

Gardenwise



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The attractive flowers of *Bulbophyllum dearei*, an orchid that recently flowered in the National Orchid Garden's Cool House.
(Photo credit: David Lim)

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"The Treasure Box" by Inch Lim, one of the Best of Show winners at the 2016 Singapore Garden Festival.
(Photo credit: NParks)

Editors

Ada Davis, Nigel P. Taylor

Production Managers

Ada Davis, Christina Soh

Design

Newmen LLC
www.newmen.info

Singapore Botanic Gardens

1 Cluny Road, Singapore 259569
National Parks Board

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

Group Direction



Dear Readers, the content in this issue of *Gardenwise* gives us a very good summary of the kinds of activity that characterise the day-to-day work of the Singapore Botanic Gardens. We learn about botanical research that has revealed the true identity of one of our largest Heritage Trees (pages 2–3), a hitherto unidentified rare nutmeg in our Rain Forest (pages 9–11) and news about the ways plants have been classified into families (pages 21–23); how we cultivate rare, endangered and iconic species, such as the Seychelles’ Double Coconut, often in partnership with others (pages 4–8 & 34–36); the Gardens’ horticultural and other heritage interest, including the greening of Singapore (pages 12–13, 18–20, 26–27 & back cover); and our ever-growing networks of international collaboration, both on- and off-site (pages 24–25, 30–31, 37 & 41). On the horticultural side we feature two articles on choice and sometimes little-known orchids, from the plant family that will always be associated with the Gardens (pages 14–17 & 38–39). Plants and gardens are also important stimuli for cultural activity, such as the imagery and

poetry that our young visitors created at the Gardens as part of the 2016 National Poetry Festival (pages 28–29). And the Gardens’ influence overseas apparently knows no limits, as reported on pages 32–33, but with an interesting twist that I can mention here. That visit to Miyazaki Prefecture, Japan in March this year revealed a surprising fact, just as our ‘plane was coming in to land at the international airport serving Miyazaki. As the aircraft descended I opened the in-flight magazine and discovered that the approaching airport was named “Bougainvillea” and after collecting our luggage we saw the mass plantings of this colourful genus outside the terminal building. So where did these plants, giving the airport its name, originally come from? Answer: the Singapore Botanic Gardens, from the late 1960s!

But the biggest area of international networking is none of the things already mentioned. The image above shows the Best of Show Landscape Garden designed by Malaysian Inch Lim for the international Singapore Garden Festival, 2016, which ran between 23 and 31 July.

This was the largest event we have ever attempted and it attracted a staggering 470,000+ visitors over the nine days of the show, staged once again at Gardens by the Bay, where it covered nearly 10 hectares! Upwards of 80 different horticultural and floral installations made up the show, including the Orchid Society of South East Asia’s competitive exhibits in the Flower Dome, where the Singapore Botanic Gardens won many of the prizes, up against international as well as strong local competition. I would like to thank the Botanic Gardens’ show director, Dennis Lim, plus everyone else in the NParks and Gardens by the Bay teams, and our many volunteers, who made the 2016 Festival such a resounding success, not forgetting either the many readers of this magazine that visited the show.

Nigel P. Taylor
Group Director
Singapore Botanic Gardens

Mysterious identity of a more than 90-year-old Silk Tree illuminated

It all started when a tourist from faraway wrote in to us, wondering about the identity of an elegant and majestic tree he encountered on Lawn E during a visit to the Gardens. The tree in question is a Heritage Tree then labelled as *Albizia lebbekoides*, a species that naturally occurs in lowland monsoon forests in Southeast Asia. The visitor's enquiry prompted us to take a closer look at the name that had been recorded for the tree, which had likely been attached to it when it arrived here as a seed from India more than 90 years ago. We compared the characteristics of the leaves with the available descriptions of *A. lebbekoides* from literature and immediately realised that its identity was dubious. While we were aware that the tree definitely could not be this species, we also knew that we would have to wait for flowering material to ascertain its true identity.

The tree flowered a few months later, and specimens were collected by our arboriculture team. Our careful examination of the flowers revealed numerous cream-coloured stamens united at the base, forming a tube. This characteristic, together with the straight flat seed pods found on the ground from

the tree's last fruiting, clearly point it to the genus *Albizia*, a group of trees known generally as silk trees. However, after carefully checking through various taxonomic treatments by the late Danish botanist Ivan C. Nielsen (1946–2007), who specialised in mimosoid legumes, especially of Asia, it struck us that this tree did not match any of the descriptions of *Albizia* native to our region. We recognised that we would have to expand our search to consider species from outside of Asia.

Consulting literature on the *Albizia* of Africa and tropical America, we found a good match with a tree bearing the name *Albizia niopoides*. Published illustrations of this species also matched very well with our specimen. However, since the SING Herbarium has only a small collection of *Albizia* specimens from outside of Asia, and these have been little curated by specialists, we needed some external help. Consequently, we sent a specimen of our tree to Dr Gwilym P. Lewis, an expert in legumes from the Royal Botanic Gardens, Kew, who confirmed that our Heritage Tree is *Albizia niopoides* var. *niopoides*, commonly known as the Caribbean Silk Tree.



The *Albizia* Heritage Tree standing at Lawn E is a Caribbean Silk Tree (*Albizia niopoides* var. *niopoides*) towering more than 40 m tall. (Photo credit: Ho Boon Chuan)

Selected features	The Gardens' Heritage Tree	<i>Albizia lebbekoides</i>	<i>Albizia niopoides</i> var. <i>niopoides</i>
Tree height / diameter at breast height	more than 40 m / 170 cm	to 32 m / 58 cm	to 25–40 m / 35–120(–150) cm
Number of pinnae per leaf	(5–)6–7 pairs	(2–)3–4(–7) pairs	(4–)6–8(–9) pairs
Number of leaflets per pinna	(25–)35–51 pairs	(5–)10–25 pairs	28–57(–63) pairs
Presence of rachis glands between pinna pairs	(0–)1–2 between distal pinna pairs	2–3 between distal pinna pairs	sometimes 1–2 between distal pinna pairs
Shape of leaflets	linear or linear-lanceolate from a bluntly auriculate base	asymmetrically (elliptic-) oblong, lanceolate or subfalcate	linear or linear-lanceolate from a bluntly auriculate base
Length and width of leaflets	7 mm by 1 mm	7–20(–27) mm by 2.5–6(–14) mm	5–8.5 mm by 0.9–1.3 mm
Presence of rachilla glands on pinna-rachises	occasionally 1 between terminal pairs of leaflets	1 each between 6–7 distal pairs of leaflets	occasionally 1 between terminal pairs of leaflets

Table comparing selected features of the Gardens' *Albizia* with those of *Albizia lebbekoides* and *Albizia niopoides* var. *niopoides*. It is clear that many characteristics of the Heritage Tree are in conflict with those of *Albizia lebbekoides*, but fall within the variation range of *Albizia niopoides* var. *niopoides*, although our specimen is unusually large for the species.

The semi-deciduous *Albizia niopoides* var. *niopoides* has a wide natural distribution from southern Mexico through Central America and the Caribbean to the northern half of South America. From the northern parts of its native range, this tree was also formerly known as *Albizia caribaea*. The many pinnae and numerous crowded narrow leaflets give the leaves a distinguishing fern-like appearance. The other variety, *A. niopoides* var. *colombiana*, is naturally occurring in a limited area around northern Colombia and northwest Venezuela. It is distinguished from the typical variety by its larger leaflets (8.5–13 mm long by 1.5–2.5 mm wide), which are also more distantly spaced, and by its almost black seed pods that are covered with a frostlike powdery secretion. In contrast, the seed pods of *A. niopoides* var. *niopoides* are typically straw brown to chocolate brown at maturity without any frostlike powdery covering.

Literature has reported that *A. niopoides* var. *niopoides* can grow to 40 m tall (but is often shorter), and has a straight bole with a pale grey or yellowish bark that peels off, revealing concentric scars beneath. These trunk features are seen in our Heritage Tree, but our towering specimen, which is more than 40 m tall, must be a record holder for the species, as its height certainly exceeds what has been recorded.

The Caribbean Silk Tree is known to have been introduced in cultivation to places across the Atlantic Ocean, including Nigeria, Mauritius, the Mascarene Islands and India. The species probably arrived early in Madagascar and was brought from there to the Royal Botanic Garden



Dried seed pods that were collected from the ground just below the tree; (top) an unopened pod and (centre and bottom) opened pods with seeds exposed. The sharp but narrow ‘wing’ along both margins of the seed pod is a distinguishing characteristic. (Photo credit: Ho Boon Chuan)



The smooth, pale grey tree bark peels off, revealing concentric scars beneath.

(Photo credit: Ho Boon Chuan)

in Calcutta in 1841. Interestingly, in 1906, *Albizia richardiana* was described based on cultivated material grown in Calcutta from seeds originating from Madagascar and erroneously assumed to be native to that island. It was later shown in 1992 that *A. richardiana* is synonymous with *A. niopoides* var. *niopoides*. From our records, we know that the Gardens’ Heritage Tree came to Singapore in May 1925 as a seed from Darjeeling, India. It was planted at its present location near Swan Lake after being germinated and nurtured into a sapling in the Gardens’ nursery for four years.

Since learning how to better distinguish members of the genus *Albizia*, we have discovered that two Javan specimens deposited in our herbarium are also *A. niopoides* var. *niopoides*. These were collected in 1941 and 1956 from cultivated plants in the Bogor Botanical Gardens, Java, Indonesia. According to their herbarium labels, one specimen came from a tree that had been received from Gabon in Sub-Saharan Africa, whereas the other had been forwarded through the Royal Botanic Garden in Calcutta and was noted as being indigenous to “British India”. We have also been informed that Kew Gardens has cultivated specimens of *A. niopoides* var. *niopoides* that originated from Bogor and Calcutta, and hence it is no surprise that it is present in our Gardens, given the past exchanges of experimental plants between the two institutions. It is also worth noting that the true *Albizia lebbekoides* has existed



A seed pod, flowers and leaf-bearing twig from the Gardens’ Heritage Tree. The leaves consist of five to seven pairs of pinnae, with each pinnae bearing up to about 50 pairs of neatly arranged narrow leaflets.

(Photo credit: Paul Leong)

in the Gardens in the past, according to a specimen deposited in our herbarium.

The Caribbean Silk Tree is a multipurpose tree. The large crown provides substantial shade, as we have witnessed in our Heritage Tree. It has a beautiful, majestic habit that makes it a good ornamental tree, although it is not commonly cultivated in this part of the world. It is sometimes harvested for its timber, which is moderately easy to work with and polishes well, and thus is suitable for making furniture and floors. It has been reported that some indigenous people in South America have used the boiled bark of this tree to treat and soothe scorpion stings.

It is incredible that it has taken nearly a century for the true identity of our Heritage Tree to be revealed. It is true that “every dog has its day”, and we certainly count ourselves lucky to have been in the right place, at the right time, to take part in this discovery. We are especially grateful for the expertise and kind assistance of Dr Gwilym P. Lewis in helping to confirm that our Heritage Tree is *Albizia niopoides* var. *niopoides*. We are very glad that this mystery is finally solved.

Ho Boon Chuan
Herbarium

Gwee Aik Teck
Plant Records

The Double Coconut: Threatened wonder of the botanical world

For centuries, seeds of the Double Coconut or Coco De Mer (*Lodoicea maldivica*) were found all around the Indian Ocean, but nobody knew their source (they were believed to grow on a tree on the bottom of the ocean!) and, found only rarely, the nuts became very valuable possessions. Those collected from the shores of the Maldives became by right the property of the kings of those islands, and people hiding them could be put to death. In the 1890s it was considered the only Seychelles palm impossible to cultivate at the Royal Botanic Gardens, Kew. It has thus long been considered a triumph of botanic gardens if they manage to grow and conserve this species *ex situ*.

A brief natural history

To successfully cultivate any plant, it helps to understand both its habitat and adaptive features. The case of the Double Coconut is particularly interesting and it is worth looking at recent studies of this palm's ecology in order to improve our ability to cultivate it at the Gardens.

