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Cover

A group learns about the growing conditions of fruits and vegetables in the new extension of the Jacob Ballas Children's Garden. (*Photo credit: Derek Liew*) **Editors** Ada Davis, Nigel P. Taylor

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Opposite page

A beautiful view from the Schynige Platte Botanical Alpine Garden in western Switzerland, taken while on a tour following the 6th Global Botanic Gardens Congress. *(Photo credit: Nura Abdul Karim)*

Group Direction



ear Readers, in our last issue we showcased the recently opened Learning Forest and it is a pleasure to report that this 10 hectare addition to the Gardens has started a significant upward trend in our visit numbers. Our high visitor-ship is doubtless being driven further since we opened the major extension to the Jacob Ballas Children's Garden on 10 November (see pages 2-8). That opening also kicked off a very popular Children's Festival, which ran over the following three weekends and included the beginning of the school holidays. It would be hard to imagine any other botanic garden worldwide that hosted as many happy children as the Gardens did during November and December!

As befits a magazine for a botanic garden, this issue features a wide range of articles on plants, algae and fungi, all of which have been researched at different times in the Gardens' history by our scientists. Our three lakes are beautiful components of our heritage landscape, but they are also home to myriad microscopic organisms, amongst them a diversity of algae (pages 9–10). The slightly rude Stinkhorn Fungi also make their fleeting appearances from time to time in our forests, including the Gardens' Rain Forest, where my co-editor Ada Davis tells me she has seen one (check out Serena's piece on pages 24–25). Amongst the true plants featured we have VIP Orchid hybrids, a 'Snowy Orchid' tree (*Bauhinia*), edible gingers for growing at home, a curious Amazonian *Anthurium* and beautifully fragrant night-flowering cacti.

The year 2017 was special for major international meetings, June seeing the once-in-four-years Global Botanic Gardens Congress organised by Botanic Gardens Conservation International (BGCI), of which the Singapore Botanic Gardens is a Patron member. This year's edition was held in Geneva (Switzerland) and included botanical excursions to the Alps (shown above and covered in pages 36-37). A month later was the oncein-six-years International Botanical Congress, held in Shenzhen (China), which attracted a record number of 7,000 participants and was preceded by the Nomenclature Section's meeting to amend the International Code, dealing with the rules on naming plants, algae and fungi (see pages 22–23 and 38–39).

Nearer to home we have accounts of diverse activities at the Gardens, whether behind-the-scenes or in the public domain: re-boxing the SING Herbarium (pages 33-34) and our popular monthly Speaker Series (pages 11–13). Other regular features cover VIP visits, the signing of a Memorandum-of-Understanding and publications by our staff and honorary research associates. Last but not least, try to visit the CDL Green Gallery to see the exhibition of the life and work of Japanese landscape designer, Junichi Inada, before it closes on 1 April 2018. His influence on Singapore's green-scapes as well as at the Gardens has been extraordinary!

Nigel P. Taylor Group Director Singapore Botanic Gardens



The extension of the Jacob Ballas Children's Garden



A 'flying fox' in the forest zone is a popular feature of the new extension. (*Photo credit: Grace Lee*)

is an exciting time to be a youngster at the Jacob Ballas Children's Garden, which has recently doubled in size. Towering tree houses linked by cargo rope bridges cater to the adventurous, a sprawling farm garden with flowering and fruiting edibles captivates young gardeners, and new forest and stream zones enable budding naturalists to make close observations of the plants and animals around. It is no wonder that the garden has been abuzz with activity since its extension opened on 10 November 2017.



The Children's Garden has doubled in size with the addition of the farm, stream, orchard and forest zones. The play, grow, explore and learn areas are located in the original part of the garden.



Colour coded trails for children to play an adventurer, naturalist or gardener for a day can be found within this 'Explorer Map', which is distributed at the visitor services counter at the entrance to the Children's Garden.

Adventurer, Naturalist or Gardener?

The extension comprises four new areas – a farm, fruit orchard, stream and a forest zone. These areas can be discovered using an 'Explorer Map', which has three colourcoded trails and activities that visitors can follow. Young visitors can choose to be an adventurer, naturalist or gardener for the day, and interpretive signs around the garden enrich their experience as they journey along the trails. A tall, airy entrance welcomes visitors to the Children's Garden. This area features festive displays and an interactive multimedia wall for way-finding and games. (Photo credit: Natalie Cheong)





Edibles such as basil, *kai lan*, green beans, tomatoes, corn, and a variety of climbing gourds thrive at the farm garden. (*Photo credit: Natalie Cheong*)



From Farm to Table

The farm is the first zone a visitor will encounter in the new part of the Children's Garden. A path flanked by tall trellises winds through an edible garden towards the farm house. When fruiting, luffas and snake gourds hang from these trellises, making quite a sight to behold. Cobs of corn, tomatoes on vines, eggplants, purple beans, chives and basil can be seen upclose in the garden.

Visitors can build on their interest in edible plants at the farm house. In this sheltered area, they can observe different methods of plant propagation, see plant and food material being composted and learn about where their food comes from. A trip to the farm zone may even inspire children to grow their own



Illustrated signs in the farm house explain the concepts of food miles and water footprints to visitors, helping them develop an understanding of the benefits of eating locally grown food. (*Photo credit: NParks*)

herbs and vegetables at home. This may make them more willing to eat their greens, and will also help to lower their greenhouse gas emissions by reducing the distance that food has to travel before reaching their dinner plates!



Colourful, eye-catching treats from the orchard zone. Clockwise from top left: Butter fruit from *Diospyros blancoi*, fruit of the Cempedak (*Artocarpus integer*), and flowers and fruit of Jambu Air (*Syzygium aqueum*). (*Photo credits: Natalie Cheong*)



Visitors have a panoramic view of the surroundings from this bridge and can observe animals, flowers and fruits up-close in the canopy of the fruit trees planted nearby. (*Photo credit: Natalie Cheong*)

Fruit Orchard Canopy Walk

Following the theme of cultivating edibles, the gardener's trail leads visitors up a bridge near the fruit orchard, allowing them to enjoy the green and gold shades of the tree canopy and a calming view of Eco Lake. During the fruiting season, additional splashes of reds, oranges and purples add a cheerful touch to the landscape. The Butter Fruit tree (Diospyros blancoi), a relative of the Persimmon, can be seen here, with its hairy orange fruit that are said to taste buttery and creamy. Further along the bridge, visitors will find Chiku (Manilkara zapota), Guava (Psidium guajava) and Jambu Air (Syzygium aqueum), as well as a variety of other fruit trees. Amongst all the trees growing here, the tastiest fruit comes from the Mangosteen (Garcinia mangostana), which is a favourite treat for squirrels and birds in the Children's Garden.



This naturalised pond in the stream zone is a dragonfly haven and a stop-over during many of our nature-based programmes. (*Photo credit: Cyrena Lin*)

Naturalising the Stream

Upon descending the bridge, a captivating streamside landscape

opens towards the right. Various species of water-loving *Dillenia* bear their showy flowers proudly, and are

interspersed by taller *Barringtonia* trees. Some of these species are of high conservation value due to their



shrinking wetland habitats. These water-loving plants are situated in an area that naturally collects water from the surrounding area before flowing into the adjacent Eco Lake. A concrete drain that was once present here has now been removed, and the area has been naturalised into a stream and pond habitat – a haven for many species of dragonflies and butterflies that children can enjoy spotting here.

Fantastic Forest

Arguably the most popular area among our young visitors is the forest zone. Tucked within a Ficus and Garcinia collection, the adventure play area has three tree houses nestled around a magnificent Malayan Banyan (Ficus microcarpa). Perched high above the ground, the tree houses are a hideaway with a view of a beautiful Inocarpus fagifer Heritage Tree. Birds are often spotted sitting on its branches, and children enjoy this vantage point before taking a ride on the 'flying fox'. The excitement is palpable as children queue to try out this new feature, which simulates the movement of gliding animals through the forest as they swoop from tree to tree.

Educational Programmes

To celebrate the opening of the Children's Garden extension, a Children's Festival was held over 16 days, from 11 to 26 November. During the celebration, children were given a teaser of the new and existing programmes run by the Gardens' Education team. These include the new 'Farm to Table' programme, a series of workshops teaching children how to grow edibles that they can use to whip up a meal. 'Nature Rambling' is another new programme which takes young explorers along a trail where experienced guides introduce them to wetland ecosystems and the creatures that live amongst leaf litter. A 'Culinary Art and Treats' series inspires young chefs in the new kitchen classroom.



