneries. While there are various forms with flowers that range from white to very pale blue, to pale blue-magenta*, only those with vivid blue flowers are harvested for food colouring. In recent years, the Blue Pea flower has gained immense popularity in East and Southeast Asia as a colour-changing floral tea, where the vivid blue pigment can be altered to produce shades of deep purple to purplish pink by adding ingredients that change the pH of the concoction. Food aesthetics aside, this floral tea has also been marketed as a health food supplement rich in antioxidants such as anthocyanins that help to prevent diseases caused by oxidative stress. Besides being used as a floral tea, the flowers can also be deep fried – tempura style – and consumed as a vegetable.

The Butterfly Pea or Blue Pea (*Clitoria ternatea*) and its flower colour forms.
(Photo credits: Lily Chen)

(Left) Only the form of the Blue Pea that has deep blue-violet flowers is grown and harvested commercially in countries such as Thailand, where (right) the flowers are also eaten deep fried.
(Photo credits: (left) Lily Chen; (right) Phiangphak Sukkharak)

The Blue Pea, however, is not the only legume species with flowers that have found their way into Asian food and drink – the flowers of several *Sesbania* species are also consumed in this region. For instance, the flowers of *Sesbania grandiflora*, a small tree known by the names of Vegetable Hummingbird, Kacang Turi (Bahasa Melayu), Katuray (Tagalog), and ดอกแค or Dok Khae (Thai), are

*This is sometimes described as a light wisteria colour, but a better match would be the colour denoted by the hexadecimal colour code #e0b0ff

The flowers of *Delonix regia* or the Flame Tree. These flowers are a seasonal delicacy in Vietnam. *(Photo credit: Lily Chen)*

cooked and consumed as a vegetable. The red-flowered form of this species is highly ornamental, but it is not as commonly planted as the white form, whose flowers are harvested commercially for consumption. One of the dishes prepared using this species is a delicious Thai curry known as แกงส้มกุ้งดอกแข or *kaeng som dok khae*, which is cooked with prawns. In the Philippines, the flowers are eaten as a salad known as *ensaladang katuray* – the blooms are blanched, then added to diced tomatoes and onions, and the mix is tossed with *bagoong* (a type of fish sauce) and vinegar before serving. The other commonly consumed species in this region, *Sesbania javanica*, has yellow flowers that are much smaller in size compared to those of the Vegetable Hummingbird, and are often added to omelettes or prepared as a dessert in Thailand. The flowers of both species are imported into Singapore, and can often be found in grocery stores specialising in Thai, Burmese or Vietnamese ingredients.

While the Blue Pea and *Sesbania* flowers are available in markets throughout the year, there are also a number of seasonal delicacies prepared from legume flowers. One example comes from *Delonix regia*, more commonly known as the Flame Tree, a species native to Madagascar that has been cultivated as an ornamental in tropical and sub-tropical regions worldwide for some time. In Vietnam, where it is called Phượng Vĩ (phoenix tail), it is appreciated not just for the visual spectacle it creates during the blooming season, but for the flowers which are collected for food. The fresh petals are added to a mix of shredded banana flowers, carrots, green mango, vegetable sprouts, herbs (such as coriander and basil), and stir-fried chicken or shrimp to make a refreshing and colourful salad. Once a common wayside tree in Singapore, the planting of this species has gradually been phased out as it is unable to bloom as profusely as it would in areas with a distinct dry season. So those of us in Singapore would likely have to travel to Vietnam to experience the visual extravaganza of this tree in full bloom, and to enjoy the delicacy made from its flowers at the same time.

On the Indian subcontinent and in Southern China, the buds and fresh flowers of the Orchid Tree or *Bauhinia variegata* are gathered from forests during the springtime and sold in markets that carry local produce collected from the wild. The flower buds of this species are used in Nepalese cuisine such as *koirala ko phool re alu ko achaar*, a chutney which includes potatoes, tomatoes and onions along with various herbs and spices. In the Yunnan province of Southwest China, where this species is native, the flowers are commonly collected and consumed by minority tribes such as the Dai, Lahu and Hani peoples and used in stir-fries or consumed deep fried. The stamens and pistils are discarded before






Sesbania flowers are often used in Thai food. (Top left) Deep-fried flowers of _S. speciosa_ are usually eaten with chilli sauce or other dips. (Top right) Blanched flowers of _S. javanica_ are eaten as a salad. (Centre left) Flowers of _S. grandiflora_ in _kaeng som dok khae_ curry. (Centre right) Flower buds of _S. grandiflora_ on sale in a Thai food stall; the anthers and ovary have to be removed from the flowers before cooking as the fertile parts are very bitter to the taste. (Bottom row) The red-flowered form of _S. grandiflora_ is grown as an ornamental, whereas the flowers of the white-flowered form are harvested commercially for food.
(Photo credits: (top row and centre left) Saowalak Bunma; (centre right) Ho Boon Chuan; (bottom row) Lily Chen)

The flowers and seed pods of *Styphnolobium japonicum*, formerly known as *Sophora japonica*. In some parts of China, the flowers are used to prepare *huái huā* rice as a springtime delicacy. *(Photo credits: (left) Lu Yuan, (right) Duan Lei)*

cooking, as they are bitter and rather unpleasant to the taste.

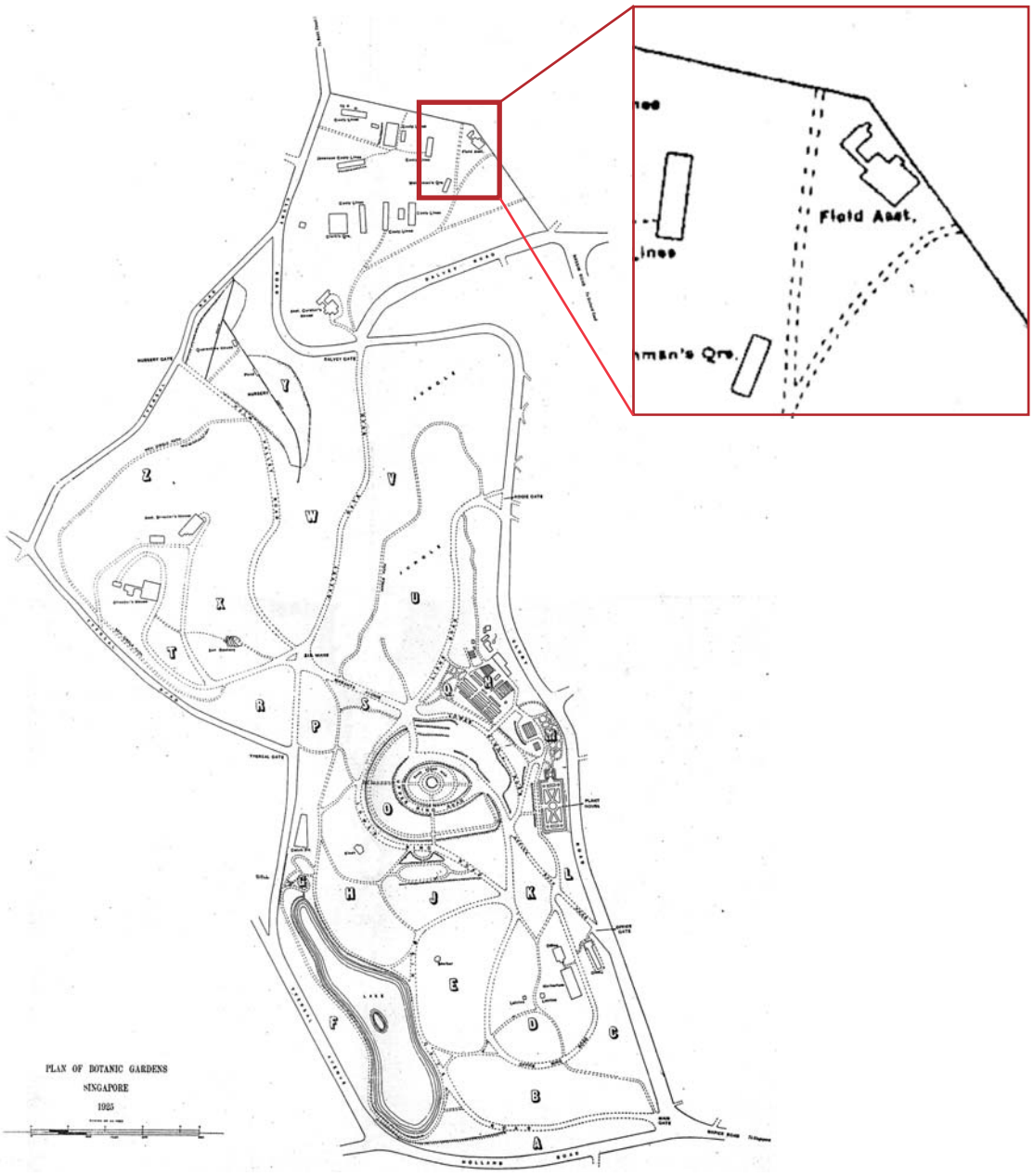
In Northeast China, it is a widespread practice to use the sweetly scented flowers of the Pagoda Tree, *Styphnolobium japonicum* (better known by its synonym *Sophora japonica*), as a seasonal delicacy. In the springtime, the flowers are collected and made into 槐花饭 or *huái huā* rice. Though the name suggests that it is a rice-based dish with flowers added to it, the truth is that there is hardly a grain of rice in it. To prepare this delicacy, the flower buds are coated with a mix of flour and seasoning such as salt (some preparations also include various spices, such as Sichuan pepper) and steamed, resulting in a dish that appears rice-like. Though they are most commonly prepared in *huái huā*, the flower buds are also sometimes used in omelettes and pancakes.

The flowers of many legumes that are consumed as food are also used medicinally. In fact, studies have shown that polyphenolic compounds isolated from the flowers of *Sesbania grandiflora* inhibit the growth of a variety of bacterial pathogens that cause food poisoning (*Escherichia coli*), typhoid fever (*Salmonella typhi*) and cholera (*Vibrio cholerae*). The regular consumption of polyphenols is thought to be beneficial to overall health and may help prevent certain diseases such as cancers. Recent studies have also shown that the flower buds of *Styphnolobium japonicum*, used for centuries in China, Japan and Korea as a traditional treatment to stop bleeding, also possess anti-inflammatory and anti-diabetic properties. They contain antioxidants, and are thought to inhibit tumours. While legume flowers may not be a prominent feature of many of our diets currently, it may be worthwhile to include more of them in our food, if only for their added health benefits.

Ho Boon Chuan
Lily Chen
Herbarium

Shedding light on House 6 and the Field Assistant's residence with historical maps

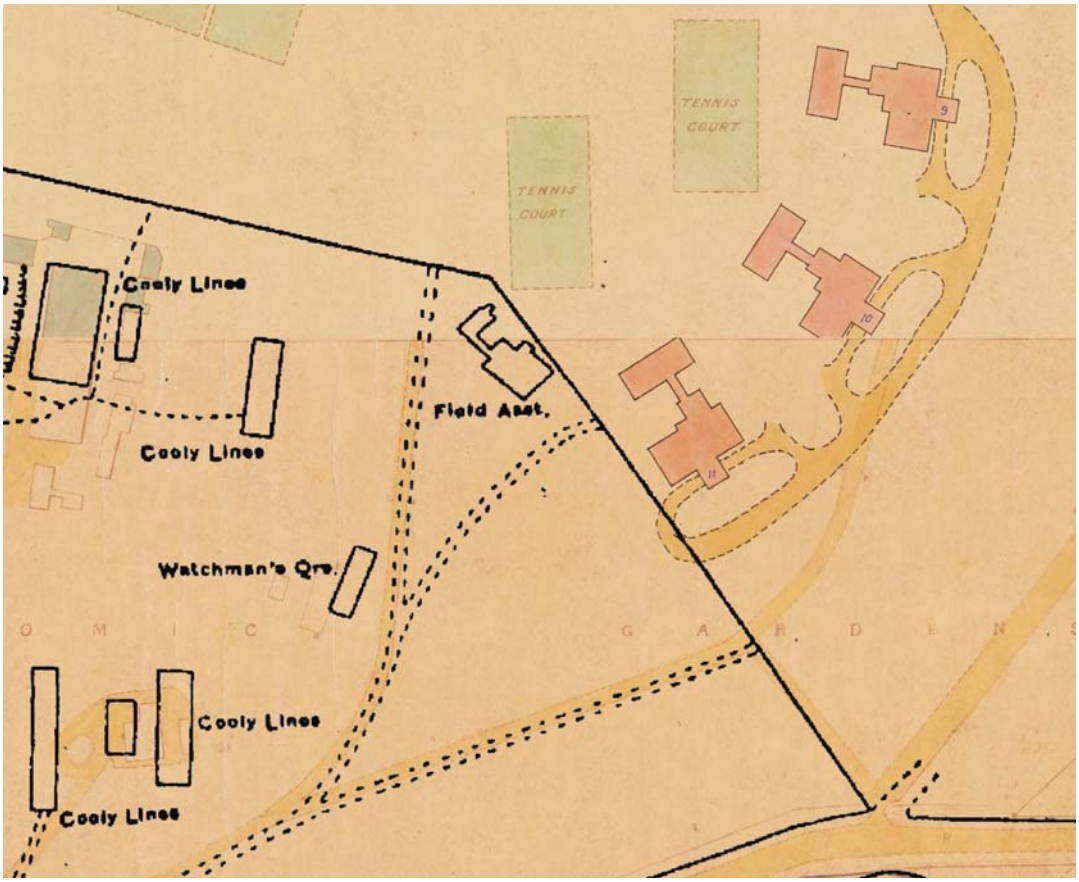
In 1919, a house was built to serve as the quarters of the Gardens' field assistant, a position that was vacant until 1923 when C.X. Furtado was employed to fill this role. Until recently, it was thought that this residence and House 6, which today houses the National Biodiversity Centre, were one and the same. This was because House 6 is the only building standing in the vicinity of the junction of Dalvey and Nassim roads, where the Field Assistant's residence first appears on a 1925 plan of the Gardens (first published in I.H. Burkill's 1927 *Illustrated Guide* to the Gardens). It also has a similar footprint as the building shown on the plan, including a long corridor leading to an annex at the back. However, we realised that there were discrepancies between the footprint and position of the Field Assistant's residence on the 1925 plan compared to what we can see with House 6 when consolidating and georeferencing old maps to understand the past extent of Cluny Lake (the historical waterbody in the west end of the Gardens). This prompted us to conduct further research into the matter using a variety of geographical resources.



