Gardenwise

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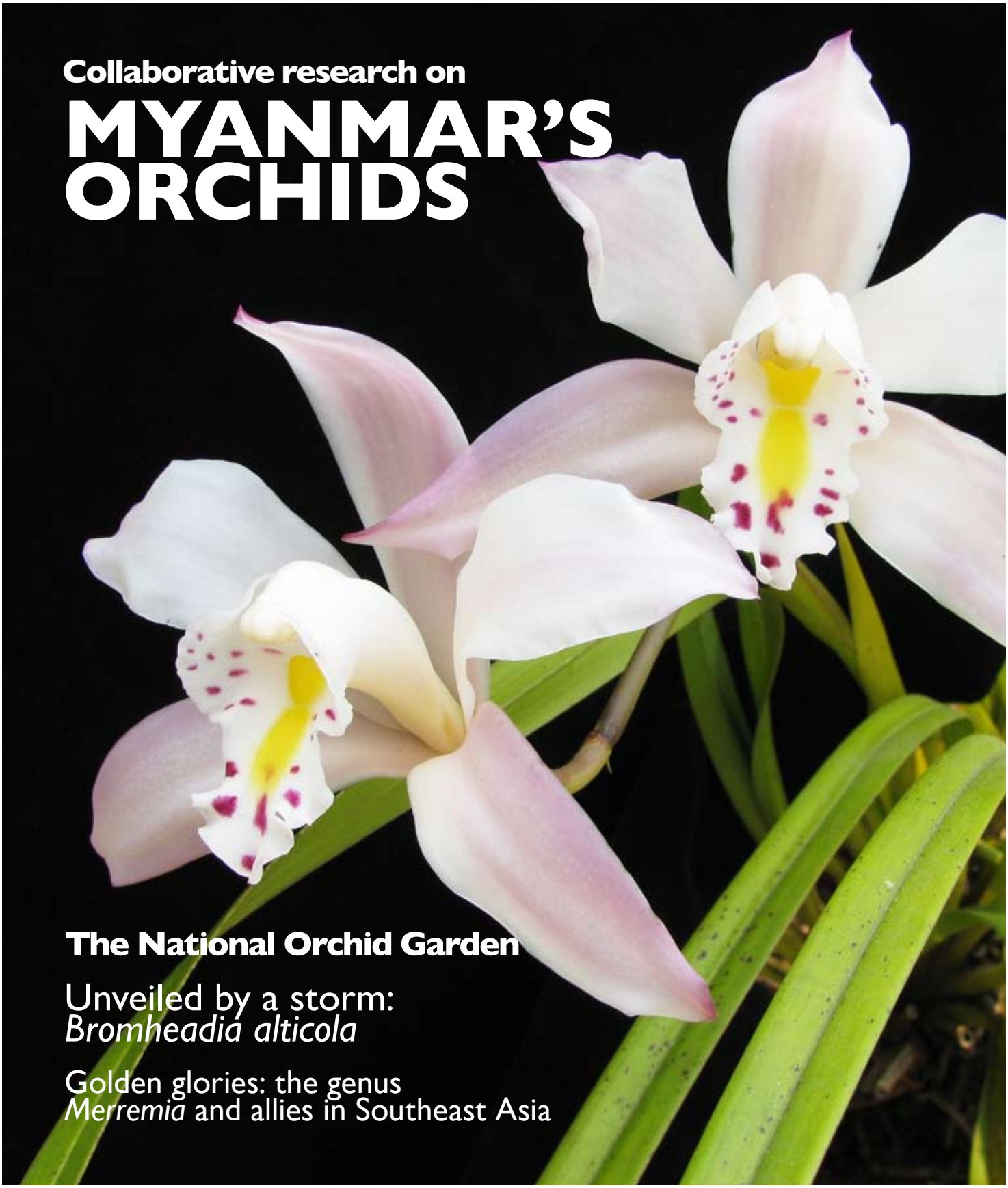

Collaborative research on MYANMAR'S ORCHIDS

The National Orchid Garden

Unveiled by a storm:
Bromheadia alticola

Golden glories: the genus
Merremia and allies in Southeast Asia

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VOLUME 37, JULY 2011

ARTICLES

REGULAR FEATURES

Cover
Cymbidium eburneum from Myanmar.
Photo by Saw Lwin.

Editors
Leong Chee Chiew
Mark Hughes
Khoon Meng Wong

Production Managers
Christina Soh
Mak Sin Chang
Low Yee Wen

Design
Splash Productions Pte Ltd

MESSAGE
FROM THE DIRECTOR

Forests contain some of our earth's most vibrant ecosystems and are the basis for products that range from medicine and food to fuel, furniture and clothing. To celebrate and highlight the importance of forest biodiversity to mankind, the United Nations has designated 2011 as the International Year of Forests.

