

Gardenwise



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Cover

Lit and decorated trees along the main paths of the Gardens created a festive atmosphere during Trees of the World 2021.

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Message from the Director



(Left) Children decorating trees in Bukit Timah Core for Trees of the World 2021. (Right) Concertgoers enjoying a performance by the Singapore Symphony Orchestra in Palm Valley. (Photo courtesy of the Singapore Symphony Orchestra)

In this message, I would like to highlight two significant events in the Gardens over the past six months in our efforts to engage our community.

The first is Trees of the World 2021, which was successfully held from 4 December 2021 to 2 January 2022. Trees of the World brings festive cheer to our visitors. Compared to the same time a year ago, the overall mood has moved from sombre, to one of hopeful anticipation that Singapore and much of the rest of the world might finally return to pre-COVID normalcy in 2022. As we wait for the COVID-19 clouds to lift, Trees of the World is our small contribution to uplift the spirits of our visitors. I was in the Gardens on Christmas Eve after a family dinner, and it was wonderful to see families, with kids and the elderly, taking leisurely strolls and enjoying the lighted scenery of the Gardens. Many posed for pictures with our lighted landscapes. This is also a tribute to our very creative Living Collections team who used our existing landscapes to great effect in creating the lighted landscapes throughout the Gardens. Although it took huge efforts to plan for logistics, coordinate with multiple parties, and fabricate decorative accessories from new and re-used materials, I could see that everyone had fun, and were justifiably proud of the landscapes they had created. It is remarkable that even as we increased the number of trees and added many more mini landscapes in this edition compared to previous years, Trees of the World continues to be fully conceived,

orchestrated and executed in-house by the staff of the Gardens.

But that's not all about Trees of the World. Trees of the World is one of the ways through which we engage our community, which we define as all our visitors, supporters and stakeholders. Since its founding 163 years ago, the *raison d'être* of the Gardens has been about serving people, and in a broader sense, mankind. This is not only about creating a beautiful place for our visitors to connect with nature, to seek solace, or be with families and friends – even our scientific work in botany and conservation loses meaning if it is not focused on generating knowledge to conserve biodiversity for mankind. Providing opportunities for the community to decorate trees in the Gardens is our way of getting the community to own landscapes that they have jointly created with us. We want the community to have a stake in the Gardens, and contribute to how we will grow in the future. We significantly expanded this effort in the 2021 edition of Trees of the World, with a new zone in the Bukit Timah Core where we dedicated all the trees for any members of the public to freely reserve and decorate. Many families came with kids and toddlers to put up the decorations and messages of well wishes on the trees, which were deliberately kept low so that they could be decorated without the need for ladders. One tree had a distinctive message from a visitor – it was in fond memory of his dog who loved to walk in the Gardens but which had died. Many others expressed their wishes for society, mankind, and the Earth.

The second is the live concerts at Palm Valley. After a hiatus of almost two years, two concerts were held in January 2022 at our iconic Shaw Foundation Symphony Stage – the NAC-ExxonMobil Concert in the Gardens by the Singapore Symphony Orchestra on 9 Jan 2022, and the Music Oasis 2022 by the Singapore Chinese Orchestra on 22 Jan 2022. Both were hybrid concerts, with the onsite performances live-streamed through our social media channels. Although live attendance was limited to substantially less than the full capacity that Palm Valley used to witness because of COVID-19 restrictions, there was nevertheless the distinctive and familiar atmosphere of the Gardens as a concert ground for performing arts groups. It was comforting to me too, with the melodies in the air, that the Gardens is now almost back to normalcy in terms of the range of activities that we are organising to engage our community as compared to before COVID-19. We are also very thankful to our partners, the Singapore Symphony Orchestra and the Singapore Chinese Orchestra, for working with us, including the piloting of smaller live performances at the Bandstand last year.

Slowly, but surely, we are reconnecting the Gardens with our community in familiar ways, and we will strive to forge new connections in the future.

Tan Puay Yok
Group Director
Singapore Botanic Gardens

A new record of plant species for Singapore growing on the Lady McNeice tree

To the staff and frequent visitors of the Gardens, the Jelawai Jaha (*Terminalia subspathulata*) Heritage Tree, standing at the southern edge of the Rain Forest along Lower Ring Road, is no stranger. Affectionately known as the ‘Lady McNeice tree’ in honour of Lady Yuen Peng McNeice, to whom the tree was dedicated in 2004, it is among the most prominent, oldest and tallest trees in the Gardens, measuring almost 50 m from ground level. With just a handful of known trees in Singapore, *Terminalia subspathulata* is considered a threatened species and listed as Critically Endangered in the second edition of *The Singapore Red Data Book* published in 2008. Other than Singapore, its native range includes Peninsular Malaysia, Sumatra, Borneo and Java.

Most visitors marvel at the height of the towering Lady McNeice tree but pay little attention to the lower part of its trunk. If they were to look closer, they would see shades of green on the buttress and exposed roots, which are in fact colonies of tiny epiphytic plants called bryophytes. Unlike parasites, epiphytic plants, or simply epiphytes, do not negatively affect the host plant, but merely use the host’s surface for physical support. Apart from playing crucial roles in ecosystem processes, epiphytes are important



The Lady McNeice Tree in the Gardens with patches of bryophytes growing on its buttress.
(Photo credit: Rockney Wong)



Shoots of *Thysanthus ciliaris* with typical jagged leaf margins. (Photo credit: Ho Boon Chuan)

Species	Family	Voucher
<i>Calymperes graeffeanum</i>	Calymperaceae (moss)	RF20-11
<i>Syrrhopodon armatus</i>	Calymperaceae (moss)	RF20-18
<i>Acrolejeunea fertilis</i>	Lejeuneaceae (liverwort)	RF20-14
<i>Cheilolejeunea intertexta</i>	Lejeuneaceae (liverwort)	RF20-12
<i>Cololejeunea wightii</i>	Lejeuneaceae (liverwort)	RF20-19
<i>Frullania gracilis</i>	Frullaniaceae (liverwort)	RF20-13
<i>Lejeunea anisophylla</i>	Lejeuneaceae (liverwort)	RF20-09
<i>Lopholejeunea subfusca</i>	Lejeuneaceae (liverwort)	RF20-17
<i>Microlejeunea ulicina</i>	Lejeuneaceae (liverwort)	RF20-10
<i>Schiffnerolejeunea pulopenangensis</i>	Lejeuneaceae (liverwort)	RF20-16
<i>Thysanthus ciliaris</i>	Lejeuneaceae (liverwort)	RF20-15

List of bryophyte species identified from samples collected from the buttress and exposed roots of the Lady McNeice tree. All vouchers have been deposited in the herbarium of the Singapore Botanic Gardens (SING) for documentation and future verification.

sources of food, habitat and shelter for animals including a vast diversity of unseen invertebrates and micro-organisms. The presence of epiphytic vascular plants is in fact a characteristic of tropical forests.

Bryophytes are non-vascular plants that share a common ancestor with vascular plants about 470

million years ago. They can exist as epiphytes even in temperate climates. Bryophytes comprise three groups – liverworts, mosses and hornworts. Their genealogical interrelationships are still a topic of scientific debate, but scientists are quite certain that they are positioned between the green algae and vascular plants. Morphologically, the three groups

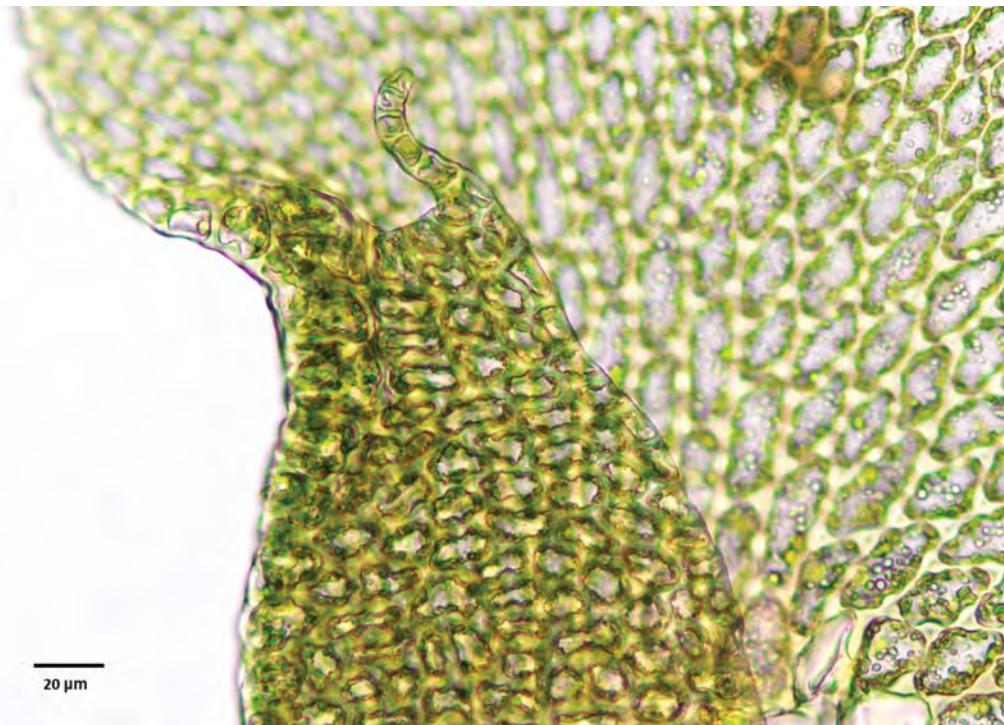
of bryophytes are essentially different in the way their spore cases have developed and how the spores are released.

As part of an ongoing survey to inventory the Gardens' species of bryophytes, it was recently discovered that the Lady McNeice tree alone harbours at least 11 species of epiphytic bryophytes, of which eight belong to the liverwort family Lejeuneaceae. Most exciting was the discovery of *Thysanthus ciliaris* growing on the tree, which is the first record of this species in Singapore!

Thysanthus ciliaris, belonging to the largely tropical Lejeuneaceae, is a rare and poorly known species from Southeast Asia. So far, only five verified collections have been recorded worldwide, of which only three specimens were collected in the last 20 years. It was first described from specimens collected in 1858 on Bangka (one of the Riau Islands in Indonesia), and the species was subsequently collected in East Kalimantan (Indonesian Borneo) in 1952, Perak (Peninsular Malaysia) in 2004, Songkhla (Southern Thailand) in 2016, and most recently Singapore in 2020. Interestingly, it almost has the same natural distribution as *Terminalia subspathulata* but is indeed a much rarer species.

As with most bryophytes, species identification is often impossible with the naked eye. Many diagnostic features of the species can only be observed under a microscope at a magnification of 40 times or more. For example, the leaf lobule teeth of *Thysanthus ciliaris* that are four to six cells long are unique among the four species of *Thysanthus* known in Singapore. The new species record for Singapore, including a detailed discussion on its identity, was published in the *Gardens' Bulletin Singapore* in December 2021.

The discovery of such a rare epiphytic species emphasises the importance of conserving old trees along with their epiphytes



An image showing a tooth on the apex of a leaf lobule of *Thysanthus ciliaris*, taken under a compound light microscope. (Image credit: Ho Boon Chuan)



The bryophyte collection in the Evolution Garden. (Photo credit: Rockney Wong)

in Singapore. We must always remember to be respectful of our native biodiversity. Not only is it illegal to remove, collect or displace plants without special permission, but is disruptive to our local ecology and threatens the survival of rare and endangered species. Apart from that, arborists should be mindful during tree inspections and other works to minimise disturbance and damage to tree trunks as they provide potential habitat for *Thysanthus ciliaris* and homes for numerous other epiphytes.

This is an example that demonstrates that one tree does not represent just a single individual, but communities of seen and unseen organisms. Hidden among them could be new species waiting to be discovered.

To find out more about bryophytes, visit the newly upgraded bryophyte display plot in the Evolution Garden.

Ho Boon Chuan
Herbarium

Rockney Wong
Living Collections

Shorea macroptera, one tree's legacy

The Gardens' Rain Forest is a 6.2-hectare patch of lowland primary forest in the heart of the city, boasting good stands of emergent species despite its isolation from the nature reserves. The Rain Forest is one of the few remaining spots in Singapore where emergents such as *Dyera costulata*, *Koompassia malaccensis* and *Shorea macroptera* still thrive. One such tree was an iconic *Shorea macroptera* Heritage Tree that until recently towered above the rest of the trees in the Rain Forest. With a trunk girth of 4.3 m and height of 48 m, it was a prominent feature of the Gardens and admired by our visitors.

Unfortunately, this old tree started to show signs of decline. This prompted second-level tree inspections by the Gardens' staff using a resistograph and other specialised equipment, which revealed that the tree had a cavity due to an internal decay. Our arboriculture team put in place a rigorous system of monitoring and mitigation measures to protect both the tree as well as public safety. However, in 2020, once our mitigation efforts were exhausted and no alternatives were feasible, the Heritage *Shorea macroptera* was felled for safety reasons.