Young visitors from My World @ Hougang learning about the plants and animals of the forest zone while on a guided tour. (*Photo credit: Hayuni Hadi*)



A tomato themed 'Farm to Table' workshop introduces children to the art of growing plants, and teaches them how to utilise the food they harvest by making a simple and delicious tomato bruschetta in the kitchen. (*Photo credits: top, Grace Lee; bottom, Jessica Chan*)



(Left) Examining the hydrophobic qualities of aquatic leaves, and (right) checking out what lives in the leaf litter during a 'Nature Rambling' programme. (Photo credits: left, Natalie Cheong; right, Cyrena Lin)



(Left) Creating imaginative masterpieces with river stones at the Nature Play pavilion, and (right) a demonstration on how flowers, bark, leaves and fruit can be used to flavour teas. (Photo credits: left, Derek Liew; right, Taufiq Jumal)



(Left) A mobile library booth offering books on plants and animals for children to borrow through a partnership with the National Library Board, and (right) children baking gingerbread cookies during the Children's Festival. (Photo credits: Cyrena Lin)





Examining plant spores and their unique adaptations through a microscope during a 'Microplant Detective' workshop. (*Photo credits: left, Winnie Wong; top right, Jessica Chan; bottom right, Sarah Seo).*



Children at a dramatised storytelling session learning about the importance of habitats. Here, they assume the roles of bees, butterflies, trees and a farmer to act out a story. (Photo credit: Jessica Chan)

The Education team will also be extending its guided tours into the new part of the Children's Garden, and will continue to run programmes such as 'Microplant Detective', a workshop that explores plants using microscopes, and the 'Celebrating Wildlife' series, which teaches children about birds of the night, adaptations of water dwellers and insect characteristics. The 'Drama in Nature' and 'Craft with Us' programmes have a loyal following, and we will continue to run these at the Children's Garden.

Natalie Cheong *Education Branch*

Article

Algae, the unseen beauties in the Gardens' lakes

The world that we live in, well-lit with fluorescent light, incandescent bulbs and neon, is a far cry from the world of phytoplankton. When viewed with sensitivity and a microscope though, one can see that their world blossoms with beauty. Curious about what algal species might be inhabiting the Gardens' lakes, we recently conducted a simple study, and were delighted at the interesting organisms that we found.

Algae, which have been known since ancient times, were traditionally grouped as plants. Carl Linnaeus first introduced the term 'algae' in 1753, but it was Antoine Laurent de Jussieu who later separated these organisms from the plant kingdom. At present, approximately 44,000 species of algae have been described, including at least 3,300 species of cyanobacteria (formerly known as blue-green algae), more than 6,000 species of rhodophytes (formerly known as red algae), and no less than 4,500 species of charophytes (green algae) with an estimated 5,000 species remaining to be described. Found in water, on land, growing on plants as epiphytes, or even within organisms as endophytes, algae are ubiquitous and of universal occurrence. They range in size from giant sea kelp to microscopic freshwater phytoplankton, the latter of which mostly includes species of cyanobacteria and green algae.

Algae have numerous uses, including for food, as photo-bioreactors to produce biofuel, and to reduce pollutants. They are also used in health supplements. Popular as a 'superfood' are the cyanobacteria known as Spirulina (*Arthrospira* spp.), which contain minerals, antioxidants and vitamins and offer a host of human health benefits.

In the Gardens, we have three iconic freshwater bodies – Eco Lake, Symphony Lake and Swan Lake – and these provide homes for some elegant species of freshwater phytoplankton. To scrutinise these inconspicuous organisms, all we needed was a phytoplankton net and a compound microscope. A phytoplankton net is a simple device, usually just a conical-shaped net bag attached to a mesh filter at the bottom. To collect our algae samples, we hauled the net through each of the Gardens' water bodies, then flushed the algae through the mesh filter and into collection tubes. Algae are delicate and begin to degenerate pretty soon after collection – to keep them fresh for as long as possible, we avoided overfilling the collection tubes, leaving some air space for them to



A species of Cosmarium from Symphony Lake.



A species of Closterium from Eco Lake.



A species of Staurastrum from Swan Lake.





A species of Staurastrum from Symphony Lake.



A species of Pediastrum from Eco Lake.



A species of *Spirogyra* from Symphony Lake.



A species of Pediastrum from Swan Lake.

'take a breather' (pun intended). We were also careful to keep the samples cool.

To capture the sophisticated features of the algae under the microscope, we added a few drops of Lugol's stain. The most abundant species that we found were types of green algae, which also constitute the largest group of algae in the world. Green algae come in a plethora of shapes, with some having little spikes or dots on the surface of their body, and some even with flagella for motility. Green algae have a cellulose cell wall, surrounded by a gelatinous layer in some species, and also contain chloroplasts that make them oxygenic photosynthesisers. The species of green algae that we recorded belong to the genera *Cosmarium, Closterium, Pediastrum, Spirogyra* and *Staurastrum*. Interestingly, we also detected a species of the cyanobacteria Spirulina in Symphony Lake.

Despite their exquisite beauty, freshwater algae go unnoticed by most people. So the next time you stop to admire the calm waters of the Gardens' lakes, take a moment to also appreciate the tiny algae living there.

"Everything has beauty, but not everyone sees it." (Confucius)

Ho Boon Chuan *Herbarium*

Regina Yeo Singapore Botanic Gardens' Volunteer

All photos by Regina Yeo



The Gardens' Speaker Series

E ach month, the Gardens hosts speakers from around the world to share their expertise on nature-related topics. For more than a decade, eminent visiting botanists and distinguished local scientists have used this platform to share their passion and the fascinating stories behind their research work. In more recent years, the series has also attracted passionate nature educators and partners who work

in environmental education and conservation.

The Speaker Series offers members of staff as well as the public an opportunity to hear first-hand accounts of exciting work being done across the globe in a wide range of areas.

These talks are free of admission charge, and also casual so registration is only required 15 minutes prior to each talk. You can find out more information on our website (www.sbg.org.sg).

Highlighted here are some examples of the recent talks conducted through the series. We hope that they entice you to keep an eye out for upcoming instalments in 2018!

Winnie Wong Education Branch

Exploring Cloud Forest Karst in Northernmost Vietnam, by Mr Bian Tan (January 2017)





(Above) Karst pinnacles and (left) a local villager in northern Vietnam. (Photo credits: Bian Tan)

In this talk, Mr Bian Tan shared images of plants, people and dramatic landscapes from Ha Giang Province in Vietnam. Mr Tan is an environmental consultant and nature educator, and visited the area at the request of the Hanoi University of Pharmacy. The goal of the trip was to survey the site of a medicinal plant conservation centre intended to benefit local hill-tribe cooperatives by providing them with horticultural expertise as well as interpretation of their cultures to foreign visitors.



Kitchen Gardens in Maharashtra, India – The Home-Grown Way to Happiness, Empowerment and Sustainability, by Dr Claire Elouard (April 2017)



(Left) A kitchen garden in India and (right) a villager with her vegetable harvest. (Photo credits: Claire Elouard)

In this presentation, Dr Claire Elouard shared an initiative to empower tribal village women in India through the creation of kitchen gardens. Using grey water (water discarded from bathing or dishwashing), vermi-compost and organic fertilizer, they are able to sustain these gardens and supply their families with fresh food. Extra produce can be sold for income to help improve their homes, pay for expenses or start small-scale businesses. Dr Elouard is an environmental consultant and the founder of the Sukh Bhumi India Trust, the non-governmental organisation which initiated the kitchen garden project.

An Amazônian Experience - New Year in Northern Brazil, by Dr Nigel Taylor (June 2017)



(Left) The Tapajós River where it is 9 km wide, taken from a hill at Alter do Chão, and (right) a village church on the Amazon River. (Photo credits: Nigel Taylor)

Our very own Dr Nigel Taylor, Group Director of the Gardens, presented this talk about a three-week adventure in the Amazon. Traveling with his wife, Dr Daniela Zappi, who is currently working in Brazil, they embarked on their trip near the confluence of the Tapajós and Amazon Rivers. From there, they took a 44-hour, 300-km long boat journey down the river to Belém, the capital of the state of Pará. During the talk, Dr Taylor shared images of the stunning scenery encountered on the journey, from the great Amazon River itself to colourful villages, small ports, forests and even the famous Teatro Amazonas opera house built in 1896 from the riches of the first rubber boom.

From Nature to Creation – Exploring New Ways to Innovate in Naturals, by Hervé Fretay (September 2017)



Givaudan is a pioneer in ethically sourced naturals, including (top) lavender and (bottom) rose petals. (*Photo credits: Givaudan*)

Mr Hervé Fretay is the Global Director of Naturals for the Fragrance Division of Givaudan. His talk focused on the use of natural ingredients to create perfumes, which dates back to ancient Egyptian times and emerged as one of the earliest global businesses in the history of humankind. Mr Fretay explained that the international trade of perfume grew through the establishment of colonial routes which allowed for greater trade and the exchange of plant species. In more recent years, the perfume industry has evolved due to the development of new extraction techniques. Givaudan sustainably sources its natural resources, and ensures that local communities are treated fairly in the process.