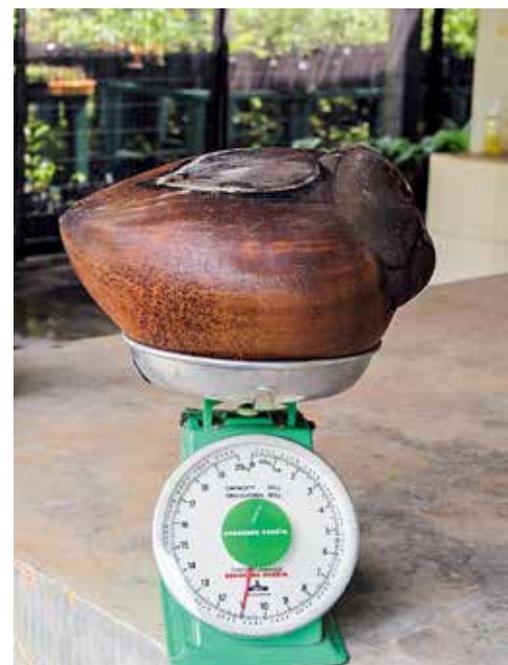
Lodoicea is a monotypic genus, with *L. maldivica* being the only species in the genus. It is also one of six genera of palms endemic to the Seychelles. They are found only there, in that isolated archipelago in the western Indian Ocean. These predominantly granitic islands are situated almost 1000 km to the north of Madagascar, 1600 km from East Africa and Mauritius and about 1800 km southwest of Sri Lanka. Within the Seychelles, *L. maldivica* occurs only on two islands, Praslin and Curieuse. The largest population is found on Praslin Island, and the best place to see it there is in the Vallée de Mai, where it is the dominant species. The Vallée de Mai is a reserve of around 20 ha extent, and was inscribed as a World Heritage Site by UNESCO in 1983.



Lodoicea maldivica in habitat in the Vallée de Mai, growing on granite bedrock.
(Photo credit: Peter Edwards)



The female inflorescence produces the largest flowers of any palm. (Photo credit: Aung Thame)



Fruit of the Double Coconut.
(Photo credit: Aung Thame)

Lodoicea is classified within the subfamily Coryphoideae of the Areaceae (the Palm family). Its nearest relatives are thought to be the Mascarene genus *Latania*, and the genera *Borassus* (e.g., *B. flabellifer*, the Toddy Palm) and *Borassodendron* (e.g., *B. machadonis*, Machado's Palm), both of which also occur in Southeast Asia. *L. maldivica* is dioecious, which means that male and female reproductive organs are borne on separate plants. Unless DNA sampling is employed, one cannot tell whether a young plant is male or female until it reaches reproductive age.

The granitic islands of the Seychelles owe their origins to the break-up of Gondwanaland during the Jurassic period. This makes them the oldest oceanic islands in the world. The soils are derived from this highly weathered granite, resulting in one of the most nutrient-deprived habitats on earth. Yet, surprisingly, the Double Coconut holds several world records: it produces the heaviest fruit of any palm (up to 45 kg), the heaviest seed in the entire plant kingdom (up to 22 kg), and the largest female flowers of all palms. Equally impressive are the large catkin-like inflorescences produced by the male plants which yield copious amounts of pollen. But some might wonder how a plant which evolved on such poor soils can afford to invest so heavily into reproduction.

Scientists who have studied the Double Coconut have discovered that the palm has evolved a very intricate method of

nutrient recycling. Each of the huge fan-shaped leaves contributes to a funnel system that intercepts all sorts of organic material (such as pollen, bird droppings or leaf litter), which is flushed to the base of the trunk when it rains. The soil immediately around the trunk is thus comparatively richer in nutrients than its surroundings. In addition, as each new leaf is formed, the oldest leaf in the crown dies, and from this dying leaf, nutrients are withdrawn to the younger leaves, so that the net nutrient costs of producing the new leaf are actually quite low. While all palms transport nutrients from the oldest to the younger leaves, this appears to be remarkably thorough in the case of the Double Coconut, leaving the oldest leaf about as nutrient rich as cardboard.

But why does the Double Coconut produce such huge seeds? There are two hypotheses which may help to explain:

- *The sibling competition hypothesis.* During the Gondwana break-up, an ancestral palm would have remained on what was to become the Seychelles. Over time, this palm lost any means of dispersal, so that its seeds would simply fall to the foot of the parent plant. This would have resulted in competition between sibling seedlings, with those with the bigger seed (having larger reserves) prevailing. This may have led to the palm investing more resources into producing fewer, but larger seeds.

- *The shade hypothesis.* Within the humid and shady conditions of the closed forests in which this palm evolved, only those seedlings that quickly grew tall enough to reach the brighter canopy would have been able to survive. At the same time, the tallest-growing seedlings would also have been those with the largest nutritional reserves. In fact, because of the large food reserves in the seed, even the first leaf of a germinating plant can reach a petiole length of 1.5 m, and within just a few years, can extend to 10 m. In contrast, it would take several decades for the plant to produce a trunk of the same height. The incredibly long petioles, with their ability to lift the huge leaves high up into the canopy and enable the juvenile plants to out-compete other species for light, undoubtedly contributed to this palm becoming the dominant species in its habitat.

So how does the pollen from the male plant reach the female plant in order to produce the huge seed? We do not yet know exactly how this happens, but in many dioecious species, successful pollen transfer from male to female plants depends on wind or insects. The structure and other characteristics of the flowers and pollen can help to indicate the means by which pollen transfer is likely to occur. In the case of the Double Coconut, the pollen is sticky, and male and female flowers exude a characteristic scent. These are good indicators of pollination by animals, yet so far no



The Double Coconut seed, the heaviest in the plant kingdom.

(Photo credit: Felix Merklinger)



The male catkin-like inflorescence with numerous small yellow flowers.

(Photo credit: Aung Thame)



The typically huge fan leaves of the Double Coconut are displayed on a juvenile plant behind Holttum Hall. (Photo credit: Felix Merklinger)



Beetle damage on the petiole of a Lodoicea leaf. (Photo credit: Felix Merklinger)

study has conclusively demonstrated a specific pollinator. Various animal vectors, including flies, bees and even geckoes have been proposed, and wind has also not been ruled out. A Seychelles legend suggests that during stormy nights, the male trees become mobile and walk to the waiting females; however, witnessing such an event results in the death of the onlooker. In any case, conclusive evidence remains to be seen!

The Double Coconut in the Gardens

Lodoicea maldivica has been introduced to the Gardens on several occasions. We first find mention of it in the annual report for the year 1875, where James Murton lists it as one of the plants cultivated here. Over the years, more plants found their way to the Gardens, where it appears that this species was cultivated at various locations. The *Illustrated Guide* to the Gardens from 1927 shows a picture of a juvenile growing on the banks of Swan Lake – judging by its size (not yet with trunk), it would probably have been planted around the turn of the century. The annual report from 1956 mentions a plant behind Holttum Hall that had been destroyed by the Red Palm Weevil (*Rhynchophorus ferrugineus*), also known as the Red Stripe Weevil,

and another specimen near the Cluny Road entrance which unfortunately succumbed to the falling branches of a nearby tree. Fortunately, four seeds had been obtained from the Seychelles and were planted in Palm Valley in 1955. In the annual report for 1963, H. M. Burkill (director of the Gardens from 1957 to 1969) stated that “The gardens have for many years been trying to establish plants of the Seychelles Double-Coconut ... but have been unsuccessful, the plants succumbing to attack by the Red Stripe Weevil”.

On 9 March 2016, one of the most iconic plants of the Gardens, a mature female Double Coconut, succumbed to disease. Efforts to nurse the plant back to health failed, but with the help of our partners from the Agri-Food and Veterinary Authority of Singapore (AVA), we could at least identify the cause of death – primary attack by the Red Palm Weevil and Rhinoceros Beetle (*Oryctes rhinoceros*), with a secondary infestation of a *Fusarium* fungal disease.

Given the additions and losses of Double Coconut plants in our collection over the years, it is difficult to be certain when the recently deceased female was planted. The adult male in Palm Valley, however, appears to be one of the four seeds planted there in 1955. Together,



A receptive female flower, as indicated by the droplet of nectar. In the Gardens, our Double Coconuts are pollinated manually – once a female flower is receptive, pollen is transferred from a male flower using a paintbrush. If the pollination is successful, the ovary will swell and the fruit will develop.

(Photo credit: Aung Thame)

this couple is responsible for all other offspring currently growing in the Gardens – one young seedling in Palm Valley and four juvenile plants on Lawn D, which is located behind Holttum Hall. Fortunately we also have 11 seeds that were produced by the female plant before it died. Once sown, they will take between six months and three years to germinate. If successful, they will be important additions to our palm collection.



A Red Palm Weevil (left) and Rhinoceros Beetle (right), the two major insect pests of *Lodoicea maldivica* in the Gardens.

(Photo credits: Edmund Chia and Felix Merklinger)

Horticultural notes

Horticulturists engaged in possibilities for conserving and keeping rare plants – such as the Double Coconut – are always on the look-out for better approaches to maintain breeding populations of these species. Here at the Gardens, our efforts are no less. Based on our current understanding of *Lodoicea maldivica*, here and elsewhere, we can make some relevant horticultural points:

Insect pests

In cultivation in the wet tropics of Southeast Asia, there are two major insect pests of *Lodoicea maldivica*, the Red Palm Weevil and Rhinoceros Beetle. The two beetles differ fundamentally in the damage they do – while the adults of the Rhinoceros Beetle feed on the leaves, the larvae of the Red Palm Weevil destroy the palm heart, resulting in plant death. But a palm wounded by Rhinoceros Beetles may also become more susceptible to attack by Red Palm Weevils, which are attracted to the scent of the damaged palm. While direct losses resulting from infestation are fairly uncommon, at least in the case of the Rhinoceros Beetle, the greater danger is the spread of infectious diseases and secondary fungal attacks. Some of these diseases show confusing symptoms and may be detected only by laboratory tests – usually when it is too late to save the palm. Because we usually do not see any symptoms of attack by Red Palm

Weevils until it is too late, we try to manage this pest by taking preventative measures against infestation. Thus, we are employing pheromone traps around the Gardens which attract and trap both species of beetle. Susceptible palms are also treated with an insecticide at suitable intervals.

Fertilisation

Interestingly, in its natural habitat, *Lodoicea maldivica* seems to experience little to no insect damage. This has been attributed to the low nutrient content of the leaves in the plant's natural habitat, presumably resulting from the poor soils there. In contrast, the Gardens' specimens are growing in richer soils, with a balanced, slow-release fertiliser applied regularly. These conditions may result in greater uptake of nutrients, in turn leading to a higher rate of attack by insects. Hence, we are currently working with AVA to test the nutrient content of our cultivated plants, and depending on these results, we may need to adapt our fertilising regime to indirectly deter these pests.

Botanic garden collaboration

Growing and reproducing important flagship species for *ex situ* conservation often requires a good collaborative network between botanical institutions. In the past, we have provided pollen and seeds of *Lodoicea maldivica* to institutions like Bogor Botanical Gardens in Indonesia, Kew Gardens in the UK, and Gardens by the Bay

here in Singapore. This exchange of living material can help to maintain genetic diversity, and the sharing of horticultural techniques will help to increase our success in growing this species.

Germination of seeds

Many Coryphoid palms, including *Lodoicea maldivica*, germinate remotely, which directly impacts the cultivation of these species. In remote germination, a cotyledonary axis (called the “petiole”) emerges and grows downward into the soil (deeply so in palms like *Lodoicea*, *Bismarckia* and *Borassus*). A swelling is produced at the apex of the cotyledonary axis, and from this swelling the first seedling root (radicle) and seedling shoot (plumule) emerge. The radicle persists for some time and produces lateral roots. The reserves in the seed have to last through its early development, until the seedling leaf can start to photosynthesise for the young plant. All of this is kept in mind when deciding where to sow one of these seeds; once planted, we know that it cannot easily be moved later – when cutting the radicle would mean killing the plant! Also aware that the cotyledonary petiole can extend very far from where the seed is planted (i.e., the shoot might emerge from a totally different place than intended), we encourage the developing root to stay near where the seed is sown by loosening the soil in the planting hole (thereby creating a place of ‘least resistance’ for it to grow within).



Planting a Double Coconut seed in Palm Valley (above), and the germinated seed one year later (below). (Photo credits: Felix Merklinger)



In remote germination of palm seeds, the cotyledonary petiole has a swelling at its apex, from which the plumule and radicle will emerge.

(Photo credit: Felix Merklinger)

In November 2014, we sowed a seed of *Lodoicea maldivica* in Palm Valley. This seed germinated within one year, and by November 2015, its first leaf had begun to emerge. For the successful germination, we first carefully selected the planting location – near the seed’s male parent in Palm Valley. The planting pit was prepared by digging a square hole about 1 m wide and 1 m deep. The hole was then re-filled with the same soil, but slightly compacted to prevent the seed from sinking too deeply. The seed was half-buried so

that the top half was still visible and the planting pit was covered in leaf litter. Lastly, a shelter was erected around the seed to prevent it from being stolen (this seed is extremely valuable and sadly traded on the black market for alleged aphrodisiac properties) and to protect it from hungry squirrels.

It takes Double Coconut seedlings 15 to 40 years to reach sexual maturity. Even at that point the plant is still considered juvenile. In habitat, the life span of a Double Coconut has been

estimated at 200 to 300 years; ideally, in a garden, this life expectancy should be surpassed. As with many plants that we grow at the Gardens, we must therefore think on a longer time scale when planting and caring for them. Our job is to make sure these rare and most remarkable plants survive for generations to come.