The removal of the tree was an exercise in itself, challenged by accessibility issues and the sheer size of the tree. After six days of intensive work by the Gardens' tree climbers and arboriculture team, all that was left of this once-towering presence that had stood in the Rain Forest for decades was a 2-m-tall stump. However, felling the *Shorea macroptera* gave us an opportunity to answer questions we had about this old tree that also have bearings on our understanding of Singapore's forests. For instance, we were curious about how much carbon it may have sequestered over its lifetime, and how old the tree may have been.



The *Shorea macroptera* Heritage Tree. This species grows up to 50 m tall and produces prominent buttresses. Its leaves are around 13 cm by 5 cm, elliptic-oblong, thick and leathery. Its fruits can be distinguished from other members of its family (Dipterocarpaceae) by its three large outer wings which are auriculate at the base. (Photo credit: Nurul Izzah)

Using LiDAR to measure the tree and assess its carbon sequestration

The three-dimensional attributes of the *Shorea macroptera* were captured using LiDAR (Light Detection and Ranging). As LiDAR requires a clear line of sight, scanning the tree from various vantage points within the Rain Forest proved to be challenging due

to the thick surrounding vegetation which obscured parts of the crown and upper trunk. Thus, scans were also taken from along Cluny Road where there was a clearer view of the crown.

To obtain accurate height and girth measurements for the entire trunk, cut sections of the trunk were also scanned after the tree was removed. Individual sections were labelled



LiDAR scanning of the *Shorea macroptera*.

(Photo credit: Nurul Izzah)



A composite image of the full tree using the individual LiDAR scans.

(Image credit: Edmund Chia)

from 1 to 20, according to the sequence of the removal. Each section was hoisted upright by a crane lorry for individual scanning, and it took two days to achieve the full scan of the trunk.

The image of the tree was reconstructed by manually shifting and coalescing the individual scans using software.

Point cloud data produced by the LiDAR scans was used to measure the physical dimensions of the tree; they were then compared to the *in situ* scans and aligned manually to derive each section's height above ground.

The volume, height and radius of the trunk had been taken in part so that we could estimate

Alignment of the trunk sections using data produced by the LiDAR scans. (Image credit: Edmund Chia)



Samples sent for radiocarbon dating. (Photo credit: Nurul Izzah)

the tree's carbon sequestration. Using the measurements from the LiDAR scans, we were able to estimate that it may have sequestered over 21,630 kg of carbon in its lifetime! Thus, despite the limitations involved with obtaining the scans, they provided useful information on the tree, and the experience has given us more confidence in using such technology in the future.

Radiocarbon dating to estimate the age of the tree

We were also interested in finding out the age of the *Shorea macroptera*, both to supplement our knowledge of the Gardens' natural heritage and to better understand tree growth rates in Singapore's forests. Unlike in temperate regions where tree age can be calculated by counting annual tree rings, tropical rainforests do not have distinct growing seasons, so most trees do not show an annual growth pattern. We therefore turned to radiocarbon dating, which is a laboratory analysis technique that provides objective age estimates for carbon-based material that originates from living organisms. Carbon from the atmosphere is sequestered and stored in the trunk as the tree grows. By measuring the carbon isotope ratios of a part of the trunk, and comparing it with known atmospheric carbon levels, the age of the tree can be estimated.

To obtain specimens for radiocarbon dating, slivers of wood were taken from three different points along the bole – at 3 m, 18 m and 40 m. The slivers were then sent to the Gardens' Seed Bank where they were dried out. After drying, smaller samples of 0.5 mm³ were taken from the larger specimens, and these were sent to a lab where they underwent accelerator mass spectrometry dating. Unfortunately, as the centre of the tree trunk near the base was damaged by rot, we were not able to obtain a usable sample from the oldest part of the tree's core. Even so, based on the samples we managed to obtain, the tree appears to have been at least 166 years old.

Conservation efforts

As many native species are rare in the wild and not commonly found in commercial nurseries, the Gardens has an active programme to collect and propagate material from the rare native plants in our collections. For trees such as the *Shorea macroptera*, this includes regular watering and application of leaf litter as mulch to retain moisture and provide nutrients, as well as a comprehensive fertilising programme to ensure that vegetative growth is followed by flowering, fruiting and seed-set. The seeds produced are collected and nurtured *ex-situ* or are left on the forest floor to germinate and grow as future succession material.

As for the *Shorea macroptera*, the tree was very successful at producing and dispersing its seeds in the Gardens. A number of its seedlings that had germinated on the grounds were collected in 2019, and these are being cared for in the Plant Resource Centre for future reforestation and planting efforts throughout Singapore.

Succession and the next generation of *Shorea macroptera*

While we are saddened by the loss of our majestic giant, we take solace in the knowledge that the tree's final years contributed significantly to our understanding of the species, and that its progeny is being used as part of Singapore's conservation efforts. Today, there are three other large *Shorea macroptera* specimens in close proximity to the tree stump, and many more will claim their rightful place within the Gardens' Rain Forest as the old tree's seedlings continue to grow. Our Heritage Tree may be lost, but she leaves behind her progeny under the watchful eyes of the Gardens' guardians to ensure that her legacy goes on.

Nurul Izzah Binte Taha Edmund Chia *Living Collections*

The SGF Hort Show 2021 Orchid Competition



During the Heritage Festival, Burkhill Hall was decorated with the competition orchids submitted by local professionals and hobbyists.
(Photo credit: Pepper Teo)

The Singapore Botanic Gardens Heritage Festival, an annual event celebrating the Gardens' rich heritage, was held from 9 to 17 October 2021 in conjunction with the Singapore Garden Festival Horticultural Show (SGF Hort Show). One of the highlights was the Orchid Competition, organised by the Gardens in partnership with the Orchid Society of South East Asia (OSSEA), where a diverse range of orchid species and hybrids were submitted by professional growers and passionate hobbyists from across Singapore for judging. The competition received overwhelming support from the local orchid community, reflecting the deep interest in orchid cultivation in Singapore. A grand total of 528 orchids, submitted by 25 exhibitors, were split by type into 71 classes and judged by a panel of 12 expert OSSEA judges. The classes spanned a wide range of orchid sections, including genera like *Dendrobium*, *Paphiopedilum* and *Phalaenopsis*, alliances like *Cattleya*, *Oncidium* and *Vanda*, as well as other miscellaneous groups such as jewel and miniature orchids.

The Grand Champion and Best Species titles were conferred on a *Dendrobium thyrsiflorum* specimen



Select classes of warm-growing competition orchids were exhibited in the Tan Hoon Siang Mist House. (Photo credit: Rachel Tan)

exhibited by Gardens by the Bay, while the Best Hybrid title went to a *Phalaenopsis Sogo Yukidian* submitted by Woon Leng Nursery Pte Ltd. The Gardens clinched the Best Specimen Plant award with our submission of *Dendrobium Singapore Golden Glory 'SBG Miracle'*, a cross between *Dendrobium Singapore*

Shanghai Symphony and *Dendrobium Anching Lubag*, and we also won the OSSEA Championship Cup as Best Professional Exhibitor, having obtained the highest number of points from the winning entries across all classes. The Best Amateur Exhibitor title was given to Christopher Teo, a member of OSSEA.



Cool-growing competition orchids were displayed in The Sembcorp Cool House.

(Photo credit: Rachel Tan)



The Clock Tower at the entrance of the National Orchid Garden was adorned with a selection of vandaceous heritage orchids. (Photo credit: Rachel Tan)

The three best entries within each class were presented with ribbon rosettes – blue for 1st place, red for 2nd place, and white for 3rd place – and 30 Best in Class challenge cup titles were awarded to the most outstanding orchids in their respective categories. In addition, the Judges Commendation was given to 17 plants in recognition of their distinctive attributes of botanical excellence or historical importance. The Gardens submitted a total of 208 orchids, winning 13 Best

in Class titles and 75 ribbon rosettes, along with the Judges Commendation for nine entries.

On top of the show judging, 21 orchids of exceptional quality and beauty were selected for award judging. Eight of these were specimens entered by the Gardens, some of which are showcased in this article. Award judging serves to set and enhance standards for orchid cultivation and hybridisation, and evaluates orchids based on five criteria –

1) flower colour, 2) flower size and texture, 3) flower shape, 4) floral presentation, and 5) other considerations such as the plant's condition, rarity, difficulty of cultivation, and floriferousness. The awards include a First Class Certificate (FCC) for orchids attaining a score of 90 points or more, an Award of Merit (AM) for those scoring 80 to 89 points, and a High Commendation Certificate (HCC) for those scoring 75 to 79 points. The Certificate of Cultural Commendation (CCC) is awarded to growers in recognition of an outstandingly well-grown and free-flowering plant.

While Orchid Competition entries have traditionally been exhibited solely at Burkhill Hall, this year the displays were extended to the recently opened Tropical Montane Orchidetum. The displays were carefully curated to showcase the variety of show classes and highlight the orchids' natural growing conditions. Burkhill Hall was beautifully decorated with the 'best of show' orchids and warm-growing competition orchids, including species and hybrids of *Cattleya*, *Dendrobium*, *Oncidium*, *Paraphalaenopsis* and *Renanthera*. Other warm-growing competition orchids, such as *Papilionananda* and *Vanda* species and hybrids, were exhibited in the Tan Hoon Siang Mist House, while cool-growing competition orchids like *Dendrochilum*, *Epidendrum* and *Maxillaria* species and hybrids were displayed in The Sembcorp Cool House, set against the backdrop of the high-elevation tropical montane flora grown there.

In celebration of the long association that the Gardens has had with orchids, a vibrant display of heritage orchids was arranged around the Clock Tower at the entrance to the National Orchid Garden. These heritage orchids are vandaceous hybrids belonging to genera such as *Aranda*, *Aranthera*, *Mayara*, *Papilionananda* and *Renanthera*, and, having combined the best traits of their parents, are known for their superior quality. Many of them have received international awards, become important in the cut-flower trade, or been named after historical figures. Some also serve as breeding stock for the creation of new orchid hybrids today.

Rachel Tan
Whang Lay Keng
National Orchid Garden



Dendrobium thyrsiflorum 'Gardens by the Bay'

Exhibitor: Gardens by the Bay

Awards : President's Challenge Cup for the Grand Champion, Penang Gardening Society Challenge Cup for the Best Species, Bournemouth Cup for the Best *Dendrobium*, Quek Kiah Huat Challenge Cup for the Best *Dendrobium* species, AM/OSSEA

This eye-catching entry had 10 inflorescences with over 200 flowers at the time of judging. Native to the Himalayas, China and northern Indochina, *Dendrobium thyrsiflorum* produces flowers that measure about 4.5 cm across and have a yellow lip tinged with white that juxtaposes with the whiteness of the petals and sepals.



Phalaenopsis Sogo Yukidian

(*Phalaenopsis* Yukimai × *Phalaenopsis* Taisuco Kochdian)

Exhibitor: Woon Leng Nursery Pte Ltd

Awards : John Laycock Challenge Cup for the Best Hybrid, Chew Bin Hin Challenge Cup for the Best *Phalaenopsis*, Nam Kee Challenge Cup for the Best *Phalaenopsis* Hybrid

This beautiful entry bore one long, cascading inflorescence of 18 white flowers, each measuring around 10 cm wide. This *Phalaenopsis* hybrid is commonly grown as a balcony plant or used in potted plant arrangements due to its elegant and long-lasting flowers.



Dendrobium Singapore Golden Glory 'SBG Miracle'

(*Dendrobium* Singapore Shanghai Symphony × *Dendrobium* Anching Lubag)

Exhibitor: Singapore Botanic Gardens

Awards : Yuen-Peng McNeice Challenge Cup for the Best Specimen Plant, Soh Kim Kang Challenge Cup for the Best *Dendrobium* Hybrid, runner-up for the Bournemouth Cup for the Best *Dendrobium*, CCC/OSSEA

With attractive chartreuse-yellow flowers measuring 7 cm across, this stunning specimen had 27 upright inflorescences bearing an impressive total of 756 flowers at the time of judging. This spectacular *Dendrobium* hybrid exemplifies the Gardens' orchid hybridisation programme, which is famous for having produced many outstanding antelope dendrobiums displaying a diverse array of flower colours, shapes and sizes.



(Photo credit: Rachel Tan)

Luilionanda Anthony Koo 'SBG Golden Caramel'*(Papilionanda Josephine van Brero × Luisia thailandica)***Exhibitor:** Singapore Botanic Gardens

Awards : Blue Ribbon, runner-up for the Tan Hoon Siang Challenge Cup for the Best *Papilionanda* Tan Chay Yan or Allied Intergeneric of *Papilionanda* Josephine van Brero Ancestry, AM/OSSEA

This entry bore one inflorescence of five flowers pleasantly coloured in a citrus orange and measuring 8 cm across. What makes this hybrid exceptional is the unique shape of its flowers, as well as their large size given the presence of *Luisia* in its parentage, as *Luisia thailandica* for instance typically bears small flowers no wider than 2 cm. With its noteworthy attributes, this hybrid paves the way for the creation of new orchid breeding lines.