New to cultivation in Singapore – *Anthurium gracile*

The large tropical New World genus Anthurium, from the Arum family (Araceae), is well known to gardeners from species such as the popular A. andraeanum and its many cultivars, with variously bright coloured spathe bracts, or from other species and hybrids, such as A. superbum and A. radicans \times A. dressleri, with attractive foliage. The recently introduced A. gracile, however, has different merits and is certainly worth growing if for no other reason than as a curiosity. A. gracile is widespread in the Amazon basin as an epiphyte or epiphytic climber. It can also be seen on street trees in towns and cities from this vast region and might almost be described as weedy in nature. So what is curious about this unassuming plant?

Grown from seed it develops remarkably quickly and can become reproductively mature in as little as six months. The first surprise is that the seeds germinate in only 48 hours and the tiny first leaf arises from a flattened first root (radicle) which is green and obviously photosynthetic. As soon as the first leaf expands the first aerial root emerges from the diminutive shoot and is almost thicker than the stem that bears it. Thereafter the leaves and aerial roots develop in equal numbers and both are green. Later, as the mature leaves begin to develop, the aerial roots continue to appear in profusion, but they have changed their appearance, which now exactly imitates those of epiphytic orchids, i.e. with the characteristic off-white epidermis, bright green growing tip and the ability to fix the plant to its perch as if with super glue. If one of these is detached from the plant and shown to an orchid expert, I guarantee the expert will say it is an orchid root! Soon after these roots develop the observant grower may notice that the plant is already bearing clusters of pinkish red fruit, yet its flowering apparently went unnoticed.



A fruiting Anthurium gracile.





The orchid-like roots of Anthurium gracile.



The spadix of Anthurium gracile.

These first clusters of fruit are borne very close to the stem and are almost hidden amongst the dense mass of aerial roots.

By 9 months old the plant is producing different, very long, slender inflorescences at the tip of which are inconspicuous spathes coloured either green or dark brownish and subtending the column of minute flowers otherwise known as the spadix. The inflorescences cannot be described as attractive, but nevertheless are obvious as they extend out from beneath the narrow pointed leaves, which are held more or less upright. After some weeks the observant grower will notice that the minute flowers along the dark brown spadix are exuding drops of nectar, which glisten in the sunlight. Some weeks after this the tiny spadix suddenly transforms itself as relatively large red fruits burst out where the flowers had been. This is the most attractive aspect of the plant and if a clump of seedlings is allowed to develop together, the bunches of berries can be borne in large numbers. The original stems will also branch at their bases and together with the ever present aerial roots can make what is otherwise a modest plant into a dense mass of greenery.

Cultivation of this species outdoors in Singapore seems easy. It can be grown in a hanging basket in very open compost, or allowed to climb up a post dressed with sphagnum moss or coconut fibre, which will need to be sprayed with water regularly. It takes partial sunshine, such as in the morning or the afternoon, but seems to prefer more shade than sun. Its propagation by either stem cuttings or seed is rapid. The whitish seeds should be separated from the sticky fruit pulp and merely placed upon the compost in the pot, not buried, and sprayed gently every day.

Nigel P. Taylor Group Director Singapore Botanic Gardens

All photos by Nigel P. Taylor



The Gardens' orchid hybrids and its VIP Orchid Programme

The Gardens' orchid breeding programme was initiated in 1928 by Eric Holttum, the Director of the Gardens at the time. Holttum created a laboratory to experiment with orchid breeding and hybridisation, and the results were free-flowering hybrids which laid the foundation for the multi-million dollar cut flower industry in Singapore.

Our orchid breeding programme has progressed since Holttum's time

with the continuous acquisition of new species and stud plants that enable us to create new and exciting hybrids. Our process begins with the selection of the parent plants based on a desired set of traits, which are then cross-pollinated. Once fertilisation is successful, the seedpods are sent to the laboratory for seed sowing and germination. When the seedlings reach a certain size, they are transferred to the orchid nursery where they continue to grow and transition from the protected environment of the laboratory to harsher outdoor conditions. The smaller seedlings are initially housed in community pots while the bigger ones are placed in individual 'thumb' pots. As they mature, they are transferred to larger clay pots and placed in bright light conditions to encourage flowering.

When the plants finally flower, they are subjected to a rigorous selection process. We look at the characteristics of the flowers,



A Gardens-bred orchid hybrid was named for The Prince of Wales and The Duchess of Cornwall on 1 November 2017. Here, the royal couple enjoy a stroll through the famous Golden Arches of the National Orchid Garden following the official naming ceremony. (Photo credit: NParks)



Aranda Malcom and Lucy Turnbull being presented to the Prime Minister of Australia and his wife by the CEO of NParks, Mr Kenneth Er, in June 2017. (*Photo credit: NParks*)



Group Director of the Gardens, Dr Nigel Taylor, presenting the Prime Minister of the Republic of Turkey with his VIP Orchid in August 2017. (*Photo credit: NParks*)

frequency of flowering, length of flower spray as well as overall plant vigour. Our aim is to create new free-flowering hybrids that are improvements over our existing orchid collection in terms of the colour, shape and size of the flowers, as well as how long they last. New hybrids that do not fit the criteria we're looking for are removed from the nursery to provide room for other hybrids to grow.

Over the years, we have succeeded in amassing a large collection of Gardens'-bred hybrids. To date, more than 600 of these have been registered with the Royal Horticultural Society (the international registration authority for orchid hybrids), making the Gardens the most prolific originator of orchid hybrids in Singapore.

The Gardens' hybrids are known worldwide for being exquisite and special, and the best of them are selected as agents to foster ties between Singapore and other nations. Usually free-flowering dendrobiums or vandaceous hybrids, they are named for state dignitaries through our VIP Orchid programme. The first VIP Orchid, Aranthera Anne Black, was named in 1956 after Lady Black, wife of the former Governor of Singapore, Sir Robert Black. In the more than 60 years since, more than 200 exclusive orchid hybrids have been named after important dignitaries.

The VIP Orchids are officially presented in a naming ceremony that takes place in the National Orchid Garden. After the naming, the orchid is cloned to ensure that the hybrid can be displayed for years to come. These orchids have been bred to do well in our equatorial climate, and they make beautiful additions to our landscape displays in the National Orchid Garden. When in bloom, they





Dendrobium Sheikha Fatima bint Mubarak (Dendrobium Jaquelyn Thomas × Dendrobium nindii)

This orchid was named after Her Highness Sheikha Fatima bint Mubarak, Mother of the Nation, United Arab Emirates, on 22 March 2017. (*Photo credit: David Lim*)



Renanthera Thongloun Sisoulith (Renanthera Kalsom × Renanthera Yvonne Bouquin)

This orchid was named after His Excellency Dr Thongloun Sisoulith, Prime Minister of the Lao People's Democratic Republic, on the occasion of his visit to the National Orchid Garden on 2 May 2017. (*Photo credit: David Lim*)



Dendrobium François Hollande (Dendrobium taurinum × Dendrobium Noor Aishah)

This orchid was named after His Excellency François Hollande, President of the French Republic, on the occasion of his visit to the National Orchid Garden on 27 March 2017. (*Photo credit: David Lim*)



Dendrobium Binali Yıldırım (Dendrobium Sunplaza Park × Dendrobium Ruby Las)

This orchid was named after His Excellency Binali Yıldırım, Prime Minister of the Republic of Turkey, on the occasion of his visit to the National Orchid Garden on 21 August 2017. (*Photo credit: David Lim*)



Aranda Malcolm and Lucy Turnbull (Arachnis hookeriana × Vanda Rockhampton Gold)

This orchid was named after The Honourable Malcolm Turnbull, Prime Minister of Australia and Mrs Lucy Turnbull, on the occasion of their visit to the National Orchid Garden on 2 June 2017. (*Photo credit: David Lim*)



Dendrobium Duke Duchess of Cornwall (Dendrobium Halawa Beauty × Dendrobium Blue Diamond)

This orchid was named after Their Royal Highnesses, The Prince of Wales and The Duchess of Cornwall, on the occasion of their visit to the National Orchid Garden on 1 November 2017. (*Photo credit: David Lim*)



Dendrobium Viktor Orbán (Dendrobium Bengawan Solo × Dendrobium Tristar Power Hybrid)

This orchid was named after His Excellency Viktor Orbán, Prime Minister of Hungary, on the occasion of his visit to the National Orchid Garden on 27 September 2017. (Photo credit: David Lim)



Dendrobium Frank-Walter Steinmeier (Dendrobium Seletar Tanduk × Dendrobium Sunplaza Park)

This orchid was named after His Excellency Frank-Walter Steinmeier, President of the Federal Republic of Germany, on the occasion of his visit to the National Orchid Garden on 3 November 2017. (*Photo credit: David Lim*)

are put on show in a special VIP Orchid area just outside of the historic Burkill Hall.