Felix Merklinger
Horticulture & Operations



A rare nutmeg finally reveals itself in the Gardens' Rain Forest

A close-up image of fruits dangling from the tree in the Rain Forest.

(Photo credit: Paul Athen)

The Gardens' Rain Forest is one of the last remaining patches of primary old-growth forest in Singapore. Despite the many land developments that have happened around the island, it has stood the test of time and remains largely preserved from when it was part of a much larger patch of primary rainforest that once covered most of primeval Singapore. Previously known as the Gardens' Jungle, the Rain Forest is small, only about 6 hectares in size. A heavily studied site since Ridley's time as the first director of the Gardens (1888–1912), it has been a haven for many a botanist looking to discover its secrets, and the recent discovery of a rare nutmeg in its midst is but the latest surprise it has yielded.

Making the discovery

On 4 February 2016, a team of herbarium staff went to the Rain Forest along the part of the boardwalk that was once Liane Road, in search of a tree whose fruits had been brought to the SING Herbarium for identification. However, our original

target was forgotten when we chanced upon a certain tree with monopodial branching, flowering and fruiting some 12 m above us. It was about 14 m tall with a trunk diameter of 40 cm. We found the tree just a couple of metres from the edge of the boardwalk and about a hundred metres from the entry point into the Rain Forest next to the landmark *Terminalia subspatulata* dedicated to Lady McNeice. From the fruits and leaves that had dropped to the ground around the tree, and with the aid of a pair of binoculars to view the inflorescences and fruits dangling from the canopy, we were able to quickly establish that it was a member of the nutmeg family, Myristicaceae. However, it wasn't any of the more common species from that family that we were familiar with and therefore we weren't able to identify it on sight. So we collected some of the leaves and fruits that had dropped to the floor of the forest, and returned to the SING Herbarium to look into it further. While we were certain that it was in the family Myristicaceae, the way the fruits were bunched together was reminiscent of *Canarium*, a genus of trees belonging to

the family Burseraceae. We had a hunch that it could be *Endocomia canarioides* (named for its *Canarium*-like bunches of fruits), a rare and Critically Endangered species of Singapore's forests. In recent times, only two trees of this species have been found – one in 2006 and another in 2009, both in the Bukit Timah Nature Reserve. They were encountered during surveys conducted by the Center of Tropical Forest Science of the Smithsonian Tropical Research Institute. Prior to the 2006 discovery, *Endocomia canarioides* was presumed to be locally extinct, as the last time it was collected in Singapore was all the way back in 1901, by Ridley, who had encountered it in a place known as Stagmont (in the vicinity of today's Choa Chu Kang). Incidentally, the first collections of this species in Singapore were also by Ridley, in 1894 – one from Bukit Timah and the other from Sungei Loyang. Upon comparing the dropped leaves and fruits collected with the specimens of *Endocomia canarioides* in the herbarium, we were elated to confirm that it was indeed that species! We quickly coordinated with our colleagues in the Plant

1. **The arboriculture worker scaling up the tree.** (Photo credit: Logan Tan)
2. **The tree exhibiting monopodial branching.** (Photo credit: Paul Leong)
3. **The arboriculture worker and collected specimens.**
(Photo credit: Paul Leong)



Records unit of the Horticulture and Operations team to engage an arboriculture worker to scale up the tree and collect a proper set of specimens to be lodged in the herbarium.

We were puzzled as to why this tree had not been identified by any of our predecessors, given that the site has been countless botanised. We confirmed that there was no record of this species' existence in the Rain Forest, either as a herbarium voucher or in the Gardens' plant records. The tree is a mature specimen, suggesting that it likely pre-dates the establishment of the Gardens and is not of re-forested stock. Furthermore, there are no records to suggest that this species has been planted anywhere in the Rain Forest. The most plausible explanation is that it has not been seen flowering and fruiting until now, and has thus been categorically assigned as an unknown species belonging to the Myristicaceae and listed in the Gardens' records as that as well.

Collecting the specimens

The very next day after we made our discovery, the Gardens' arboriculture team set out to collect specimens for the herbarium and seeds for propagation in the Plant Resource Centre. In order to ensure that the tree was safe to climb, an arborist first conducted a tree inspection. The area was then cordoned off and the climber donned a safety harness and set up the climbing equipment. To get the climbing rope high up in the tree, a throw line, attached to a weight at one end, was tossed up and over a main branch. Then the weight was removed and a stronger climbing rope was tied onto the throw line so that it could be pulled up and over the branch. The climber's harness was then attached to one end of the climbing rope, and by pulling on the opposite end of the rope in a pulley fashion the climber was able to pull himself up into the canopy. Still not quite close enough to reach any flowers or fruits, a long pole pruner was hauled up to the climber so that he could cut fertile branches from the tree. Some of these were made into herbarium specimens and some were sent to the nursery as material for propagation.



An inflorescence showing the greenish yellow flowers. (Photo credit: Paul Leong)



A complete set of specimens for the SING Herbarium. Note the ramiflorous inflorescence. (Photo credit: Paul Leong)

Propagation and conservation efforts

Tropical rainforest species such as *Endocomia canarioides* typically bear recalcitrant seeds, meaning they don't survive the drying and freezing process commonly used to enable long-term storage, and this poses challenges for conservation. Despite this, our propagation efforts seem promising so far, as some of the seeds that were collected have already germinated. However, some of the seeds will likely not germinate because they were too immature when collected. Thus, the tree in the Rain Forest will be regularly monitored via ongoing phenology surveys conducted by the Gardens' staff, as future flowering and fruiting events will provide us with further opportunities to harvest more propagative material in our efforts to conserve this rare native species. The propagated plants can then be planted in the Rain Forest, or even reintroduced into Singapore's nature reserves.



A close-up view of the male flowers.

(Photo credit: Paul Leong)



A close-up view of the fruits. Note the aril with the lacinate apical portion.

(Photo credit: Paul Leong)

Endocomia canarioides

Endocomia canarioides is endemic to parts of Southeast Asia, namely Peninsular Thailand, Sumatra, Peninsular Malaysia and Singapore. As a testament to its rarity, it is listed as globally Vulnerable on the IUCN Red List of Threatened Species. However, like many rainforest species, it does not flower or fruit regularly, making positive identification a challenge. Thus, this species could be better distributed than currently thought, including in Singapore, where older specimens from the SING Herbarium indicate it was once present in Bukit Timah, Stagmont, Bukit Mandai and Choa Chu Kang.

The bark of *Endocomia canarioides* is pale greyish brown with faint fissures. The main branches are devoid of leaves near where they are joined to the trunk. The leaves and leafy twigs are instead crowded around the apical

region of the branches. Hence, when looking upwards from the ground level, one would quickly notice a distinctive monopodial branching system that looks like spokes of a wheel radiating from the trunk. This characteristic immediately makes it stand out as a species belonging to the Myristicaceae or Annonaceae family. There are also distinctive swellings where the main branches join the trunk (these also provide excellent places for a tree climber to lasso a rope onto!). When cut, the branches slowly emit a watery sap of a pale cloudy pink. The leaves are leathery and glossy, mid to dark green above and grey-green below.

The inflorescences of this species tend to arise amongst the lower leaves of the leafy twigs, or more frequently along the bare twigs and branches, a condition known as ramiflory. The tree is monoecious, meaning each individual plant bears both male and female flowers. The inflorescence is a panicle of 10 cm or more in length, with a loose clustering of small greenish yellow flowers, each about 1.5 mm in diameter and with three to five petals that emit a faintly sweet scent. The inflorescences tend to consist predominantly of male flowers. The fruits are in bunches of three to four, hanging like those of a *Canarium* (hence its specific epithet '*canarioides*'). The fruits are green when unripe, about 8 cm long, turning yellow and splitting lengthwise along a suture into two segments, unveiling a single seed that is covered with a cream aril. The aril is almost entire, except near the apical region where it is somewhat split and faintly segmented (lacinate). The seed is about 5.5 cm long.

Paul Leong
Koh Sin Lan
Ali Ibrahim
Paul Athen
Herbarium

Edmund Chia
Logan Tan
Gwee Aik Teck
Horticulture & Operations

The Rain Forest, its significance and conservation

Amazingly, more than 500 species of native plants have been found within the small fragment of forest known as the Gardens' Rain Forest. In the years between 1880 and 1955, 21 plant species new to science were discovered within its confines. These have been described in scientific papers and the specimens vouchered and stored in the SING Herbarium's collection of Type specimens – the original specimens from which those species were described and named. Four of the Type specimens collected from the Rain Forest were named after H.N. Ridley, namely *Syzygium ridleyi*, *Morinda ridleyi*, *Spatholobus ridleyi* and *Meliosma pinnata* subsp. *ridleyi*, in tribute to that prolific botanist and important figure in the Gardens' history.

Today, the Rain Forest serves as a good introduction for visitors interested in learning about lowland dipterocarp rainforests. It also continues to be an important habitat for native rainforest fauna such as the Brown Tree Snail (*Amphidromus inversus*), Hill Myna (*Gracula religiosa*) and Greater Racket-tailed Drongo (*Dicrurus paradiseus*). However, similar to many rainforest fragments elsewhere, its thinning canopy and more open conditions pose challenges to the growth, survival and regeneration of the existing flora. We are making ongoing efforts to replant vegetation gaps with a combination of fast-growing native trees and more slow-growing sensitive tree species, with the goal of accelerating the closure of the canopy while striving to attain a species composition that is representative of typical primary rainforests of this type in the region. We are also currently monitoring the flowering and fruiting of the rarer species found there so that we can propagate and incorporate them into our future reforestation efforts.

An early photograph of the Gardens





The early photograph of the Singapore Botanic Gardens reproduced here is amongst the most interesting we have seen to date. It was purchased off eBay by one of the Gardens' botanical researchers, Dr Michele Rodda, to whom the undersigned is very grateful for permission to publish it here. This image is taken from near the Officers' Mess of the former Tanglin Army Barracks, now the site of the Ministry of Foreign Affairs headquarters, and shows the south-eastern segment of the Gardens with the Bandstand being in the top left of the image (features further to the west, such as Swan Lake or the swamp that preceded it are not within the camera's view). Closest to the camera is the path descending from the Officers' Mess down to what is now Minden Road, with the track it meets being the modern Holland Road (formerly part of Napier Road). Unlike the equally early image of the visit to the Gardens by the young King Chulalongkorn (see *Gardenwise* 42: 4–5, 2014), the present image cannot be precisely dated, but from what we can see it was taken some time between 1870 and 1875. We know that the Officers' Mess was not constructed until c. 1870 so the presence of the path leading down from the Mess suggests that the photograph could not have been taken prior to that year. In the centre of the image is an imposing figure dressed in a white suit. He has a fine beard and appears to be holding something, perhaps a plant to be added to the Gardens. Without doubt, this figure is none other than Lawrence Niven, the Scotsman who first designed and developed the Gardens from 1860 for the Agri-Horticultural Society (see *Gardenwise* 41: 2–3, 2013). We know that Niven went on home leave in 1875 and never returned to Singapore, so this fixes the date of the image as no later than that year.

Two details visible in the image make it particularly interesting. First, there are the Gardens' workers busy with various tasks. Some are likely to have been convicts from India, whom we know were supplied by the colonial

government to help develop the site. Many of the plantings that they are tending seem to be quite young and the site thus appears very open in aspect compared to the dense vegetation we see here today. Second, in the distance we can see the Gardens' jungle or Rain Forest. However, the image of this is rather shocking as it shows a ragged looking forest with various tall trees either dead or dying. How can this be explained? Until recently I might have concluded that, contrary to accepted wisdom, the Rain Forest was not a pristine environment untouched by man when the Agri-Horticultural Society acquired the land. However, recent events suggest another interpretation. In late April and again in early June this year (2016) the Gardens was twice hit by "micro-burst" storms of great ferocity. Both of these did considerable damage to parts of our Rain Forest, the first at its southern edge, near the Bandstand, the second at its north-western edge near Palm Court. Lightning strikes could also explain the state of the Rain Forest in the 1860/70s, since Bandstand Hill, which the forest approached at the time, would have been prone to such massive electrical discharges and the trees of course lacked the lightning protection systems that we have in place today. Clearly, until the recent storms took their toll, the Rain Forest had fully recovered from its disturbed state as seen in this historic photograph.

Historic photographs, such as that reproduced here, can tell us things about the Gardens' early history that no other source has recorded. If any of our readers come across other early images, we will be most pleased to hear from you!