The *Illustrated Guide* to the Gardens by I.H. Burkill clearly shows the Field Assistant's residence in the top right corner of the Gardens' extent, near Dalvey and Nassim roads, on this plan of the Gardens from 1925. *(Image courtesy of the Singapore Botanic Gardens Archives)*

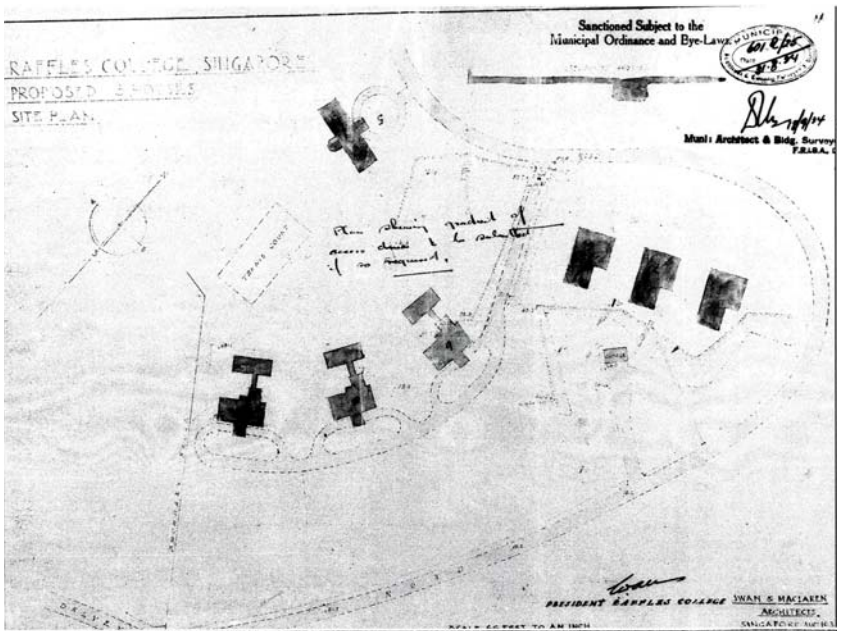
We overlaid topographical and aerial maps from the 1920s to the 1970s onto present-day digital map layers, which enabled us to georeference the 1925 plan and thus compare the position of the Field Assistant's residence with more recent maps. This revealed that House 6 was actually a separate building located nearby but further east of the Field Assistant's residence. Since the latter building is no longer standing, this means that the residence would have been removed at some point. From our mapping investigation, we know that it was located where the Dipterocarp plot outside the Healing Garden along the Red Brick Path is today. Further investigation is needed to understand more about its history, but we do know from aerial images and maps dating to 1970 that it existed until at least then. It is likely to have been removed by the 1980s to make way for the development of the Bukit Timah extension of the Gardens.

(Left) An overlay of the 1925 plan onto a topographic map from the 1920s. (The date is uncertain but the existence of the Economic Gardens labeled further north on the map indicates that it was produced before Raffles College occupied the area in 1924). The Field Assistant's residence appears on the topographic map with coloured hatching, and its footprint matches that of the 1925 plan. (Right) By then overlaying digital building layers from a 2014 Topographic Survey, we could see that House 6 is actually a separate structure slightly east of the Field Assistant's residence. The residence itself was located where the Dipterocarp plot outside of the Healing Garden is today.
(Topographical maps courtesy of the Singapore Land Authority)

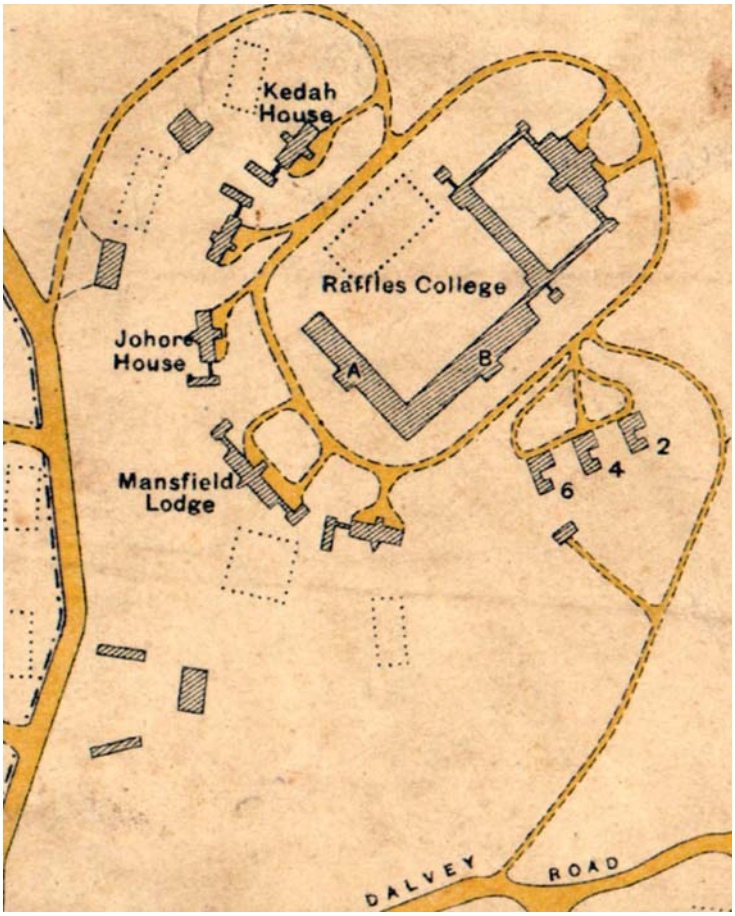


House 6, on the other hand, was designated a Conserved Building in 2013. It is one of three structures originally belonging to Raffles College which are identified as block numbers 9, 10 and 11 on building plans, with Block 11 being the location of House 6. These structures were designed

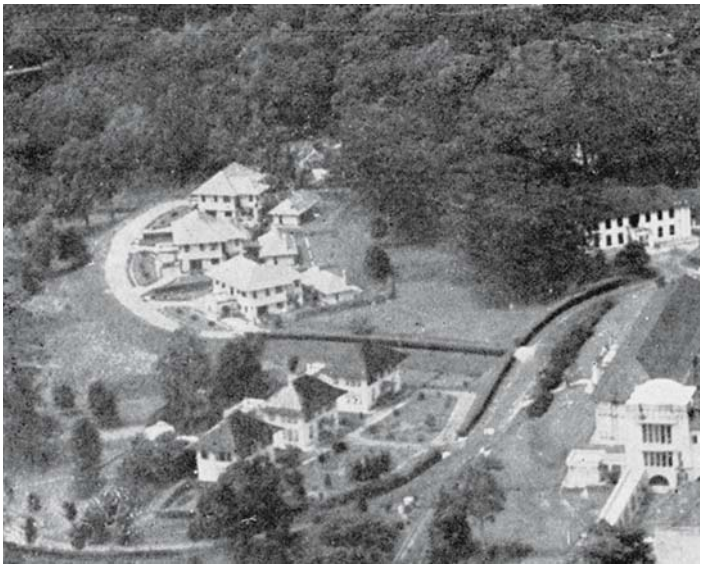
An overlay of the 1925 plan onto a 1920s map of Tanglin Mukim (township), showing in pink Blocks 9, 10 and 11 (the latter being House 6, furthest to the left in the trio of blocks). These were probably later additions to the map after the 1920s, as another building near Dalvey Road (not visible in this cropped image) is also highlighted in pink and annotated "PERM. TO ERECT APPR. 6-10-53", indicating that it was only permitted to be erected in 1953.
(Tanglin Mukim map courtesy of the Singapore Land Authority)



(Left) A different map of the same area from the 1920s showing the three blocks annotated as 9, 10 and 11. The annotation "B.P. 601Q/25" refers to the corresponding building plans of these structures. The red/blue outlines in contrast to the dark grey outline of other buildings may indicate that they were added to the map later. (Right) The building plans themselves have the municipal stamp date of end-August 1934, which indicates the likely time period of approval of the design and/or construction. The numbering of 601/25 [1925] was likely assigned as a reference to the entire set of plans for Raffles College, and may or may not have been produced at the same time, but only approved or executed later. *(Images courtesy of (left) the Singapore Land Authority and (right) the National Archives of Singapore)*

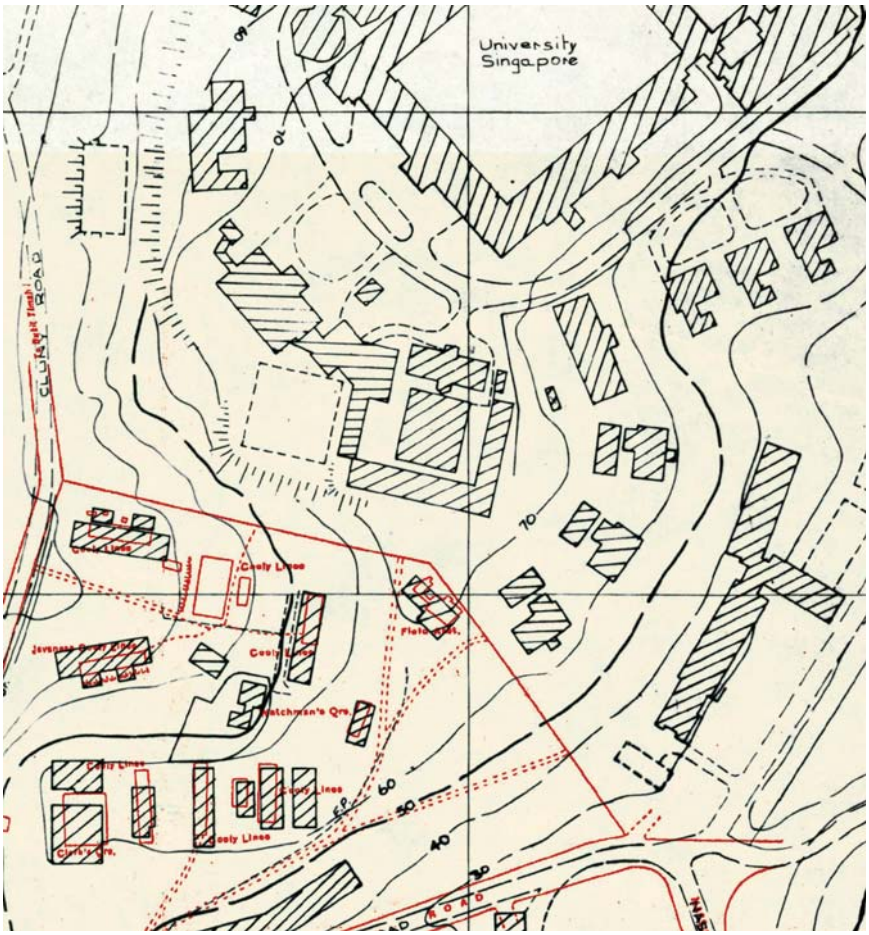


A topographical map produced by the FMS (Federated Malay States) Survey Department, likely from surveys in 1933 (as annotated elsewhere on the map), lacking Blocks 9 to 11 and the road leading to them, indicating that by 1933 they were still not built.
(Image courtesy of the National Archives of Singapore)



An aerial view of Raffles College taken around 1939. Blocks 9, 10 and 11 (House 6) are the three houses in the upper left, while the Field Assistant's residence can be seen in the vegetation behind Block 11.
(Image credit: Raffles College Collection, courtesy of the National Archives of Singapore)

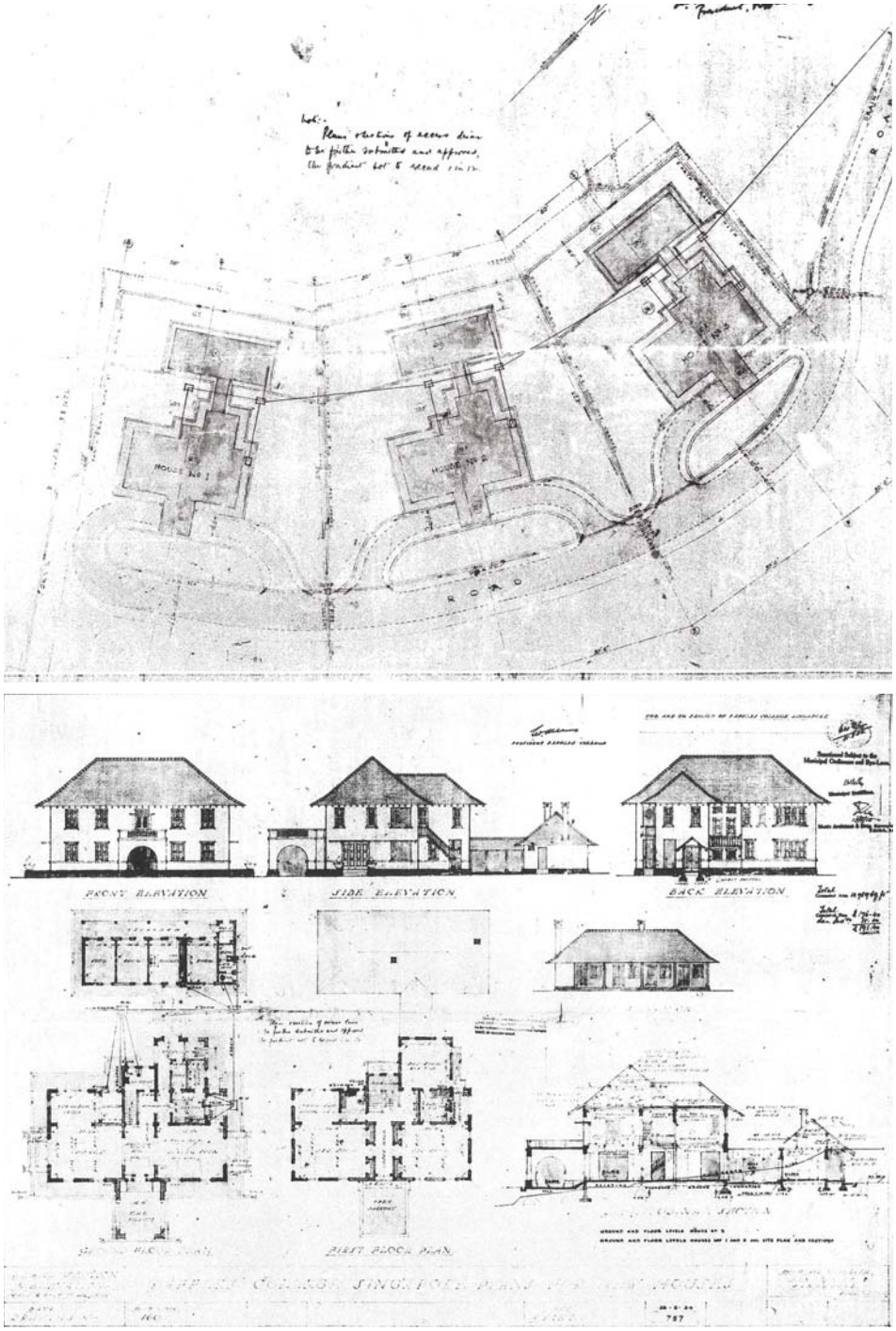
Overlays of the 1925 plan onto (left) an aerial image dating to the 1950s, and (right) the Singapore Town Map from 1958, showing the actual footprint and location of the Field Assistant's residence relative to the houses at Blocks 9, 10 and 11.
(Image credits: (Left) Aerial image by the British Royal Air Force, from a collection held by the National Archives of Singapore. Crown copyright. (Right) Town map courtesy of the Urban Redevelopment Authority)



The Field Assistant's residence is still indicated on this 1970s Instrumental Plot by Singapore Improvement Trust, which is overlaid with the 1925 plan of the Gardens. The instrumental plot was based on aerial photographic surveys between March 1969 and May 1969, as indicated elsewhere on the map.
(Topographic map courtesy of the Singapore Land Authority)

by the pre-eminent architectural firm Swan & MacLaren. Only one building plan exists for all three buildings as they shared the same design, consisting of two-storeys, five bays, a tiled roof, a porch at the centre with half-round arches at the side and front, a central staircase tower projecting out at the rear, and a single-storey ancillary building connected to the house by a covered walkway. The side elevation of the plan shows a door leading out, which in House 6 is not currently present, and there was also a balcony that has since been walled up to become part of the interior, with the roof extended over it. Neither of the houses at Blocks 9 and 10 are still in existence.