Singapore is home to many different types of forests. Although we are a small island state, we have lowland dipterocarp rain forests, freshwater swamp forests, mangrove forests, and coastal forests that we are proud to consider as natural heritage. With nature reserves, other natural areas, parks, tree-lined roads, park connectors and waterways, and increasing green cover, the whole of Singapore is an urban forest. This urban forest has a direct impact on our well-being, helping to regulate our climate, clean our air by absorbing carbon dioxide and dust, lower ambient temperatures by shading, and reduce soil erosion.

Appropriately, the Gardens has held the "Forests, People, Environment" exhibition on 2 - 24 July to celebrate the International Year of Forests, highlighting the importance of forests, the significance of Singapore's urban forest and how everyone can play a part to conserve it so that we can all enjoy a higher quality of life. In the early years of Singapore's greening, the Gardens provided the expertise and planting material. Today the work done by our researchers helps to enrich the urban areas with orchids, gingers, and other types of plants. Our educational programmes connect plants and people so as to cultivate an appreciation for plants, nature and the environment. These are key roles for a botanic garden and they are part of the Singapore Botanic Gardens' heritage.

We will build on them as we develop the Learning Forest, the extension to the Jacob Ballas Children's Garden, the Ethno-botanical Garden and more. We will strengthen our engagement with the community and create greater opportunities for education and outreach. In the coming few months we will launch the Healing Garden. Public access will be improved with the opening of the MRT Station in Bukit Timah core. Work will be carried out on the Climber collection, Fragrant Garden and Foliage Garden.

All the Gardens' educational tours will be on offer when we participate in NParks' first Parks Festival in September. Our staff members are actively involved in the run up to the World Orchid Conference in November. We will be helping to set up various displays and to organise various aspects of the Conference. After the World Orchid Conference, the Gardens will round up the year with the Trees of the World light-up. There is much to look forward to and I thank our dedicated staff members for their wonderful efforts.

Leong Chee Chiew

Paul K. F. Leong

THE LADY'S SLIPPER OF GUNUNG JERAI

P. callosum var. *warnerianum* in its natural habitat.

Orchids in the genus *Paphiopedilum* are also known as lady's slippers. The lady is Venus, the goddess of love who is also known as Aphrodite in Greek mythology. Her alternative name in Greek is *Paphia* and *pedilon* in Greek means slipper. Hence the name of this group of orchids with a characteristic pouch or slipper-shaped lip is an allusion to her footwear. Species of *Paphiopedilum* are found in Asia, ranging from Nepal, India, southern China and Myanmar to Indochina, Thailand and down to Peninsular Malaysia, the Philippines, Borneo, Indonesia, Papua New Guinea and the Solomon Islands. To the western plant collectors of the nineteenth century, these beautiful large-flowered orchid species were held in great esteem and represented the epitome of oriental exoticism.

To the western plant collectors of the nineteenth century, these beautiful large-flowered orchid species were held in great esteem and represented the epitome of oriental exoticism.

Paphiopedilum belongs to the orchid subfamily Cypripedioideae, whose flowers typically consist of a characteristic large dorsal sepal, united lateral sepals that form a synsepal, a short column bearing a stalked stigma at the base and two lateral anthers above as well as a prominent modified infertile stamen in the form of a shield-shape staminode. The lip is enlarged to form a pouch and the petals are usually spreading, sometimes twisted and sometimes warty. Differences in the morphology of the dorsal sepal, synsepal, staminode, lip, petal and ovary are diagnostic characters for distinguishing species. The ovary is also a useful taxanomic character to distinguish *Paphiopedilum* (unilocular) from the South American genera *Phragmipedium* and *Selenipedium* (trilocular) of the same subfamily.

Gunung Jerai, formerly known as Kedah Peak, is a curious stand-alone mountain. Due to its isolation it is a good subject for floristic study, and especially for understanding geographic speciation. At a height of 1,217 metres, it is the second highest mountain in the state of Kedah after Gunung Bintang. The author made a recent trip with colleagues from the Forest Research Institute of Malaysia to an elevation of about 800 to 1000 metres above sea level where the terrain is sandstone, in search of a lady's slipper orchid species, *Paphiopedilum callosum* var. *warnerianum*, which occurs there. *P. callosum* var. *warnerianum*, like most *Paphiopedilum* species, is a terrestrial orchid. It has beautiful leaves that are mottled pale and dark green above and an inflorescence that bears a long lasting, single large flower that is about 9 cm across. The dorsal sepal is orbicular ovate to sub-circular, white with a band of purple around the mid section, with

distinct veins arching from the base towards the acute apex. The veins are striped green at the base and deep purple above. The petals are held at about 45 degrees from the horizontal axis, pale green in colour fringed with purple at the margins and towards the tip, with maroon warts on the upper margin and purple hairs on both the upper and lower margins. The tips of the petals may be slightly curved upwards like an old fashioned moustache. The lip is maroon-brown with darker veins and the incurved side lobes are greenish-white and warty.