Nigel P. Taylor
Group Director
Singapore Botanic Garden

Orchids galore flowering in the National Orchid Garden's Cool House

The Orchid family (Orchidaceae)

In total there are about 22,000 to 27,000 different orchid species in nature, making the orchids one of the largest plant families on our planet; the exact number depends on the opinion of the botanist who is talking about them. Orchids are found all over the world and in nearly every habitat type, from tropical rainforests to marshlands, semi-deserts and subarctic tundras. The only areas in the world where we do not find any orchids are true deserts, high glacier-covered mountains and polar regions. But orchids are not evenly spread over the world's surface. Tropical and subtropical regions harbour by far the greatest orchid diversity, while significantly fewer orchids are found in other parts of the world. In particular, orchids abound in the cloud forests of tropical and subtropical mountains, where they often drape the branches of huge forest trees.

Orchids are generally herbaceous plants, meaning that they do not have woody parts like trees and shrubs do. Most orchids in the tropics grow on trees (called tree orchids or epiphytic orchids), but they do not receive any nutrients from them and are therefore not parasites. Many other orchids grow on the ground (called ground orchids or terrestrial orchids) or on rocks (lithophytic orchids). A few orchids are lianas that climb on trees or shrubs; for example, species of the genus *Vanilla*.

There is an enormous diversity in the structures of various parts of orchids, all of which contain essential clues for the botanist who wants to identify or classify them. There are

a few important characters in their vegetative architecture (including the stems, leaves and roots), but the most distinguishing characters are found in their floral structure. Unlike most other flowering plants, orchid flowers are almost always strongly irregular in symmetry (called zygomorphic), which in effect means that the lower flower half looks very different from the upper. This is because the

median inner segment of the six perianth lobes is a strongly modified and very elaborate organ called the lip or labellum. In the centre of the flower there is a complicated entity termed the 'column' which contains the reproductive organs of the orchid flower. However, many botanists feel that floral characters have been over-emphasised in the past, and argue that these are partly



Bulbophyllum dearei

*Dendrobium densiflorum**Dendrobium victoriae-reginae*

the result of adaptation to a specific pollination mode rather than a reflection of their evolutionary relationships. Classifications based on structural (=morphological) characters alone have proven unsatisfactory in many cases, and molecular data are increasingly being used in order to classify orchids.

Conservation

Sadly, all over the world natural habitats are being destroyed to make way for cities, roads, airports, factories, agricultural land, etc. As these habitats disappear, so do many of the plant and animal species which they support, and orchids are no exception. Protected areas are being set aside by authorities to conserve at least some biodiversity-rich areas, and both national legislation and international treaties help to protect certain species. Apart from this *in situ* conservation, many orchids are being conserved through *ex situ* methods that involve growing and propagating extremely rare and highly endangered species in a nursery, with the ultimate aim of reintroducing them into the wild.

Botanic gardens around the world, including the Singapore Botanic Gardens, play an important role in *ex situ* plant conservation.

Our National Orchid Garden contains a cool house which enables us to cultivate a variety of montane orchid species. The Cool House is a glass structure (much like a greenhouse) which is temperature-controlled via an air-conditioning system that is set at 24°C during the day and 20°C at night. A misting system provides mist once every hour, simulating the sort of montane environment one would experience in such places as Mount Kinabalu and the Cameron Highlands.

Highlighted in this article are some species that have flowered recently in the Cool House. We have included cultivation notes for those interested in growing these spectacular orchids.

Bulbophyllum dearei

This commonly cultivated species is naturally distributed from Peninsular Malaysia to Borneo and the

Philippines. It can be found growing on trees at elevations between 700 and 1200 m. The species was named in honour of Lt Col. Deare of Englefield Green, near Egham, in Surrey, UK, who flowered the type specimen.

The pseudobulbs are large and ovoid, 1.8–4 cm long by 1–2.8 cm wide, each with a thick leathery leaf measuring 7.5–22 cm long by 3–6.6 cm wide. The inflorescence is around 9.5–14 cm long and bears a single flower. The flowers are often scented and measure 4–5 cm in diameter.

This species should be planted in pots or baskets and given partial shade. The plant does well in hot to cool temperatures and requires regular watering and fertilising.

Dendrobium densiflorum

This attractive species is distributed in northeast India, Nepal, Bhutan, Myanmar, Thailand and southwest China. It can be found at elevations between 1000 and 1900 m, where it grows as an epiphyte or lithophyte in areas with distinct seasons.



Lycaste macrophylla



Phragmipedium fischeri



Stanhopea anfracta

The pseudobulbs are usually around 30–45 cm long and angular. The leaves are persistent, grouped at the apex of the pseudobulb, and approximately 15 cm long by 4 cm wide. The inflorescences are pendulous, arise sub-apically and bear many flowers of a cheerful yellow colour. Each flower is 3–5 cm across, fragrant, and lasts for one to two weeks. The labellum is fibrillated. The plant blooms in spring.

This species should be grown in temperatures that are intermediate to cool, with bright filtered light. Local growers should reduce watering from around December through March, to allow the plants to dry out. Watering and fertilisation should be generous when new growth is observed. A well-drained growth medium is required.

Dendrobium victoriae-reginae

This species is endemic to the Philippines, where it can be found in Baguio, Bontoc, Canlaon, Camiguin, Davao, Ifugao, Mindoro, Negros, Nueva Vizcaya, Pampanga and Quezon. It grows on trees at high elevations from 1300 to 2600 m, with its roots covered in damp moss, and favours cool, mossy forests with year-round rainfall. It was described by Loher in 1897 who dedicated it to Queen Victoria in commemoration of the Victorian Jubilee.

The pendent, semi-deciduous pseudobulbs are often branched near the base, tangled, and usually around 30–40 cm long, occasionally reaching up to 120 cm in length. The closely-set leaves are grouped in the apical half of

the pseudobulb and measure 7.6 cm long by 1.3 cm wide. This commonly cultivated species is prized for its bluish flowers which are borne on short inflorescences that emerge from lateral buds on older stems. The flowers are waxy and measure about 3–4 cm across, with about two to five flowers (occasionally up to 12) on each inflorescence.

This orchid should be cultured in semi-shade, with cool to intermediate temperatures in a highly humid environment year-round. While it tolerates some dryness for brief periods, it should not be allowed to remain dry for lengthy periods. It is well suited to being grown in a hanging basket due to its pendulous habit, in a well-drained medium.

Lycaste macrophylla

This species is distributed in western and northern South America and encompasses many subspecies and forms, some of which have flowers that are slightly scented. The species can be found at elevations between 400 and 2400 m in wet montane forests.

The ovoid to pear-shaped pseudobulbs retain their plicate leaves for up to two years. As in most of the related genera, the inflorescences produce a single flower. The flowers are fairly large in this species, measuring up to 10 cm in diameter. Flowering is successive over several months in summer and autumn in subtropical climates. The flowers have reddish brown sepals, white petals and lips with red markings.

Phragmipedium fischeri

Native to Ecuador, this epiphytic species can be found at elevations of approximately 1400 m, along streams, in full shade, and where it is exposed to a constant breeze. It was named for Jerry Lee Fischer, owner of Orchids Limited of Plymouth, Minnesota.

The leaves are around 3.2 cm wide by 20 cm long. The inflorescence is about 20 cm long and bears two to several

flowers which open successively. The flowers are a deep pink to mauve and approximately 5 cm across.

Stanhopea anfracta

This species is distributed from Ecuador to Peru and Bolivia, on the eastern slopes of the Andes where it can be found in wet cloud forests at elevations of 700 to 1400 m.

The pseudobulbs are ovoid, each bearing a single plicate leaf. The inflorescence is pendulous, bearing between seven and 13 flowers that are each about 6 cm in diameter. The sepals and petals are yellow-orange. A rather large, reddish brown eye-spot is usually present on each side of the lower lip portion which is sharply bent at the mid-point, forming the shape of a 'U' when viewed laterally. The middle part of the lip has thick 'horns' and the upper lip portion is reflexed and thickened at the apex. The column is very large and conspicuous, and cream-white with red dots on the sides.

Vanda coerulea

This species was discovered in 1837 in the oak and pine forests of the Khasia Hills of northeast India and described ten years

later by William Griffith. It is distributed through the mountains of northeast India, Bangladesh, Myanmar, Thailand and southwest China, and can be found at elevations of approximately 900 to 1500 m. It is named for the beautiful colouration of the flowers, which can vary from purple through shades of lilac to blue and white. The flowers are usually tessellated.

This species has been so coveted by orchid collectors around the world that wild populations face continued threats from illegal collection and habitat destruction. Previously recorded from a single location in the Khasia Hills of Meghalaya, it was considered extremely rare in the wild due to over-collection and because it grows on oak trees that are locally harvested for charcoal production, and was placed on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I. Subsequently, further discoveries of the species were made, resulting in its transfer to CITES Appendix II, although the threat of over-collection is still very real.

The plant is monopodial and grows as an epiphyte. The leaves are strap-like and leathery. The inflorescences are occasionally branched, bearing up to 30 flowers per plant on multiple flower spikes. Each flower measures about 13 cm across. The species' unusual trait of branching inflorescences, added to the lovely colouration of the flowers and their size, makes it a choice parent for hybridisation.

The species is cold tolerant and adapted to low night-time temperatures, rendering it difficult to grow in tropical and subtropical regions. Given optimal growing conditions, however, the plant may produce flowers four or five times a year, remarkable for species in the *Vanda* alliance.

David Lim

National Orchid Garden

Gillian Khew

Conservation and Molecular Biology

Hubert Kurzweil

Herbarium

All photos by David Lim



Vanda coerulea



Celebrating Singapore's horticultural

Last year, the Singapore Botanic Gardens was inscribed as Singapore's first UNESCO World Heritage Site by meeting two key criteria, one of which stems from being an outstanding example of a British tropical colonial botanic garden and the best preserved of its kind. The design of the Gardens was strongly influenced by the English Landscape Movement which was the height of fashion in the late 18th to mid-19th centuries, when the Gardens was founded. The English Landscape Movement presents an idealised view of nature which includes characteristics such as large and open sweeping lawns, gently undulating topography, serpentine water bodies, grand vistas framed by strategically located groves of trees, and focal structures such as pavilions, bridges and follies. All of these characteristics are prevalent in the Gardens, and especially so around the site of the new Heritage Garden.

Situated on Lawn E, the Heritage Garden frames arguably the finest view of the Gardens looking down over Swan Lake. From this viewpoint you can see most of the lake, including, at its far southern end, the giant Burmese Banyan (*Ficus kurzii*) Heritage Tree that is believed to be older than the Gardens itself. The island in

the lake, dominated by a majestic Nibong (*Oncosperma tigillarum*), is also visible from this viewpoint.

The site of the Heritage Garden was selected for its significance in the social history of Singapore. In the early years of self-government, the then Ministry of Culture regularly staged open-air cultural concerts known as Aneka Ragam Ra'ayat, or People's Variety Show. Between 1959 and 1964, there were 200 of these shows, the first of which was held at the Gardens on 2 August 1959, on a specially constructed stage. The show was officially opened by the then Prime Minister, Mr Lee Kuan Yew, who addressed the large crowd with the sentiment, "Here, under open skies, Malays, Chinese, Indians will, I hope, discover the materials for a national art and national culture".

The planting palette for the Heritage Garden was chosen to celebrate the early days of Singapore's greening movement, which was launched on 16 June 1963 by Mr Lee Kuan Yew when he planted a Pink Mempat (*Cratoxylum formosum*) at Farrer Circus. The Heritage Garden features the Pink Mempat, as well as two other species of *Cratoxylum* – *C. cochinchinense*, commonly known as Kayu Arang, and *C. maingayi*,

or Maingay's Mempat. All three are attractive trees known for shedding their leaves during times of drought, following which new reddish leaves are produced. More than 80 types of plants are featured in the Heritage Garden, making the new themed area a must-see for visitors. In this article, we would like to highlight some of the plants on display there, including attractive shrubs from the Coffee family (Rubiaceae) and an assortment of interesting foliage plants. We hope that local gardeners will find inspiration from the Heritage Garden, and thus, have included growing tips for select plants.



The Heritage Garden was opened in May 2016. (Photo credit: Nicholas Yeo)



heritage

The view of Swan Lake from the Heritage Garden. (Photo credit: NParks)

A selection of plants from the Coffee family

The Heritage Garden features a good variety of shrubs from the Coffee family. Walking down to the right from the Bonsai House, visitors cannot miss the colourful parade of *Mussaenda* cultivars that line one side of the footpath. Their vibrant colours come from the floral bracts, which are long lasting. These plants were initially introduced from the Philippines and grow well in Singapore and Malaysia.

Also from this family is the Liberian Coffee (*Coffea liberica*). This attractive shrub produces clusters of white, fragrant flowers. In comparison to other, more popular species of *Coffea* used in the beverage industry, such as Arabica (*C. arabica*) and Robusta (*C. canephora* var. *robusta*), Liberian Coffee produces larger berries and is more suited for growing in the lowland tropics due to its greater heat tolerance.