There are no clear annotations on the building plans that indicate the purpose of the buildings at Blocks 9, 10 and 11, but there are newspaper articles from the 1920s and 30s that provide some insight. A *Straits Budget* article titled 'Building Raffles College', dated 19 January 1928, mentions that "at lower levels on the slopes of the hill, there will be seven staff houses and the President's House", and another article in the *Malaya*



Building Plan 601Q/25 showing (top) a detailed view of the road leading to Blocks 9, 10 and 11, and (bottom) elevation drawings and details of the design used for all three houses built.
(Image courtesy of the National Archives of Singapore)

Tribune from 16 July 1929 describes the grounds prior to its opening the following week as having "five sets of permanent quarters for the President and Professors", also indicating that tenders were being called for three additional houses for assistant professors. This points to there being initially eight houses that were first built by around 1930, namely at Blocks 1 to 5 which correspond to Houses 1 to 5 (now housing the Gardens' Centre for Ethnobotany, Centre for Education and Outreach, Centre for Urban Greenery and Ecology, and Seed Bank, as well as the Institute of Policy Studies at the National University of Singapore), and at Blocks 6 to 8 which no longer exist but were situated further along University Road past House 5, where the northeastern end of the Healing Garden is today. The building of yet another three staff houses was mentioned in the annual report of Raffles College for the academic year 1935–1936 (published in the *Malaya Tribune* on 23 September 1936), and the municipal stamp on the building plans for Blocks 9, 10 and 11 was dated just two years before in end-August 1934, likely indicating the date of approval prior to construction. The three additional houses were therefore very likely to be Houses 9, 10 and 11, and built between 1934 and 1936.

From oral histories obtained by a colleague whose former office was in the National Biodiversity Centre at House 6, or Block 11, we know that this building was once the residence of College faculty, whom we learnt to be Professor Kiang Ai Kim at one point in time. We have been able to correspond with the professor's granddaughter, Angeline, for more information. She indicated that her family had stayed in the building from 1959 to 1960 and mentioned that the house was the residence for the Master (principal administrative officer) of Raffles Hall, which is known as Raffles Building today. She confirmed that the address of the house where the family stayed was No. 11, University, Singapore 10, and that there were indeed two other houses of the same design, which they knew as No. 9 and No. 10.

This investigation shows the value of using current and historical geographic resources in confirming our understanding of the Gardens' past. If aligned properly with accurate geographical references, historical maps can be used to give us a more exact look into the past at a spatial level and address misconceptions that we have about our history. While it turns out that the Field Assistant's residence and House 6 are not one and the same, we have enriched our knowledge of the Gardens' heritage through the process of this map exploration.

Edmund Chia
Living Collections

Building water resilience at the Singapore Botanic Gardens

A postcard featuring men manually loading water from Swan Lake to distribute on bullock carts around the Gardens.
(Image courtesy of the National Museum of Singapore, National Heritage Board)

All gardens need water; botanical institutions are no exception. For public gardens which are also conservation-minded, there is a need to balance providing verdant gardens for the public's enjoyment and meeting plant conservation goals, while conserving the resources needed to bring these gardens to life. Maintaining this balance is crucial to the Singapore Botanic Gardens, and we can tell from historical records and initial design that water sustainability has always been a concern for the Gardens.

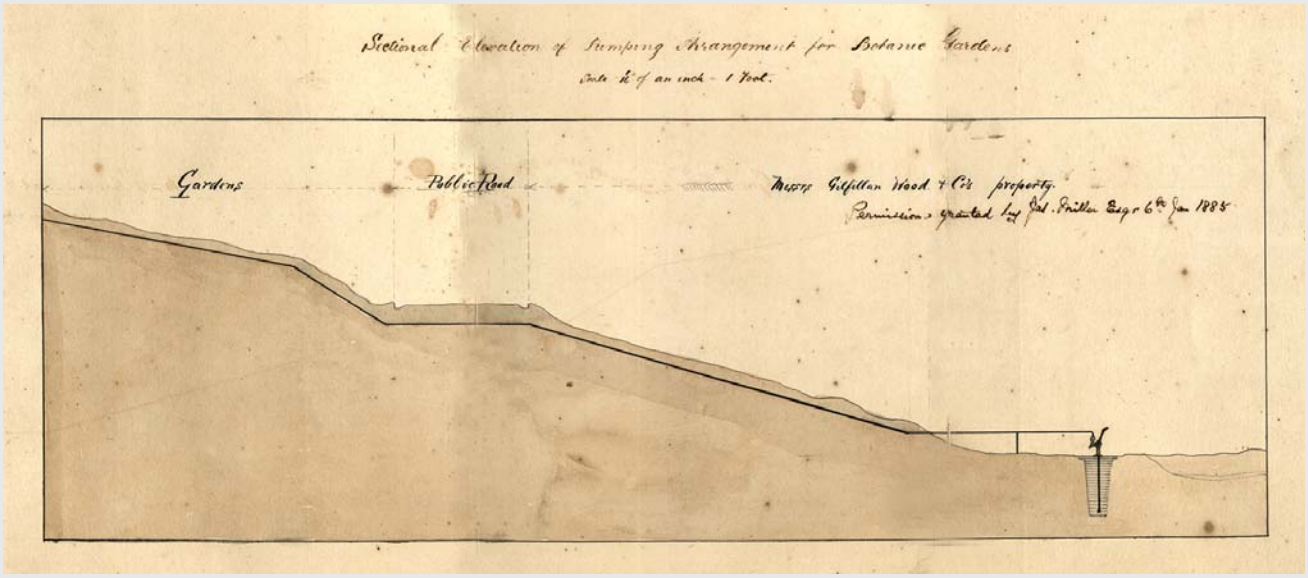
History of irrigation in the Gardens

Swan Lake, or Main Lake as it was formerly known, was constructed in 1866 under the guidance of Lawrence Niven, then Superintendent of the Gardens. It was part of the initial 22 hectares of land acquired for the establishment of the Botanic Gardens in 1859, and during periods of drought, was also an important source of water for irrigation. Getting this water to the plant collections, however, was extremely difficult, as there was no piped irrigation system. Successive superintendents from James Murton to the Gardens' first director, Henry Ridley, bemoaned the laborious irrigation required during periods of drought, with Ridley commenting in the 1889 Annual Report that "some arrangement is wanted by which water can be laid on to all parts of the Gardens".

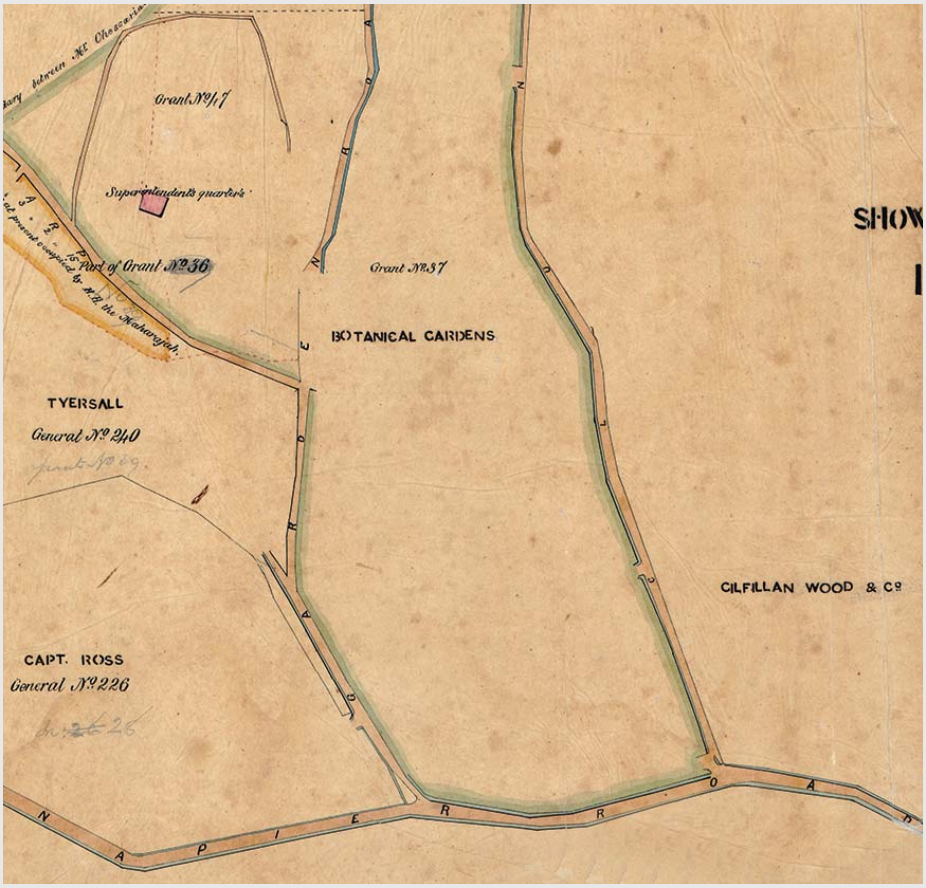
Drought-related difficulties featured in almost every annual report of the early 1900s, and the need for an alternative irrigation system became more and more pressing. The issue of water resilience was precipitated by severe droughts in the early 1900s and the closure of a nearby well that had previously been the main source of water for irrigating the plant houses. To irrigate the grounds, water then had to be

Well, well, well....

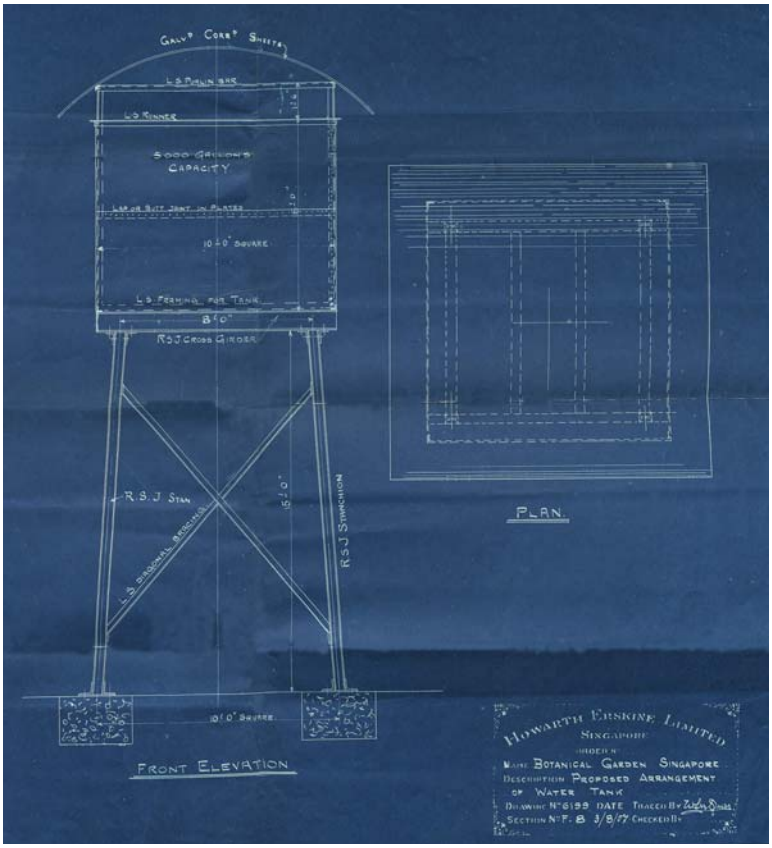
Before 1900, the various plant houses located near today's Cluny Road were irrigated using water obtained from a well situated on private property on the opposite side of Cluny Road. A hand pump was installed at the well after Nathaniel Cantley, then Superintendent of the Gardens, sought permission from the landowners Gilfillan, Wood & Co. in 1885. This well must have been an important source of water as its closure was mentioned in official correspondence when justifying the need for a new irrigation system. The closure of the well due to the sale of the private property was a lesson for the Gardens on the need for water self-sufficiency.