(Photo credit: Rachel Tan)

Papilionanda Tan Hoon Siang 'SBG Pride of Singapore'*(Papilionanda Josephine van Brero × Vanda Somsri Pink)***Exhibitor:** Singapore Botanic Gardens

Awards : Red Ribbon, AM/OSSEA

This entry had one inflorescence with 12 richly coloured pink flowers each measuring 12 cm across. This hybrid is named after the late Tan Hoon Siang, a successful businessman, philanthropist, and descendant of Tan Tock Seng. An orchid pioneer, Tan Hoon Siang is well known for producing a beautiful hybrid named after his father, *Papilionanda* Tan Chay Yan, which helped to put Singapore on the world map for orchid cultivation and hybridisation.



(Photo credit: Rachel Tan)

Renantanda Singapore Gardening Society 'SBG Scarlet Exuberance'*(Renanthera Kalsom × Vanda Rosy Lips)***Exhibitor:** Singapore Botanic Gardens

Awards : AM/OSSEA

Renantanda is a bigeneric hybrid of *Renanthera* and *Vanda*, typically yielding large blooms, multiple sprays and long-lasting flowers. The flowers produced tend to be reddish due to the dominant colour influence of its *Renanthera* parentage. This entry featured 18 dark red flowers and five buds on one erect inflorescence, with the flowers measuring 6 cm in width. This hybrid was named after the Singapore Gardening Society, in honour of the society's 80th anniversary in 2016.

***Vanda lombokensis*****Exhibitor:** Singapore Botanic Gardens**Awards :** Blue Ribbon, runner-up for the Koh Keng Hoe Challenge Cup for the Best *Vanda* Species

This striking species is native to Lombok and the Lesser Sunda Islands. It produces yellow flowers heavily spotted with magenta, measuring approximately 7.5 cm across.



(Photo credit: Rachel Tan)

Dendrobium Jerry Janine Mateparae 'SBG Fuchsia'*(Dendrobium Lim Choo Neo × Dendrobium lineale)***Exhibitor:** Singapore Botanic Gardens**Awards :** Judges Commendation, AM/OSSEA

This is a VIP hybrid produced by the Gardens. It was named in 2015 after Jerry Mateparae, New Zealand Governor-General at the time, and his wife, Janine Mateparae, to mark 50 years of diplomatic relations between Singapore and New Zealand. This entry had four inflorescences bearing 33 flowers and five buds, with each flower measuring about 4 cm wide.



(Photo credit: Rachel Tan)

Eulophia Shamara 'SBG Corduroy Song'*(Eulophia euglossa × Eulophia guineensis)***Exhibitor:** Singapore Botanic Gardens**Awards :** Blue Ribbon, Wiltech Agrotechnology Challenge Cup for the Best Miscellaneous Orchid Hybrid, AM/OSSEA

This attractive orchid is a primary hybrid produced from two *Eulophia* species native to Africa. This entry sported 38 flowers and 10 buds borne on a single erect inflorescence, with each flower measuring 5.5 cm in width.

***Maxillaria callichroma 'Gardens by the Bay'*****Exhibitor:** Gardens by the Bay**Awards :** Blue Ribbon, Mandaiana Challenge Cup for the Best Miscellaneous Orchid Species, reserve Grand Champion, AM/OSSEA with CCC

Native to the high-elevation cloud forests of Colombia and northern Venezuela, this cool-growing species has orange-yellow flowers with reddish markings on the back of the petals. The labellum is white with a yellow centre and has red striations on the side lobes. This entry sported a remarkable 80 flowers, each measuring nearly 7 cm across and borne on a single inflorescence.

(Photo credit: Rachel Tan)

Exploring the origins of a remnant of early ornamental cast ironwork



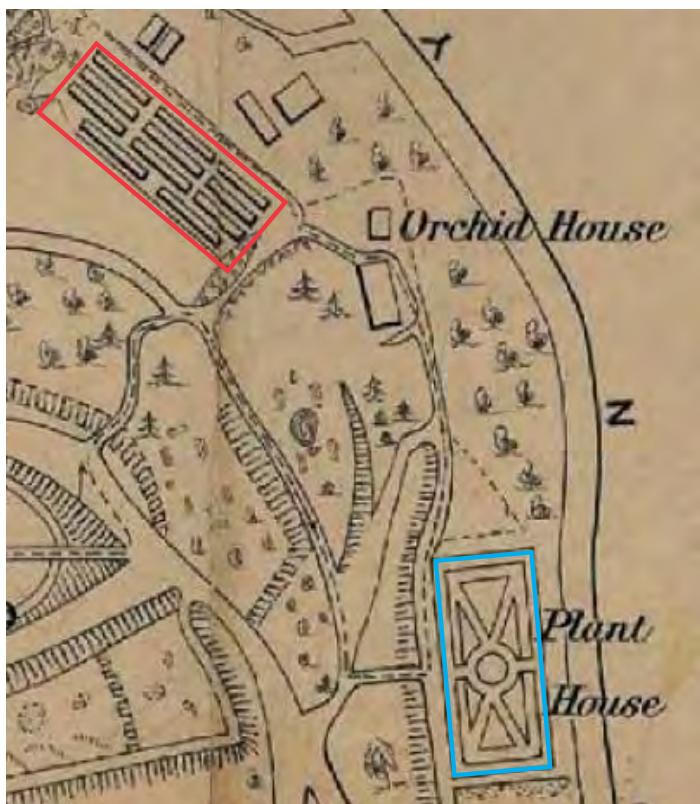
The iron railing at the Plant House. (Photo credit: Tan Wan Xin)

Have you ever noticed the rather antiquated iron railing at the northwestern end of the Plant House? Low and inconspicuous, this cast iron fence looks like it

belongs to a different time compared to its surrounding features. Little did we realise that it is a piece of history hidden in plain sight, as we discovered by investigating its potential origins.

The earliest mention of what may be this fence appeared in the *Annual Report on the Botanic Gardens, Singapore, for the year 1882*, in the context of the construction of a house for propagating plants. Located at the present-day Potting Yard, this propagation plant house required the levelling of “1,500 square yards on the edge of the jungle on the North side of the Garden”; it also had “three lines of staging”, which can be seen in maps published in 1889. After it was built, “the house was enclosed by 230 yards of unclimbable iron fencing selected by the Hon’ble Captain H.E. McCallum, R.E., and obtained from England”. At the time, McCallum was standing in for the outgoing Engineer, J.F. McNair, according to a *Singapore Daily Times* article from 19 January 1881. He was to be Singapore’s head of public works with this new appointment, and later became the Colonial Engineer for Singapore in the 1890s.

(Left) An extract from the 1889 map published in the *Guide to the Botanical Gardens* by Walter Fox, showing the propagation house (highlighted red, where the Potting Yard is today), and the ‘exhibition’ Plant House (indicated in blue).



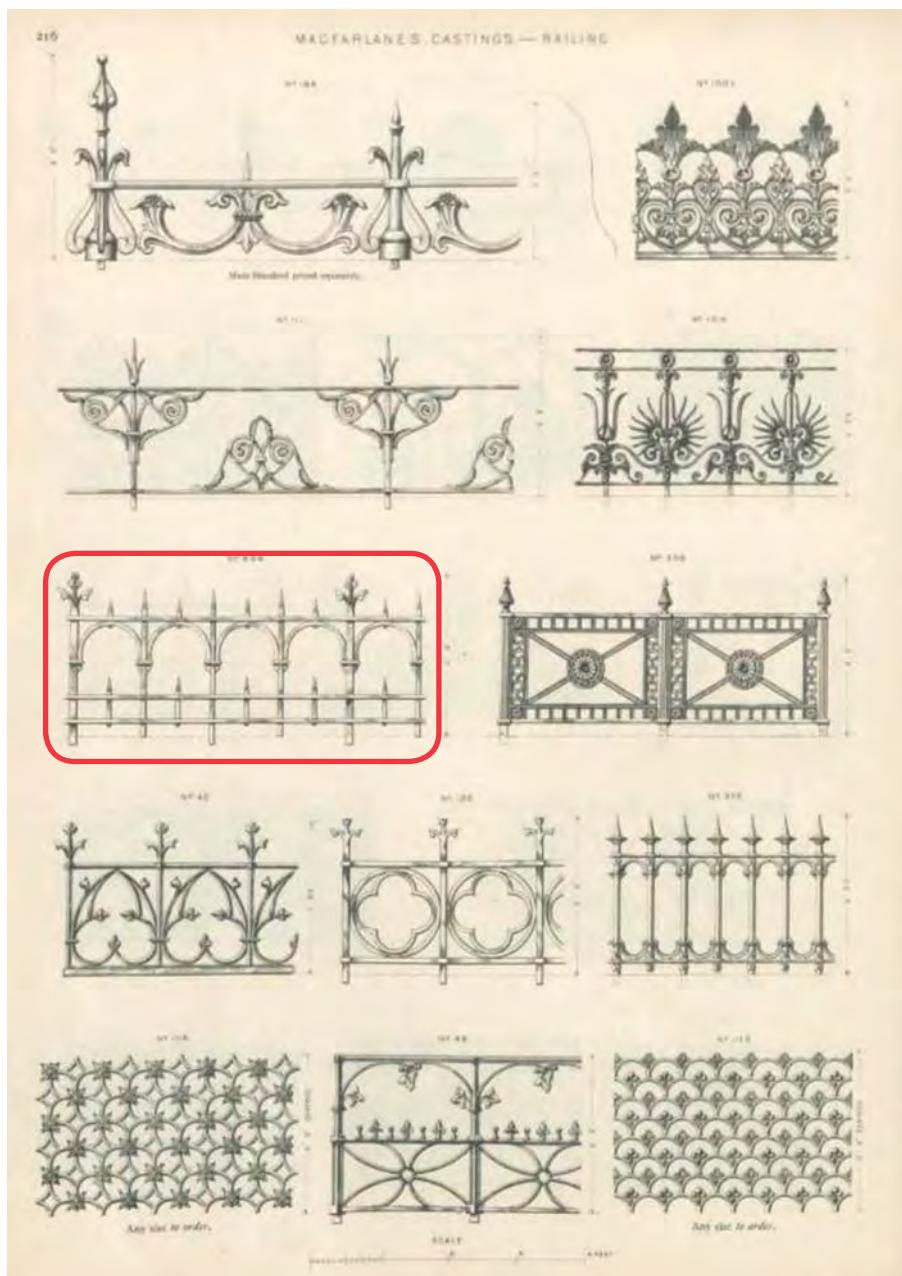
The same annual report from 1882 also mentioned an exhibition plant house, which was referred to in later reports as the “large plant house”, or just the “plant house” from roughly the 1950s onwards. This is the same feature that we refer to today as the Plant House, although the structure itself is not the original as it has been modified over the years. The Plant House was historically used as an exhibition ground for flower shows and ornamental displays of potted plants. According to the 1882 report, it was built with an initial design of “4 large triangular blocks of staging, one round centre piece, 4 tables and 3 lines of staging round the outside path”, and this design is also reflected in the early maps from 1889. In the *Annual Report on the Botanic Gardens, Singapore, for the year 1884*, it was mentioned that “the unclimbable iron railing which surrounded the propagation nursery has been removed and

placed around the exhibition building". This suggests that the remnant cast iron fence found at the Plant House today may be the same fence mentioned in the 1882 report.

Continuing our research into the vintage of the fence, we found the website of a UK-based company specialising in restoring historic landscape furnishings. There, we noticed the same design motif of the Plant House fence associated with what they called the "historic MacFarlane Company design"¹. This refers to fence designs that are common in British ironwork made by Walter MacFarlane, who founded and owned W. MacFarlane & Co. Ltd in Glasgow, Scotland, a company also known as the Saracen Foundry. It turns out that many notable structures in Singapore such as Lau Pa Sat (the former Telok Ayer Market which opened in 1894)², the Istana, the Old Parliament House and the Chinese temple Thian Hock Keng originated from this foundry, which was already among the most illustrious ornamental ironwork manufacturers worldwide in that period³. McFarlane's ironwork here and elsewhere in Singapore are historically significant examples of Victorian era ornamental ironwork, of which many in the UK were unfortunately destroyed or salvaged to support the war effort during the Second World War.

The first volume of the *Illustrated Catalogue of MacFarlane's Castings* that was published around 1882 includes the exact same design as our fence, suggesting that it may have originated from this foundry. The fence bears the same ornamentation, with clasped motifs joining each looped section between the pickets, and posts with fleur-de-lys finials spaced about three pickets apart.

Various advertisements of McFarlane & Co.'s ironwork in Singapore published in 1883 in the *Straits Times Weekly Issue*, and payments from the municipality



A page from the first volume of the *Illustrated Catalogue of MacFarlane's Castings* (6th ed.), which is dated to around 1882. The design of the Plant House fencing is circled in red.