A range of *Gardenia* species and cultivars can also be found in the Heritage Garden. Bunga Cina (*Gardenia jasminoides*) is an old favourite, and in addition to the species, there are three cultivars on display, including two with double-petalled flowers. The

Mussaenda cultivars



Mussaenda 'Calcutta'



Mussaenda 'Dona Eva'



Mussaenda erythrophylla 'Dona Luz'



Mussaenda erythrophylla 'Queen Sirikit'

Growing tips:

Mussaenda cultivars thrive best when grown in full sun. They need to be hard-pruned regularly to encourage a bushier growth habit. If allowed to grow unchecked, they will become leggy, with the lower portions of the stems gradually becoming bare and unsightly.

Tahiti Gardenia (*G. taitensis*) grows as a sprawling shrub with large glossy leaves and large, white, showy flowers, while the Glossy-leaved Gardenia (*G. nitida*) produces clusters of hanging flowers, each with a long, slender floral tube. Also showcased are the native Swamp Gardenia (*G. tubifera*) and *G. mutabilis*. The flowers of these two species exhibit interesting colour changes as they mature; they start out white when they first open around dusk, turn pale yellow by the following morning and are deep yellow by noon. By the third day, the flowers can take on an orange colour, depending on the species.

In addition to the Gardenias, the Heritage Garden features other fragrant shrubs from the Coffee family. These include the native but locally Endangered *Tarennia fragrans*. This densely branched plant produces outstanding fragrant white flowers that wither to a yellowish colour and occur in large clusters. *Ixora finlaysoniana* and *I. hookeri* are two other species from the Coffee family that produce fragrant flowers.

Liberian Coffee



Coffea liberica

Growing tips:

Liberian Coffee grows best under semi-shaded conditions with moist, well-drained soil. When planted closely, this shrub can serve as a hedge in a shadier part of the garden where many other woody shrubs do not thrive.

Gardenia, Tarennia and Ixora



Gardenia jasminoides



Gardenia taitensis



Gardenia tubifera



Gardenia mutabilis



Tarennia fragrans



Ixora finlaysoniana

Growing tips:

Gardenia, *Tarennia* and *Ixora* tend to do best when planted under direct sunlight. Under lower light levels, plants can become pest-ridden. A common observation of plants grown under insufficient light is damage to young leaves by chewing insects. The frequency of flowering will also be reduced. These plants need to be grown in a location with well-drained and moist soil. They tolerate neither drought nor water-logging with the exception of *Gardenia tubifera*, which is more tolerant of water-logged conditions.

Gardenia and *Ixora* can get leggy with time and hard-pruning is sometimes necessary to encourage a bushier and more compact growth habit. Avoid frequent pruning, however, as plants produce new flower buds on new growth.

In general, *Gardenia*, *Tarennia* and *Ixora* can be propagated vegetatively via stem cuttings.

Foliage plants

Surrounding the Heritage Garden Gazebo is a selection of “old school” foliage plants which include *Dracaena* and aroids such as *Aglaonema* and *Dieffenbachia*. Their foliage comes in a dazzling range of colours, shapes and textures. *Dracaena* species and cultivars were popular landscaping and house plants in the 1970s to 1980s, and are revered by the local Chinese as auspicious because their occasional blooms are thought to bring good fortune. *Aglaonema*, commonly called Chinese Evergreens, have also been popular for decades, with the earlier hybrids created in the 1960s and 1970s based on *A. commutatum* and *A. nitidum*. They feature dark green, lance-shaped leaves that are marked in silver. In the

1980s, hybridisation efforts using *A. rotundum* in Thailand and Indonesia introduced a whole new range of colourful cultivars with attractive leaves that have red or pink colours in them. The common name of *Dieffenbachia*, Dumbcane, refers to the toxic effect of the plant sap, which contains calcium oxalate crystals that cause irritation and swelling of the tissue in the mouth and throat, resulting in temporary loss of speech. *Dieffenbachia* are robust herbaceous shrubs with straight stems and attractive simple leaves with white, light green or yellowish green spots and flecks on them.

Wilson Wong
Horticulture & Operations

Jason Wright
Design

Foliage plants



Dracaena goldieana



Aglaonema ‘Pink Anyamane’



Dieffenbachia ‘Tropic Snow’

Growing tips:

Dracaena, *Aglaonema* and *Dieffenbachia* make particularly good house plants because they can be propagated easily via stem cuttings and can tolerate a fair amount of shade. Cultivars of *Aglaonema* with pink or red leaves, such as ‘Pink Anyamane’, require heavy shade, making them especially good plants for the office or home. They also require a well-drained and aerated growth media with coarse coconut husk chips incorporated. In contrast, *Dieffenbachia* require higher light levels to maintain their foliage colours and patterns, and keep from becoming etiolated.

All photos by Dr Wilson Wong, unless otherwise indicated



Changing ideas of plant families



Clerodendrum villosum, formerly in Verbenaceae, now in Lamiaceae. (Photo credit: Preecha Karaket)

The desire to classify the world around us is a very basic human trait: is it edible/inedible, poisonous/benign, dangerous/safe, pleasing/noxious? Since time immemorial humans have classified plants based on their utility or superficial similarity. Only in the last few centuries have we grouped them based on a closer study of their inherent characteristics. Since the late 18th century it has become accepted that we classify species into genera, genera into families, and families into orders (although sometimes referred to with different terminology) in a strict hierarchy. The idea of the species has changed relatively little over the centuries. The concepts of the genus,

family and order have, however, changed considerably over time. In this article let us look at one of these levels in the hierarchy, the plant family.

As we have explored in previous ‘Taxonomy Corner’ articles, modern taxonomic botany is said to begin with the publication of *Species Plantarum* by Linnaeus in 1753. Linnaeus did not describe plant families in the sense we use them today but did arrange his species into groups corresponding to the number of stamens and pistils each had. This is referred to as his ‘sexual system’ and was considered shocking under the prudish conventions of his day. The problem of the sexual system was that it obviously grouped

together quite disparate species and, conversely, separated species that otherwise were rather similar.

Building upon the work of Linnaeus and earlier French botanists such as Adanson, Antoine-Laurent de Jussieu attempted to systematically arrange all plants into genera and families in his *Genera Plantarum* of 1789 in a more ‘natural’ system. Although family delimitations have changed, new families have been added as the world has been explored, and some families have come and gone as data has accumulated, much of Jussieu’s system has survived to the present day. The idea of a ‘natural’ classification, favoured by Jussieu and his contemporaries,



The plant family

The plant family is that level in the hierarchy with names that end in -aceae. For example, Dipterocarpaceae for the family of trees dominant in Southeast Asia's primary forests. Some families have names which do not follow this rule but which reflect their widespread acceptance as distinct entities since before scientific classifications, such as: Cruciferae, Compositae, Gramineae, Guttiferae, Labiatae, Palmae and Umbelliferae. Even for these non-standard names, a standard version also exists for the same families, namely Brassicaceae, Asteraceae, Poaceae, Clusiaceae, Lamiaceae, Arecaceae and Apiaceae, respectively. These standard versions are increasingly being used to the exclusion of the alternative forms.

remained rather nebulous, especially prior to the widespread acceptance of evolutionary ideas. Many families adopted by Jussieu were already widely accepted in folk culture, such as the Asteraceae (the Daisy family), the Poaceae (the Grass family), and the Apiaceae (the Carrot family). These 'natural' families were supposed to be easy to define, stable and memorable. And, of course, they were very much the product of a European world view without much encumbrance from the massive diversity yet to be described from the tropics.

Since Jussieu's *Genera Plantarum*, many and varied systems for placing species and genera into plant families have been published. In the 19th century there were a number of multi-volume works, arranged by family, that attempted to account for every species known, such as De Candolle's *Prodromus* (1824–1873) and Don's *A General History of the Dichlamydeous Plants* (1831–1838). As the number of known species grew exponentially in the 19th and 20th centuries, attempts to describe all of them into a hierarchical system of genera and families became



Wrightia religiosa in the Apocynaceae, more closely related to *Hoya* than to *Alstonia*.
(Photo credit: David Middleton)

impossible. Instead, discussions on plant families were centred around the genera to be included.

That all organisms arose through the process of evolution became rapidly accepted soon after Darwin and Wallace promulgated their ideas. The term 'natural' came to be associated with an idea that the species in a genus and the genera in a family were meant to be closely related through evolution. The process of classifying plants, in theory reflecting evolutionary relationships, remained, however, rather unchanged from earlier systems. This consisted of knowledgeable people looking at features of the plants and assessing whether those features suggested an evolutionary relationship or not.

A major change in thinking about how plant families should be defined began from around the mid-1980s and became more mainstream through the 1990s. This was due to the advent of phylogenetic methodology, in which species are grouped based on the shared possession of derived characters. As data generated by gene sequencing became increasingly



Alstonia pneumatophora in the Apocynaceae.
(Photo credit: David Middleton)

available, coupled with phylogenetic methodology and increasing analytical power through better computers, relationships between huge numbers of species could be investigated. Phylogenetic trees to show the relationships between species in a genus and genera in a family often confirmed many of the families that we were already familiar with. It



Hoya graveolens, formerly in the Asclepiadaceae, now in Apocynaceae. (Photo credit: Preecha Karaket)

gradually began to be accepted that all of the species in a family had to have a single common ancestor, and it also came to be accepted that all of the descendants of a common ancestor should be classified together. This may seem self-evident but the reality was that, at all levels in the taxonomic hierarchy, groups were often classified separately when they had evolved some remarkable feature that had taken them off into a new and distinct direction so that they no longer much resembled their ancestor, nor the other descendants of that ancestor. The expectation now is that, despite their dissimilarity, they must be classified together. The Apocynaceae, discussed below, is a case in point.

Two families familiar to us in Singapore, now with very different delimitations, are the Lamiaceae (the Mint family) and Apocynaceae (the Frangipani family). The Lamiaceae, as previously defined, was a family of herbs and shrubs such as mint, basil, sage and lavender, with many more species in temperate regions than in the tropics. In tropical regions the related family Verbenaceae included

shrubs, trees and climbers such as teak, the Beauty Berry and Pagoda Flower. Research using DNA sequence data has shown that the Lamiaceae and most Asian woody Verbenaceae are more closely related to each other than either are to the rest of the Verbenaceae. These Asian Verbenaceae have now been moved into the Lamiaceae. The invasive *Lantana* and widely cultivated *Duranta*, both from the New World, remain in Verbenaceae but there are now no native species in Singapore.

The Apocynaceae is familiar in Singapore through the widely planted Frangipanis, *Plumeria* spp., and Allamandas, *Allamanda* spp., and also through the native Pulai, *Alstonia* spp. and Pong Pong, *Cerbera* spp. There are many other native species of shrubs, trees and climbers. The family Asclepiadaceae is also familiar in Singapore due to the popularity of cultivated *Hoya* spp. and the *Dischidia* spp. often seen festooning the trees. Although long recognised as being closely related, the Apocynaceae and Asclepiadaceae were separated on what was perceived to be the very different morphologies of the

reproductive parts. Recent research using both DNA sequence data and morphological data suggests that the Asclepiadaceae evolved within the Apocynaceae, possibly more than once. A consequence of this is that a *Hoya* from the Asclepiadaceae is more closely related to *Wrightia* from the Apocynaceae than *Wrightia* is to *Alstonia*, also from the Apocynaceae. It would, therefore, be untenable to maintain the former family distinctions and they have been combined into a single family which must be called Apocynaceae, the earlier name, under the rules of botanical nomenclature. Although there are exceptions, the large majority of species in the newly enlarged and defined family have white latex and most have opposite leaves, making it still rather easy to identify.

It is likely we are now entering another period of relative stability in the definition of plant families. This is something to be welcomed!

David J. Middleton
Herbarium

Botanical Research Fellows in the Gardens 2015–2016

Until recently the Singapore Botanic Gardens awarded Research Fellowships to botanists to carry out research in the Singapore Herbarium (SING). Sadly, we have had to discontinue this scheme. The SING Herbarium holds rich collections of specimens from the Malesian region, and these are an important resource for research on the plant biodiversity of Southeast Asia. Over 90 Fellowships have been awarded since 2004, and some of these Research Fellows have also shared their wealth of knowledge through public talks given as part of the Gardens' monthly Speaker Series. The 2015–2016 Research Fellows and their achievements are presented below.



Dr Xue Bine (Photo credit: Ho Boon Chuan)



Dr Dong Shi-Yong (Photo credit: Bazilah Ibrahim)



Ms Nadhaniel Simonsson Juhonewe
(Photo credit: Michele Rodda)

Ms Nadhaniel Simonsson Juhonewe, a Swedish researcher based in Papua New Guinea with the National Research Institute since 2010, visited SING from 8 Feb to 1 Mar 2016. During her visit, Nadhaniel worked with her longtime collaborator Dr Michele Rodda, our resident Apocynaceae-Asclepiadoideae researcher. Together, they are working on manuscripts that tackle the taxonomy and systematics of asclepiads (Apocynaceae), with a focus on *Hoya* and *Dischidia* of the island of New Guinea.