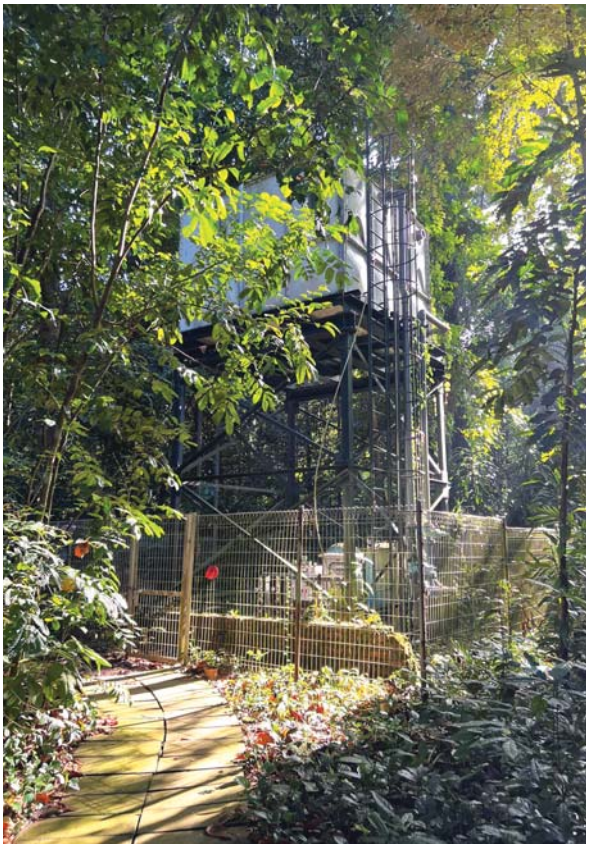
Schematic of the well and hand pump located on the property of Gilfillan, Wood & Co.
(Image courtesy of the Singapore Botanic Gardens Archives)



Map showing the Botanic Gardens adjacent to land owned by Gilfillan, Wood & Co.
(Image courtesy of the Singapore Land Authority)



Blueprint plans dating to 1907 for the proposed arrangement of a steel water tank mounted on a steel tower. The tank was installed the following year in the Rain Forest as part of the new irrigation system that drew water from Swan Lake. *(Image courtesy of the Singapore Botanic Gardens Archives)*



The existing water tank mounted on a tower in the Rain Forest, 2022. *(Photo credit: Beverly Tan)*

drawn manually from Swan Lake and distributed around the Gardens on a bullock cart, an arrangement that was clearly unsustainable and expensive. Thus, the Gardens' team had to look for other solutions. One potential solution was to lay pipelines from the municipal water supply, but this was ultimately rejected given that municipal water would likely be rationed during drought.

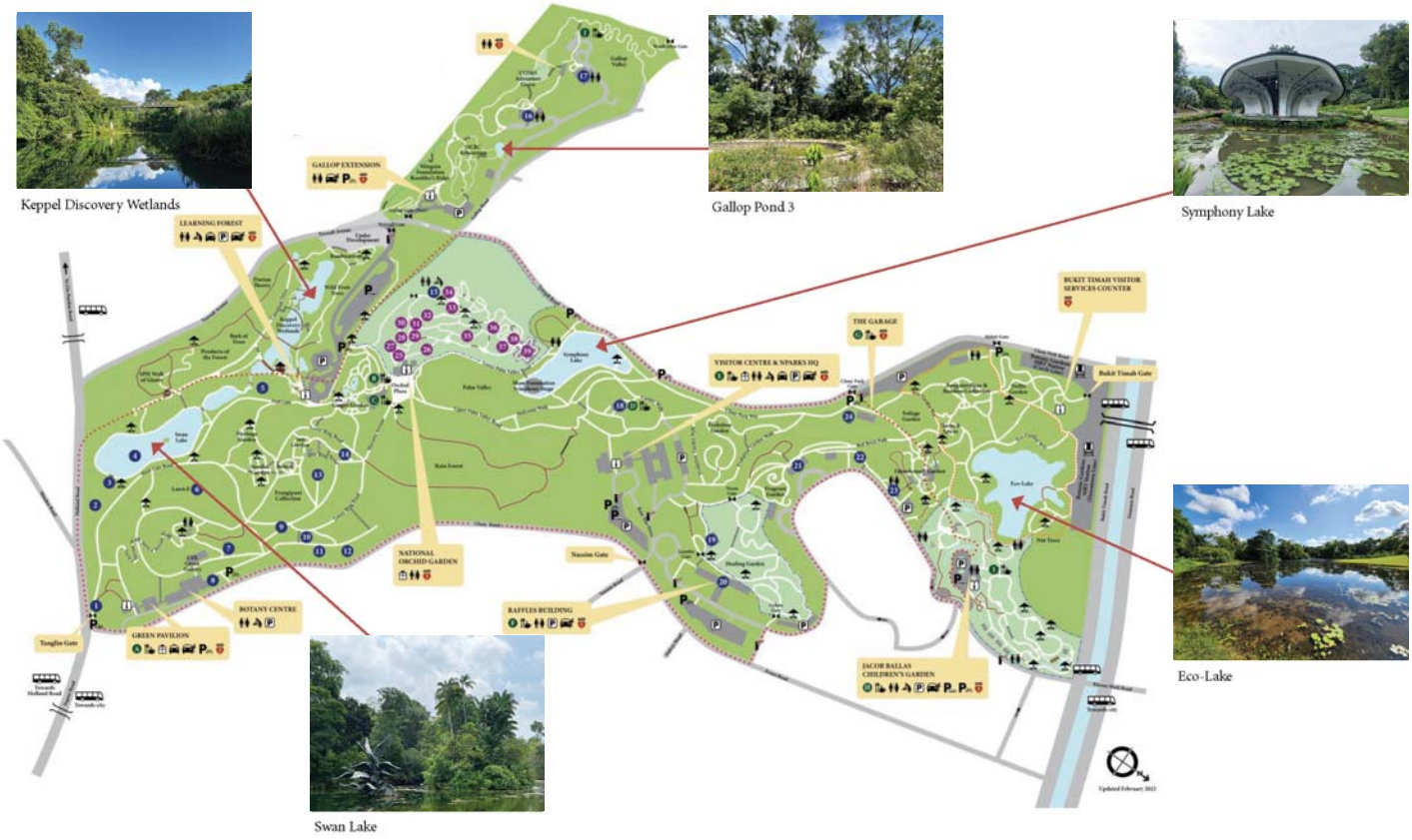
A movement towards water self-sufficiency

The proposal that was ultimately accepted allowed the Gardens to move towards self-sufficiency in meeting its watering needs by capitalising on the existing Swan Lake as a water catchment. Under the leadership of Henry Ridley, then Director of the Gardens, a system of pumped irrigation was installed in 1908. Water was pumped from the lake to an elevated water tank located in the Gardens' Rain Forest, then known as the Jungle, and piped from there across the Gardens by gravity flow.

This system not only saved manpower and cost, but also ensured a steady supply of water for the Gardens for many years. During the drought in 1963, when many parts of Singapore suffered cuts in municipal water supply, the Gardens was still able to rely on its Swan Lake water source and distribution system to maintain its collections. Although the level of the lake receded by about 45 centimetres, the irrigation system survived this stress test and helped tide the Gardens through to the end of the drought. While the elevated tank installed in 1908 has since been replaced, we still use the same location in the Rain

Funding the project

The significant role played by the Gardens in developing Malaya's rubber industry is well known. Interestingly, the 'dividends' from Ridley's research in rubber also helped the Gardens with its water woes. During periods of drought from 1895 to 1905, about 10% of the Garden's annual budget was spent on labour-intensive watering. The additional income from the sales of rubber plants and seeds greatly supplemented the budget and helped tide the Gardens through the droughts while not compromising on other operational expenditures. The entire pumped irrigation system installed in 1908 (costing $5,000) was also financed from the sale of rubber derived from Ridley's experiments!



Map of the Gardens, 2022, highlighting the major waterbodies.

Forest today as a key store of water before it is distributed through our current irrigation system.

Water sustainability in our Gardens today

Today, one major waterbody can be found in each core area of the Gardens: Swan Lake at Tanglin Core, Symphony Lake at Central Core, Eco-Lake at Bukit Timah Core, and the Keppel Discovery Wetlands at the Tyersall-Gallop Core. Other water catchment ponds have also been created in newer developments, such as Pond 3 at the Gallop Extension. Most visitors probably only think of these waterbodies as beautiful landscape features, as locations for showcasing aquatic plant collections, or as wetland ecosystems for biodiversity conservation, but they also play a critical role in supporting our operations by serving as vital reservoirs of water for irrigation.

In total, the water collected in our waterbodies and distributed around the Gardens by our current irrigation system is able to meet 72% of our water needs. And while we can probably never achieve full water self-sufficiency, as potable water is needed for buildings and fine misting such as in the Cool House at the National Orchid Garden, we are committed to finding ways to become even more water-sustainable. For instance, we are exploring ways to increase the capacity of our waterbodies. There are also projects underway that assess existing irrigation demands to use water more effectively and judiciously. With climate change bringing about more frequent and intense weather events such as droughts and heat waves, the need to move towards water sustainability is more important now than ever.

Maintaining the balance between keeping our plant collections lush and healthy, while being mindful of our ecological impact, has always been and will continue to be a priority for the Gardens. The many projects being implemented today stand testament to our commitment to this, as we build on our long heritage of water conservation to position the Gardens to be ready for a more climate uncertain future.

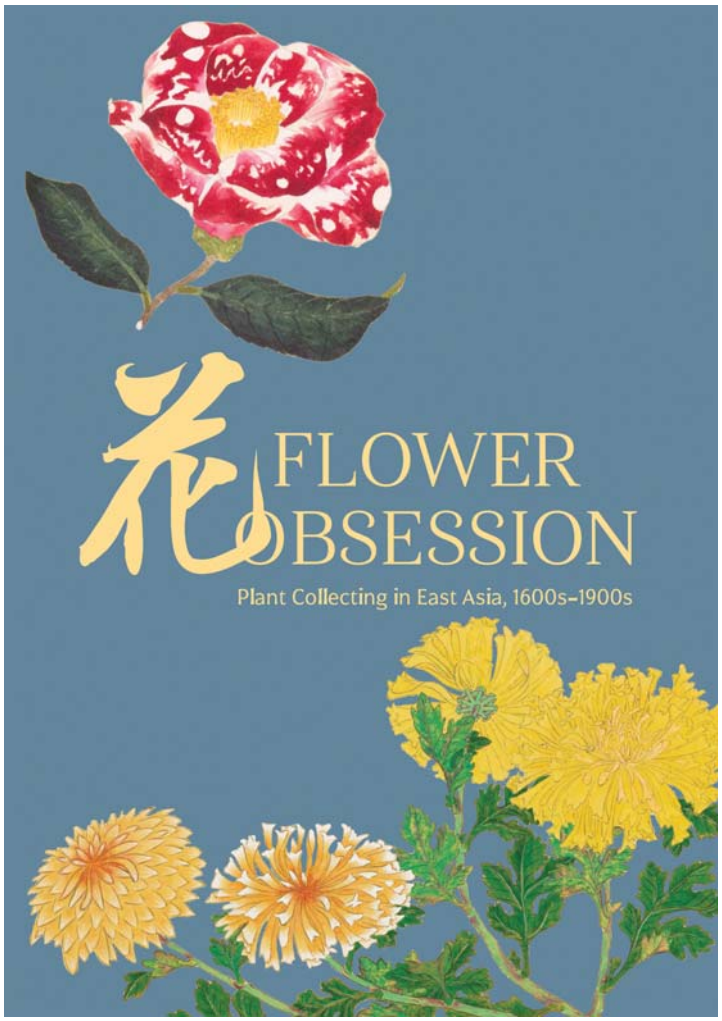
Beverly Tan
Living Collections

Ritika Tandon
Facilities Management

The authors would like to acknowledge the Singapore Botanic Gardens Library's assistance in this research.

Flower Obsession: Plant Collecting in East Asia, 1600s–1900s

This is the first exhibition at the Botanical Art Gallery to feature artworks on loan from two important overseas institutions: Higashiyama Botanical Gardens and the private Soukaen Bunko in Nagoya, Japan. The library of Higashiyama Botanical Gardens contains numerous and important materials that belonged to Itō Keisuke, a botanist from Nagoya and the first Japanese doctor of science. Soukaen Bunko is custodian of one of Japan's leading collections of illustrated botanical publications and manuscripts. This private library of Mr Ogasawara Saemonnojo Ryoken has been built up since 1970 when he began to collect literature and materials related to plants and horticulture in the Edo period.



The aim of the exhibition is to draw connections between the long-established tradition of flower painting in China and Japan and the use of drawings for the purpose of identifying traditional horticulture plants. It features about 100 items including printed books, manuscripts and photographs, many of which have not been exhibited outside of Japan before, and showcases drawing styles that were influenced by the naturalistic depictions of flowers and birds, as well as fish and insects, in East Asia.

The items presented in the exhibition include works by scholars Itō Keisuke, Iinuma Yokusai and Iwasaki Tsunemasa, who documented both wild and cultivated plants. They produced richly illustrated publications which formed the start of modern Japanese botany.

Also featured is a selection of materials dedicated to *kihin,* or unusual variegated plants, encyclopaedic works, materials on orchids, morning glories and *Rohdea japonica*, and those that showcase flowers that have, for centuries, been fairly ubiquitous in the arts and plant collecting traditions of East Asia.

Works on display in the gallery that are related to peony, lotus, chrysanthemum, iris and lily. For centuries, these flowers have been fairly ubiquitous in the arts and plant collecting traditions of East Asia.

An Akitafukizuri print made from the leaves of *Petasites japonicus* subsp. *giganteus*, dating to the early 20th century. It illustrates a technique used to print large leaves that was developed by the Miyakoshi family in Akita prefecture in 1862. The technique has been handed down from generation to generation in the family, and the details of production remain a family secret. The huge prints produced by the family are used as decoration; for example, they may be pasted on fusuma sliding doors or mounted as hanging scrolls.
(On loan for the exhibition from a private collection)

This exhibition is on at the Botanical Art Gallery in the Gallop Extension until 23 October 2022. The Gallery is open from 9am to 6pm every day, except for the last Thursday of each month, and admission is free. An exhibition catalogue can also be obtained from the Gallery or downloaded from **go.gov.sg/flowerobsession2022-exhibitioncatalogue**. Although the catalogue is available free of charge, a minimum donation of $10 to the Garden City Fund is recommended for each copy, which will support our efforts to bring botanical art to the Gardens. Donations can be made at **go.gov.sg/sbgart**.