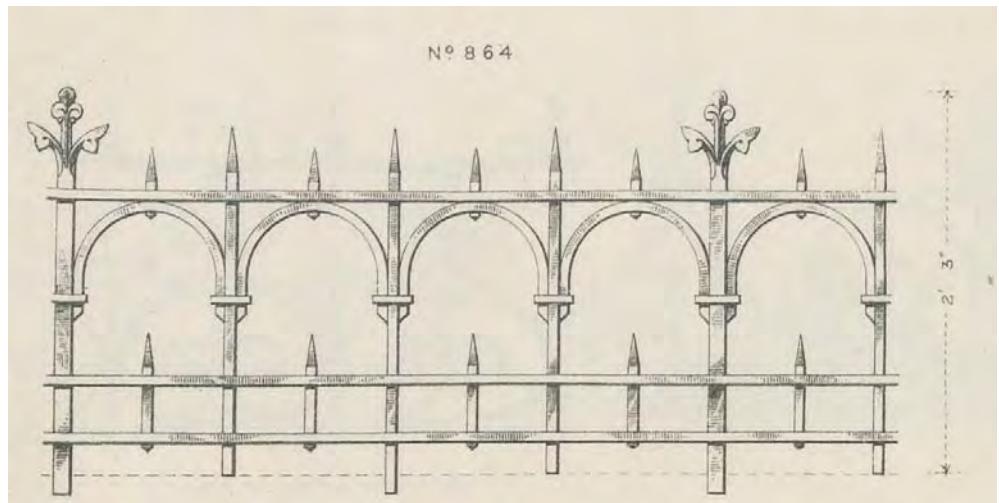
to McFarlane & Co. for ironwork in other parts of Singapore in 1884, suggest that the company had a local business presence and was involved in some municipal and non-municipal public works during that period. It also appears that MacFarlane himself may have travelled to Singapore around this time, as a 'W. MacFarlane' appears in the 27 January 1882 passenger

manifest of the steam ship *Deccan* that was published in the *Singapore Daily Times*. That the fence might have come from MacFarlane is not surprising as European foundries like MacFarlane's were often preferentially sourced for public works projects through direct business links with middlemen entities known as Crown Agents during the colonial period.

¹ Lost Art Limited (n.d.). *Lost Art Catalogue of Fencing, Gates and Railings*. Available online at www.lostart.co.uk/pdf/fencing-gates-and-railings.pdf

² Berry, G. (2017). Scots in Singapore: Remembering Their Legacy. *biblioasia* 13(3): 18–23.

³ Tan, I.Y.H. (2015). *Global Transfusion and Local Hybridity: A Study of Historic Ironmongery in Singapore*. Conference paper for the 1st Southeast Asia Architecture Research Collaborative (SEAARC) Symposium, 2015.



(Top) A close-up of the design drawing of the fence from the *Illustrated Catalogue of MacFarlane's Castings*. (Bottom) The fence at the Plant House. (Photo credit: Edmund Chia)



(Left) The Main Gate at the junction of Cluny and Napier Roads in 1965, and (right) a zoomed-in view of the railing detail which resembles the remnant fence found at the Plant House.
(Courtesy of Singapore Botanic Gardens Archives)

However, there is an alternative possibility for the origin of our fence. The 1901 annual report for the Gardens mentioned a desire to replace the difficult-to-maintain bamboo hedge that stretched from the Main Gate to Office Gate with a "low wall surmounted by an iron railing similar to that in front of the Lunatic Asylum" (likely referring to the psychiatric hospital at the old Sepoy Lines at the time). On 5 October 1903, it was published in the *Straits Settlement Government Gazette* that the government had budgeted 2,200 dollars for the "erection of dwarf wall and iron railing" at the Gardens, which was completed in 1904. From postcards dating to 1965, we can see that the same design of the fence at the Plant House was reflected in the railing design of the Main Gate. This means that the remnant fence could also have come from the Main Gate railing, which was replaced with wire fencing in the following years.

Whether our remnant cast iron fence originated at the propagation house in 1882 and was later transferred to the Plant House, was originally part of the Main Gate boundary erected in 1904 along Cluny Road, or whether the original fences at both locations just happened to be of the same design, is unclear. Still, we can be certain that the design has been around since at least 1882 from its recorded publication in the catalogue, and that the fence itself has likely existed since at least 1904. With no records that any restorations were ever done to it, which is also suggested by its antiquated footing, this makes the structure among the oldest features of the Gardens. Keep a look out for this historic feature of the Plant House the next time you pass by!

Edmund Chia
Living Collections

The author would like to acknowledge Dr Michele Rodda for his advice and comments on the article.

Monitoring the monitors



The sharp claws of *Varanus nebulosus* make it an excellent climber.

Monitor lizards are large reptiles that mostly belong to the genus *Varanus*. They are distributed from Africa to parts of the Asia-Pacific region. Globally, there are approximately 80 recognised species, and three of them are found in Singapore. The rarest of these is Dumeril's Monitor, *Varanus dumerilii*, which occurs in the Malay Peninsula, Sumatra and Borneo, including the islands of Bangka, Belitung and the Riau Archipelago. Rediscovered locally in 2008 after an absence of 75 years, the species is difficult to chance upon as it is nocturnal and restricted to the Central Catchment Nature Reserve.

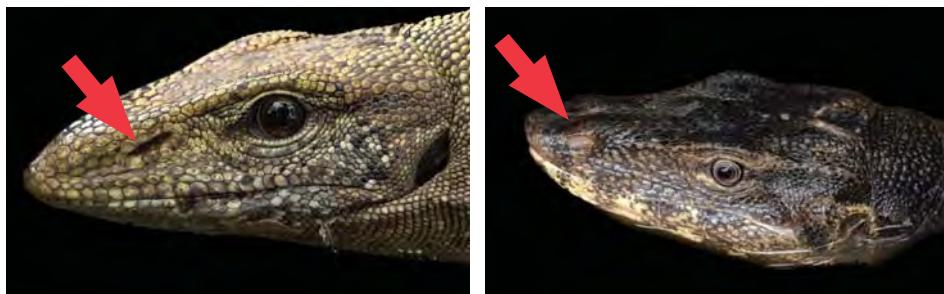
The other two species in Singapore are the ubiquitous Malayan Water Monitor, *Varanus salvator*, and the Clouded Monitor, *Varanus nebulosus*, both of

which are found in semi-forested areas. They often occur alongside one another within their range from Sri Lanka and southern China to the Malay Peninsula, Sumatra and Java. While both species are widespread in Singapore today, *V. nebulosus* has only become more common in recent years and was a rare sight here just over a decade ago.

Varanus nebulosus was first recorded in the Gardens in 2013, but now we commonly find it along with *V. salvator* basking and foraging within the patchwork of managed lawns, forests and water bodies around the grounds. These monitors attract interest among visitors and often get mistaken for the Komodo Dragon, *Varanus komodoensis*. Although *Varanus nebulosus* is common and wide-ranging, there has been little research published on the species and

thus we wanted to learn more about it by studying the population within the Gardens. We worked with the Herpetological Society of Singapore and Dr Benjamin Lee from NParks' Wildlife Management Research team to conduct a short three-month study to answer some burning questions on their population size, ecology, and interactions with other wildlife in the Gardens.

Six marked *Varanus nebulosus* were monitored for more than 280 hours. Each of these individuals were observed for four days, with their activity being monitored for approximately 12 hours starting from the time they left their shelters to forage to the time they returned to rest. We recorded observations of interactions with other wildlife, including prey, to provide some insight to their diet. The gut contents of specimens from Lee Kong Chian Natural History Museum (LKNHM) were also dissected for this study, and prey items were identified and assigned to the closest taxonomic rank possible. To estimate their population across the Gardens, a census was conducted once a week for six weeks.



(Left) *Varanus nebulosus* and (right) *Varanus salvator*. The position of the nostrils and shape of the snout are two of the few ways that they can be differentiated. As *Varanus salvator* is more water dependent, its nostrils are located closer to the tip of the snout.



The epithet *nebulosus* means 'clouded', referring to the yellow spots that can be found all over the body. This colouration is more distinct in juveniles.



(Left) Law Ing Sind and Law Ingg Thong, co-founders of the Herpetological Society of Singapore (HSS) and the lead researchers of the study. (Right) Lai Simin from the Gardens' Living Collections team collecting data on a young monitor. (Photo credits: Jolene Lim)

Angelina Wan, a member of HSS and assistant to the researchers, observing a monitor.

Population size, shelter and range

The census estimated at least 53 individuals of *Varanus nebulosus* in the Gardens, with the highest concentration of them recorded in the Tanglin and Tyersall Cores.

Shelters were defined as areas where individuals sought refuge for the night, and mainly consisted of four types: tree cavities, tree trunks and branches, ground burrows, and palm axils. *Varanus nebulosus* are adept tree climbers and often favour tree cavities for refuge as opposed to ground burrows. In this study, tree cavities accounted for most of the shelters used. The cavities that were actively being utilised by this species were mostly found within the Tanglin and

Tyersall Cores, which corresponded with observations of their higher densities within these areas.

The study found that their home and foraging territory ranged from 1.57 ha to 5.11 ha. While they foraged independently, their territory was shared with other individuals, and occasionally, antagonistic behaviour between foraging monitors was observed. They did not appear to have specific preferences for hole sizes, as we observed some adults using very narrow entrances. Often, if the cavity was large enough, it was occupied by as many as four individuals without evidence of antagonistic behaviour. If a tree had multiple cavities, each cavity had a different monitor in it.

Activity budget and diet

The individuals of *Varanus nebulosus* that we observed in the Gardens spent most of their day foraging, followed by resting and basking. The main bulk of their diet consisted of invertebrates, and a single monitor was observed to consume as many as 125 earthworms in a span of four hours. Of the dissected specimens from LKCNHM, a single gut contained 70 cockroaches.

Inter- and intra-specific interactions

Varanus nebulosus are known to compete with nesting birds for tree cavities, and staff from the Gardens' Living Collections have observed this on the grounds, even outside of the



(From left to right) *Varanus nebulosus* wedged between a co-dominant tree trunk, resting in a tree cavity, and on the trunk of a palm.



(Left) Dissecting a specimen from LKCNHM, which revealed that (right) cockroaches made up most of this individual's diet.



A camera trap caught this monitor being chased away from the nest cavity of a family of Spotted Wood Owls. The owls eventually abandoned the nest. (Photo credit: Jolene Lim)



A tick on a monitor.



Copulation between a male and female *Varanus nebulosus* in the Gardens.

scope of this study. For instance, they witnessed one monitor take over the nesting cavity of a family of Sunda Scops Owls (*Otus lempiji*) after the owlets fledged, and no other animals have attempted to use it since as the cavity is still occupied by the monitor. Through camera traps set up within the Gardens, staff have also recorded an individual attempting to enter the nest cavity of a family of Spotted Wood Owls (*Strix seloputo*), only to be chased away by one of the parents.

Most of the monitors observed during the study had ticks, with as many as 23 ticks on a single individual. The ticks have been tentatively identified as *Amblyomma helvolum*, which are known to infest Varanid lizards. Ticks are a common external parasite on reptiles and are generally harmless. However, a tick infestation may cause an individual to become anaemic.

We observed copulation between one of the tagged males and a female. The copulation lasted for 89 minutes before the male was chased away by a larger male, which proceeded to mate with the same female for another 95 minutes. We also observed burrowing behaviour by females on two separate occasions. This prompted the deployment of camera traps to monitor the clutches, but the eggs from both clutches were predated on by a *Varanus salvator* the very next day.

This study has provided interesting insight into the behaviour, ecology and population of *Varanus nebulosus* within the Gardens, which will provide a foundation for longer-term monitoring. As a large green space within Singapore's highly

urbanised landscape, the Gardens serves as a refuge for monitor lizards, which in turn play an important ecological role as scavengers through biomass decomposition and recycling. Remember to be mindful and sensitive toward any wildlife that you encounter in the Gardens; appreciate them from a distance so that we can all enjoy this space together.

**Law Ing Sind
Law Ingg Thong
Angelina Wan**
Herpetological Society of Singapore

**Lai Simin
Jolene Lim**
Living Collections

All photos by Law Ing Sind & Law Ingg Thong unless otherwise indicated

The looped string or woven bags of New Guinea

New Guinea is the largest tropical island in the world, and it is one of the few remaining least disturbed tropical regions with about 80% of the island still covered in old-growth or primary rainforest. The island's topography is generally rugged, largely caused by a complex geological history. New Guinea is immensely rich in biological diversity, with birds-of-paradise being some of its iconic animals. These spectacular birds are famous for their showy and attractive plumage, and elaborate courtship rituals during the mating season. In terms of plant life, a recent inventory focused on flowering plants by a consortium of multinational botanists recorded 13,634 species, the richest of any island flora ever documented systematically. Sixty-eight percent of the species listed are only known to occur in New Guinea and nowhere else in the world. Politically, the island is divided into two somewhat equal halves at the centre; the western portion is known as Indonesian New Guinea (Papua and Papua Barat provinces), while the eastern portion forms the independent nation of Papua New Guinea. Despite the political boundary, the islanders share a common cultural identity, and this can be seen for instance in the handmade looped string or woven bags that are ubiquitous on the island.

The handcrafted looped string or woven bags are known as *noken* (in Bahasa Indonesia) in Indonesian New Guinea, and otherwise called *bilum* (in Tok Pisin language) in Papua New Guinea. In 2012, the *noken* was inscribed on UNESCO's List of Intangible Cultural Heritage, as a cultural heritage of Indonesia that requires preservation and better protection to prevent the craft, culture and tradition from being lost through time. At present, the looped string or woven bags are a common

sight in New Guinea as these bags are still being used daily by people from all walks of life. The bags are usually slung across the chest or over the shoulders when carrying daily lightweight essentials, or from a tumpline on the head when carrying heavy loads such as cassava, firewood, a small domestic pig, or even a baby.