The Gardens named a number of its spectacular orchid hybrids for important dignitaries in 2017. Some examples are presented here.

Whang Lay Keng David Lim National Orchid Garden



Two Epiphyllums for easy cultivation in Singapore

genus Epiphyllum The includes a number of epiphytic cactus species with flattened stems resembling leaves. The name comes from the Greek *epi* = on/upon, and *phyllon* = leaf, indirectly referring to the flowers which appear to be borne upon leaves, though in reality these are stems! At the outset it is important to stress that, botanically speaking, these are the cacti with slender white nocturnal flowers, not the so-called 'orchid cacti' also popularly known in horticulture as epiphyllums which, however, have highly coloured day-time flowers and are species and more often hybrids belonging to the genus Disocactus. Both genera are native to tropical America, *Epiphyllum* ranging from southern Mexico and the Caribbean southwards to Southern Brazil and

Argentina. While many cacti, other than those that bear true leaves, usually struggle to grow in Singapore's climate outdoors, with its very warm nights to which their physiology is unsuited, the true Epiphyllums do well here as long as the situation is a sunny one and the substrate well-drained. Two rather different plants will be described and illustrated now, but there are various others worth experimenting with, including *E. hookeri, E. oxypetalum* and *E. thomasianum*, the last two of which can be seen in the Botanic Gardens' Fragrant Garden.

Epiphyllum pumilum

This very pretty species deserves to be more widely grown and is easy to propagate, so it is strange that it is currently not more popular (however, we know plants go in and out of fashion). If planted in a hanging basket it will grow vigorously until its roots become cramped, when it will start to flower regularly. Large plants can open dozens of flowers in a single night, which fill the air with their delicious sweet fragrance. Like the closely related, but much larger-flowered E. oxypetalum, the flowers can be made into soup, their mucilaginous quality being popular in China where E. oxypetalum is often cultivated for this purpose and is even included in the Flora of China. E. pumilum originates from southern Mexico and Guatemala. Its flowers, though somewhat variable in size, are amongst the smallest in the genus (hence the epithet pumilum), but are often borne in large numbers, in coordinated flushes every three to four weeks. They open around 11pm and



Epiphyllum pumilum flower-bud.



Epiphyllum pumilum growing in a container alongside multiple other epiphytic cacti.



Epiphyllum phyllanthus 'Curly'.



Epiphyllum phyllanthus 'Curly' seedlings, with their stems already curling.

only close as the sun's heat strikes the plant the following morning. Fruits are not normally formed in Singapore as I suspect the plant is represented by a single self-incompatible clone. In nature the flowers probably attract hawk moths, but these insects have not been observed visiting them in Singapore. After many flowerings the plant may run out of un-used flowering areoles, the inconspicuous felted cushions that characterise all cacti and in desert species bear the familiar spines that are normally absent in most Epiphyllums. Since these areoles can only produce a single flower, fresh ones need to be developed on new growth if the plant is to continue to bloom, which can be stimulated either by pruning and then feeding the plant with a balanced fertiliser, or by moving it into a larger container. Alternatively, a cutting can be taken from the mother plant and grown on until it becomes root-bound, when flowering will begin again.

E. phyllanthus 'Curly'

The typical naturally-occurring forms of this species look rather different to the dwarf mutant form discussed here, which I suspect is known only in culture. I first encountered it on sale in a local market during Lunar New Year in 2012, when the plant on offer at a high price was ornamented by its deep pinkish fruits. Later, I acquired a specimen from another market at a fraction of the earlier asking price. Typical *E. phyllanthus* is a widespread tropical American epiphyte, ranging from Colombia southwards to Argentina and very common in Brazil, where it displays a broad ecological tolerance. Its relatively large and broad flattened stems are straight and can reach 1 metre in length. The tubular flowers are often extraordinarily long and open their contrastingly small perianths to attract a specialised hawk moth with a very long proboscis and analogous to that which visits the famous Madagascan Comet Orchid (Angraecum sesquipedale), as famously predicted by Charles Darwin before the actual insect was known to science. The mutant cultivar named here is unusual in various ways. Apart from the dwarf size of all its parts, the stems refuse to grow in a straight line, but instead curl irregularly into contorted configurations. The flowers, which often fail to open properly (i.e., they are cleistogamous), are very short for the species and consistently set fruit, indicating that this clone is selfcompatible. Moreover, the fruits are packed with small seeds, only around 2 mm long (the seeds of typical wild forms are at least 4 mm) and if these are sown the seedlings that develop are identical to the parent plant, with stems that curl from the start, suggesting that this mutant is genetically determined. This is a somewhat weird horticultural freak that nevertheless has attractive fruits. As a final observation I should note that the epithet phyllanthus effectively repeats the generic name's intended meaning, again using the Greek: *phyllon* = leaf, and *anthion* = flower!

Nigel P. Taylor

Group Director Singapore Botanic Gardens

All photos by Nigel P. Taylor



The International Code of Nomenclature for algae, fungi and plants

In previous 'Taxonomy Corner' articles I have referred to the *International Code of Nomenclature for algae, fungi and plants* (ICN) but in this article I want to explain what it is, how it has evolved over time, and how it is governed.

The ICN is the set of rules to ensure stability and clarity in the naming of algae, fungi and plants. That species have a single name that we agree upon is something that most people take for granted. We can do this only because we have a complex set of rules that governs how algae, fungi and plants are named, including provisions on how to apply the rules for those named in the past when the standards were much woollier.

There are a number of different Nomenclatural Codes for the naming of biological organisms. Apart from the one governing the names of algae, fungi and plants, there is the International Code of Nomenclature for Cultivated Plants (ICNCP), the International Code of Zoological Nomenclature (ICZN) and the International Code of Nomenclature of Bacteria (ICNB). There are also systems for viruses and the classification of plant communities. Each of these Codes has its own set of rules and its own way of being governed. Apart from the ICNCP which builds upon the ICN, they are independent of each other although they share many common principles. One of the fundamental rules in the naming of algae, fungi and plants is that no two organisms governed by the ICN can have the same name. If they do, then these are called homonyms and the one published later is considered illegitimate. The same is not true across the Codes, which is why Pieris the plant and Pieris the butterfly, and Vallaris the plant and Vallaris the extinct rodent,

are all allowed – because in each case the names arose separately under the rules of the ICN and ICZN. Both Codes only bar homonyms for organisms governed by their own Code (although the ICN at least recommends against creating new cross-*Code* homonyms). Recent attempts to bring these Codes together under a unified *BioCode* have been unsuccessful, with little support from both botanists and zoologists.

A systemised approach to naming algae, fungi and plants first began in 1753, which was the year that Linnaeus published his Species *Plantarum* and the binomial was coined (see Gardenwise 43, page 26). Slowly, conventions arose as to how plants (and at that time algae and fungi were also considered to be covered by the word 'plant') should be named, along with competing treatises on best-practice. It was not until the 1867 Botanical Congress in Paris that the international botanical community adopted written rules. Between 1867 and 1930, innumerable botanists and committees of botanists, along with polemicists of various shades, added their great wisdom to the debate. This resulted in many splits, often along national lines, and many competing sets of rules. These splits were slowly resolved such that by the early 20th century there remained only one serious split between those who followed the American Code of Botanical Nomenclature, first published in 1904, and those who followed the various editions of the Code formulated under the auspices of the International Botanical Congress (IBC). There were fundamental differences in practice between these two Codes, and they remained quite separate until the schism was healed at the IBC in Cambridge in England in 1930. The Cambridge Code was only published in 1935 but could really be considered

to be the first truly international *Code* that all botanists would uphold. It arose out of compromise between the American and International Codes, adopting the best of each.

Arguably the next most important step was the establishment of the International Association of Plant Taxonomists (IAPT), which arose out of a meeting held in Stockholm in 1950. All future proposals to amend the ICN, and many wider discussions on nomenclature, were then channelled through the IAPT's journal *Taxon*. This concentration of nomenclatural matters into one forum has made it much easier for the wider botanical community to keep abreast of developments.

The rules governing the naming of algae, fungi and plants are still discussed and revised at the Nomenclature Section meetings that are part of each IBC. The latest such meeting was held in Shenzhen, China, in July 2017 (see pages 38-39) and the decisions made there will lead to a new edition of the International *Code of Nomenclature for algae, fungi* and plants which, following earlier precedence, will be abbreviated to the ICN and, when distinguishing it from other editions, will also be referred to as the Shenzhen Code. At these Nomenclature Sections, each participant has a vote but Singapore Botanic Gardens as an institution also has three votes. The taxonomists at the Gardens, therefore, met before the IBC to discuss how we should cast these three votes on each proposal, almost 400 in all. The proposals themselves are published in the journal Taxon between the Congresses and then summarised and distributed for consideration before each Congress by the secretariat.