Michele Rodda
Research and Conservation & Botanical Art Gallery

All text and images by Dr Michele Rodda

A historical background to the development of the works on display

Flower painting was established in Asia as a distinct art genre centuries before it became established in Europe. Chinese flower painting dates to the 300s CE when flowers became popular subjects of the educated class of scholar-artists known as literati. Focusing more on personal expression than literal interpretations of natural subjects, Chinese literati paintings commonly featured flowers through the depiction of plants which were called 'The Four Gentlemen' – the plum blossom, orchid, chrysanthemum and bamboo, which were traditionally painted in black ink. Flowers were also prominent in the classical Chinese genre of bird-and-flower painting which dates to the 900s and became popular in Japan from the 1300s onwards. In the 1600s and 1700s, flower painting became accessible to the Chinese and Japanese middle class, including merchants and artisans, as dedicated manuals

Illustrations of Camellias from *Kinka shokubutsu zusetsu* [Kinka plant illustrations], a multi-volume series of sketchbooks by Itō Keisuke, also known as Kinka, compiled 1893–1899. A collection of materials on *Camellia* species and cultivars, it contains illustrations taken from foreign journals, original drawings, a list of *Camellia* names, and a study on the patterns found on their petals.
(On loan for the exhibition from Higashiyama Botanical Gardens)

Roses from *Honzō zufu* [Illustrated encyclopaedia of materia medica], a mid-1800s manuscript by Iwasaki Tsunemasa, also known as Iwasaki Kan-en. *Honzō zufu* has a complex publication history. Iwasaki completed 96 autograph volumes in 1828 including almost 3,000 illustrations of plants. The volumes numbered 5 to 8 were printed in 1830, 9 and 10 were likely printed shortly after but they didn't sell well. The other volumes were distributed to subscribers as manuscript copies transcribed from the original set. All volumes were printed in colour woodblock from 1916 to 1923. The plants are arranged following the Japanese translation of *Ben cao gang mu* [Compendium of materia medica] by Li Shizhen, the celebrated Chinese herbalist.
(On loan for the exhibition from Soukaen Bunko)

Fūran-fu, or *Vanda falcata* (formerly *Neofinetia falcata*), in a manuscript from 1830. The artist is unknown, but possibly Akiotei Shujin, known as 'The Master of Akio-tei'. *Vanda falcata* is an evergreen perennial orchid that grows on the trunks and branches of large trees in the mountains west of central Honshu in Japan as well as in China and Korea. Forms with unusual flower and leaf shapes were first collected from the wild and then selectively bred. This manuscript contains illustrations of 25 varieties.
(On loan for the exhibition from Soukaen Bunko)

were published. While these long-established forms of depiction are not necessarily useful for plant identification as they tend to focus more on aesthetics than accuracy, they are an important early source of information on which plants were cultivated and appreciated, and were the basis for the development of more accurate forms of plant depiction aimed at identification.

Separately, China was producing texts on materia medica (including plants, animals and minerals believed to have medicinal properties) since the Eastern Han Dynasty (25–220 CE). An important example is the illustrated *Ben cao gang mu* [Compendium of materia medica], written by Li Shizhen (1518–1593) and first printed in Nanjing in 1596. In 1607, one copy of this compendium arrived in Japan and fell into the hands of the first shōgun, Tokugawa Ieyasu (1543–1616). This event had a lasting impact on Japanese scholars, eventually leading to the development of the study of local natural history. *Ben cao gang mu* was copied, commented upon, and, in 1637, published in Japanese (as *Honzō kōmoku*). This inaugurated a period during which Japanese plant knowledge was derived from books brought from China. Every effort was made to identify the plants of Japan with those of China and correlate Chinese and Japanese names.

Scholars soon realised that Chinese and Japanese plants may differ. Consequently, from the middle of the 1600s, rather than copying earlier Chinese illustrations, new ones were drawn from wild or cultivated Japanese specimens, regardless of whether they had a Chinese identification or not. An independent recording of Japanese plant diversity began.

The importance of accurate descriptions and illustrations became apparent and the focus of scholars began to shift from materia medica to documentation of the diversity they found in the wild as well as in cultivation. Although Chinese books on natural history continued to be translated and published in Japanese, original publications from Japan, often with skilfully rendered illustrations, increased in popularity. From the mid-1800s, Japanese scholars started adopting the Linnean plant classification system and Latin names, and dissections and close-ups of diagnostic plant parts began to be included in illustrations in a similar fashion to those of Western publications.

The obsession with flowers in East Asia also translated into the practice of growing plants, as horticulture was considered a suitable activity for men of power, learning and influence in Japan during the Edo period (1603–1868). This was a long period of peace which started when Tokugawa Ieyasu was appointed shōgun. He moved the government to Edo (now Tokyo), far away from the imperial capital Kyoto. Ieyasu supported the diffusion of plant studies from China and was described as 'a lover of flowers'. Both his son Hidetada and grandson Iemitsu were keen

Illustrations of *asagao*, or morning glories, in *Tohi shūkyō*, a three-volume work published in 1857 and edited by Naritaya Tomejiro. It contains images of *asagao* from Edo and the countryside from various earlier publications. Although it is littered with errors and modified original images by altering their colours, it was popular and widely distributed amongst enthusiasts. The editor is credited for introducing a large persimmon-coloured morning glory, which became very popular. *(On loan for the exhibition from Soukaen Bunko)*

***Ko-omoto*, or small *omoto* (*Rohdea japonica*), in *Ko-omoto nayose*. Published in the 1830s, this work was edited by Mizuno Issai (Chūkyō) and illustrated by Sekine Untei. On 15 and 16 September 1832, an exhibition of *ko-omoto*, sponsored by Mizuno Issai, was held at Kuramae Hachimansha, a shrine in Edo. The plant exhibits were drawn by Sekine Untei and printed as a set of coloured woodblock prints with much attention paid not only to the plants but also to the beautiful pots.** *(On loan for the exhibition from Soukaen Bunko)*

Chrysanthemum paintings from *Hyaku kikuzu maki* [Handscroll with illustrations of 100 chrysanthemums], a two-part manuscript dating to 1704. It includes illustrations of 50 varieties of prized chrysanthemums by Murata Sannaka Hitoshiran, and is a valuable record of the varieties cultivated in the early 1700s in Ise, Japan. *(On loan for the exhibition from Soukaen Bunko)*

An 1855 painting of irises by Matsudaira Sadatomo, also known as Sakingo. In his illustrated manuscript, *Kashō baiyōroku* [Record of cultivating irises] (1848), Matsudaira Sadatomo inserted a note explaining that he had gathered seeds of wild irises at Asaka-no-numa near Fukushima and used them for breeding. His manuscript was acclaimed among contemporary books on gardening. Matsudaira devoted his life to breeding irises. He distributed new varieties to other enthusiasts, who started their own collections.
(On loan for the exhibition from Soukaen Bunko)

plant growers, with the latter reported to have overlooked the affairs of state in order to dedicate his time to growing bonsai. Most of the later Tokugawa shōgun also shared this passion for plants.

The late Edo period saw the most substantial expansion of ornamental horticulture in Japan. Plants were prominently featured in arts, drove scientific development, and affected politics and the economy. The practice of 'alternate attendance', or *sankin kotai*, was at the heart of this phenomenon. *Daimyō* (feudal lords) were required to live in Edo every other year. Consequently, grand townhouses were built around Edo castle and their lavish gardens were planted with species from throughout Japan. Never before had such a variety of plants and growing skills been concentrated in one city. Plants were exhibited, sold or exchanged, and plant competitions were held often. When the *daimyō* returned to their home domains, unusual plants and novel horticultural practices would travel with them, revolutionising the nation's gardening culture.

Japanese native species were cultivated side by side with species from abroad, and species with symbolic significance became popular throughout East Asia. The desire for new, rare plants for competitions led to selective hybridisation aimed at obtaining new and unusual horticultural varieties. Plant breeding and propagation techniques that are now associated with modern horticulture were already well understood by Edo gardeners, and specialised nurseries were established to support their efforts.

A wealth of illustrations developed to document exhibitions, and to illustrate plants with short flowering periods or that were too delicate to exhibit easily. Collections of plant illustrations started to assume the role of sales catalogues, and although they were not initially intended for use within Japan, after the Edo period new catalogues were produced specifically to support overseas trade.

A wide selection of these materials can be seen in Singapore for the first time in this exhibition.

Nurturing the next generation of botanists

The Singapore Botanic Gardens is popular for its stunning diversity of tropical plants, but it is also a repository of knowledge and a place of research, plant conservation and education. Teaching about the diversity and fundamental importance of plants for human life, alongside offering opportunities for the public to engage with nature, are key roles of the Gardens. Botanical education is crucial at a time when many people have become ever more removed from the natural world.

Two new courses were recently conducted by Gardens' staff for undergraduates from the National University of Singapore (NUS) and Nanyang Technological University (NTU). Unique for university courses, the lessons were conducted off campus in the Gardens, making good use of both our living collections and laboratory facilities. The NUS course 'Vegetation and Plant Diversity of Southeast Asia' was developed by Dr Wong Khoon Meng and Dr David Middleton from the Gardens, coordinated by Dr Chong Kwek Yan and Dr Amy Choong from NUS, and ran on 11 Saturdays from 15 January to 9 April 2022. The NTU course 'Plant Taxonomy and Molecular Phylogenetics' was developed by Dr Gillian Khew and Dr Daniel Thomas from the Gardens, coordinated by Dr Hong Yan from NTU, and held over six days, from 28 February to 5 March 2022.

The NUS course aimed to introduce students to the vegetation types and plant diversity of Southeast Asia with a special focus on taxonomic groups that can be found in Singapore. The 20 students that signed up for the course learnt about plant classification, evolution and biogeography, in addition to ethnobotany and the fundamental

(Top) Dr Ho Boon Chuan and (bottom) Dr Stuart Lindsay teaching students about bryophytes and ferns at the Fernery.
(Photo credits: Dr Chong Kwek Yan)

(Left) Dr Wong Khoon Meng and (right) Dr Louise Neo demonstrating plant forms and characteristics to students along the MacRitchie Nature Trail. *(Photo credits: (left) Dr Chen Junhao, (right) Dr Amy Choong)*

NParks' CEO, Mr Kenneth Er, giving a guest lecture for NUS students.
(Photo credit: Dr Chong Kwek Yan)

importance of plants, botanical research and plant conservation for people. We took full advantage of the location of the course and the thematic curation of parts of the Gardens to expose the students to a diversity of plants. For one session on bryophytes (hornworts, liverworts, mosses) and ferns, the students visited the Fernery. For another session on monocots, the students were brought to the core of the Gardens where they rotated around stations for lessons at the Ginger Garden, outside the National Orchid Garden, and at Palm Valley – attractions with collections of monocot groups that are conveniently near each other. The only lesson that was not conducted on the Gardens' grounds was a field trip to the MacRitchie Nature Trail in the Central Catchment Nature Reserve, where the students learnt about observing and recognising plant forms and characteristics in the natural environment. For the last lesson, the students visited the Gardens' Seed Bank and Centre for Ethnobotany, and were treated to a sharing by NParks' CEO Mr Kenneth Er on plant conservation in Singapore.

The NTU course aimed to introduce students to the taxonomic and molecular biology techniques utilised as part of the toolkit of the modern botanist. The lecture topics included the history and philosophy of plant taxonomy, an introduction to plant taxonomy and systematics, plant molecular biology techniques, molecular phylogenetics, population genetics and historical biogeography. Practical sessions included a field trip where the students were taught how to collect plant specimens and press them to make herbarium vouchers, as well as how to store plant tissues for DNA extraction. The six students were taught laboratory techniques such as DNA extraction and DNA library preparation for genome sequencing, and bioinformatics techniques for the analyses of genome sequence data. On the last day of the NTU course, each student gave a presentation in which they applied the knowledge gained from the course to solve a hypothetical research question.

Lecturers and students of the NTU course. *(Photo credit: Dr Matti Niissalo)*

Dr Matti Niissalo and Ms Choo Le Min showing the students how to determine the quality and quantity of their DNA extracts. *(Photo credit: Dr Gillian Khew)*

Dr Daniel Thomas leading a field trip.
(Photo credit: Dr Gillian Khew)

Dr David Middleton teaching students about herbarium vouchering.
(Photo credit: Dr Gillian Khew)

Dr Gillian Khew leading a lab practical on DNA extraction. *(Photo credit: Dr Matti Niissalo)*

Several of the Gardens' staff researchers are also adjunct faculty members at NUS and NTU, and in this role they facilitate the teaching of courses, supervise student research projects and mentor student interns. Many botanic gardens around the world have similar arrangements with advanced educational and scientific research institutions. With these efforts, we aim to increase awareness, appreciation and knowledge of the plants around us. We also intend to run these courses annually with the hope of nurturing a new generation of plant scientists in Singapore.

Chong Kwek Yan
Gillian Khew
David Middleton
Daniel Thomas
Khoon Meng Wong
Research and Conservation

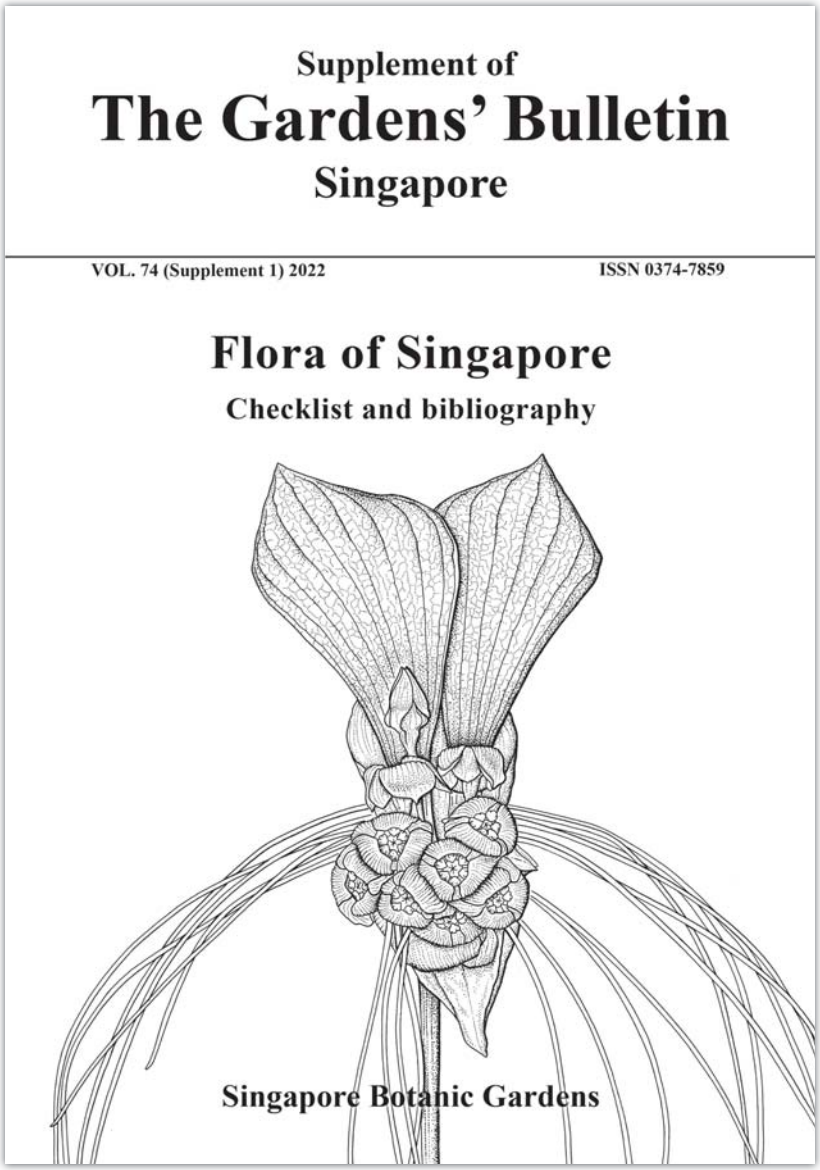
We would like to thank Dr Tan Puay Yok for encouraging these higher-education initiatives; Mr Donovan Teo, Ms Tan Hui Min, Dr Hong Yan (NTU), Ms Bazilah Mohd Ibrahim and Ms Sarah Lim for assisting with venues and logistics for the courses; and Dr Amy Choong (NUS), Dr Chen Junhao, Dr Louise Neo, Ms Seah Wei Wei, Dr S.K. Ganesan, Dr Ho Boon Chuan, Dr Stuart Lindsay, Dr Jana Leong-Škoničková, Dr Adrian Loo, Dr Matti Niissalo, Ms Choo Le Min, Mr Yeo Chow Khoon and Mr Ang Wee Foong for generously contributing their time to help with the teaching.