Traditionally, the bags are handmade mainly by women using plant fibres. Some of the native plants known to be utilised are species of *Cypholophus* (Urticaceae), *Ficus* (Moraceae), *Gnetum* (Gnetaceae), *Goniothalamus* (Annonaceae), *Myristica* (Myristicaceae), *Pandanus* (Pandanaceae) and *Phaleria*



A woman carrying a baby in an expandable nylon bilum, Mount Hagen, October 1990.
(Photo courtesy of Sue and Jim Hick)



A woman with a *bilum* slung over the top of her head as she feeds a baby in Koinambe village, Jimi Valley, 1978. (Photo courtesy of Sue and Jim Hick)

(Thymelaeaceae); as well as *Hibiscus tiliaceus* (Malvaceae), *Kleinhowia hospita* (Malvaceae) and *Pipturus argenteus* (Urticaceae). Non-native plants are also sometimes used. On a botanical research trip in 2019 to Mount Arfak on the Bird's Head Peninsula (Papua Barat province, Indonesia), an artisan from the Indabri village was recorded to utilise fibres from the leaves of cultivated pineapples, *Ananas comosus* (Bromeliaceae), to make her speciality *noken*. In Papua New Guinea, artisans from Port Moresby were documented making *bilum* using fibres from the leaves of cultivated *Agave sisalana* (Asparagaceae), a plant native to the Americas where it is traditionally used to make rope, mats and baskets.

The process involved in making looped string or woven bags is extremely intricate and labour intensive, and it varies between communities. It has been well documented that communities along the shoreline mainly produce woven bags, while highland communities make looped string bags.

When making looped string bags, the branches, stems, bark or leaves of the preferred plant are harvested, cleaned and cut into the desired length. They are then heated over a fire and soaked in water in a step



A simplified flowchart illustrating some of the steps of making a looped string bag observed at Indabri village, Bird's Head Peninsula, Papua Barat province, Indonesia.



Muit Mince, an artisan from the Indabri village with her speciality looped string noken made from pineapple fibres.



A tightly looped *noken* made from a woody, climbing species of *Gnetum*, for carrying small and lightweight essentials such as gardening or hunting tools, *Piper betle* leaves and betel nuts.



Examples of woven *noken* made from bark fibres or leaves of *Pandanus* species (Pandanaceae), originating from coastal communities in (from left to right) Raja Ampat, Japen and Biak.

known as decortication, in which unwanted plant tissue is removed. The bast fibres obtained from this process are dried under the sun, which may take months depending on prevailing weather conditions. The dried bast fibres are rolled tight into a strong yarn or string by hand along the thigh. The yarn or string is sometimes coloured using natural dyes, for example, with a black dye obtained from bruising mature inflorescences of *Cypholophus* species (Urticaceae), or a dark-orange dye derived from processing the root bark of *Morinda* species (Rubiaceae).

The yarn or string is then handwoven into bags using a looping technique by creating a pattern like a figure 8. Occasionally, looped string bags are decorated with bird feathers, cuscus (a marsupial) fur, thin strips of stem fibre from orchids (species of *Dendrobium* from the section *Diplocaulobium*), colourful plant seeds, animal bones, or even seashells, but these bags are largely used for ceremonial purposes.

In contrast, the process of making woven bags is simpler as the decortication step is not required.



An exquisite and highly prized *noken anggerek* or orchid *noken* from the highlands of Nabire. The foundation of this looped string bag is made from the fibre of a *Gnetum* species. During the looping process, thin strips of yellow- and brown-coloured stem fibres obtained from a *Dendrobium* species were incorporated to produce this beautiful looped string bag.

Plant materials are harvested, cleaned and cut into strips, and then put under the sun to dry for months. Later, the dried strips of plant fibres are interlaced by hand and formed into bags of various sizes and patterns. Similar to the making of looped string bags, the plant fibre strips are sometimes coloured



Examples of *noken* used for ceremonial purposes and decorated with (from left to right) unidentified bird feathers, likely cockatoo feathers and Cassowary feathers.



School children using *noken* as their school bags on Biak Island, Papua province. An example of a *noken* made from synthetic material (nylon) can be seen on the right.



The majority of the population in Indonesian New Guinea identify themselves as Christians. This woven *noken* from Biak almost resembles a modern handbag and was made from the bark fibres of a *Phaleria* species.

with natural dyes, and can also be decorated with bird feathers, seashells, coloured seeds and animal bones.

As sourcing and production of natural fibres is a lengthy and meticulous process, many artisans have turned to cheap synthetic materials and artificial dyes as alternatives. Today, the production of looped string or woven bags provides an additional source of income to families and empowers women to play a significant role in protecting the culture that is unique to the Papuan people.

Low Yee Wen
Herbarium

All images by Low Yee Wen unless otherwise indicated

Examples of looped string and woven bags featured in this article are from a personal private collection acquired since 2014 from the Papua Barat province, Indonesian New Guinea

The king of fruits: Ethnobotany and diversity of the durians

The durian is one of the most iconic fruits of Southeast Asia and is familiar to most

Singaporeans. The word 'durian' is derived from the Malay word *duri* which means 'thorn' and refers to the outer husk of the fruit. The name of the genus, *Durio*, is derived from this. There are about 27 to 30 species of *Durio* known worldwide. Most of these are distributed in West Malesia (Borneo, Peninsular Malaysia, Singapore and Sumatra) and a smaller number can be found in Myanmar, the Philippines and Thailand. At least six *Durio* species produce edible fruits, the most well-known being the common durian or Durian Biasa (*Durio zibethinus*).

The common durian is prized as the 'king of fruits'. Alfred Russel Wallace, who discovered the theory of evolution by natural selection around the same time as, but independently of, Charles Darwin, described the unique taste and smell of the durian as such:

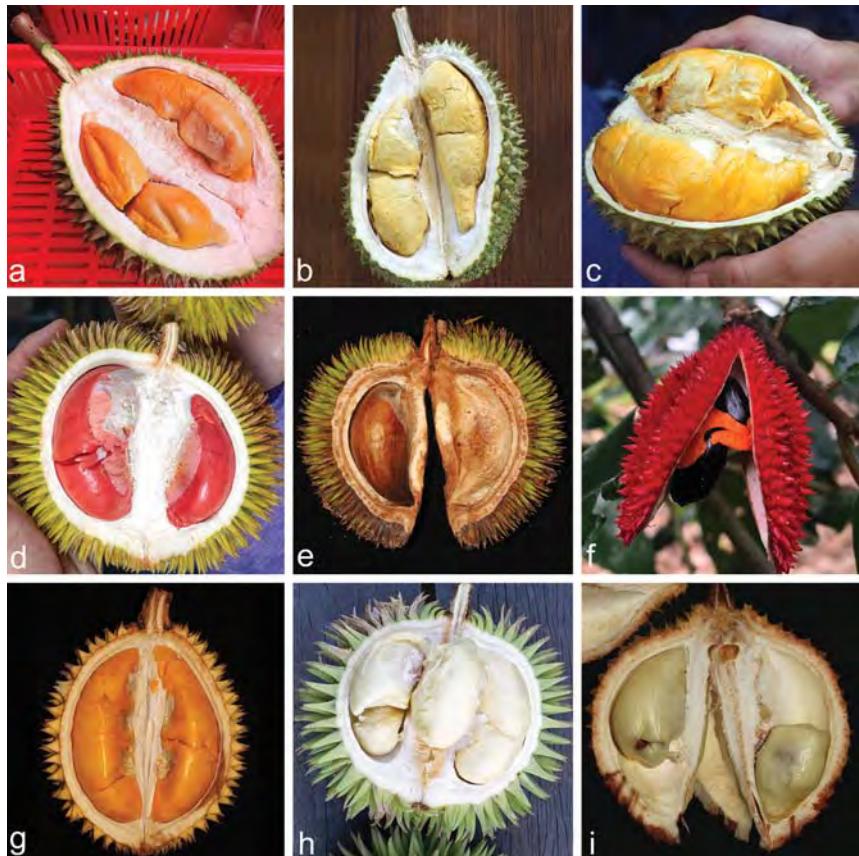
"A rich custard highly flavoured with almonds gives the best general idea of it, but there are occasional wafts of flavour that call to mind cream-cheese, onion-sauce, sherry-wine, and other incongruous dishes.

Then there is a rich glutinous smoothness in the pulp which nothing else possesses, but which adds to its delicacy. It is neither acid nor sweet nor juicy; yet it wants neither of these qualities, for it is in itself perfect. It produces no nausea or other bad effect, and the more you eat of it the less you feel inclined to stop. In fact, to eat Durians is a new sensation worth a voyage to the East to experience..."

I should certainly choose the Durian and the Orange as the king and queen of fruits."

Naturalist Sir Alfred Russel Wallace's description of the durian, in a letter to botanist Sir William Jackson Hooker, published in 'On the Bamboo and Durian of Borneo' in Hooker's *Journal of Botany and Kew Garden Miscellany*, Volume 8 (1856).

The common durian is considered native to Borneo and Peninsular Malaysia or Sumatra. There are many local names for this species, and the fact that several are close variations of 'durian' suggests the very early spread of this word throughout the region.



A selection of durians. (a–c) *Durio zibethinus* cultivars, (d) *D. graveolens*, (e) *D. singaporense*, (f) *D. griffithii*, (g) *D. kutejensis*, (h) *D. oxleyanus*, (i) *D. testudinarius*. (Photo credits: (a–c) yearofthedurian.com; (d, h) S.K. Ganesan; (e–g, i) X.Y. Ng)



The names for durian in various languages of Southeast Asia.
(Image by Louise Neo)



Article

The durians we consume in Singapore are mainly cultivars imported from Peninsular Malaysia. The period of peak harvest in Malaysia usually runs from June to September, with a minor season from December to February. The common durian has been consumed mainly within Southeast Asia historically; however, the trend has changed in recent years and China is now the world's largest consumer, with annual sales there exceeding 500,000 tons. The 'Musang King'/'Mao Shan Wang' cultivar is prized in China and known to fetch high prices. The 'Black Thorn' cultivar is also increasingly favoured. Since 2019, there have been trials to cultivate *Durio zibethinus* in Hainan, South China.

More than 500 *Durio zibethinus* cultivars have been documented worldwide. Registered cultivars in Malaysia are numbered with a 'D' prefix, but the popular ones also have



Examples of popular *Durio zibethinus* cultivars in Singapore.
(Clockwise from top left) 'Musang King' (D197), 'Red Prawn' (D175), 'Golden Phoenix' (D198), 'Sultan' (D24).
(Photo credits: yearofthedurian.com)



Flowers of *Durio zibethinus*. The petals are eaten in curries in Indonesia and East Malaysia. (Photo credit: S.K. Ganesan)

local names. Popular cultivars in Singapore and Peninsular Malaysia include 'Musang King'/'Mao Shan Wang' (D197), 'Sultan' (D24), 'Red Prawn'/'Udang Merah' (D175), 'Golden Phoenix' (D198), 'Tekka'/'Green Bamboo' (D160) and 'Black Thorn' (D200).

The Singapore Botanic Gardens has a diverse collection of 12 durian species. These are: *Durio dulcis*, *D. graveolens*, *D. griffithii*, *D. kinabaluensis*, *D. kutejensis*, *D. lowianus*, *D. macrantha*, *D. macrophyllus*, *D. oxleyanus*, *D. singaporense*, *D. testudinarius* and *D. zibethinus*. Perhaps the most spectacular of these is *Durio graveolens*. There are two large specimens of this species inside the National Orchid Garden. These trees have fruited in the past and have orange fruits with thick, vivid red lipstick-like arils. This species occurs in the wild in the lowland forests of Borneo, Peninsular Malaysia, the Philippines (Palawan), Sumatra and Thailand. It is also sometimes cultivated in villages in these areas. It grows to a big tree reaching 50 m tall with buttresses up to 3 m high. The fruits open on the tree when they are ripe and the seeds fall out. There appears to be more than one form of this species. The form called Marahang or Durian Merah has thick red arils which taste bland, akin to avocado. Other forms have thin yellow, orange or red sweet arils and green, yellow or orange fruits that do not open on the tree, but, like the common durian, open on the ground after falling from the tree. The vernacular names of these sweet forms include Durian Dalit and Durian Ralit.



Different colour forms of *Durio graveolens* from Sabah.
(Photo credits: S.K. Ganesan)



The diversity of aril colours known in *Durio graveolens* in Sabah.
(Photo credit: S.K. Ganesan)

Another interesting durian found in the National Orchid Garden is a medium-sized specimen of *Durio testudinarius*. This tree has flowered in the past and the flowers are borne near the base of the tree. This species is endemic to lowland forests in Borneo, where it is found in Brunei, Sabah and Sarawak. It is also sometimes cultivated in villages in these areas. Trees of this species can grow to about 20 m tall, and the fruits have been described as aromatic. The arils are white to pale yellow and completely cover the seeds. They are eaten fresh and are watery and sweet or sometimes slightly creamy. The taste has also been described as somewhat acidic and more like jackfruit than durian. The Malay vernacular name of this species, Durian Kura-Kura, can be translated to ‘tortoise durian’. This could have arisen because the fruits are borne near the base of the trunk and thus are presumably accessible to tortoises.