An important decision made in Shenzhen was to formalise in much



more detail the procedures by which the ICN could be amended. Currently, there is a short description of the procedures, referred to as Division III, but this really only sets out the roles of office bearers and who may vote on amendments to the ICN, not how the voting should proceed. Until now, most procedures for the Nomenclature Section, including how voting would be done and the thresholds to pass proposals, were set out at the beginning of each meeting. The new version is much longer and more detailed about the processes and procedures before, during and

between the actual Nomenclature Sections.

Another important proposal at the Shenzhen meeting was that provisions in the ICN that apply only to fungi, and never to algae or plants, henceforth will be debated and voted on at International Mycological Congresses rather than at the Nomenclature Sections of International Botanical Congresses. This proposal was passed following much debate as to whether this was the start of a split into separate botanical and mycological Codes. The next Nomenclature Section of the International Botanical Congress will be in 2023 in Rio de Janeiro in Brazil. So soon after the IBC in Shenzhen it is tempting to believe that we must have resolved all pressing nomenclatural issues, but by 2023 botanists around the world will have published dozens, probably hundreds, of new proposals to amend the ICN again and the debate will be renewed.

David Middleton *Herbarium*



Phallus or Stinkhorn Fungi

erhaps no organisms in nature are more suggestive than those belonging to the aptly-named fungal group Phallus. A major genus in the family Phallaceae, the Dictionary of the Fungi (10th Edition) estimates that there are 18 species of Phallus. They are characterised by their development from an 'egg' (known as a volva) into an upright fruiting body which bears a mass of spores. Known as a gleba, this spore mass can smell yeasty and bread-like to foetid, depending on its stage of development and the species. Phallus are commonly known as Stinkhorn Fungi because of this odour, which attracts flies for spore dispersal.

Interestingly, Stinkhorn Fungi are edible. If a menu has 'bamboo pith', or 'bamboo fungus' listed among the ingredients of a dish, it is likely to be *Phallus indusiatus*. This species is also known for its health and nutritional benefits, and can be purchased from Traditional Chinese Medicine stores dried. On inspection, it can be recognised easily in these shops by its indusium and pseudostipe.

Stinkhorn Fungi can be distinguished from one another by their receptacle (or cap), which can be glabrous, rugose, reticulate, etc., with a perforate or imperforate apex (the pore). Some species may have a net-like 'skirt' at the base of the gleba called an indusium, and this can vary in length. Other characteristics can be used to differentiate the species as well, such as the colour of the stipe, the surface texture and colour of the volva, the shape and colour of the cap, and the size, shape and colour of the spores.

Recently, a Stinkhorn Fungus appeared just outside of the Herbarium at the base of some bamboo plants. Its location was convenient as we were able to monitor it at different stages of maturation. Based on its appearance, we believe it to be *Phallus atrovolvatus* (see figures 1–3). First described in 2005 from Costa Rica, this species has also been recorded in India. Although our fungus looks morphologically similar to the specimens from both Costa Rica and India, it would be interesting to confirm via molecular sequencing that they are indeed the same species.



Fig 1. A longitudinal section through the smooth greyish 'egg' of Phallus atrovolvatus.



Fig 2. *Phallus atrovolvatus* at different stages of development: (right) the undeveloped 'egg'; (centre) the fully emerged fruiting body before the indusium fully comes down; and (left) the fully developed fruiting body just before the gleba becomes a stinky, gluey mess (to attract flies for spore dispersal).



Fig 3. *Phallus atrovolvatus*. Though its gleba was not yet fully mature, flies were already beginning to gather on it.



Fig 4. Newly emerged *Phallus multicolour* from Bukit Timah Nature Reserve.



Other species of Stinkhorn Fungi known from Singapore include *Phallus multicolour* (shown in figures 4–5). It would be exciting to discover if there are any unrecorded species in our City in a Garden, so if you chance upon any interesting-looking specimens, please send photographs in to the Herbarium!

Serena Lee Herbarium

All photos by Serena Lee

Fig 5. A dried specimen of *Phallus multicolour* from the Herbarium's fungal collection.



Gingers Galore!

The Zingiberales, more commonly known as the Ginger order, consists of eight plant families comprising gingers and their relatives. They yield numerous familiar species that are used as ornamental landscape plants, cut flowers, food crops, spices and traditional herbal medicines. Many of these plants can be admired at the Ginger Garden and Heliconia Walk of the Singapore Botanic Gardens.

The true gingers make up the largest family (the Zingiberaceae) in the Ginger order. Its members are herbaceous plants which spread via rhizomes and produce leafy shoots called pseudostems. Their inflorescences are produced basally, apically, or both, depending on the species, and they may or may not be showy.

In Singapore, various ginger species are used in landscaping for their longlasting inflorescences and lush foliage. Edible gingers are used to whip up a tantalising range of local dishes as well. Rhizomes of Ginger, Turmeric and Greater Galangal and the unopened inflorescences of the Torch Ginger are commonly seen in supermarkets and wet markets, with the Geylang Serai Market and Tekka Market having the widest variety of edible gingers in Singapore. Rhizomes purchased from these markets can easily be propagated into plants at home. They can be planted whole or cut into pieces, but in the latter case, care should be taken to ensure they have a growing point. All of the species mentioned here should be planted in soil rich in organic material that is able to retain moisture but also drains well.

Torch Ginger

The most visually outstanding of the edible gingers commonly seen in Singapore is the Torch Ginger (*Etlingera*

elatior). Also known as Bunga Kantan in Malay, this species can grow to a towering height, with its leafy shoots reaching up to 4 m or more. A sizeable clump makes a stately focal point in an outdoor garden, and its flowers attract sunbirds, which feed on the nectar.

The inflorescences emerge from the ground and terminate in a head of flowers surrounded by waxy bracts. As the outer bracts unfurl, the inflorescence looks like a flaming Olympic torch, hence its English common name. The



Immature Torch Ginger inflorescences for sale in a local market.







There are different varieties of Torch Ginger that produce pink, red or white inflorescences. The pink variety is the most common, while the white variety is quite rare in cultivation, at least in Singapore. The red variety does not seem to flower as frequently as the others.

unopened inflorescences are shredded and added to the local Chinese dish *rojak*, to give it a tangy flavour.

The Torch Ginger should be planted in full sun or partial shade. Plants started from rhizomes take about two years before they start to flower, but impatient gardeners can buy established plants from local nurseries.

Greater Galangal

The fresh rhizomes of Greater Galangal (*Alpinia galanga*) are readily available for sale in Singapore's markets. Two types of rhizomes can be found, the tender

young rhizomes which appear pale pink, and the very tough, older ones which are beige. Both kinds are used to flavour curries and other dishes, although the young ones have a less intense flavour.

The Greater Galangal plant is not usually planted as an ornamental, although it has lush leafy shoots that grow in a tight clump. Each leafy shoot can reach up to about 1.5 m in height. Mature plants will produce flowers on erect spikes, and these occasionally lead to round, red fruits that are used in Traditional Chinese Medicine.

Greater Galangal is rather easy to grow and fuss-free. It does best planted outdoors in the ground, in full sun or partial shade.

It can be started from rhizomes at home, or established divisions can be bought from local nurseries.



Rhizomes of the Greater Galangal. (*Photo credit: Jana Leong-Škorničková*)



The flowers of the Greater Galangal. (*Photo credit: Jana Leong-Škorničková*)



Dried rhizomes of the Greater Galangal. (Photo credit: Jana Leong-Škorničková)

Turmeric

The rhizomes of Turmeric (*Curcuma longa*) are well-known for their use in Ayurveda and Traditional Chinese Medicine, and are also a natural source of yellow dye. They are an important ingredient in many curries, and can be used either fresh or in a dried and powdered form. The latter is also used as a much cheaper alternative to saffron in the famous Spanish dish, *paella*. The fresh leaves are also sold in local markets, and these are used to flavour fish curries.

Turmeric grows as an herbaceous perennial, producing a clump of simple leaves that are held relatively upright. It can attain a height of about 1 m. Mature plants require a dormancy period to induce flowering. However, even then,





A Turmeric inflorescence.

the inflorescences can be hard to notice because they have light green bracts that blend in with the foliage.

Turmeric is easy to grow, and does best if planted directly in the ground outdoors. It thrives in partial shade, but can also be grown under direct sunlight. Turmeric can be started at home from rhizomes or purchased as potted plants from local nurseries.