A new checklist and bibliography of the plant diversity of Singapore

On 21 May 2022, the new *Flora of Singapore: Checklist and bibliography* was published as a supplement to *Gardens' Bulletin Singapore*, available in hard copy and online. At 860 pages long, it is the most comprehensive and accurate summary of the plant diversity of Singapore published to date. We can assert this with confidence as it has been compiled by over 100 field botanists and *Flora of Singapore* authors and all content has been carefully checked by NParks' researchers from the Native Plant Centre and Singapore Botanic Gardens.

The new checklist and bibliography includes all species of bryophytes, lycophytes, ferns, gymnosperms and angiosperms that are found in the wild (native, naturalised and casual) in Singapore. It attempts to account for all names of species and infraspecific taxa that have ever been reported for Singapore, along with the publications that recorded each of the names. The native or non-native status for all taxa is given, along with the most recent conservation assessment for each native taxon, updated when the authors knew the most recent assessment to be incorrect.

The need for a *Flora of Singapore: Checklist and bibliography* arose from an awareness of two rather different issues. Firstly, the 2009 *Checklist of the total vascular plant flora of Singapore* by Chong, Tan & Corlett lacks bryophyte data and was becoming rather out of date. The new checklist and bibliography addresses both of these issues by including bryophytes and by ensuring all data are updated. Secondly, the editors of the *Flora of Singapore* were finding that there was quite a body of rather obscure literature on the plant diversity of Singapore that was sometimes being



The *Flora of Singapore: Checklist and bibliography* complements the ongoing Flora of Singapore project. *(Photo credit: Tok Yin Xin)*

overlooked by *Flora of Singapore* authors. As the new checklist also includes extensive bibliographic data, the *Flora of Singapore* authors now have a comprehensive list of names that must be incorporated into the accounts along with the publications that record these names for Singapore. This resource will enable future *Flora of Singapore* accounts to be researched and written more efficiently.

The Chong et al. checklist has been the primary source of data on the plant diversity of Singapore from when it was published in 2009. In the intervening years, botanical research in Singapore and the wider region has continued at a fast rate, including the description of new species and publication of many new records, along with changes in generic delimitations. These records and changes are scattered in the literature and a consolidation into a single publication makes it more accessible for a range of users. In addition, the larger team of people involved in the new checklist, coupled with a strong attention to often complex nomenclatural and orthographical issues, have led to very many name changes or spelling corrections for existing species. Checking the original sources of data has also led to the exclusion of many species from the Singapore flora when no evidence could be found that they have ever occurred here. For the most part, these were names which were later found to be misapplications of known species. In other cases, no evidence could be found as to what species was actually intended or the name was credited to Singapore for various spurious reasons and became fixed in the record. In the new checklist and bibliography, these have been listed in an excluded section. Conversely, a number of species were found that do or did occur in Singapore but which have long been overlooked.

The *Flora of Singapore: Checklist and bibliography* includes a discussion on the definitions of categories such as native, naturalised, casual and cryptogenic and, for the native species, the IUCN conservation assessments are given for each taxon. Although we did not set out to assess and update the status of every species in Singapore as part of this exercise, we did decide that we would ensure that any status revisions made from 2009 onwards were reflected in the list, that any taxon not previously assessed and for which an assessment could readily be made was given a status, and that any previous assessment known to be incorrect was duly updated. This work, which resulted in more than 1,000 revised status and/or conservation assessments (about one-third of the flora), will make completion of the plant assessments for the forthcoming new *Red Data Book* for Singapore fairly straightforward.

The checklist and bibliography includes 2,654 native species, 479 naturalised/casual species and 101 species whose status as native or not is uncertain (called 'cryptogenic' taxa) – 3,234 species in all. These figures have been arrived at after an assessment of the approximately 8,000 names used in about 50,000 literature records since 1820. We found that 860 of these names had been misspelt, that 900 names were applied to species incorrectly, that 275 names were used that were not allowed to be under the rules governing the naming of plants, and that 450 names were used for which there appeared to be no specimen evidence that these plants have ever actually occurred in the wild in Singapore at all! Altogether, 56% of names are now considered to be synonyms, meaning that the same species has been described more than once and the rules have been applied to determine which is the correct name, which sometimes leads to a name change.

The new *Flora of Singapore: Checklist and bibliography* provides the most accurate current benchmark data for the plant diversity of Singapore but we should emphasise that no piece of work is ever the last word on a subject. New scholarship, forest exploration, and examination of existing herbarium material from Singapore for the ongoing *Flora of Singapore* will lead to new discoveries and revised assessments of species as a consequence of intensive study. The more we study, the more we shall know, and the better we shall be able to understand and protect Singapore's rich natural heritage.

David Middleton
Research and Conservation

Stuart Lindsay
Native Plant Centre

Ho Boon Chuan
Chong Kwek Yan
Research and Conservation

Ian Turner
Singapore Botanical Liaison Officer at Royal Botanic Gardens, Kew

Microgreens, quick and easy-to-grow edibles for the urbanite

The majority of Singapore's residents stay in high-rise dwellings where space and sunlight are usually limited. These two factors, coupled with the hectic work schedule typical of many urbanites, can make the cultivation of edible plants extremely challenging. As such, I have been asked numerous times about edible plants that are fast-growing, fuss-free, require little space and are easy to cultivate. My suggestion is to try microgreens.

The two most common microgreens that can be seen in Singapore are the seedling of the Maple Pea (*Pisum sativum* var. *arvense*), also known as '*dou miao*', which is prepared as a stir-fried leafy green, and Wheatgrass (*Triticum aestivum*), which is juiced to make a beverage. There are a range of other plant species that are grown as microgreens which are either used in small quantities for garnishing, such as by high-end restaurants, or in larger amounts and tossed in salads.

It is important to note that microgreens are not the same as sprouts. Microgreens can be defined as seedlings with fully developed seed leaves, also known as cotyledons, still retained on the plant. Depending on the species, the first set of true leaves (which develop after the cotyledons appear) may have emerged by the time the crop is harvested. Microgreens are typically harvested and consumed without roots. In contrast, sprouts are newly germinated seeds with un- or under-developed cotyledons. True leaves, in this case, have not emerged and chlorophyll may or may not be present in the cotyledons. Commonly encountered sprouts in Singapore include those of Alfalfa (*Medicago sativa*), Mung Bean (*Vigna radiata*), Adzuki (*Vigna angularis*), Black Mung Bean (*Vigna mungo*) and Soybean (*Glycine max*). To add to the confusion, consumers will also encounter what are called baby greens. These are more developed young plants with more than two true leaves when harvested. Examples that can be found in the supermarket include baby spinach and rocket.

As such, sprouts, microgreens and baby greens are all greens that are grown and harvested based on their age and size: sprouts being the youngest and smallest, microgreens older and larger, and baby greens the oldest and largest. Among the three types of edible seedlings, sprouts have the shortest crop cycle but they are not the easiest to grow – their cultivation does not involve a growing medium but they require frequent and multiple washings with fresh water to ensure a successful and safe-to-eat crop. In contrast, a longer crop cycle is often needed for the cultivation of baby greens, requiring additional fertiliser and possibly increasing the incidence of pests.

Depending on the species, microgreens may or may not need to be grown in media. Some species can be grown soilless using a store-bought microgreen cultivator which consists of an inner, perforated growing tray and an outer tray that holds water. Microgreens can also be grown soilless using several sheets of paper towels or in growing media such as cocopeat or peat moss.

The crop cycle for microgreens can vary from seven to about 14 days, and for the home gardener, fertilisers are not needed. In most apartment situations, pest issues are uncommon due to the short crop cycle. Microgreens also do not need a lot of light. As such, they can be placed on the windowsill where they can be exposed to indirect or filtered sunlight. They can also be grown under a desk lamp or grow light that is switched on for about 12 hours daily.

How to grow your own microgreens

Here is a method that is suitable for growing all types of microgreens. It makes use of a clean, disposable food container and a fresh, soilless growing medium.

Step 1:

Wash the microgreen seeds and remove any broken seeds and debris. Soak the seeds in clean tap water for about six hours. After the soaking period, you will notice that the seeds look plump due to the absorption of water. This process is known as priming and it will help induce a higher and quicker rate of germination.

Step 2:

If possible, puncture holes into the base of the disposable food container for drainage. If this is not possible, the gardener will need to exercise care when watering to avoid oversaturation, as the seeds and microgreens will need to be kept moist at all times, but not soaking wet.

(Step 1.) **Maple Pea seeds that are dry (left) and have been soaked overnight (right). Soaked seeds swell as they take up water. They are described as 'primed' and this is done to promote even germination.**

(Step 3.) **Primed Maple Pea seeds sown on a layer of substrate, in this case, moist peat moss. While the seeds should be sown densely, make sure there is only one layer of seeds and they do not overlap or stack on top of one another.**

(Step 4.) **A second similar-sized container filled with some water added to serve as a weight (and sealed tightly to prevent mosquitoes from breeding). It is placed on top of the sown seeds to press them down so they have good contact with the moist substrate. The weight also helps to direct roots from newly germinated seeds to go into the substrate.**

(Step 4.) **Seed germination just one day after being sown. At this point the set-up should still be kept in a dimly-lit or dark location.**

Fill the base of the container with fresh, moistened peat moss or cocopeat up to a depth of about 1 cm. Garden soil, used peat moss and used cocopeat should be avoided due to the presence of potential pathogens that will affect seed germination.

Step 3:

Sow the primed seeds on top of the moistened growing media. The seeds should be sown densely but not to the extent that the seeds overlap one another. There should be a single layer of seeds with some space left between the seeds.

Step 4:

It is a good idea to place another similarly-sized container filled with some water on top of the seeds. The added weight will help to press the seeds down so that they make contact with the moist growing medium; this will help to ensure even seed germination and subsequent growth.

The entire set-up can be placed in a dimly-lit or dark place at this stage. Ensure the growing medium remains moist throughout the germination and growth stages. Moist growing media will appear darker in colour and feel heavier when the container is lifted.

(Step 5.) **Seedlings starting to grow. At this stage, the weight can be removed. It is also a good time to remove any seeds that have not germinated or have turned mouldy. The set-up can be moved to a bright place, say, on the windowsill or under a grow light.**

(Step 6.) **The shoots after about nine days, ready for harvest. This is done by cutting them near the base, just before the leaves open up and tendrils begin to appear. Delays should be avoided as the microgreens can become fibrous to taste. For Maple Pea microgreens, the cuts can be made just above the stem nodes to allow side shoots to grow, leading to a second harvest. (For most other microgreens, only one harvest can be obtained as those seedlings do not have a node for new growth after being cut.)**

Step 5:

Once you see that the seedlings have started to grow, you can remove the weight and move the set-up to a windowsill or under a grow light. With a light supply, the seedlings will turn green and develop additional colour, depending on the species grown.

Note that light intensity will affect the appearance and flavour of microgreens. Higher light levels will generally result in a firmer texture, more compact stature and more intense flavour and colour, indicating a higher composition of beneficial phytochemicals.

Step 6:

Once the desired size of the microgreens has been achieved, cut them just above the growing medium using a pair of sharp, clean scissors. If you are not eating the microgreens right away, store them inside a sealed container or bag, without rinsing, in the chiller compartment.

When you are ready to enjoy your harvest, remember to give the microgreens a rinse or two under clean tap water to remove debris before food preparation. After harvest, the growing medium, together with the roots, can be composted and used to pot up other plants.

Possibilities with microgreens

Cultivating microgreens can be used as an educational activity making use of recycled materials. Requiring very small volumes of growing media, they can easily be grown with used plastic food take-away

Maple Pea microgreens were grown to become the 'hair' of this 'pot man'. Making cute containers and sowing microgreens can be fun for the whole family over a simple weekend or as a holiday activity.

Microgreens can be used to make festive displays. For this Easter display, Garden Cress, Red Amaranth and Red Cabbage microgreens were first started in egg shells. They were subsequently put into a shallow basket and decorated with flowers harvested from the garden.

containers. The type that come with a lid make ideal receptacles for growing microgreens, as the lid can help to keep in moisture when the seeds are still germinating. Also, the translucent nature of such containers allows the gardener to monitor the growing process easily.

However, microgreens need not be grown in boring looking containers. As a fun, family-bonding activity, parents can help their children put together a 'pot person' using differently-sized pots and cable ties. Children can then decorate it by gluing on items such as googly eyes, ribbons and buttons. The head of the 'pot person' can be filled with a growing medium and then sown with microgreen seeds. Once the microgreens are ready for harvest, children can help to cut the 'hair' of the 'pot person'.

Microgreens also have decorative potential. Different microgreens with varying colours and textures can be planted in containers for various festive seasons, for example using Oriental rice bowls for Chinese New Year or eggshells at Easter. These can be dressed up even further to create fancy tabletop displays or centrepieces, sure to be conversation starters wherever they are placed.

Wilson Wong
Jurong Lake Gardens

All photos by Dr Wilson Wong

Edible fungi in Sabah and Singapore

In Asia, countries such as China, Japan, India and Sri Lanka have mycophilic cultures with long traditions of foraging for wild mushrooms. However, in places such as Borneo, Peninsular Malaysia and Singapore, there is little adequate documentation on ethnomycological knowledge of wild edible and poisonous mushrooms. Much of the information that we do have about local species is from research done by EJH Corner, former assistant director of the Gardens who was an expert on fungi. Building on this work, the Singapore Botanic Gardens is now collaborating with the laboratory at the Institute for Tropical Biology and Conservation (University Malaysia Sabah) in Sabah to continue the systematic revision of several groups of fungi based on DNA barcoding and morphology. In the spirit of this collaboration, here we share some of the interesting fungi species consumed by local communities in Sabah, and highlight some of the commercially available mushrooms that are well-loved in Singapore.