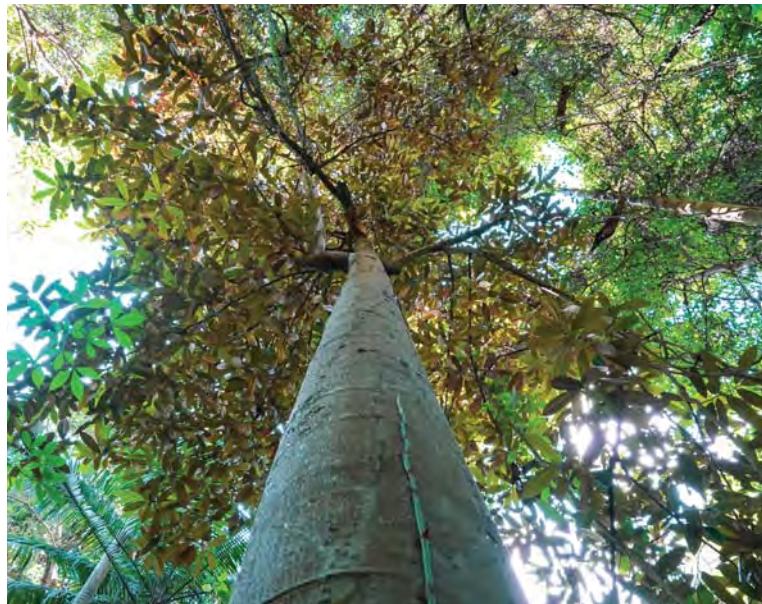


Durio testudinarius. (Left) Flowers borne near the base of a tree in the Gardens, and (right) fruits near the base of a tree in Sabah. (Photo credits: Koh Sin Lan, Chan Chew Lun)

Two durian species occur in the wild in Singapore: *Durio singaporenensis* and *Durio griffithii*. They are restricted to primary forest patches in the Bukit Timah and Central Catchment Nature Reserves. Both species can also be found in the Gardens' living collections, planted at Lawn O near the Bandstand.

Durio singaporenensis grows to a big tree exceeding 40 m high and small thin buttresses are sometimes present. The fruits are borne on the branches and open on the tree. A white leathery aril is found at the base of the seed, to which it adheres when dry. This species is also found in lowland forests in Peninsular Malaysia, and the timber is used for indoor construction. The Malay vernacular name, Durian Daun (= leaf durian), is generically applied to this and other species with arils that are inedible to humans. Another vernacular name for this species, Durian Bujor, can be translated to ‘elongated durian’, and may refer to the oblong leaves.

Durio griffithii is a small or sometimes medium-sized tree, growing up to 30 m tall with small buttresses. It is known to start flowering when only 3 m in height. The flowers are axillary and the fruits open on the



Durio singaporenensis tree in the Central Catchment Nature Reserve. (Photo credit: S.K. Ganesan)



Durio singaporenensis. (Left) A leafy twig and flowers, and (right) a fruit splitting into five parts, all from the Central Catchment Nature Reserve. (Photo credit: X.Y. Ng)



Durio griffithii. (Left) A flower, and (right) a fruit splitting on the tree, both photographed in the Gardens. (Photo credits: S.K. Ganesan, X.Y. Ng)

tree. The aril is thin, orange or red, and covers only the base of the seed. The aril is not palatable; however, the quick maturity of the tree, profuse, attractive flowers, and the small scarlet fruits suggest there is scope for it to be used as an ornamental plant. There are two varieties of this species. *Durio griffithii* var. *griffithii* is native to Borneo, Peninsular Malaysia, Singapore and Sumatra, while *Durio griffithii* var. *acutifolius* is endemic to Borneo. The Malay vernacular name of this species, Durian Tupai, can be translated to ‘squirrel durian’.



Article

Other species of interest are *Durio kinabaluensis* (Durian Tapuloh), *Durio kutejensis* (Durian Luas, Durian Tapis) and *Durio oxleyanus* (Durian Beludu, Durian Sukang). These species all have edible arils.



Durio kinabaluensis. (Top) A fruit with Gunung Kinabalu in the background, (bottom left) cream-coloured arils completely covering the seeds, and (bottom right) leaves and a split fruit showing the five compartments, from Sabah. (Photo credits: S.K. Ganesan)



Durio oxleyanus. (Top) Fruits on sale in a Ranau market, (bottom left) a closer look at the curved spines on the fruit, and (right) an open fruit showing the four segments, all photographed in Sabah. (Photo credits: S.K. Ganesan)



Durio kutejensis. (Top) Distinctly lobed, greenish-yellow fruits from Kalimantan. (Photo credit: Paul Leong) (Bottom left) A yellow fruit from Brunei, and (bottom right) orange arils in a fruit from Brunei. (Photo credits: X.Y. Ng)

More information about the diversity and ethnobotany of the durians can be found in an ongoing exhibition at the Centre for Ethnobotany. Described in the exhibition are the many other ways that the common durian can be eaten, apart from eating the arils fresh – for example, by preserving them or turning them into various products. The exhibition also showcases the durian species native to Singapore and some of the other durians that are used as sources of food, medicine and material by people in Southeast Asia. Other topics covered include pollination and dispersal of durians.

The King of Fruits: Ethnobotany and Diversity of the Durians exhibition will be on at the Centre for Ethnobotany until the end of May 2022. The Centre is open daily from 9 am to 6 pm, except for the last Wednesday of every month. Admission is free, so do stop by on your next visit to the Gardens.

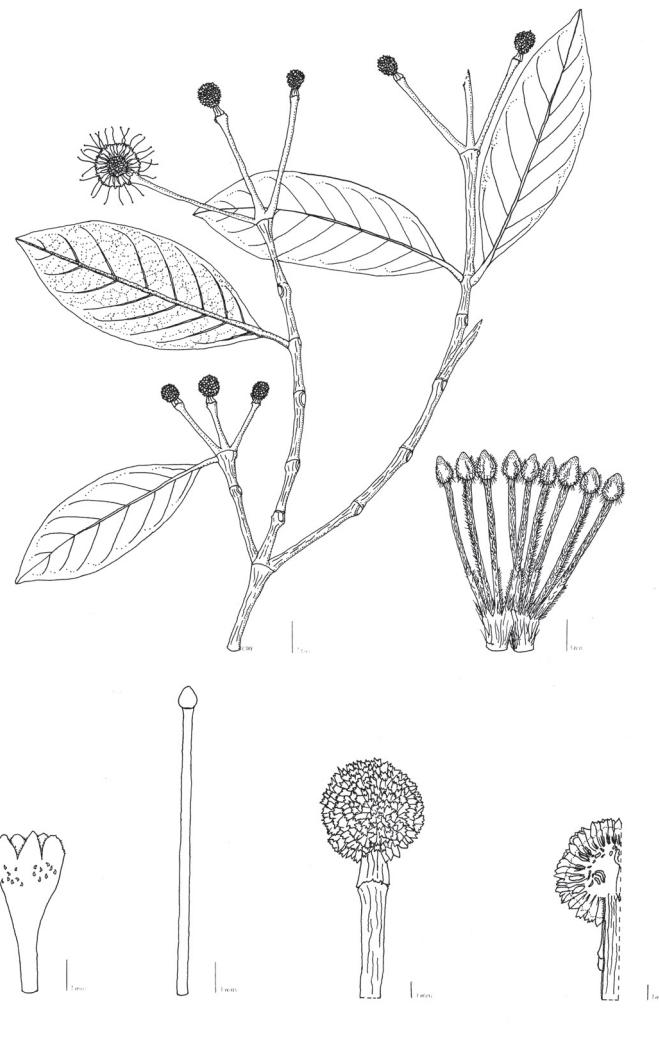
**S.K. Ganesan
Louise Neo
Herbarium**



Endemic species in Singapore

Plants have no concept of borders between countries. Plant species mostly have distributions that long predate the establishment of the nation states in which they occur, and they move naturally to new areas and countries based on the dispersal ability of their seeds or spores and the availability of suitable habitats. Many species do, however, occur within a single country and we then refer to them as being endemic to the country in which they occur. There are several reasons why a species may be endemic to only one country, such as when a species has a very restricted range or because the barriers to dispersal beyond that country are too great. An example of the former could be a species that requires the colder conditions of a mountain top but there are no mountains nearby to disperse to. An example of the latter could be a species growing in a country which is also an island and has seeds that are not adapted to long distance dispersal, such as by birds or wind. In many cases, species are endemic to a single country because the country in question is huge. The species may be very widespread within the country, but it is possible that suitable habitats do not occur beyond the country's borders or occur only so far away that natural dispersal is not possible. For example, countries such as China, the United States, Brazil and South Africa are noted for their large numbers of endemic species.

Singapore, on the other hand, is a rather small country and, despite being an island state, is extremely close to Malaysia and not very far from islands that are part of Indonesia. The forest types found in Singapore are all found in Malaysia and Indonesia and they are within relatively easy dispersal distance for many plant species. Consequently, the vast majority of native plant species found in Singapore are also found in other countries, particularly in Peninsular Malaysia. Nevertheless, as mentioned in volume 57 of *Gardenwise*, the species found in Singapore each constitute a unique element of our natural heritage and each is a vital link in the complex ecological web that



Neonauclea kranjiensis
H.N. Ridley
No. 6511
SING 0231851

Neonauclea kranjiensis, drawn by E. Tay.

forms Singapore's habitats, even though most are not endemic.

What is perhaps surprising is that despite Singapore's small size and proximity to other countries with similar habitats, Singapore does indeed have several species that are endemic and, therefore, known nowhere else in the world. As a result of active exploration and research for the *Flora of Singapore* project, building on the work of those who have come before, we are now aware of 11 species of land plants that are endemic to Singapore. These are the flowering plants *Dendrobium laciniosum* and *Nervilia singaporense* (Orchidaceae), *Hanguana rubinea* and *Hanguana triangulata* (Hanguanaceae),

Neonauclea kranjiensis (Rubiaceae), *Strychnos ridleyi* (Loganiaceae) and *Zingiber singapurense* (Zingiberaceae); the mosses *Splachnobryum temasekensis* (Pottiaceae) and *Ectropothecium singapurense* (Hypnaceae); and the liverworts *Riccardia latifronsoides* (Aneuraceae) and *Gaojeunea hoi* (Lejeuneaceae). *Bolbitis × singaporenensis* was considered to be an endemic species but is now treated as a hybrid, albeit still not known from elsewhere. *Cryptocoryne × timahensis* was described as a hybrid only known from Singapore but has now also been reported from Johor in Malaysia. Of the 11 endemic species, six have been described only within the last 10 years. For species such



Gaolejeunea hoi habit. (Photo credit: Wen Ye)



The flower and leaf of *Nervilia singaporensis*. (Photo credits: Matti Niissalo)

as *Nervilia singaporensis* and the two *Hanguana* species, their recent descriptions as new endemic species arose out of intensive studies of these plants and their relatives both within Singapore and in the wider region, resulting in the conclusion that the plants in Singapore were previously misnamed and were distinct from those in neighbouring countries. For species such as *Zingiber singapurens* and *Gaolejeunea hoi*, their recent descriptions arose out of finding plants in Singapore that had no previous name and when studied were found to be distinct from their relatives elsewhere. *Gaolejeunea hoi* is only the second known species in the genus and the other species is only known from China. These five recently described endemic species in Singapore are all rather rare and have

all been assessed as globally Critically Endangered or Endangered. The sixth recently described endemic species, *Neonauclea kranjiensis*, is unknown in the wild and was described from a single herbarium specimen collected in 1894. It is therefore believed to have been globally extinct even before it was described for the first time.

Neonauclea kranjiensis is one of four endemic plant species in Singapore, the other three being *Dendrobium laciniosum*, *Strychnos ridleyi* and *Riccardia latifrondoides*, that have not been collected or seen for many years and are defined as nationally extinct under the criteria used in Singapore's *Red Data Book*. They are, consequently, also defined as globally extinct. However, we need not lose all hope as more than 100

species once believed to have become extinct in Singapore have since been rediscovered in our forests. The four endemic extinct species have not yet been amongst these, but there is a chance that one day they may be found. In addition, as discussed in volume 54 of *Gardenwise*, Singapore's forests are more thoroughly explored than those of our neighbouring countries. Although this would suggest a lower chance that the extinct species could be refound in Singapore, it does raise the possibility that with further exploration of southern Peninsular Malaysia and nearby parts of Indonesia, these species may be found there instead. They would then, of course, no longer be endemic to Singapore, but they would at least no longer be globally extinct. This possibility is not as far-fetched as it may sound. The species *Spatholobus ridleyi* and *Thunbergia dasychlamys* were previously believed to be endemic to Singapore but are now also recorded from other countries, *Spatholobus ridleyi* even as far away as Thailand. *Riccardia latifrondoides* is an extremely small plant that is easily overlooked and could be found again in Singapore or in neighbouring countries where the mosses and liverworts have been less well collected and studied.