Dr Xue Bine, an assistant professor from the South China Botanical Garden, was at SING from 1 to 21 Jul 2015. Bine is the fifth recipient of the Gardens' Burkill Fellowship. Her term here was based on the proposed morphological study of the genus *Monoon* (Annonaceae). A large part of the study was focused on the genera *Polyalthia sensu lato* and *Enicosanthum*, and involved the re-identification and transfer of some species to the genus *Monoon*. While here, Bine curated over a hundred specimens, which includes providing annotations to some of the unidentified species in the collection. She also shared some references on the current taxonomic status of *Polyalthia* with our herbarium staff.

Dr Dong Shi-Yong, an associate professor from the South China Botanical Garden, was at SING from 6 to 26 Sept 2015. The focus of his study was the taxonomy of the fern genus *Tectaria* (Tectariaceae). While here, Shi-Yong curated and photographed around 2,000 specimens, including the type collections, and re-identified over 200 specimens. During his stay, Shi-Yong also managed to provide

an impromptu training session to the herbarium staff on how to distinguish members of the *Asplenium nidus* group and also how to recognise *Tectaria* species in Singapore.

Dr Rogier de Kok curated a large part of our Lauraceae collection during his time at SING from 2 to 31 May 2015. He focused particularly on the genera *Cryptocarya*, *Hexapora*, *Cinnamomum* and *Beilschmiedia* as part of his study for the Flora of Peninsular Malaysia. Some specimens of these genera are housed only at SING and no other herbarium. During his visit, Rogier annotated a total of 513 herbarium sheets, and at the same time located 22 type specimens from the general collection. He also cited a new record for Singapore, *Cryptocarya nitens*, based on two collections made in 2006 from the Bukit Timah Nature Reserve. Rogier was invited to return to SING from 4 Jan to 7 Apr 2016, to work on the Lamiaceae for the Flora of Singapore. During this period, Rogier also presented a talk on 'The Lamiaceae of Singapore: An Overview' at the March session of the Gardens' Speaker Series.

Dr Rogier de Kok*(Photo credit: Serena Lee)***Prof. Kai Müller and Prof. Dietmar****Quandt** *(Photo credit: Ho Boon Chuan)***Ms Emily Warschefsky***(Photo credit: Bazilah Ibrahim)*

Prof. Kai Müller from the Institute for Evolution and Biodiversity and Director of the Botanical Garden of the University of Münster, Germany, and **Prof. Dietmar Quandt** of the Nees Institute for Biodiversity of Plants at the University of Bonn, Germany, were at the Singapore Botanic Gardens from 28 Sep to 2 Oct 2015. While here, Kai and Dietmar collaborated with Dr Gillian Khew from the Orchid Breeding and Conservation Biotechnology Laboratory to conduct a phylogenetic training workshop for staff of the Gardens at Ridley Hall. The 18 attendees were introduced to molecular phylogenetic methods through lectures as well as practical sessions using various software such as PhyDE and PAUP. Dietmar also had discussions on an ongoing project targeting early diverging land plants with Dr Ho Boon Chuan, our resident Leguminosae and bryophytes researcher.

Dr Carmen Puglisi from the Royal Botanic Garden Edinburgh, UK, was at SING from 22 Feb to 20 May 2016. Carmen has been researching the family Gesneriaceae for the past six years with a particular interest in the taxonomy, phylogeny and biogeography of species that grow on limestone in Southeast Asia. While here, Carmen examined specimens of *Damrongia*, *Dorcoceras*, *Microchirita* and *Middletonia* as part of her study for the Flora of Thailand. Her current focus is the taxa occurring in Thailand and Myanmar. During this period, Carmen also presented

Dr Carmen Puglisi*(Photo credit: Bazilah Ibrahim)*

a talk on 'Gesneriaceae in the Flora of Thailand: New Discoveries and Old Challenges' at the April session of the Gardens' Speaker Series.

Ms Emily Warschefsky, a PhD candidate from Florida International University, USA, visited SING from 6 to 20 Sept 2015, as part of her dissertation studies on the flora of East and Southeast Asia. While here, Emily studied specimens in our collections that are pertinent to her project on the phylogenetics of mangoes and their wild relatives (*Mangifera* spp.). She also worked with staff from the Plant Records team to collect samples around the Gardens to be lodged in the herbarium and for molecular study.

Mrs Lutul Sulistyaningsih*(Photo credit: Bazilah Ibrahim)*

Mrs Lutul Sulistyaningsih, from the Herbarium Bogoriense, Indonesia, was at SING from 6 to 19 Sept 2015 to work on a taxonomic revision of Smilacaceae in Malaysia. The Smilacaceae is a rather complex family consisting of two genera, namely *Smilax* and *Heterosmilax*. While here, Lutul looked at over 456 SING specimens from various regions and made 119 new determinations, including a possible new species recorded from Papua.

Bazilah Ibrahim
Herbarium



‘Singapore Botanic Gardens — Our Heritage’: Roadshow and assembly talks for primary and secondary schools

On 24 February, 2016, a roadshow entitled ‘Singapore Botanic Gardens – Our Heritage’ was held at Cedar Girls’ Secondary School, along with an assembly talk. Five staff from the Gardens’ education team headed down to the school for the roadshow in the morning, targeting students during their recess break.

The first recess session reached out to about 120 lower secondary students, while the second session engaged around 100 upper secondary students. We set up a table in the canteen to display specimens of Pará Rubber (*Hevea brasiliensis*), Saga (*Adenantha pavonina*), and Kapok (*Ceiba pentandra*), which were used to engage the students and test their knowledge on seed dispersal mechanisms. We also explained the significance of these species with regard to the Gardens’ heritage.

A spin-the-wheel game with questions about the Gardens was also set up in the canteen, with students receiving a special button badge for their participation. To further create awareness of the Gardens’ heritage and get students interested in the assembly talk scheduled for the afternoon, five members of the school’s Environment Club took on the role of rovers to interview and chat with other students in the canteen. The assembly talk reached out to the entire school population of more than 1,400 students and teachers, and the 12 students who correctly answered questions during the talk were rewarded with a ‘50 Years of Greening Singapore’ tote bag as a prize.



Assembly talk at the newly completed performing arts theatre at Raffles Girls’ Primary School. (Photo credit: Winnie Wong)



Members of the Cedar Girls’ Environment Club going around to interview fellow students and create awareness of the heritage of the Gardens. (Photo credit: Winnie Wong)



Winnie Wong explaining how rubber seeds are dispersed through the explosive method.
(Photo credit: Goh Mei Yi)

The roadshow and assembly talk at Cedar Girls' was a trial run for school outreach programmes still to come. As luck would have it, an opportunity arose to take the roadshow and assembly talk to Raffles Girls' Primary School on 25 April. During recess, the girls actively participated in the roadshow. Some of them managed to put a name to the "cute little red seeds" that they have collected in jars and bottles at home, and others were fascinated when they discovered the picture of the iconic Tembusu tree on the back of their five-dollar notes. Within an hour and a half, as many as 350 students across all grade levels walked away with a button badge as a token of appreciation for their active participation.

Following the roadshow activities, the Gardens' education team proceeded to give a talk to at least 400 Primary 6 students. The talk provided an introduction to the history of the Gardens, including some of the people crucial to its development. Mr Henry Ridley, also known as 'Mad Rubber' Ridley, featured prominently as the director responsible for bringing about the rubber boom that transformed the region's economy. Mr Eric Holttum, the 'father' of the Gardens' orchid breeding programme, was also featured during the talk.

A question and answer session concluded the assembly talk, with mini Sara keychains given out as prizes for correct answers. Sara, a *Botanicosaurus*,



Assembly talk addressing 1,400 students at Cedar Girls' Secondary School.
(Photo credit: Tan Hui Min)



Students from Raffles Girls' Primary School actively participating in the spin-the-wheel game in the hopes of winning a button badge. (Photo credit: Winnie Wong)

is the mascot of the Gardens' educational programmes, and she has a penchant for leading children around the Gardens and participating in educational activities. Sara's friendly disposition makes her a hot favourite among children, and her popularity with the young participants of the assembly talk might have been partially responsible for their quick (and accurate!) answers during the question and answer session.

The roadshow and assembly talk proved a success with the students of both Cedar Girls' Secondary School and Raffles Girls' Primary School. We bid the enthusiastic students goodbye with encouragement to visit the Gardens in the future. With their newfound knowledge of the Gardens' past, it is hoped that the students will be in a better position to appreciate the site not just as a place for recreation, but as an important piece of our heritage.



Janice Yau explaining how Saga seeds are dispersed and how they were used by people in the past.
(Photo credit: Winnie Wong)



Students exploring the light and fluffy seeds of the Kapok.
(Photo credit: Winnie Wong)

**Janice Yau
Tan Hui Min
Goh Mei Yi**
Education Branch



On-the-Spot Poetry and Photography Competition for primary school children

An inaugural On-the-Spot Poetry and Photography Competition for primary school children was held on 28 May 2016, Saturday, at the Singapore Botanic Gardens, in conjunction with the 2016 National Poetry Festival. A total of 19 children between 9 and 12 years old participated in this competition.

After a poetry workshop by Eric Francis Tinsay Valles, participants

were guided around the Gardens to capture a memorable moment using cameras sponsored by Canon Imaging Academy. The participants were then given an hour to come up with poetry masterpieces, based on the theme of reflecting with nature.

While the entries were being judged, five local authors-cum-poets held a poetry reading. These creative individuals were Elijah Chai, Ann Ang,

Tan Chin Guan, Yong Shu Hoong and the renowned pioneer of Singapore literature, Professor Edwin Thumboo, who also gave away the prizes for the top three winning poems.

The winning poems were by Christie Chong, Lam Le En and Owena Eng, and are presented here.

Janice Yau
Education Branch



(Photo credit: Christie Chong)

THE THORN AMONGST THE ROSES

*Autumn arrives,
the leaves start yellowing, and the air has become still.
The bare twigs, so solemn, so unsightly.
The little twigs that look like thorns,
They are abandoned, they are looked down on.*

*But nothing happens, nothing changes, for they still hang in there
They still cross paths with one another, as they start maturing together,
a little by a little.*

Who are we to despise them?

*They have found a new life, they have found a new purpose.
They dance around in the refreshing wind,
not willing to give up, not willing to back out.*

*The wind blows, autumn has passed, they start to renew,
as the butterflies slowly start to emerge from the twigs again.*

Nature as teacher, persevere and strive.

Christie Chong
Age 12, Qifa Primary School



(Photo credit: Lam Le En)

*The rain drizzled over the garden,
the petals refresh in its power.
Sliding with slowness, the droplet
makes friendship and joy with the flower.*

*But love for the water was over
the sunshine was drying the floor.
Slowly and slowly the flower,
was alone in the garden once more.*

Lam Le En
Age 10, Home school



(Photo credit: Owena Eng)

*A thriving tree, a wild weed, crossing paths with fate.
Their friendship grows, their friendship breaks, Every.Single.Day.
The thriving tree, superior and tall, thinks lowly of the pathetic weed.
The wild weed, crazy and reckless, is overwhelmed with insecurities.
“Why am I friends with a silly little weed?” the thriving tree wonders.
“I’m in despair, have low self-esteem,” the naïve weed ponders.
But this is what makes their friendship special, I’d say, with different
perspectives and different insights.
Undergoing so much transformation and change, jealousy and
superiority inevitably ignites.
But as time passes, weeks, months and years, it naturally heals all
wounds.
Now that they’ve changed, friendship’s okay, here’s what they’d
really, really like to say.
“We’re all special, unique and different, in each and every way.”
They’ve crossed paths, transformed and changed, over and over and
over again.
The storms are over, a bright light shines, they see the morning sun.
They both smiled. The poem is done.*

Owena Eng
Age 12, Qifa Primary School



The Asia Pacific Orchid Conference 2016

The 12th Asia Pacific Orchid Conference (APOC) was held at the IMPACT Forum, Exhibition and Convention Center at Muang Thong Thani, Nonthaburi, Thailand from 19 to 27 March 2016. This event takes place once every three years, with the objectives to promote the awareness and development of the hybridisation, cultivation, science and conservation of orchids as well as to support research in these fields in the Asia Pacific Region. The 12th APOC also included contests and competitions in the areas of landscape display, potted flowers, cut flowers, container gardens and floral arrangements, as well as in 'orchid art' such as watercolour paintings and photographs of orchids. There was also a marketplace for plant sales.