***Schizophyllum commune*, the split-gill mushroom also known as Kodop, cooked in a salad with wild ginger.** *(Photo credit: Jaya Seelan)*

The largest ethnic group in Sabah are the Dusun, and they consume a variety of wild mushrooms. One species that is widely eaten on a daily basis is *Schizophyllum commune*, a split-gill mushroom known as Kodop. This mushroom is mostly found on dead rubber wood or different types of logs. Most of the time, the Dusun fry this mushroom with anchovies and sometimes mix them in porridge. Some also like to make a salad with it in combination with Tuhau (a type of wild ginger). This is one of the delicacies that can be found in the local food around Kundasang, Ranau and Tambunan.

There are several edible mushrooms within the family of Polyporaceae (mostly wood-decaying fungi) that are preferred among the local communities. *Lentinus sajor-caju* is a fleshy and tasty mushroom commonly called Lengkugan, Mengkugan or Ungkugan in different districts in Sabah. Interestingly, it has lots of different shapes and the morphological variations have led to many synonyms for this species. When young, the mushrooms are white to brownish and fleshy, but they become leathery and hence difficult to chew as they become older. Also from the same family, *Lentinus squarrosulus*, called Kulat Susu or Kulat Putih, is well-known among the locals, although some are very skeptical about their edibility because they have threadlike, brownish scaly fibrils on their cap which make them look poisonous. *Lentinus polychrous* is another edible wild mushroom in Sabah, but there its distribution appears to be very limited and confined to certain areas. Interestingly, it seems to be somewhat common in Singapore, given the number of photos of this species growing on dead logs posted by hikers on social media!

Species of *Pleurotus*, known as oyster mushrooms, are delicious and many readers would have eaten commercial ones sold in markets. In Sabah there are two interesting species, *Pleurotus tuberregium*, commonly called Dunsul, and *Pleurotus giganteus*, known as Salimmatuwo. These wild oyster mushrooms are very selectively eaten by local communities, and they are also present in Singapore and Peninsular Malaysia (where Dunsul is known as Cendawan Seri Pagi).

Dusun communities are also well aware of *Auricularia* species, the jelly ear mushrooms that they call Kulat Kerong or Kulat Telinga Kera. Widely consumed in Asia, many locals love to add these to herbal or noodle soups, and some species are cooked together with local vegetables. Also favoured by the local Dusun is the rare species of *Hygrocybe* known as Kulat Sorukan (not Shah Rukh Khan!); this is the only yellow-orange mushroom that is considered edible among the Dusan people.

Foraging for mushrooms in the wild can be dangerous, however, and mushroom poisoning cases increase every year during Sabah's rainy season, depending on the types of mushroom species fruiting at the time. Without scientific means to

(Top row) *Lentinus sajor-caju*, an edible species that is only palatable when young, as indicated by the ring around the stipe known as an annulus. (Centre row) *Lentinus squarrosulus*, an edible species distributed in Africa and Asia. (Bottom row, left and right) *Pleurotus giganteus* and *Lentinus polychrous*, from the Bukit Timah Nature Reserve.
(Photo credits: (top and centre rows) Jaya Seelan; (bottom row) Serena Lee)

(Left) A species of *Auricularia*, or jelly ear mushroom, which is widely consumed in Asia. (Right) A species of *Hygrocybe* that is seasonally found in Sabah and cooked with chicken by the local communities. *(Photo credits: (left) Jaya Seelan; (right) Rossiti Karim)*

identify species in the wild, the Dusun use knowledge of mushrooms based on myths and interpretation. The most notorious species frequently misidentified is *Chlorophyllum molybdites*, or the Green-spored Death Angel, which is mistaken for edible termite-associated mushrooms in the genus *Termitomyces*, as they are found in somewhat similar grassy habitats.

Here in Singapore, we may not have a foraging culture but mushrooms certainly feature in many of our favourite dishes. A wide variety can be found in local markets and eateries, and fortunately we can enjoy them safely without having to worry about misidentification. One popular example is the Shitake, *Lentinus edodes*, a species native to East Asia where it can be found growing in warm and moist climates. As in other parts of Asia, it is used locally to add umami to stir-fries and soups. Other examples are *Phallus induciatus*, or the Bamboo Pith Fungus, which is common in vegetarian herbal soups, as well as species of *Auricularia*, or wood-ear fungi, which can be found dried or fresh in local markets. (For more information on these fungal groups in Singapore, see previous articles of 'From the Earth' in volumes 50 and 55 of *Gardenwise*.)

Setting aside *Pleurotus tuberregium* which we mentioned earlier occurs naturally in Singapore, there are a number of edible oyster mushrooms that can be found here commercially. These include the King Oyster, *Pleurotus eryngii*, which is often used as 'vegetarian abalone' in Singapore's vegetarian

(Left) The poisonous mushroom species *Chlorophyllum molybdites*, which is sometimes misidentified as a *Termitomyces* as they grow in similar habitats. (Right) The edible *Termitomyces gilvus*. *(Photo credits: Jaya Seelan)*

(Left) *Lentinus edodes* and (centre) *Auricularia* sp. from a wet market in Singapore; (right) *Phallus induciatus* from a local grocer.
(Photo credits: (left and centre) Serena Lee; (right) Amy Choong)

(From left) *Pleurotus eryngii* and *P. ostreatus* from a Singapore supermarket; *P. djamor* and *P. citrinopileatus* grown locally from mushroom kits. *(Photo credits: (left and second from left) Serena Lee; Gillian Khew; Jana Leong-Škorničková)*

Packaged mushrooms for sale in Singapore supermarkets: (Left) Bunapi-shimeji and Buna Shimeji (*Hypsizygus tessulatus*); (centre) enoki, and (right) 'mountain enoki' (*Flammulina velutipes*). *(Photo credits: Serena Lee)*

White button and Swiss brown mushrooms in a Singapore market, and portobellos on a grill. *(Photo credits: (left) Serena Lee; (right) Derek Liew)*

culinary scene, as it has a wide stipe and when sliced and cooked, is very much like sliced abalone in look and texture. *Pleurotus ostreatus* is a grey mushroom that can be found in local supermarkets, while the pink *P. djamor* and yellow or golden *P. citrinopileatus* are popularly grown in Singapore from edible mushroom-growing kits.

Native to East Asia, the brown beech mushroom, *Hypsizygus tessulatus*, is sold as Buna Shimeji, while the white beech mushroom, which is a selected cultivar of this same species, is called Bunapi-shimeji. These fungi are in the same family as *Termitomyces*, the termite-associated mushrooms that are commonly sold not only in local markets of Southeast Asia but in tropical Africa. Enoki, as most of us know it, is *Flammulina velutipes*, and the wild species and its cultivars in no way resemble each other. The cultivated mushrooms are grown in a carbon dioxide-rich environment to nurture the development of long thin stems. The white-capped enoki get their white colour by being grown in the dark; the brown-capped ones, which are presumably grown under different lighting conditions, are marketed as 'mountain enoki'. But perhaps the most familiar to many of us is *Agricus bisporus*, a species native to grasslands in Europe and North America. Believe it or not, white button mushrooms, Swiss brown mushrooms and portobello mushrooms are all this much-loved fungus; the button mushrooms are harvested when immature whereas the portobellos are grown to their mature state, at which point their cap can measure 10 to 15 cm across.

In Singapore, there is a chance that local edible fungi species may one day make it to our supermarkets as experiments are underway to screen species for toxicity and suitability for cultivation through the use of agritechnology. In Sabah, researchers are also experimenting with the cultivation of known wild edibles that could be introduced to the local industry. It is hoped that availability of cultivated mushrooms in the local markets, in combination with increased awareness through public education, will decrease incidents of mushroom poisoning in Sabah. In the meantime, fungi species in both Singapore and Sabah will be documented on a yearly basis in order to compile information for herbarium materials and domestication studies.

Serena Lee
Herbarium

Jaya Seelan Sathiya Seelan
Institute for Tropical Biology and Conservation
University Malaysia Sabah, Malaysia

Marvellous Trees, a programme for preschools

Prior to the Covid-19 pandemic, the sight of preschool groups touring the Singapore Botanic Gardens was a near-daily occurrence. They arrived by the busloads, making the Gardens lively with their energy, inquisitive questions and enthusiastic remarks. For some of these children, it may have been the first time they got to see or sniff a living lemongrass plant, or watch a mimosa shut its leaves. Unfortunately, the pandemic halted field trips, limiting lessons for preschoolers to their classrooms and neighbourhoods. To continue educating these early learners about the importance of nature and conservation during this period, we launched a new virtual programme titled 'Marvellous Trees' in July 2021.

This popular 30-minute talk catered to children aged 5 and 6, and was designed to instil in the children the following learning objectives: to appreciate the importance of trees, to understand different characteristics across different trees, and to encourage environmental sustainability. Trees were selected as the main focus of the programme because they are found across Singapore, enabling children to engage with them easily and thus making them a good starting point to pique their interest in nature.

The preschoolers were given opportunities to exercise their gross motor skills during this movement-based talk. For example, they were guided to form different shapes of tree crowns (e.g., umbrella and conical shapes) with their bodies and physically mimic the life cycle of a tree (from a seed to a fully-grown tree). These actions allowed children to be actively engaged despite being socially distanced in schools. Participants were also introduced to commonly found fauna in our Singapore neighbourhoods. To conclude the session, we emphasised a message on the 4 Rs – Refuse, Reduce, Reuse and Recycle – to the little ones.

Screenshots from the virtual talk, showing Tan Hui Min from the Gardens' education team guiding children from PCF Sparkletots Preschool @ Ayer Rajah-Gek Poh Blk 48 (DS) to imitate a tree.

A pre-talk drawing by Chua Zhi Shan Sean, student from K1 Honest, PCF Sparkletots Preschool @ Ayer Rajah-Gek Poh Blk 48 (DS).

A post-talk drawing contributed by My First Skool at Blk 245 Bishan.

As a pre-programme activity, the children were tasked to draw annotated pictures featuring trees. This activity allowed us to capture the children's imaginations and gauge their preliminary understanding of trees. Some of these drawings were incorporated into the presentation, turning the talk into an event co-created with the children. As it is important to gain the support of teachers, we also provided teacher previews and briefings. The teachers helped with tasks like guiding the children to 'grow' into trees, so that they too played an active role in the talk.

So far, we have connected with over 1,540 children from 35 preschools through this programme, encouraging these early learners to develop an interest in trees and nature. We hope that this will ignite a spark in them to care for nature. As local Covid-19 restrictions ease, we look forward to adapting 'Marvellous Trees' into a school-based talk and adding it to our repertoire of face-to-face programmes for preschools.

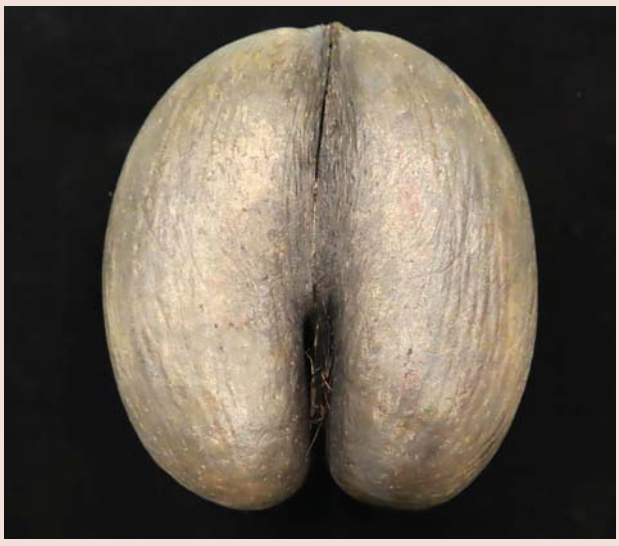
Chen Ming Li
Tan Hui Min
Education

Coming of age, the first blooms of a maiden

On the beautiful islands of the Seychelles in the Indian Ocean, there grows a legendary palm that produces fruits that are the largest and heaviest in the world. This palm is *Lodoicea maldivica*, commonly known as the Coco-de-Mer (Sea Coconut) or the Double Coconut. The Singapore Botanic Gardens has been fortunate to receive viable seeds of this incredible palm species from exchanges with other botanic gardens throughout our history. Two individual palms stand out from these exchanges in the last century, a female and a male that were separated by distance within the Gardens (Double Coconuts are dioecious, with separate male and female plants). Planted at Lawn D and in Palm Valley, respectively, they thrived and matured to allow for pollination to be carried out by hand, resulting in successful fruit-set many times. The female plant produced a few strong viable seeds but unfortunately passed on a few years back, but the male plant is still alive and thriving, along with their progeny at Lawn D and in Palm Valley.

Thirty-three years after the successful fruit-set from the first hand-pollination exercise in 1989 (see *Gardenwise* vol. 11, pp. 12–15), an offspring at Lawn D has finally reached full maturity and bloomed! At the time of writing, around seven inflorescence spikes at

A grove of Double Coconuts at Lawn D, including the first-flowering female progeny from our hand-pollination exercise in 1989.



Over the centuries, some half a dozen scientific names have been coupled to this palm by different botanists. However, under the universally accepted International Code of Nomenclature, there can only be one scientific name for a species, which is acknowledged as valid by a consensus of taxonomists. *Lodoicea maldivica* is the currently accepted name of this palm, and the rest are, as such, considered synonyms. It is a pity though that one of its archaic botanical names is no longer used in science, given that it very aptly describes its extremely unique and distinct seed shape. That synonym is *Lodoicea callypige*, the species' epithet meaning 'beautiful buttocks' in Greek, undoubtedly referring to the bi-lobed shape of the nut that gives it the appearance of a pair of well-formed buttocks!

An inflorescence spike protruding out from a huge leaf sheath, with large bud-like flowers.

Many inflorescence spikes at various stages of maturity.

various stages of maturity could be seen poking out between the humongous leaf sheaths. A number of the spikes had protruding bud-like flowers and gummy exudate at their tips.

For years, our horticulturists were unable to identify the gender of the saplings that had germinated from the seeds harvested from the Gardens' only female mature palm at Lawn D. This is because without flowers, there are no distinctive outward visual characteristics of the young palms to establish their gender. However, with the recent knowledge that these palms only become sexually dimorphic as adults, researchers have developed male-specific sex-linked markers using double-digest restriction site-associated DNA (ddRAD) sequencing. This will now enable the determination of gender in immature individuals, as well as exploration of how sex ratios change with environmental conditions and age, which may assist in conservation work on this palm species *in situ*.