Sand Ginger

Sand Ginger or Lesser Galangal (*Kaempferia galanga*) is best known locally by its Malay names, Cekur and Kencur. Its leaves are thinly sliced and added to the traditional Malay salad known as *ulam*. The rhizomes are also used in cooking, as well as for medicine. The Chinese in Singapore use the name sand ginger, or *sha jiang*, to refer to the rhizomes, while the entire plant is known as *shan nai*. The rhizomes of this species are brown and roundish, and much smaller than those of most of the other culinary ginger species.

The Sand Ginger plant is almost stem-less, producing leaves that appear to hug the ground. Its flowers are white with purple markings, and look like butterflies. They are short-lived, lasting no more than half a day. Sand Ginger requires a dormancy period to produce flowers.

Due to its small size, Sand Ginger can be grown successfully in a container as well as in the ground. It requires full sun, and care should be taken during the rainy season when snails and slugs tend to chew on the leaves. Sand Ginger can be started from rhizomes at home, but it is important to not bury them too deeply in the soil. Potted plants can occasionally be found for sale in local nurseries.



Rhizomes of the Sand Ginger.



(Left) A Sand Ginger flower and (below) the plant's growth habit.





(Left) The short rhizome segments attached to long swollen roots that give the Chinese Keys or Fingerroot plant its name, and (right) its flower.

Chinese Keys

Not commonly seen in local markets, Chinese Keys or Fingerroot (*Boesenbergia rotunda*) gets its common names from the unique appearance of its rhizomes and roots (see above). Commonly used in Thailand, where it is called *krachai*, this ginger is used as both a medicinal and culinary herb and is sometimes sold in Singapore as Thai Ginger.

Chinese Keys is a short and clumping plant, with oval green leaves that have red sheaths. The flowers are small and pink, and appear between the leaf sheaths, easily getting lost in the mass of foliage. This plant requires a dormancy period to induce flowering.

This ginger is suitable for beginners, and can be grown successfully in a container. Outdoors, it should be placed in partial shade, and can be exposed to filtered sunshine for at least half the day if kept on a balcony or in a corridor. Plants can be started at home from fresh rhizomes, but in the markets, they are often sold with the growing points cut away for better presentation. Such rhizomes can be wrapped in moist sphagnum moss to encourage the emergence of new buds, and then planted.

Ginger

Zingiber officinale is the ginger that most people are familiar with in Singapore. Simply called 'ginger' in the markets, its rhizomes are thick, branched, and have a thin brown corky outer layer. The centre is yellow and has a distinctive spicy scent and flavour. Requiring little introduction, these rhizomes are used extensively in Asian cooking. They are also used medicinally to treat nausea, vomiting, and a range of other ailments.

The pseudostems of the Ginger plant can grow to 1.5 m in height. It flowers occasionally, and its inflorescences are cone-shaped spikes with overlapping green bracts. The flowers are pale yellow with a dark red to maroon lip that has yellowish dots and striations on it.

This species is not easy to grow in Singapore. It does best in full sun, but is recommended to be planted in a container so that it can be moved to a dry place during the rainy season. It requires a dormancy period to induce flowering, but this needs to be forced as the plant will stay evergreen in the tropics otherwise. It should not be watered at all during the dormancy



A Ginger inflorescence. (Photo credit: Jana Leong-Škorničková)

period. Ginger can be grown from rhizomes bought at the market, but these should not be planted too deeply.

Wilson Wong

Horticulture and Operations

All photos by Dr Wilson Wong, unless otherwise indicated



The Snowy Orchid – an 'orchid' that isn't an orchid at all

G rowing along the outer wall of the Botany Centre, facing the CDL Green Gallery, are a few stands of *Bauhinia acuminata*, a plant that flowers freely throughout the year and produces lush green leaves. Passing visitors frequently stop to admire their large, yet delicate, pure white flowers, and are rewarded with a subtly sweet but

clean fragrance if they get up-close to them.

Bauhinia acuminata is a large shrub or small tree that can grow up to 3 m tall and belongs to the Pea family (Fabaceae or Leguminosae). It is commonly known in English as the Snowy Orchid or White Bauhinia, and in Malaysia and Indonesia it



The snow-white flower and leaves of Bauhinia acuminata. (Photo credit: Nura Abdul Karim)

is known as Kupu-kupu (meaning 'butterfly') or Bunga Perak ('silver flower'). The genus *Bauhinia* is named after the Swiss-French botanist brothers Johann (Jean) Bauhin (1541–1613) and Caspar (Gaspard) Bauhin (1560–1624), and the specific epithet *acuminata* refers to the pointed tips of its leaves.

The Snowy Orchid is native to parts of tropical Asia and has been extensively cultivated and introduced to Africa, the Americas, Australia and even the United Kingdom. It occurs naturally in tropical deciduous forests, scrublands and secondary forests. It has fairly large leaves (6–15 cm long and wide) that are bi-lobed and resemble an ox's hoof in shape. Its showy, scented flowers have five petals, are 8–12 cm across, and are produced in racemes. Its fruits are pods that measure 7–15 cm long and 1.5–1.8 cm wide.

Bauhinia acuminata thrives in full sun or partial shade and prefers a fertile, mildly acidic soil that drains well but retains moisture. While its beautiful and delicately scented flowers merit its wide cultivation as an ornamental, it also has numerous medicinal uses. Sometimes called Penawar Seribu ('a thousand cure'), its leaves, bark and roots are reported to have antifungal and antibacterial properties. In Ayurvedic, Unani and Siddha systems of traditional medicine, the stems, bark and roots are used to treat stomach disorders and malaria. In Malaysia and Indonesia, decoctions made from the bark and leaves are given for asthma, leprosy, venereal diseases and to treat bladder stones. Unsurprisingly, the eye-catching flowers are used as hair ornaments by ladies in Java and Malaysia.

Nura Abdul Karim *Library, Training and External Relations*



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The SING boxes – to infinity and beyond!

ost of our herbarium specimens are kept on shelves in a climatecontrolled room. Previously they were stored in cardboard boxes, which had the benefit of being easily accessible but they were neither water- nor pest-proof. This would only be a problem in the unlikely event of a fire that could set off the water sprinkler system or if storage pests (for us, the Tobacco Beetle, Lasioderma serricorne) managed to evade our other lines of defence.

Having identified the need to update our storage system we surveyed the facilities of other herbaria and were particularly taken with information we received from Karina Knight of the Western Australian Herbarium in Perth, Australia. She and her colleagues had created a water-resistant herbarium box and was kind enough to send us a sample. We wanted something similar, but fully water-tight (not just water-resistant) while enabling us to easily file and access our herbarium specimens. With this idea in mind, we set out to engage a vendor that could work with us to design a box that was functional and durable. The project took some time to get up and running, but by mid-2017 we began to fine-tune the design of the boxes. Mock-ups created from 3D printing technology came from Korea and when we were finally satisfied with the design, the boxes were manufactured in Penang, Malaysia. They were transported to Singapore via 40-foot trucks.



Prototypes in their various stages. The final design is shown on the right. (*Photo credits: Serena Lee & Bazilah Ibrahim*)



The daily delivery of new boxes. (Photo credit: Bazilah Ibrahim)



Folding up of box inserts for the bryophyte collection. (Photo credit: Serena Lee)

Feature • Around the Gardens



One of the "it's almost over" days. (Photo credit: Derek Liew)



Dr David Middleton putting the final box in place. (*Photo credit: Derek Liew*)

On 4 September 2017, the first load of boxes arrived. This was the beginning of an all-hands-on-deck, month-long, half-day routine of transferring herbarium sheets quickly but carefully into the new boxes. We also had to cut up the old cardboard boxes so they could be flat-packed and taken away to be recycled. Each day, on average, 1,152 boxes arrived, and the entire operation took 1,028 total man-hours to complete. There was an amazing synergy as operational and research staff of the Herbarium came together to get the work done. By the third week, our backs were all but broken, our hands trembling and our fingers long-blistered but healed, yet morale was still high. It was truly a wonderful team bonding exercise. The honour of placing the final box, number 23,000, was given in an impromptu 'closing ceremony' to our head of research and Keeper of the Herbarium, Dr David Middleton. This was followed by a well-deserved pizza treat!

Serena Lee Bazilah Ibrahim Herbarium



Dynamic duo Derek and Farez with the completed boxes. (*Photo credit: Seah Wei Wei*)





Memorandum-of-Understanding signed with the National Arboretum Canberra

22 June 2017, the National Parks Board (NParks) entered into a Memorandum-of-Understanding (MoU) agreement with the National Arboretum Canberra (NAC) in Australia. The signing ceremony was held at the Gardens and attended by Mr Andrew Barr, the Chief Minister of the Australian Capital Territory (ACT); Ms Liz Clarke, Director of NAC, Venues Canberra; and several senior officials from the ACT government. The delegation was hosted by the CEO and Deputy CEO of NParks, Mr Kenneth Er and Dr Leong Chee Chiew, respectively, together with the Group Director of the Singapore Botanic Gardens, Dr Nigel Taylor.