Species that are endemic to a country do not hold much meaning in biological terms as their definition as endemic is tied to the political boundaries of a country, which may or may not coincide with natural barriers. Nevertheless, the presence of endemic species within a country does place a responsibility on that one country to protect the species to prevent global extinction. Species that are believed to have gone extinct in the distant past, such as *Strychnos ridleyi* and *Neonauclea kranjiensis* which have not been seen since the 19th century, are unlikely to be rediscovered, but the National Parks Board is ensuring that Singapore's remaining endemic plant species are protected whilst ongoing research and exploration will lead to a better understanding of Singapore's plant diversity, including its endemic species.

David Middleton
Herbarium



Publications by Gardens' staff in 2021

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Starting edibles from stem cuttings

Many familiar edible plants are raised from seeds. In the last issue of *Gardenwise*, I showed how you can grow Asian greens from seeds. However, seeds may not always be available, and this process also needs patience, time and effort to nurture the seedlings to reach horticultural or physiological maturity so that they can be ready for harvest.

Some edible plants can be multiplied vegetatively. In this article, I share a selection of edible plants that can be propagated from stem cuttings. You can use this as a fun and educational weekend project to familiarise your kids with edible plants and get them to prepare stem cuttings for propagation. Teachers can also adapt the procedures to involve students in projects for school.

You can use recycled clear plastic cups for rooting the stem cuttings. One cup will serve as a container to hold the growing medium, and the clear plastic will allow you to see the development of the roots. Drainage holes must be cut into its base first. A second plastic cup can be placed on top to create a miniature greenhouse. This will help conserve moisture for the cuttings so that they do not wilt as that can impede the rooting process. You will also need to make some small holes in this second plastic cup to allow excessive heat and moisture to escape. Use a soilless growing mix for rooting the cuttings as it will be less likely to become compacted and thereby permit the growth of fine roots. Vermiculite works well for rooting plants such as Mediterranean herbs, and in some cases, perlite can also be mixed in to promote aeration and drainage if required.

The stem cuttings of some of these edible plants can be rooted in water. For readers who wish to incorporate some form of aesthetics into the process, one idea is to display them in nice glass bottles with some water. With this method, they can be used to decorate a windowsill or tabletop while waiting for the roots to develop.



(Left) Stem cuttings can be rooted inside a set of recycled clear plastic cups which will act as a miniature greenhouse to help conserve moisture. In this example, the author has used this setup to root rosemary cuttings. (Right) Holes can be made in both cups by cutting a bit of the plastic from the edge of the base.



Stem cuttings taken from edible plants can be put together to create an aesthetically pleasing arrangement. Some edibles will produce roots in water, and these can be potted up in growing media after they have rooted. Shown here are (clockwise from left): Sweet Potato (*Ipomoea batatas*), variegated Jewels-of-Opar (*Talinum paniculatum*) with Water Leaf (*Talinum triangulare*), Okinawan Spinach (*Gynura bicolor*) and Apple Mint (*Mentha suaveolens*).



Edibles that root easily in either a growing medium or water:



Brazilian Spinach (*Alternanthera sessilis*; pictured left), Okinawan Spinach (*Gynura bicolor*; pictured right), Longevity Spinach (*Gynura procumbens*) and Sambung Nyawa Batik (*Gynura pseudochina* var. *hispida*)



Sweet Potato (*Ipomoea batatas*, pictured left), Waterleaf (*Talinum triangulare*, pictured right) and Jewels-of-Opar (*Talinum paniculatum*)



Herbs such as Basil (*Ocimum basilicum*; Thai Basil pictured left), mints (*Mentha* spp.; Apple Mint pictured centre), Indian Borage (*Coleus amboinicus*; variegated variety pictured right), and Mexican Tarragon (*Tagetes lucida*)

Edibles that have better success rates when rooted in a growing medium:



Cekur Manis (*Sauvopis androgynus*)

When using glass bottles, make sure you do not squeeze too many cuttings into one bottle. Change the water every few days to reduce the incidence of mosquito breeding as well as to reintroduce dissolved oxygen for the cuttings. No fertiliser is needed during the rooting process.

When taking stem cuttings for propagation, avoid trying to root very long stems as water is not efficiently transported up the stems and such cuttings will tend to wilt. Stems that contain three to four nodes constitute an ideal length and remember to cut the stem end just beneath a node. For most species, semi-hardwood cuttings have a

better success rate; these are stems that are still green but not too soft and tender. Tip cuttings that are soft and tender will lose moisture easily and wilt. Whether you are rooting in a growing medium or in water, the bottom part of the stem that will be buried or submerged must be stripped of all leaves; otherwise, they will rot and cause the cuttings to fail. Otherwise remove very large leaves or cut them in half to reduce the rate of transpiration.

During the rooting process, it is vital to situate the cuttings in a cool bright location with filtered or reflected sunlight, or under grow lights, as photosynthesis still needs to take place



Cassava (*Manihot esculenta*); woodier, internodal cuttings tend to have better success rates for this species



Mediterranean herbs such as Rosemary (*Salvia rosmarinus*; pictured), Lavender (*Lavandula spp.*), Sage (*Salvia officinalis*), Oregano and Marjoram (*Origanum spp.*); these root most reliably in vermiculite (according to the author's personal experience)

for root production as well as to prevent etiolation. Avoid a windy location as constant drafts can cause the cuttings to dry out. Once sufficient roots have been produced, the cuttings can be transferred into a pot with a suitable growing medium and gradually hardened off before putting them in their final growing location. They can also be grown hydroponically using a sponge cube or a soilless, granular medium that is fertigated with a nutrient solution.

Wilson Wong
Jurong Lake Gardens

All photos by Dr Wilson Wong



The Golden Gardenia, a garden showstopper!

An impressive medium-sized tree located in the Bukit Timah Core recently joined in the spirit of the holiday season. It produced a profusion of flowers in brilliant shades of ivory, yellow and orange that looked like cheery golden ornaments against its dark green foliage. Known scientifically as *Gardenia tubifera*, this stunner belongs to the Coffee or Ixora family (Rubiaceae). This species is commonly known in Malay as Chempaka Hutan (Forest Champac) and Golden Gardenia in English, the latter name appropriately describing the colour of its blooms! This plant is native to Thailand, Peninsular Malaysia, Singapore, Sumatra and Borneo, and naturally occurs in rainforests and along water streams with sandy soils. In Singapore it is Presumed Nationally Extinct and now only known from cultivated collections.

The genus *Gardenia* is named in honour of the Scottish physician and naturalist Alexander Garden (1730–1791), who spent much of his life collecting and studying the flora and fauna of South Carolina in the United States. The species epithet *tubifera* is Latin for ‘with a trumpet’ and refers to the flowers. According to *Plants of the World Online*, there are currently 164 accepted species under the genus *Gardenia*. Most species are found in the tropical and subtropical regions of Africa, Asia, Madagascar and



The Golden Gardenia strikingly covered in the golden hues of its scented flowers.

the Pacific Islands. Many of the native gardenias from the paleotropics (the floristic kingdom that comprises tropical areas of Africa, Asia and Oceania) produce a diverse array of natural compounds, such as flavonols, flavones and triterpenes, which accumulate on the vegetative and floral buds and may be secreted as yellow to brown droplets of resin. Several species of *Gardenia* have been used in folk medicine in

various countries to treat a variety of ailments.

The Gardens' *Gardenia tubifera* is an evergreen tree about 15 m in height with smooth brown-grey bark. Its leaves are opposite, simple, glossy and leathery, with prominent veins on the underside. The leaf blades are elliptic and measure about 12 to 16 cm long. The flowers are large, tubular and produced singly



The flowers of *Gardenia tubifera* change colour from ivory to golden yellow and finally a brilliant orange as they mature.



A close-up of the attractive flowers.

at the twig tips. They have eight petals and measure around 5 cm in diameter, and the corolla tube is up to 15 cm long. These attractive bisexual flowers are intensely perfumed in the evenings and last six or seven days each. When they open on the first day, they are a beautiful ivory white; on the second day they begin turning golden yellow and finally on the third day they become an intense orange. The fruit is globose in shape, about 4 to 5 cm in diameter, and pale green in colour. When mature, it splits open to reveal several seeds embedded in a bright orange to reddish pulp.

The Golden Gardenia makes for a conversation piece in any garden with its attractive flowers that change colour, produce a lovely fragrance, and appear copiously a few times a year. This striking tree grows best in full sun with minimum competition from the roots of other trees. In heavy shade the flower production will be greatly reduced. The Golden Gardenia also needs a rich, moist but well-draining, acidic soil to thrive.

Keep an eye out for this beautiful tree on your next stroll in the Bukit Timah Core. If you're lucky to see it in full bloom, you will undoubtedly be cheered by the sight and smell of this spectacular Golden Gardenia!

Nura Abdul Karim
Research and Conservation

All photos by
Dr Nura Abdul Karim



Trees of the World 2021



Visitors appreciating the Trees of the World display at Orchid Plaza.

The Singapore Botanic Gardens' Trees of the World 2021 brought together the Gardens, the community and our partners to bring festive cheer to one of Singapore's favourite green spaces and raise funds for our Give to the Gardens programme. More than 200 donors, community groups and members of the public participated, decorating 200 specially selected native trees that were spread across the Gardens. The decorated trees were lit from 7 pm to 12 midnight each day between 4 December 2021 and 2 January 2022.

We saw participation from corporations and individuals that supported sustainability and the Gardens' mission to connect people with plants. A good number of the participants made use of reused or upcycled items for decorating their trees.



Upcycled materials used as decorations.



Decorated trees in the Bukit Timah Core.



The landscape display at the Nassim Gate Visitor Centre made for a nice photo spot.



The Swan Lake gazebo was beautifully transformed by staff of the Gardens.

To extend the Gardens' community engagement efforts, members of the public were invited to decorate trees in the Bukit Timah Core. This proved to be a popular initiative as these trees were fully subscribed within a few days of opening for registration.

Specially designed miniature landscapes were also created by Gardens' staff to link the trees on display and provide a festively decorated route from one end of the Gardens to the other. A photo exhibition was also put up at the Nassim Gate Visitor Centre to give visitors a glimpse of the hard and fun work that went on behind the scenes in putting

up the trees and miniature landscape displays for Trees of the World.

The native trees used for the light up, including *Ardisia elliptica*, *Diospyros buxifolia*, *Garcinia prainiana* and *Neolitsea cassia*, will be planted in nature reserves, parks and gardens across Singapore in support of our OneMillionTrees movement.

The contributions raised from Trees of the World will go to support our research, conservation, education and outreach work. With community support, the Gardens contributes to the conservation of our local and regional

flora, inspires a love for nature and engenders environmental stewardship, helping to create a more sustainable Singapore.

Through the Garden City Fund, NParks' registered charity, projects like Trees of the World help to support our rich natural heritage and vision to become a City in Nature. Visitors can find out more about the Garden City Fund and how they can contribute to the Give to the Gardens programme at gardencityfund.gov.sg.

Jane Tan
Events and Exhibitions



Pen and ink illustrations from the Singapore Botanic Gardens Archives

On view at the Botanical Art Gallery until 3 April 2022, the exhibition *Botanical Lines, Pen and Ink Illustrations from the Singapore Botanic Gardens Archives* showcases a selection of drawings made to illustrate scientific and popular publications in Singapore from the 1920s to the present. These illustrations are usually kept out of sight in the Gardens' archives and only taken out when needed for study. The older drawings dating from the 1920s to the 1960s required curation, which was done starting in 2020. This involved rearranging, rehousing in archival boxes, databasing, and assessing their states of conservation. The curation of these works enabled us to select the most representative drawings for the exhibition which would allow us to show examples of past research at the Gardens and explain the different uses of the illustrations and their production and printing processes.

The early line drawings in the collection were not made by artists but by botanists who made them for their own publications. Murray Ross Henderson, curator of the herbarium (1924–1942) and later acting director (1946–1949) then director (1949–1954) of the Gardens, was a particularly prolific illustrator. His earliest drawings, which are undated but were likely made from the early 1930s, illustrate new species from the Malay Peninsula. His drawings often include two different sets of initials: M.R.H. (Murray Ross Henderson) for the dissections, and M.P.H. (possibly his wife Margaret) for the plant habit. Edred John Henry Corner, assistant director (1929–1942) and subsequently a civil internee at the Gardens until the end



Display of drawings dating from the 1920s to 1960s.



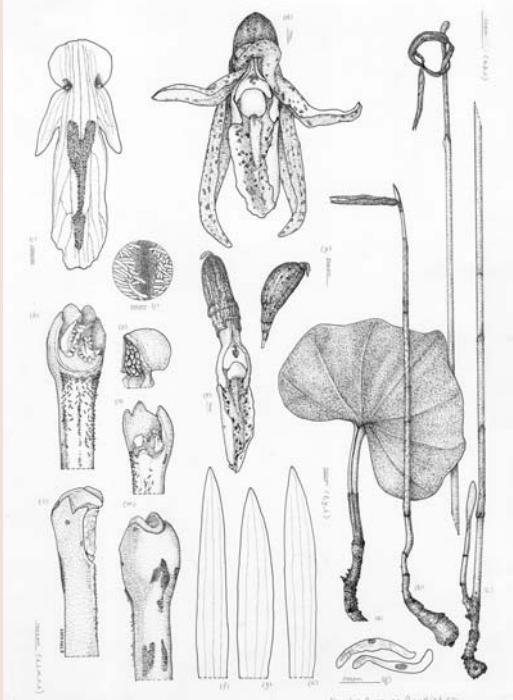
A selection of drawings made by Edred John Henry Corner for his two-volume publication *Wayside Trees of Malaya*.