The whole life cycle of the Double Coconut is excruciatingly slow for a propagator. First, the plant must grow 20 to 40 years to reach maturity and start flowering. In order to produce fruit, the flowers from the female plants must be pollinated with the pollen from the male plants. This is a challenge in part because the female flowers are only receptive for about three to five days. Once a female flower is successfully pollinated, the ovary will begin to swell visibly within two weeks. It will then grow rapidly, reaching its maximum size of around 40 to 50 cm in diameter and 15 to 30 kg after one year. At this stage, the fruit can be harvested, but the seeds will take about another two years to germinate and sprout leaves.

Given its very slow growth rate and restricted natural distribution range, compounded by anthropogenic and environmental threats, it is not surprising that this palm is officially classified as an Endangered species by the International Union for Conservation of Nature (IUCN).

With approximately 8,000 mature plants left in the wild as of 2019, this palm and its habitat in the Seychelles are now protected. Trade of the nuts is controlled by the Coco-de-Mer (Management) Decree of 1995 in the Seychelles. However, cultivated palms are grown on a number of other islands and in some tropical botanic gardens around the world.

We are extremely fortunate to have healthy groves of this endangered palm in our collections, and we invite you to see up-close this first-flowering female progeny that will hopefully continue to thrive and bear another generation of offspring.

Nura Abdul Karim
Research and Conservation

All photos by Dr Nura Abdul Karim

Extending a welcome to the National Research and Innovation Agency of the Republic of Indonesia

Whang Lay Keng, Gardens' Curator of Living Collections, showing BRIN staff orchid displays within the National Orchid Garden.

On 27 May 2022, the Singapore Botanic Gardens played host to a visiting group from Indonesia's new National Research and Innovation Agency or Badan Riset dan Inovasi Nasional (BRIN), along with staff from its collaborating private management companies, PT Mayaksa Alam Permai and PT Mitra Natura Raya. The BRIN group, comprising eight members led by their Acting Deputy Chairman, Dr Yan Rianto, had requested a study tour of the newly established Sembcorp Cool House in the National Orchid Garden, and its adjacent nursery, and also asked to learn about general management of an established heritage tropical botanic gardens.

While here, the group were briefed by Gardens' staff on our history and current activities, as well as the sustainable technologies utilised in the Sembcorp Cool House and nursery. Staff from both sides also exchanged experiences and challenges faced in the daily operations of our respective botanic gardens.

Dr Yan and colleagues also shared some background information about their new agency. BRIN is a cabinet-level government agency formed by the Indonesian government in 2019. Originally it was attached to the Ministry of Research and Technology, but was separated and established as a new non-ministerial government agency directly under the President of Indonesia in 2021. Under a 2021 Presidential Decree, the agency has now become the sole national research agency of Indonesia. The declaration decreed that all Indonesian national research agencies, namely the Indonesian

Teams from the Gardens and BRIN having an informal sharing and discussion session about the current work, organisation and challenges of our respective institutions.

The BRIN team being briefed by Zailan Dollah, Acting Deputy Director of the Gardens' Facilities team (in the centre), about the sustainable features of the Sembcorp Cool House which include its cooling systems and energy saving infrastructure.

Institute of Sciences (Lembaga Ilmu Pengetahuan Indonesia, LIPI), Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi, BPPT), National Nuclear Energy Agency of Indonesia (Badan Tenaga Nuklir Nasional, BATAN) and National Institute of Aeronautics and Space (Lembaga Penerbangan dan Antariksa Nasional, LAPAN) would merge into BRIN. As such, the Institute of Sciences, which the Gardens has had a long working relationship with, is no more. Fortunately, the researchers that we have interacted and collaborated with for years are still employed within the new BRIN agency.

We have enjoyed hosting our colleagues from BRIN, and look forward to collaborating with the new agency in areas of botanical research and botanic gardens management in the years to come.

Nura Abdul Karim
Research and Conservation

All photos by Dr Nura Abdul Karim

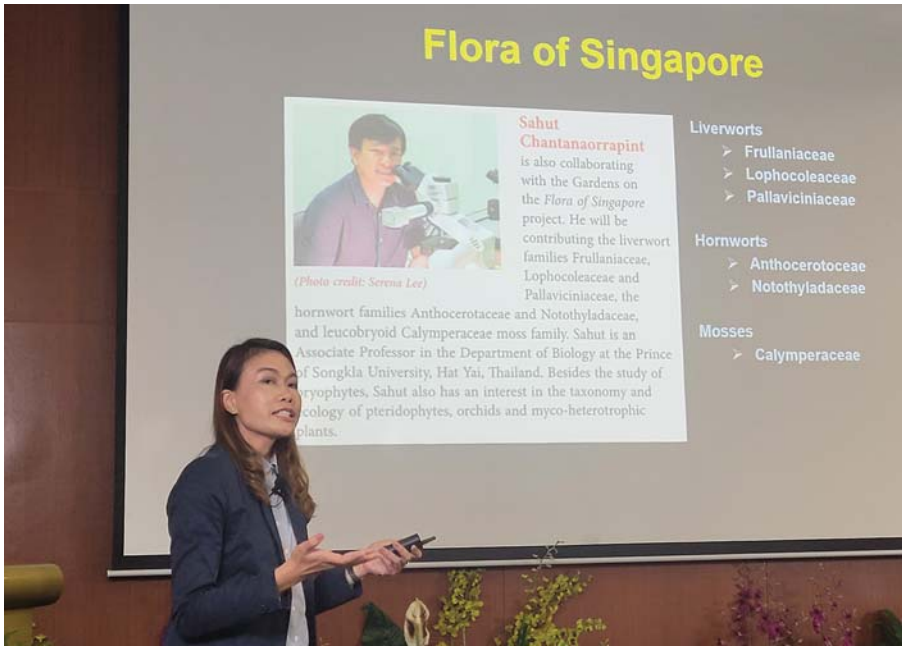
The 18th Flora of Thailand Conference, Singapore, July 2022

The 18th Flora of Thailand Conference was held in the Singapore Botanic Gardens from 18 to 22 July 2022. The conference is usually held every three years, up until now alternately between Thailand and somewhere in Europe. At the Editorial Board meeting held in Krabi in August 2017 it was decided, however, that the 18th Flora of Thailand Conference would be held at the Singapore Botanic Gardens in 2020 rather than in Europe. Due to the pandemic, we were unable to host the conference in 2020 and it was postponed to 2021. It was then postponed again until 2022 when we decided to go ahead with the conference in light of the improved conditions and easing of travel restrictions. However, to ensure that funding and travel limitations were not a hindrance to participation, it was decided that the conference would be held both physically and online. The opening ceremony was hosted by Minister for National Development Desmond Lee, and the conference was formally opened by HRH Princess Maha Chakri Sirindhorn of Thailand on the morning of 18 July. The Singapore Botanic Gardens and the Thai botanical community were honoured that she agreed to open the conference, and we thank the Royal Thai Embassy staff in Singapore for their help with the visit.

The theme of the conference, *Plants without borders: Connections to Malesia*, was intended to stimulate discussion of the floristic similarities and biogeographic connections between Thailand and Peninsular Malaysia and, hence, the rest of Malesia, including Singapore. This theme was explored in a welcome lecture by Dr David Middleton from the Singapore Botanic Gardens, who noted the very large overlap in species between Singapore, Peninsular Malaysia and Thailand. The theme was further explored by

Opening Ceremony Host Minister Desmond Lee delivering his address before Her Royal Highness Princess Maha Chakri Sirindhorn (seated) opened the conference.

Jiratthi Satthaphorn, winner of the best lecture by a student, delivering his talk on the genus *Clerodendrum*.



Keynote speaker Dr Phiangphak Sukkharak delivering her talk on bryophyte studies in Thailand and the wider region.

Participants enjoying the conference dinner.

the keynote speakers in the last lecture of each day from Tuesday to Friday. On Tuesday 19 July, Dr Kitichate Sridith from Prince of Songkhla University in Thailand discussed connections from the Himalayas through Thailand to Peninsular Malaysia, in particular noting that climax vegetation in various parts of the region is not always forest. On Wednesday 20 July, Dr Malin Rivers from Botanic Gardens Conservation International gave the keynote lecture on the *Global Tree Assessment* which aims to assess the conservation status of every known tree species by the year 2023. On Thursday 21 July, Dr Sandy Knapp from London's Natural History Museum gave a lecture entitled *Think local, act global – uniting plant taxonomy across borders*, in which she shared her experience of floristic work in Central America and her global monographic work on the genus *Solanum*. Lastly, on Friday 22 July, Dr Phiangphak Sukkharak from Burapha University in Thailand gave us an overview of studies on mosses, liverworts and hornworts in Thailand, shared plans to compile a bryophyte Flora of Thailand, and drew parallels with bryophyte studies in neighbouring regions.

Two of the keynote lectures were delivered virtually along with many of the other conference lectures over the week. In each case, at the end of the lecture the speaker joined the conference online to take questions. The speakers who delivered their lectures in Singapore were filmed and broadcast for the virtual participants. With only a couple of minor hiccoughs, the hybrid format worked remarkably well, with questions and answers flowing freely between online and in-person participants. The lectures covered a wide variety of botanical themes, from progress on revisions of plant families for the Flora of Thailand and other regional projects to ecological studies in the region to ethnobotany to plant anatomical studies. There was also a poster session which could be viewed either physically at the Gardens or online for the virtual participants.

At the end of the week, prizes were given to the best lecture delivered by a student and the best poster by a student. The prize for best lecture was given to Jiratthi Satthaphorn from Prince of Songkhla University in Thailand and the Royal Botanic Gardens Kew for his talk on the genus *Clerodendrum*. The prize for the best poster was given to Punvarit Boonprajan of Silpakorn University in Thailand for his work on the genus *Derris*.

Instead of having a whole day midweek excursion as is usual at Flora of Thailand conferences, half day excursions were held on the Tuesday and Thursday mornings around the Botanic Gardens and to Sungei Buloh Wetland Reserve. The lectures then resumed in the afternoons, enabling participants from far away countries to join. On the Friday afternoon, Dr Henrik Balslev, one of the joint Editors-in-chief of the *Flora of Thailand*, delivered the report from

Group photo of the non-virtual participants.

Participants on an excursion to the National Orchid Garden.

the Flora of Thailand Board. He affirmed that it was still intended that the Flora would be completed in 2024, covering all approximately 11,000 vascular plant species, and that the next two Flora of Thailand conferences would be in Denmark in 2024 and Bangkok in 2025. This was followed by a discussion, primarily involving the younger participants, on the future of botanical research in Thailand post completion of the Flora.

All through the week, the participants were able to exchange research ideas and plans, or simply catch up socially and online with colleagues they may not have seen or contacted for some time. For those who were in Singapore there was also a reception and a conference dinner.

Organising a conference in the Covid-19 era, even at what we presume to be the tail end of the pandemic, was rather nerve-wracking but the local, international and online participants provided very positive feedback and we were very pleased to have made the decision to go ahead with it. The Organising Committee would like to thank everybody who helped to ensure the conference ran smoothly.

David Middleton
Research and Conservation & Chairman, 18th Flora of Thailand Organising Committee

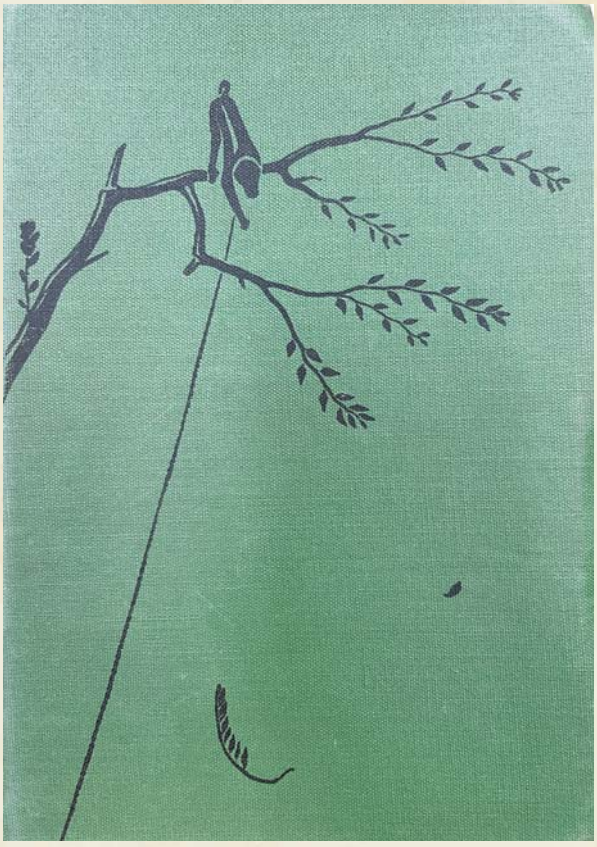
All photos by Derek Liew

Corner and his monkeys

EJH Corner was the Singapore Botanic Gardens' assistant director from 1929 to 1942, and subsequently a civil internee at the Gardens until the end of the Japanese Occupation. He first focused his research on mycology (the study of fungi) but upon realising that most fungi are very seasonal in their production of fruiting bodies, he broadened his interest to documenting the general flora of the region, with a special focus on large trees. This culminated in the publication of *Wayside Trees of Malaya* in 1940, a classic work that is a key element of Corner's scientific legacy.

Corner conducted extensive field research to observe the plants *in situ* and to collect specimens. Obtaining specimens from tall trees was, however, very complex and often impossible. Corner noted that many households across the Malay Peninsula had domesticated pig-tailed macaques, also known as berok monkeys, which were trained to collect fruit such as coconuts. He then decided to 'employ' his own berok monkeys to collect plant specimens. Corner's extensive work with monkeys is documented in his biographical account, *Botanical Monkeys* (1992).

A photograph of Merah I dangling from a tree branch, with Corner in the foreground.



The cover of *Wayside Trees of Malaya*, 1940 (first edition).

Corner was a keen artist and photographer. Of the 259 drawings included in *Wayside Trees of Malaya*, most were done by him. These and hundreds more are present in the Gardens' archives. Among Corner's photographs are numerous images of monkeys. One of them shows Merah I, a monkey obtained by Corner in Kelantan, dangling from a high tree branch. This image is very similar to the cover design of *Wayside Trees of Malaya*, and might have been the inspiration for it.

Michele Rodda
Research and Conservation & Botanical Art Gallery