The agreement was signed by Dr Taylor and Ms Clarke, and witnessed by Mr Er and Mr Barr. Following the signing ceremony, short presentations were given on the respective work being done by NParks and NAC, and then the Australian delegates were given a tour of the heritage core of the Gardens and the National Orchid Garden.

The signed agreement covers, amongst other things: the possible exchange of staff for training and capacity building in the fields of conservation biology, environmental science and arboriculture; collaboration in habitat enhancement projects; potential plant exchanges; and workshops and other academic activities. The agreement will be in effect for five years.

Since the signing, officers from the ACT government and NAC have visited the Gardens to discuss the possibilities of hosting Friends of the NAC and receiving staff from NAC as part of a professional staff exchange programme. NAC staff are interested in learning how the Gardens is managed and would also like to get involved in the next Singapore Garden Festival which is planned for



Dr Nigel Taylor, Group Director of the Singapore Botanic Gardens, and Ms Liz Clarke, Director of the National Arboretum Canberra, signing copies of the MoU agreement, witnessed by Mr Kenneth Er, CEO of the National Parks Board, and the Honourable Mr Andrew Barr, Chief Minister of the Australian Capital Territory. (Photo credit: Timothy Ong)



The Australian delegates viewing the rare botanical books and botanical drawings held in the Library of Botany and Horticulture. (*Photo credit: Timothy Ong*)

July 2018. In exchange, NParks staff would potentially visit NAC to learn more about their 'Internet of Things' technology, which is used by NAC to monitor soil conditions and manage the forests which are under their care. This technology was developed in collaboration with a research team from the University of Canberra, and could be useful for NParks to help manage its nature conservation areas. This MoU is no doubt a significant milestone in forging a strong working relationship between NParks and NAC, and it is hoped that more collaborations with common objectives for environmental protection and the conservation of trees will be fostered in the coming years.

Nura Abdul Karim

Library, Training and External Relations



Strengthening ties between the world's botanic gardens



The opening of the Global Botanic Gardens Congress on 26 June 2017. The delegates were welcomed with the playing of the Swiss alphorn. (*Photo credit: Nura Abdul Karim*)

International Conference Centre Geneva, in Switzerland, was the venue of the 6th Global Botanic Gardens Congress, held from 26 to 30 June 2017. The Congress had the theme 'Botanic Gardens in Society: Visions for the Future, and was hosted by the Conservatory and Botanical Garden of the City of Geneva, in collaboration with Botanic Gardens Conservation International (BGCI). It attracted more than 550 participants from 65 countries, representing 300 botanic gardens worldwide, including the Singapore Botanic Gardens.

A diverse range of networking opportunities and stimulating programmes was offered during the Congress. The programmes were divided into five key thematic areas: science for society, plant conservation, education and outreach, management challenges and communication via landscapes. More than 200 oral presentations, roundtable and panel discussions, workshops and poster presentations were given, many of which highlighted the growing importance of botanic gardens in helping to achieve the Sustainable Development Goals set out by the United Nations. These goals include addressing environmental challenges such as climate change, food security, biodiversity conservation and sustainability – areas where botanic gardens can help to bridge the gap between science and society.

Fundamental issues facing botanic gardens across the globe were addressed during panel discussions, such as the lack of trained horticulturists available to maintain living collections, and the lack of genetic diversity in plant collections. The need for botanic gardens to work within the frameworks of national and regional strategies, the need to focus on highest priority and greatest impact flagship species in conservation efforts, and the need to focus on filling biogeographic and phylogenetic gaps in collections were also discussed during the panel discussions. Also highlighted was the lack of action and/or understanding by a number of botanic gardens of the importance of the Global Strategy for Plant Conservation (GSPC) in driving conservation actions. It was stressed that botanic gardens need to be proactive in urging for a renewal and update of the GSPC for the post-2020 period, and aligning this strategy to the Sustainable Development Goals.

Botanic gardens were encouraged during the Congress to become more involved in generating and managing data and information relevant to ongoing and advanced scientific assessments, and to utilise and share data resources to effectively develop plant collections. Embracing new technologies such as climate



Participants were offered an optional post-Congress excursion to western Switzerland, which included a stop at the beautiful Schynige Platte Botanical Alpine Garden, shown here. (Photo credit: Nura Abdul Karim)



The Conservatory and Botanical Garden of the City of Geneva celebrated its 200th anniversary during the Congress, and the occasion was marked by a grand gala dinner. Also celebrated was the 30th anniversary of Botanic Gardens Conservation International. (Photo credit: Nura Abdul Karim)

change vulnerability prediction models and resource conservation technology was promoted to help strengthen the management of plant collections, landscapes, facilities, and human and financial resources. One of the days of the Congress was designated 'Tree Tuesday' and was dedicated to highlighting the latest developments towards ensuring zero tree extinctions in the

future. 'Tree Tuesday' was sponsored by the Morton Arboretum and organised by the Global Trees Campaign, and sessions throughout the day focused on the importance of trees to humankind, current tools available to support tree conservation, opportunities and challenges for botanic gardens in conserving tree species, and progress towards the Global Tree Assessment. This project aims to provide conservation assessments of the world's tree species by 2020; the Singapore Botanic Gardens has signed on to this project as a collaborator.

The Congress was a resounding success, increasing awareness of the importance of collaborations between botanic gardens towards conserving the world's flora. The next Global Botanic Gardens Congress will be held in Melbourne, Australia, from 7 to 11 February 2021.

Nura Abdul Karim *Library, Training and External Relations*



The XIX International Botanical Congress

The International Botanical Congress (IBC) is held every six years. It consists of two parts, the Nomenclature Section (see pages 22–23) and the main conference. The 2017 IBC, the 19th such event, was held in Shenzhen, China, from 23 to 29 July, with the Nomenclature Section from 17 to 21 July. It was the largest ever IBC with nearly 7,000 registered participants from 109 countries. The Singapore Botanic Gardens sent four participants: Ho Boon Chuan, David Middleton, Nura Abdul Karim and Daniel Thomas. In addition, NParks sent Stuart Lindsay from the Horticulture and Community Gardening Division. Two of us attended the Nomenclature Section which had around 100 participants from 30 countries.

Each morning of the main conference

began with plenary lectures to all participants in the vast hall of the Shenzhen Conference and Exhibition Center. These plenary lectures were delivered by notable figures in many and varied subdisciplines in botany. The rest of the morning on each day was spent on keynote lectures in two or three parallel sessions, again delivered by notable botanists.

The afternoons were taken up with the so-called mini-symposia. At any one time there were usually more than 20 parallel sessions to choose from, with a total of around 1,500 talks delivered over the six days. The subject matter of each mini-symposium could be on any one of a wide range of topics: taxonomy, evolutionary studies, biogeography, ecology, education, policy, conservation, physiology, genetics, etc. Considerable time was necessary for each participant to peruse the 264 page programme to decide which session to attend and the choice appeared to be endless. The organisers provided an app to aid with scheduling. With so much on offer it became inevitable that the sessions we each wanted to attend sometimes clashed.

The delegation from Singapore was active in many of the mini-symposia, one of which was dedicated to the Biodiversity Heritage Library (BHL) and had the theme 'Empowering Discovery through Free Access to Biodiversity Knowledge'. A number of the BHL global partners presented talks during this session, including one of our delegation who spoke about 'The Challenges of a Botanical Library in the Tropics and the Need for Restoration and Digitisation of Materials'. Another



The Shenzhen Conference and Exhibition Center. (Photo credit: Stuart Lindsay)



There were over 1,000 poster presentations to peruse at the conference, conveniently displayed on electronic and searchable boards. (Photo credit: David Middleton)



A large area of the conference centre was allocated to trade stalls promoting, among other things, high-tech lighting and hydroponic systems for indoor gardening, equipment for vertical greenery, herbarium specimen scanners, and several prestigious scientific publishers. (Photo credit: Stuart Lindsay)

mini-symposium was on 'Asian and Chinese Bryology', which was coorganised by another member of our group and featured 12 speakers. This symposium included a talk on the life and work of the late Benito C. Tan, a former Keeper of the Singapore Botanic Gardens' herbarium (see *Gardenwise* 48, page 2). We were also active in sessions on Apocynaceae, Annonaceae, Ericaceae, ferns, biogeography and many more subjects. The evenings were filled with various associated satellite meetings and events for special-interest groups.