A team consisting of staff from the Gardens and members of OSSEA (the Orchid Society of South East Asia) took part in the International Landscape Display Competition, in the large size category (6 × 6 square metres). Planning and preparations for our display started in December 2015. The team came up with the theme 'Jubilant Garden – Celebrating over 50 Years of SG Orchids' for our display, which was designed by Simon Tan, deputy director of the National Orchid Garden. The design featured a series of orchid covered arches and frames to tell the story of orchid hybridisation in Singapore over the decades. It showcased the developments and changes in trends with regards to orchids as cut flowers and in landscaping, from Singapore's early days until today. A variety of orchid hybrids was selected to best represent different time periods, including some of our heritage orchids. To reflect our identity as a City in a Garden,



Selecting foliage plants at the plant market on our first day in Thailand. (Photo credit: Koh Poo Kiong)



Setting up for the International Landscape Display Competition. (Photo credits: Koh Poo Kiong)

The setup team. Back row, from left to right: Koh Poo Kiong, Mark Choo, Simon Tan, Teo Chan Seng and Dennis Lim. Front row, from left to right: Bohr (our counterpart from Thailand), Cai Miao Qin, Chin Li Li, Rebecca Tan, Rockney Wong and Tan Zhi Jian. Not shown are volunteers from OSSEA, Sue Cheng and Ling Kam Keong. (Photo credit: Dennis Lim)



the orchids were set in a lush tropical garden, with a path leading through the arches and frames to represent the passage of time. In advance of the competition, we set up a full size mock-up of our design to fine-tune the measurements and spacing of the arches. By early March 2016, all of the necessary preparations had been made, and we were ready for the competition.

As soon as the team touched down at Bangkok International Airport on 14 March, we headed straight to the plant market in search of foliage plants to complement the orchids in our display. We managed to acquire some beautiful groundcover and unique foliage plants from local nurseries. We had from 15 to 17 March to bring our design from the drawing board to life, and we wasted no time during the open hours of the exhibition hall in setting up the display. Judging was held on 18 and 19 March, and we earned an Honourable Mention Award for our hard work. The Singapore Botanic Gardens also entered 18 orchids in the potted flowers competition, and we won seven awards in this category.

The 13th APOC will be hosted in Kuching, Sarawak, Malaysia in 2019.

Chin Li Li
Micropropagation

Mark Choo
National Orchid Garden



The tear-down team, Sheryl Koh and David Lim. (Photo credit: Chin Li Li)



Ready for the competition. Front view (left) and back view (right) of the final display created after four days of hard work. (Photo credits: Rebecca Tan and Tan Zhi Jian)



A small piece of Singapore in Miyazaki Prefecture...

In October 2015, Mr Shunji Kuono, Governor of Miyazaki Prefecture, Japan, extended an official invitation to the Group Director of the Singapore Botanic Gardens, Dr Nigel Taylor, and Deputy Director, Dr Nura Abdul Karim, to attend the official opening of a new tropical glasshouse at the formerly named Aoshima Sub-Tropical Botanic Garden, one of our longstanding sister gardens (see *Gardenwise* 46: 38, 2016).

The official opening was held on 26 March 2016, and also commemorated the renaming of our sister garden as the Miyakoh Botanic Garden, Aoshima. Miyakoh Holdings Pte Ltd had sponsored both the upgrading of the glasshouse and the maintenance of the botanic garden for up to three years, at an annual cost of 3 million Japanese Yen (approximately S\$371,155). Following Miyazaki City's rules regarding donor recognition, the botanic garden will be named after the corporate donor for as long as the funding continues, and thereafter, may revert to its historical name.

Governor Shunji Kuono officiated at the opening ceremony, which was a grand affair attended by Miyazaki's well-regarded personalities from the fields of science, horticulture, business, politics, sports and the arts. Before the start of the ceremony, Shinto priests offered prayers around the new building. A local traditional dance troupe opened the ceremony, followed by speeches from the governor, the CEO of Miyakoh Holdings and other guests of honour,



The ribbon cutting ceremony at the opening of the new glasshouse on 26 March 2016.
(Photo courtesy of Miyakoh Botanic Garden, Aoshima)



Dr Nigel Taylor paying a courtesy call to the Governor of Miyazaki Prefecture, Mr Shunji Kuono.
(Photo credit: Nura Abdul Karim)

including Dr Nigel Taylor. A ribbon cutting ceremony then commenced, which was followed by a viewing of the spanking new glasshouse by the governor and VIP guests. The modest glasshouse has two levels that cover an area of about 610 square

metres; the upper deck is for viewing purposes only, while the bottom level showcases tropical plants.

The new glasshouse holds a pleasant surprise for visiting Singaporeans. Taking centre stage is a replica of our

Merlion fountain, placed amongst colourful and beautiful orchids. Through Dr Nura's assistance, the Miyakoh Botanic Garden, Aoshima was able to obtain permission from the Singapore Tourism Board, which holds the rights to the Merlion, to display a replica of this symbolic icon of Singapore in the glasshouse. The display also includes a panel detailing key activities and events between our two gardens, as well as some of the orchids that have been gifted from our Gardens. Together, these items bear testimony to the longstanding relationship of our two institutions.

Also showcased in the glasshouse are beautifully landscaped beds of striking tropical ornamentals. At the heart of these displays are plants gifted from the Singapore Botanic Gardens over the years, including cultivars of *Bougainvillea*, a *Cassia fistula* tree grown from seeds donated in 1965, pots planted with *Papilionanthe* Miss Joaquim, and VIP orchids named after the Japanese royals, Emperor Akihito and his wife Empress Michiko, who visited our Gardens in the 1970s and 1980s.

Later in the afternoon, Dr Nigel Taylor gave a talk at the Miyazaki City Plaza about Singapore's evolution into a City in a Garden. It was attended by some 200 people comprising members of the public as well as staff of the Miyazaki Parks Association and the Miyakoh Botanic Garden, Aoshima as well as civil servants from the Miyazaki City government.

The Singapore Botanic Gardens would like to take this opportunity to wish our friends from the Miyakoh Botanic Garden, Aoshima continued success in the future and hope our working relationship will strengthen with each passing year.



The VIP guests at the opening of the new tropical glasshouse.
(Photo courtesy of Miyakoh Botanic Garden, Aoshima)



The Merlion fountain takes centre stage in the brand new tropical glasshouse at the Miyakoh Botanic Garden, Aoshima. (Photo credit: Shinichiro Ito)

Nura Abdul Karim
Library, Training and External Relations

Partnering Methodist Girls' School in the conservation of native plants



David Lim giving a guided tour of the National Orchid Garden to the students of MGS. (Photo credit: Koh Siew Lian)

In November 2015, the vice principal of Methodist Girls' School (MGS), Mr Vincent Ong, contacted the Gardens' Dr Nura Abdul Karim to explore the possibility of a collaboration to conserve *Platycerium ridleyi*, a native fern sadly presumed to be extinct in Singapore. Commonly known as Ridley's Staghorn Fern, *P. ridleyi* was named in 1909 after Henry Nicholas Ridley, who discovered it in today's Bukit Timah Nature Reserve. This species was previously cultivated at MGS in 2006 by science teacher Mrs Lam Mei Kien in the school's life science research laboratory. The

school had purchased stock plants, and cultivated plantlets from them through tissue culture methods. After learning about the school's previous experience with Ridley's Staghorn Fern, Mr Ong (who joined the school after the project), along with Mrs Lam, were hoping to collaborate with the Gardens to reintroduce this unique and beautiful native fern back into Singapore.

A meeting was convened at the Gardens' Ridley Hall in late January 2016. During the meeting, the original objective of working toward the conservation of Ridley's Staghorn



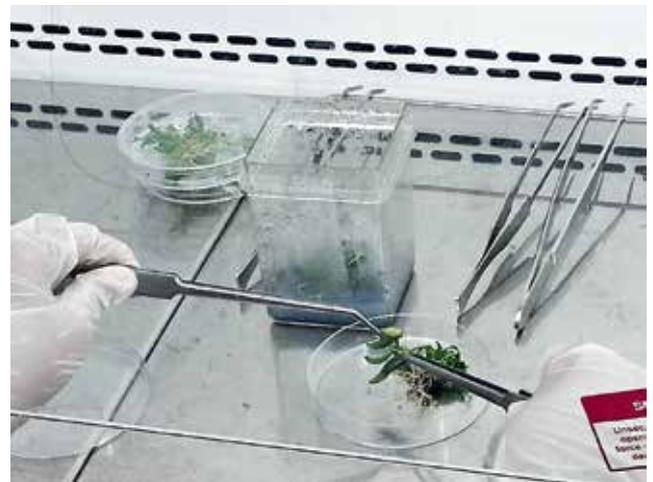
The first collaborative meeting between staff from the Gardens and MGS. From left: Koh Teng Seah, Yam Tim Wing, Lam Mei Kien (MGS), Nigel Taylor, Liu Heock Hing (MGS), May Liow (MGS), Vincent Ong (MGS) and Nura Binte Abdul Karim. Not pictured is Chin Li Li.

(Photo credit: Chin Li Li)



Tour outside the orchid micropropagation laboratory (left) and hands-on workshop on culturing *Globba leucantha* (right).

(Photo credits: Lam Mei Kein and Ho Boon Chuan)



Demonstration of orchid culture techniques at the MGS laboratory.

(Photo credits: Lam Mei Kien)

Fern evolved into a broader project aimed at assisting Gardens' staff with *in vitro* propagation of native gingers and orchids for reintroduction into Singapore. The micropropagation laboratory is actively engaged in cultivating select species of gingers and orchids via tissue culture, and it was mutually agreed to train the MGS students so that they could get involved in the Gardens' efforts to conserve these native plants.

A site visit to the school's science and research laboratories was arranged for 3 March 2016, in order to assess the suitability of the MGS facilities to carry out micropropagation of native gingers and orchids. Students were selected from the Secondary 2 cohort to take part in the project. The students were to be mentored

by their science teacher, Mrs Lam, and trained by relevant staff from the Gardens. Two workshops were arranged to provide training to the students, one to be held at the Gardens' micropropagation laboratory and the other at the MGS research

laboratory. The workshops were conducted by Mr Koh Teng Seah, Ms Chin Li Li and Ms Koh Siew Lian from the Gardens' micropropagation team, and Dr Yam Tim Wing, Mr Peter Ang and Ms Felicia Tay from the native orchid conservation team.



Aung Thame giving a hands-on workshop on how to acclimatise *Globba leucantha* from the laboratory to the outdoors.

(Photo credit: Koh Siew Lian)



Handing over the uncontaminated flasks with *Globba leucantha* that were cultured by the MGS students at the Gardens.

(Photo credits: Lam Mei Kien)

Mrs Lam and nine students from MGS attended the first hands-on workshop at the Gardens. Before the workshop began, the students were given a briefing about the laboratory and the work done there. Mrs Lam and the students also had a brief talk with the Gardens' ginger taxonomist, Dr Jana Leong-Škorničková, and the curator of the living ginger research collection, Mr Aung Thame, about the gingers selected for their conservation project and how to take care of these plants.

During the workshop, the students were given specimens of the native ginger *Globba leucantha* to kick-start the collaborative project. The students were taught basic tissue culture techniques, which they used to culture their gingers in flasks. The intent was to create 'parent' or stock

material for the students to later propagate in their school laboratory. The students initialled their flasks so that they could track the success (or failure) of their cultures over the next few weeks. To everyone's delight, after three weeks, the flasks contained healthy-looking plantlets with no visible contamination. Considering that the students had just learnt the tissue culture techniques, they had done very well!

On 10 March, Dr Yam and his team led the second workshop at the MGS research laboratory, where he demonstrated the techniques of culturing native orchid seeds and sub-culturing orchid seedlings. Some native orchid culture stocks were also made available to the school for use in practical laboratory sessions.

Besides the workshops, the students also had an opportunity to learn from Mr Aung Thame on the next step after successful culturing, i.e. the potting up of the cultured plantlets and the process of acclimatising the plantlets from the laboratory setting into the more harsh outdoor conditions. Dr Nura and Mr Aung Thame helped to assess the sites within the MGS compound that had been selected for planting some of the native gingers cultured by the students. They advised on site suitability, soil rectification and irrigation, and suggested other native plants that could also be planted at the school.

It is hoped that the Gardens' collaboration with MGS will create awareness in the younger generation of the importance of conserving native plants, and that by exposing the youngsters to the behind-the-scenes work carried out by the Gardens' staff, they will better appreciate the long process behind this important work. This partnership is a small but significant step toward reaching our goal of involving more Singaporeans in our native plant conservation efforts.

The participating students from MGS. (Photo credit: Lam Mei Kien)



Koh Teng Seah
Orchid Breeding and Micropropagation

Nura Abdul Karim
Library, Training and External Relations

Lam Mei Kien
Methodist Girls' School



Learning and sharing...