Illustration of *Heptapleurum ridleyi* (formerly *Schefflera musangensis*) by Murray Ross Henderson and M.P.H (possibly his wife Margaret Henderson), published in 1933 in the *Gardens' Bulletin, Straits Settlements*.

Why it is still necessary to draw plants: the example of *Nervilia singaporensis*

Nervilia singaporensis is a small terrestrial orchid which was first collected by Henry Nicholas Ridley more than a century ago, but identified as a new species only recently when it was collected in flower by researchers from the Gardens. In the wild the specimens have one or few leaves that die when the plant goes dormant, and the small flowers are produced on leafless plants. Therefore, to fully describe and illustrate the plant it was necessary to make observations and take photographs over a period of a few months. The flowers do not naturally open, making observations difficult, and photographs are insufficient for illustration purposes. Digital images of the plant were obtained in the field, and they were used to illustrate the species. A pen and ink illustration was made by Evonne Koh to complement the photographs. This single illustration concisely represents the entire life cycle of the plant, including dissections of the diagnostic features of the flower used for comparison with similar species.

Nervilia singaporensis,
drawing by Evonne Koh.



A showcase with a copy of *Flora of Singapore*, volume 13, published in 2019 (cover image by Waiwai Hove), shown next to the original and the published illustration of *Wrightia laevis* (by Loh Xiang Yun).

of the Japanese Occupation, was also a prolific illustrator. In the Gardens' collection are numerous illustrations of microscopic features of fungi which were published in the 1920s, as well as hundreds of drawings done for his two-volume publication *Wayside Trees of Malaya*, first published in 1940.

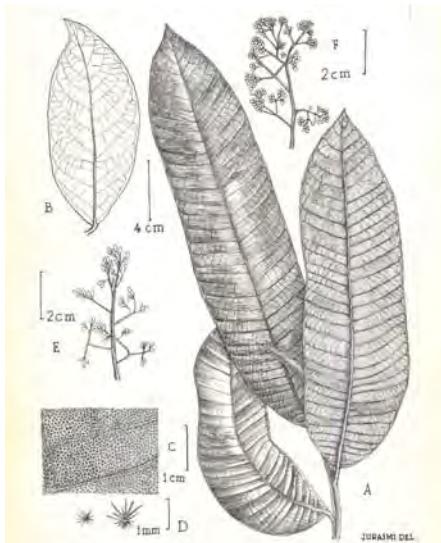
The earliest artist engaged to do line drawings at the Gardens was Chan York Chye. Based on our annual reports he was employed between 1942 and 1945, however the dates on his drawings show that he was active at the Gardens between 1939 and 1947. One of the most prolific artists whose works are in

the collection is Juraimi bin Samsuri, employed by the Gardens from 1942 until his premature death in 1971. He made illustrations for scientific monographs, popular books and a large number of scientific papers.

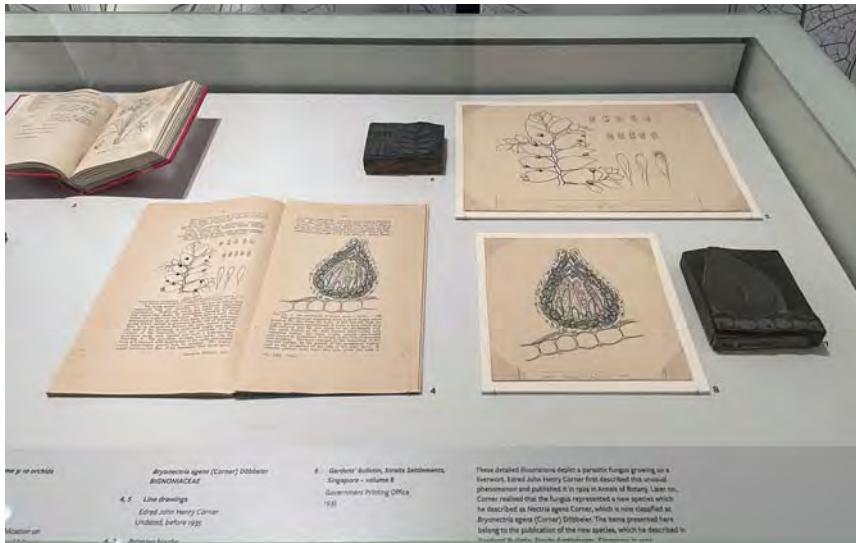
Many publications that in the past were illustrated with line drawings, particularly those aimed at the general public, would now be illustrated using coloured photographs. However, when it comes to the publication of new or rare species, or monographs, line drawings are still very much needed today as they were in the past. Even since photography became widely

available in the 1940s and 1950s, the use of drawings has remained critical as new species are not always described from live flowering material but rather from dry herbarium specimens. Photographs of herbarium specimens can be used for scientific publications; however, shapes of flowers and minute parts are often poorly preserved on specimens or difficult to capture in photographs and therefore need to be drawn.

Since 2012, the production of line drawings in Singapore has been revived and new artists have been engaged and trained by the Gardens' herbarium to do illustrations for scientific papers and the *Flora of Singapore*, a ten-year programme to research, catalogue and describe all plant species found here in the wild. The artists engaged so far are Cheng Puay Koon, Violette Chye, Waiwai Hove, Evonne Koh, Li Dan, Loh Xiang Yun, Debbie Teo and Joseph Joshua Yang. Other artists from overseas institutions have also been engaged in the production of line drawings. The works of these artists have since been added to the Gardens' collection of botanical artworks, including more than 250 new line drawings so far.



Horsfieldia hellwigii var. *pulverulenta*, a drawing by Juraimi bin Samsuri from the 1960s that exemplifies the sharp lines, hatching (used to represent the fine venation on the upper surface of the leaf), and stippling (used to represent the finely hairy lower surface) which characterise line drawings.



A display of original drawings, printing blocks and final publication of a paper by Edred John Henry Corner published in the *Gardens' Bulletin, Straits Settlements* in 1935, describing the new species of fungus *Nectria egens*, now classified as *Bryonectria egens*.

The production and printing of line drawings, past and present

Today, most botanical artists still work with paper and ink to create botanical illustrations using a process of examining, sketching, composing and inking that has changed little in the past century. The process starts with the examination and dissection of the available plant material. In the best-case scenario, the artist has material available that is freshly collected from the field or obtained from a cultivated plant. More often though, the material available for examination is a dry herbarium specimen, and sometimes spirit-preserved specimens. The artist therefore needs to be able to reconstruct the three-dimensional shapes of various plant parts using reference images of similar species, working from experience and through discussion with the botanist who commissioned the drawing. The plant is first sketched in pencil, allowing easy correction to the shape and size of each of the elements, as well as adjustments to the composition.

The artist needs to decide on the composition and degree of magnification of each element of the drawing very early in the process, when the drawing is still a pencil sketch and can be easily modified. Inking is done using a variety of pens of different thicknesses filled with

black archival ink. The plant shapes are represented with sharp, even lines of appropriate thickness, hatching using a series of thin parallel lines that may crosshatch, and stippling using dots of different sizes and densities. Hatching is generally more suitable for simple bold drawings, or for almost flat or gently curving surfaces such as leaves. Hatched lines can also be used to indicate a cut surface. Stippling allows a more delicate transition in tone and is used to render plant parts that are rounded in shape, such as fruits or flower buds. Nowadays, composition can be perfected digitally before final inking. Even inked illustrations can still be scanned and digitally edited if necessary. In the past, changing the composition without the need to make a new drawing was done manually by cutting out the various components and pasting them back together in the desired position.

In contrast to the process of creating botanical illustrations, digital technology has revolutionised the way drawings are prepared for publication. Today, line drawings are scanned at high resolution, digitally edited and easily incorporated into layouts in preparation for print. Until the late 20th century, however, preparing a drawing was only half of the process required to see it in print. During most of the 19th century, scientific publications used lithographic reproduction, often based

on original watercolour paintings or sometimes on pencil drawings, whereas later scientific publications started using photoengraving that enabled the transfer of an image to a printing plate without the need to re-draw it. In photoengraving, the original image is transferred photographically to a metal block coated in a light sensitive layer, scaled up or down as needed, then the nonimage areas are dissolved in an acidic etching bath so that the illustration can be printed in relief. The printing blocks were proofed and if necessary modified before the final print run. The scientific manuscript (generally typewritten) was set together with the images and printed concurrently. A final set of proofs including both images and text was checked once again before printing.

While the 21st century will no doubt bring new technologies that enable botanists to study plants from new perspectives, the deceptively simple botanical illustration retains its role as an analytical tool that provides an alternative and complementary way of 'seeing' a plant. It is concise, transcends language barriers, and is aesthetically pleasing as well.

Michele Rodda
Herbarium & Botanical Art Gallery

All images by Dr Michele Rodda



Spotlight on the Gardens' recently named hybrids

Papilionanthe SG Women

Parentage: *Papilionanthe Seletar Red Diamond* × *Papilionanthe Adina*



This orchid was created by the Gardens in celebration of the continued progress, contributions and achievements of all SG Women. It was named in a ceremony officiated by President Halimah Yacob at the Istana on International Women's Day on 8 March 2021. Its inflorescences are about 30 cm long and bear three to six flowers, each about 7 cm across. The petals and dorsal sepals are mauve, the lateral sepals are white with

pale mauve, and the lip is scarlet-purple with an orange-yellow throat streaked with red veins.



Dendrobium Expo 2020 Dubai

Parentage: *Dendrobium Peter Furniss* × *Dendrobium Lim Tee Hooi*



This orchid was created by the Gardens in honour of Expo 2020 Dubai and to commemorate Singapore Day at Expo 2020 Dubai on 22 January 2022. Its inflorescences are up to 50 cm in length with 10 to 23 flowers, each around 5 cm in width. The sepals and petals are golden yellow, and the lip is earth-toned and lined with light purple veins.

Dendrobium Ismail Sabri Yaakob

Parentage: *Dendrobium Singapore Blue Antler* × *Dendrobium Singa Friendship*



This orchid was named after His Excellency Dato' Sri Ismail Sabri Yaakob, Prime Minister of Malaysia, on 29 November 2021. Its inflorescences are up to 50 cm in length with 25 to 35 well-arranged flowers, each approximately 5 cm in width. The sepals are light greenish cream and adorned with purple striations, while the gracefully twisted petals and lip are coloured a brilliant lavender blue that beautifully complements the sepals.



Papilionanda Kamala Harris

Parentage: *Vanda Kulwadee Fragrance* × *Papilionanthe hookeriana*



This orchid was named after Kamala D. Harris, Vice President of the United States of America, on 23 August 2021. Its inflorescences are about 40 cm long and bear up to 15 well-arranged flowers, each about 8 cm in width. The sepals and petals are pinkish purple and adorned with prominent purple spots and tessellations. They are complemented by a magenta lip.

Whang Lay Keng

National Orchid Garden



Banks' Florilegium

London: Alecto Historical Editions, published in association with the British Museum (Natural History)

Published between 1980 and 1990, Banks' *Florilegium* is a wonderful collection of 738 printed illustrations of plants from Australia, Brazil, Java, Madeira, New Zealand, the Society Islands and Tierra del Fuego. Its production was conceived more than 200 years earlier when the plants were documented and collected as part of Captain James Cook's 1768–1771 expedition to the South Pacific Ocean aboard the HMS Endeavour. During the trip, illustrator Sydney Parkinson made hundreds of drawings of plants and animals as they were collected by scientists Joseph Banks and Daniel Solander, including many that were new to science at the time.

After returning to England, Banks intended to publish a major work with illustrations of the plants collected and employed 18 engravers who worked for 13 years on the production of copper-engraved plates based on Parkinson's drawings. Unfortunately, they were never published during Banks' lifetime. A selection of 315 illustrations of Australian plants were printed as lithographic reproductions by the British Museum (Natural History) between 1900 and 1905, and the Gardens' library has two sets of this publication.



Dillenia alata, collected along the Endeavour River in Australia, is from New Guinea and tropical northeastern Queensland. It is now widely cultivated and also found in local gardens.



Banksia serrata, one of the species collected in Botany Bay, Australia, and one of the most iconic and complex illustrations published in Banks' *Florilegium*.

A selection of 30 original copper plates were printed in 1973 and published with the title *Captain Cook's Florilegium*. The illustrations of both publications were printed in black ink, most likely as originally intended by Banks because the engravings are extremely detailed.

The illustrations published in Banks' *Florilegium* were made using for the first time all the original 738 copper plates which were printed using a very unusual colour printing technique called *à la poupee*. Individual colours are first applied to the plate with a twist of cloth (called the *poupee*). When all the colours have been applied, the non-print area of the plate is wiped clean, and the plate can be manually printed on a sheet of dampened paper using a printing press. The majority of the copies printed were subscribed by institutions or private collectors and it is now a very scarce and valuable publication. A complete set of Banks' *Florilegium* was generously donated to the Gardens' library in 2019 by Mr Tan Jiew Hoe, President of the Singapore Gardening Society.

Michele Rodda
Herbarium & Botanical Art Gallery