Conferences generally, and large conferences such as this one especially, give us the opportunity to interact with people whose work we often read and admire, stimulating us with new thinking and inspiring us to learn more. At the same time, we get to encourage others in their botanical careers and share the passion we have for our work. Networks and connections are formed in the tea breaks and over lunch, making the world smaller.

At the closing ceremony of the IBC, the participants endorsed the 'Shenzhen Declaration on Plant Sciences' with a byline 'Uniting plant sciences and society to build a green, sustainable Earth'. The Declaration was drafted by 14 eminent botanists and called for seven priorities for strategic action in the plant sciences.

The organisers in China are to be commended for their excellent organisation of such an enormous undertaking. Each day we were handed the *Congress News*, a newspaper published in both English and Chinese specifically on what was happening at and around the conference. We even had a message of welcome from President Xi Jinping.

The next IBC will be held in 2023 in Rio de Janeiro in Brazil.

David Middleton Ho Boon Chuan Daniel Thomas Herbarium

Stuart Lindsay *Horticulture and Community Gardening*

Nura Abdul Karim *Library, Training and External Relations*

The Shenzhen Declaration on Plant Sciences endorses these seven priorities for strategic action in the plant sciences:

- 1. To become responsible scientists and research communities who pursue plant sciences in the context of a changing world.
- 2. To enhance support for the plant sciences to achieve global sustainability.
- 3. To cooperate and integrate across nations and regions and to work together across disciplines and cultures to address common goals.
- 4. To build and use new technologies and big data platforms to increase exploration and understanding of nature.
- 5. To accelerate the inventory of life on Earth for the wise use of nature and the benefit of humankind.
- 6. To value, document, and protect indigenous, traditional, and local knowledge about plants and nature.
- 7. To engage the power of the public with the power of plants through greater participation and outreach, innovative education, and citizen science.



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Feature • Key Visitors to the Gardens

July-December 2017



His Excellency Frank-Walter Steinmeier, President of the Federal Republic of Germany, with the orchid *Dendrobium* Frank-Walter Steinmeier on 3 November 2017.

Mr Abdul Mutalib, Permanent Secretary, Ministry of Home Affairs, Brunei

H.E. Sheikh Abdullah Ahmad Al Humoud Al-Sabah, Director General and Chairman of the Board of Environment Public Authority, Kuwait, and delegates

Ms Anna Zasadzińska, Head of The Heritage Interpretation Centre, Museum of Warsaw, Poland, and Commissioner for UNESCO World Heritage

Mr Asset Issekeshev, Mayor of Astana, Kazakhstan

Mr Ban Ki-moon, former Secretary-General of the United Nations, and Madam Yoo (Ban) Soon-taek, South Korea

Mr Baurzhan Baibek, Mayor of Almaty, Kazakhstan, and delegates

H.E. Binali Yıldırım, Prime Minister of Turkey

Mr Bo Liu, Minzu University of China

Mr Bob Harwood, Northern Territory Herbarium, Darwin, Australia

H.R.H. Princess Chakri Sirindhorn of Thailand

H.R.H. Charles Philip Arthur George, Prince of Wales, and H.R.H. Camilla Parker Bowles, Duchess of Cornwall, United Kingdom

Dr Daniele Cicuzza, Universiti Brunei Darussalam, Brunei

Delegation from the Sami Parliaments of Norway, Sweden and Finland **H.E. Frank-Walter Steinmeier**, President of Germany

Dr Geoffrey Levin, Canadian Museum of Nature, Canada

Dr Hans-Joachim Esser, Botanische Staatssammlung München, Germany

Dr Jan-Frits Veldkamp, Naturalis Biodiversity Center, Leiden, The Netherlands

Dr Joeri S. Strijk, Guangxi University, China

Mr Joseph Schooling, Olympic Gold Medallist, Singapore

Ms Julia Sang, Sarawak Forestry Corporation, Malaysia

Ms Kathy Leigh, Head of Service and Director-General of the Australian Capital Territory government, and Ms Bronwen Overton-Clarke, Deputy Director-General, Workforce Capability and Governance of the Chief Minister, Treasury & Economic Development Directorate of the Australian Capital Territory government, Australia

Dr Lindy Cayzer, Australian National Herbarium, Canberra, Australia

Dr Lynn Gillespie, Canadian Museum of Nature, Canada

Mr Manuel de la Estrella, Royal Botanic Gardens, Kew, United Kingdom

Dr Mark Hughes, Royal Botanic Garden Edinburgh, United Kingdom

Dr Mark Newman, Royal Botanic Garden Edinburgh, United Kingdom



Dendrobium Duke Duchess of Cornwall was named after Their Royal Highnesses, The Prince of Wales and The Duchess of Cornwall, during their visit to the National Orchid Garden on 1 November 2017.

Mr Mick Gentleman, Minister for the Australian Capital Territory Legislative Assembly, Australia

Dr Mohammed Kamrul Huda, University of Chittagong, Bangladesh

Ms Nur Aliah binti Mohamad Khaduwi, National University of Malaysia

Ms Nur Syazwana Bt. Munzani, National University of Malaysia

Mr Ong Poh Teck, Forest Research Institute of Malaysia

Ms Oudomphone Insisiengmay, Muséum National d'Histoire Naturelle, France

Ms Pénélope Komitès, Deputy Mayor of Paris, France

Mr Peter O'Byrne, Sabah, Malaysia

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

Dr Pramote Triboun, Thailand Institute of Scientific and Technological Research, Thailand

Mrs Rana Al-Nibary, General Manager of the Scientific Center of Kuwait, and Dr Hamad Ali, Board Member of the Scientific Center of Kuwait

Dr Rani B. Bhagat, Anantrao Pawar College, India

Dr Ruth Kiew, Forest Research Institute of Malaysia

Dr Saw Leng Guan, Penang Botanic Gardens, Malaysia Dr Shu-Hsien Tseng, Director General of the National Central Library, Taipei, and Mdm Shu-Ya Hsieh, Mayor of Yunlin County Douliu City Office, and directors from various libraries in Taiwan

Ms Sunisa Sangvirotjanaphat, Chulalongkorn University, Thailand

Ms Syahida Emiza Suhaimi, Forest Research Institute of Malaysia

Mr Syarif Fasha, Mayor of Jambi, Indonesia

Mr Tsuyoshi Esechi, Deputy Director, and Mr Takashi Maruyama, Manager, from the International Affairs Division of the Kagoshima Prefectural Government, Japan, Mr Xu Yuan Shao Kennard, ASEAN Regional Director of the Kagoshima Prefectural Government, Japan, and Ms Shoko Yumisashi, Deputy Director/Kagoshima Prefecture, Japan Council of Local Authorities for International Relations (CLAIR), Singapore

H.E. Viktor Orbán, Prime Minister of Hungary

Dr Vinod B. Shimpale, The New College, Kolhapur, India

Dr Wei-Bin Xu, Guangxi Institute of Botany, China

Dr Yea-Chen Liu, National Chiayi University, Taiwan

Ms Yip Pin Xiu, Paralympic Gold Medallist, Singapore

Dr Yong Kien Thai, University of Malaya, Malaysia

Dr Yumei Wei, Guangxi Institute of Botany, China

Miniature Waterfall Garden

7 ater features add beauty to a garden, attract wildlife, and have a calming effect on people, stimulating the senses like no other garden accents can. This is why, in 1969, a series of small waterfalls was constructed in the Dell, near the northern end of Swan Lake. The waterfalls would have reduced the ambient temperature, likely making this spot one of the coolest in the Gardens at the time. Adding to the gentle music of the waterfalls, the croaking of frogs would have helped to make it an especially delightful little corner for visitors to discover.

On display in the miniature waterfall garden were species specially selected for their ability to grow in moist environments, such as the Elephant Fern (*Angiopteris evecta*) and Fishtail Palm (*Caryota mitis*), both native to Singapore, and the Fern-leaf Tree (*Filicium decipiens*) which comes from Sri Lanka and India. For added colour, the Cardinal's Guard (*Pachystachys*)



One of the miniature waterfalls, photographed sometime in the 1970s.



A 1983 map of the Gardens showing the location of the miniature waterfall garden. It was reachable by a path that curved around the northern part of Swan Lake.

coccinea), several species of *Heliconia*, Red Ginger (*Alpinia purpurata*) and the unusuallooking Bat Flower (*Tacca integrifolia*) were also planted there.

In 1986, the miniature waterfall garden was given a makeover with the addition of new water pumps and plantings. The enhancements helped to make this little garden feel even more dense, shady and wild than before, but led to a bottleneck in the passage of water from Tyersall to Swan Lake during periods of heavy rain. In 1989, a new master plan was unveiled for the Gardens, and the decision was made to remove the waterfalls. However, a new waterfall was incorporated years later as part of the Ginger Garden, and this has proven to be a popular feature for many visitors to this day.

Christina Soh *Library*



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