On 29 March 2016, a 16 member delegation from Hyogo Prefecture, Japan was hosted by the Group Director of the Singapore Botanic Gardens, Dr Nigel Taylor, and assisted by the Deputy Director, Dr Nura Abdul Karim, for a half-day visit. The delegation mainly comprised members of the Hyogo Prefecture Assembly and two staff from the Japan Council of Local Authorities for International Relations, Singapore (CLAIR). The main purpose of the team's visit was to learn about Singapore's greening policies and the nation's transformation into a City in a Garden. The team also wanted to know about the general management of the Botanic Gardens, as one of the top attractions in Singapore. The delegation was given a tour of the grounds following an indoor briefing. The visit went well and our Japanese visitors were very impressed with the careful urban planning and support of the government that has resulted in the vibrant green city that we enjoy today. The delegation also spoke highly of the Gardens' landscape and plant displays.

Another foreign study group was hosted by the Gardens on 4 May 2016. This time the delegates comprised the curator and other staff from the Joseon Royal Tombs Management Office in South Korea. There are 42 royal tombs of the members of the Korean Joseon Dynasty (1392–1910), 40 of which are located in South Korea, while the other two tombs are in North Korea, just north of the Demilitarized Zone that separates the two countries. The Royal Tombs of the Joseon Dynasty, a site which comprises the 40 tombs located in South Korea, was inscribed as a UNESCO World Heritage Site in 2009. These tombs are scattered in over 18 locations in and around Seoul. They were built to honour the royal ancestors of the Joseon Dynasty, to show respect for their achievements, as a symbol to assert their royal authority and to protect their spirits from evil.

The Joseon Royal Tombs Management Office is an affiliate of the Cultural



The Royal Tombs of the Joseon Dynasty, Seoul, South Korea.

(Photo courtesy of the Joseon Royal Tombs Management Office)



The staff of the Joseon Royal Tombs Management Office with Dr Nigel Taylor (centre) and Dr Nura Abdul Karim (far left), prior to their tour of the Gardens.

(Photo credit: Sharona Mohamad)



Dr Nigel Taylor (back row, fourth from left) and Dr Nura Abdul Karim (back row, far left) with the delegation from the Hyogo Prefecture Assembly during their visit to the Gardens.

(Photo credit: Yuyuan Gueh)

Heritage Administration (CHA) of South Korea and is responsible for preserving and managing the Royal Tombs. Since its establishment, the Office has visited various organisations overseas who are in charge of managing and preserving cultural heritage sites inscribed on the UNESCO World Heritage List. The delegates visited the Gardens with the intent of exchanging information and learning about the management of our heritage site. They were also interested in how we take care of our trees, as they would like to better conserve the natural forest surrounding the Royal Tombs. Due to its proximity to the tombs, this forest is considered sacred and has thus been spared from logging and development. This is fortunate because it holds a good number of native Korean trees and other flora.

Dr Taylor was happy to share the history of the Gardens and our journey of becoming inscribed as Singapore's first UNESCO World Heritage Site with the curator of the Royal Tombs, Ms Youngrok Park, and the Management Office staff. Dr Taylor also explained how the site is managed and about our education programmes that aim to introduce the Gardens to members of the public (both local visitors and foreigners). Likewise, the curator took time to present a short clip on the Royal Tombs of the Joseon Dynasty and how they are managed. Overall, both parties found the visit a useful learning experience and vowed to assist each other in the future.

Nura Abdul Karim
Library, Training and External Relations



Not the usual Dendrobiums...

The lovely yellow and red striped flowers of *Dendrobium distichum*.



Dendrobium is a huge genus of orchids that was named by a Swedish botanist and taxonomist, Olof Swartz, in 1799. Currently, the genus numbers about 1,200 species which are distributed throughout tropical and subtropical Asia, the islands of the South Pacific and into Australia. The name *Dendrobium* is derived from the ancient Greek *dendro*, meaning 'tree', and *bios*, meaning 'life', essentially in reference to the epiphytic nature of the members of this genus.

Recently, a number of orchids came into bloom at the National Orchid Garden, including a number of *Dendrobium* species and hybrids. Highlighted here are three *Dendrobium* species with inconspicuous flowers which might have missed the admiration of our recent visitors.

Dendrobium distichum is a medium sized epiphyte that is native to the Philippines, where it is usually found

in swamps, bogs and mangroves by the coast, at elevations ranging from sea level up to 900 m. The leaves are rigid, sword-like and arranged in two rows along flattened, overhanging stems. The attractive flowers are borne on short terminal inflorescences that originate from the apex of the stems. They are about 7 mm wide, with yellow sepals and petals that have red stripes running along their length. The flowers are noted to be slightly fragrant. This orchid is highly



The vanilla-scented flower of *Dendrobium leonis*, with its striking lip.

are usually pale green or yellow and the lip is very pale green and strikingly flushed with dark purple. The flowers have an extremely sweet vanilla-like fragrance which can be detected from a distance. The Botanic Gardens, through its native orchid conservation programme, has been actively propagating and reintroducing this native species into reserves and parks around Singapore.

Dendrobium peculiare is another small to medium-sized epiphytic orchid. It can be found in Peninsular Malaysia and Sumatra, and usually occurs in cool montane forests at elevations of around 1300 to 1700 m. It has basally swollen and slightly zigzag stems with internodes about 2.5 cm apart, which carry several apical, nearly terete (i.e., cylindrical and tapering) grooved leaves, each about 9 cm long. Its species epithet, *peculiare*, refers to its peculiar looking ovo-globular shaped flowers. They arise singly from the apical nodes of the stems and are about 1.5 cm across. The flowers are very short lived and pure white in colour, except for the lip which is tinged in yellow. The lip also has well-developed side lobes.

So the next time you visit the National Orchid Garden, take a closer look at the *Dendrobium* species growing there, especially in the Orchidarium. You might be surprised to find that many have inconspicuous but still lovely flowers, which are an interesting contrast to the large and colourful hybrids showcased in abundance elsewhere in the Orchid Garden.

Nura Abdul Karim
Library, Training and External Relations

David Lim
National Orchid Garden

All photos by David Lim



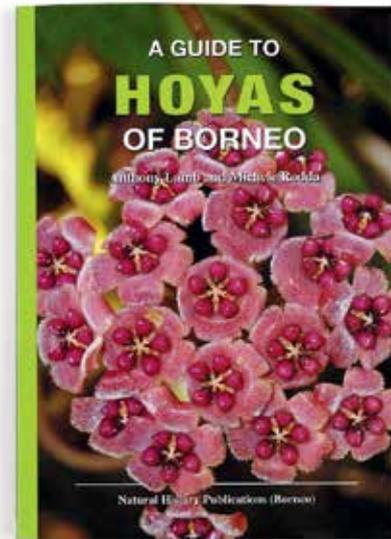
The short-lived flower of *Dendrobium peculiare*.

desirable as an ornamental plant as it thrives under semi-shade conditions. It requires moderate watering.

Dendrobium leonis is a native of Singapore and can also be found in Thailand, Peninsular Malaysia, Laos, Cambodia, Vietnam, Sumatra and Borneo, where it grows in lowland rainforests at elevations of 100 to 1500 m. It is a small to medium-sized epiphyte that occasionally occurs as a lithophyte on limestone cliffs. Its

specific epithet *leonis* is in reference to its flowers which resemble the jaws of a lion. This species has multiple tufted stems and can grow up to 25 cm in length. The leaves are thick and succulent, laterally flattened, smooth and very stiff. They are distichous and overlapping in arrangement, giving the stems a zigzag appearance. The flowers occur singly at the apex of the stems and range from 1.3 to 2.0 cm across. The tepals (the petals and sepals cannot be clearly differentiated)

A Guide to Hoyas of Borneo



by Anthony Lamb and Michele Rodda, with contributions by Linus Gokusing, Steven Bosuang and Sri Rahayu. (With notes on cultivation by N. Simonsson Juhonewe.)

Published in 2016 by Kota Kinabalu: Natural History Publications (Borneo), with the support of Tan Jiew Hoe, President of the Singapore Gardening Society.

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Well known as horticultural plants to many, hoyas nowadays command a following all of their own. The rage has accelerated since the 1990s, with nurseries giving increasing attention to producing and distributing species and forms both for easy

cultivation and as limited collector's items. Hoya societies fuel plant-hunting and an eagerness to find and name novelties but hitherto there has been comparatively little consolidated effort to study these plants scientifically.

As there are an estimated more than 400 species of hoyas within Southeast Asia, a region of extensive landscape transformation, it makes sense to have an organised scientific exploration and review of the taxonomy of this genus. Such a review is now given importance at the Gardens, where Dr Michele Rodda collaborates with both state agencies and local conservation facilities in various countries to achieve more up-to-date inventories of *Hoya* diversity, which can then be assessed carefully against living and reference material. Borneo is a natural first focus, where Anthony Lamb made a fruitful career in agricultural science and cultivated a specialist interest in natural history and horticulturally attractive plant groups, including hoyas. They have teamed up with Linus Gokusing, Steven Bosuang (Sabah's Kipandi Park) and Sri Rahayu (Bogor Botanic Garden) to present this most beautiful introduction to Borneo's hoyas.

Of the 72 known *Hoya* species in Borneo (and there should be more as work progresses), the selection in this book includes an impressive 67 species, accompanied by useful notes and on which are lavished some of the most sumptuous images of these plants ever published. By these alone, this book underscores the beauty and diversity of hoyas.

A prominent feature that distinguishes the scientific basis of this account is the provision of an identification key to the wild and cultivated *Hoya* species known for Borneo. This is an uncomplicated key which many will be happy to use, developed for the identification of live plants. The preamble to the "Selection of Species" includes chapters on their diversity, taxonomic history, general plant structure and distinctive characteristics, environment and habitats, as well as aspects of conservation and notes on cultivation.

Obtain a copy (or more to give away, if you have like-minded friends).

Khoon Meng Wong
Herbarium



January–June 2016



Dendrobium Juan Carlos and Lorena Varela was named after His Excellency Juan Carlos Varela Rodriguez, President of the Republic of Panama, and Mdm Lorena Castillo De Varela, who visited the National Orchid Garden in April 2016. The orchid was presented to them by Mr Kenneth Er, CEO of NParks.

Dendrobium Juan Carlos and Lorena Varela (*Dendrobium* Brandi × *Dendrobium* Ahulani Hinojosa) is a free flowering hybrid with striking purplish red flowers.

H.H. Prince Abdul Fattaah,
Brunei Darussalam

Mr Anders Lindström, Nong Nooch
Tropical Botanic Garden, Thailand

Dr Ang Ming Chee, George Town
World Heritage Incorporated, Malaysia

Dr Art Vogel, Universiteit Leiden,
The Netherlands

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Permanent Representative of Libya
to the United Nations

International Palm Society
with 124 of its members

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Speaker of the Grand National
Assembly of Turkey

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Koo Botanic Conservation
and Environmental Protection
Foundation, Taiwan

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President of the Republic of Panama,
and **Mdm Lorena Castillo De Varela**

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University of Malaya, Malaysia

Dr Yukiko Yamada, former
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Ministry of Agriculture, Forestry
and Fisheries, Japan, and member
of expert panel for Joint FAO/WHO
Meeting of Pesticide Residues

Prof. Yutaka Shiroyama, Graduate
School of Landscape Design and
Management, University of Hyogo, Japan

Mr Zeke Chen Wei-Yen, Dr Cecilia Koo
Botanic Conservation and Environmental
Protection Foundation, Taiwan



Topiary of the Gardens



Children in the Topiary Garden in 1968.



The Topiary Garden in 1969 (top) and 1988 (bottom).

Topiary is the practice of clipping trees and shrubs into different patterns and shapes. Since the days of ancient Rome, topiary has been an important form of garden decoration. Its name is derived from *topiarius*, the Latin term for a landscape gardener. The plants used in topiary are usually evergreen, mostly woody, and have small leaves or needles. Some garden designers view topiary as an integral part of modern gardens and as an art form in its own right. As well as geometric forms, ornamental shapes such as birds and animals are popular topiary subjects.

As many of us know, starting in 1875 the Singapore Botanic Gardens had a zoological collection, but the expense of feeding and housing the animals led to the decision in 1903 to abolish the zoo. But this wasn't the only period of time that animals were featured in the Gardens. In the 1960s, a topiary garden full of fanciful animal forms was created in a small triangular space near today's Ginger Garden. Shrubs of *Carmona retusa* were trained and sculpted on wire supports to assume the shapes of animals such as a dinosaur, an elephant, a crocodile, a dog with a wagging tail and an eagle on the edge of flight.

For many years, the Topiary Garden was a source of joy for our visitors, attracting the attention of children and adults alike. It lasted until 2003, when the space was needed to accommodate a coach drop-off point for visitors to the newly opened Ginger Garden. So the Singapore Botanic Gardens can boast that in our past we had not only a zoo with real animals, but a 'zoo' of fantastical ones too!

Christina Soh
Library