P. callosum var. *warnerianum* presents a taxonomic problem. As its name implies, it is classified as a variety of the species *Paphiopedilum callosum*. This species is closely related to four others: *P. barbatum*, *P. lawrenceanum*, *P. hennisianum* and *P. fowliei*. The latter three are confined to Borneo, the Philippines and Palawan respectively, and *P. barbatum* occurs from northern Sumatra to Peninsular Malaysia (Johore in the south to as far north as Penang and east as Terengganu). *P. callosum* occurs from Laos and Cambodia to Thailand and so the presence of *P. callosum* var. *warnerianum* in southern Thailand and the adjacent north-west part of Peninsular Malaysia seems to bridge *P. callosum* and *P. barbatum*. Its flower structure is also intermediate between the two species. In *P. callosum*, the dorsal sepal is larger and fuller; its petals are more pendent, shaped like a more pronounced 'curvy moustache', described as subsigmoid. In *P. barbatum*, the dorsal sepal is more ovate than round and the petals are held more horizontally. However, *P. barbatum* varies in flower colour, the angle of the petals and other flower structures, hence whilst at the far extremes, both *P. barbatum* and *P. callosum* are quite distinct; the variety *P. callosum* var. *warnerianum* (with its fair share of variations), seems to ameliorate the differences. So, there are several questions to ponder: - Are *P. barbatum* and *P. callosum* variants of the same species or distinct in their own right? Should *P. callosum* var. *warnerianum* be more appropriately classified as a variety of *P. barbatum* or even a species in its own right, or remain as a variety of *P. callosum*? Is there only one species of *Paphiopedilum* on Gunung Jerai or is *P. barbatum* present as well and could the *Paphiopedilum* found there be a hybrid of the two species? More research is needed before a stand can be taken on these taxonomic conundrums.

Paul K. F. Leong
Herbarium

P.T. Ong

Paphiopedilum barbatum

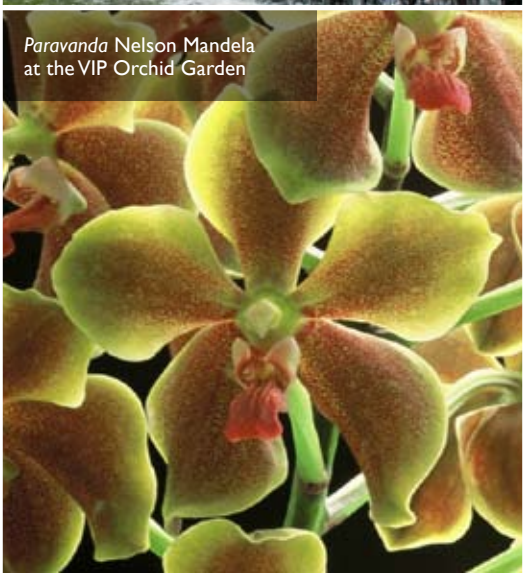
Misting at the Tan Hoon Siang Misthouse

The entrance of the National Orchid Garden

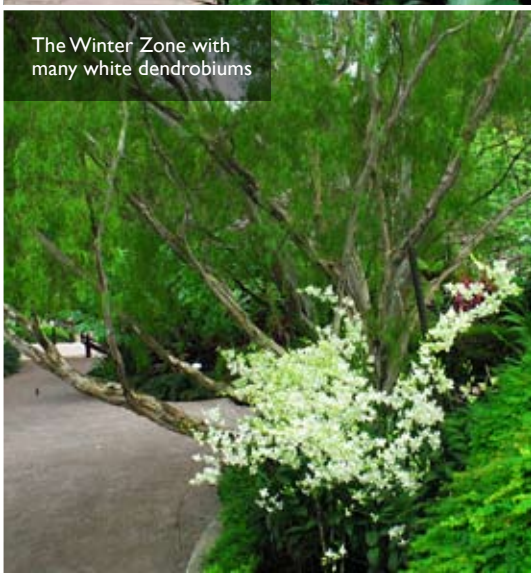
The tranquil Crane Fountain in the Spring Zone

VIP Orchid Garden houses hybrids that are named to honour visiting heads of state and dignitaries

Burkill Hall houses the famous VIP Orchid Garden



Paravanda Nelson Mandela at the VIP Orchid Garden



The Winter Zone with many white dendrobiums





THE NATIONAL ORCHID GARDEN

Located at the centre of the Gardens, the National Orchid Garden (NOG) is an extremely popular attraction for both local and overseas visitors. Spread over three hectares on the western slope overlooking Palm Valley and the Gardens' Rainforest, the site of NOG was selected for its prominent location and its suitability to grow and display orchid plants.

The construction of NOG was an important part of the 10-year master plan to redevelop the Gardens initiated by Dr Tan Wee Kiat in 1988. Recognising the Gardens' historical importance in the international orchid community, both for horticulture, public enjoyment and scientific research, Dr Tan saw an urgent need to expand the old 40 year old Orchid Enclosure, which housed the Gardens' orchid collection.

Opened by then Prime Minister Lee Kuan Yew on 20 October 1995, it is the most comprehensive collection of tropical orchids in the world and the crown jewel of the Gardens. The NOG is the result of the Gardens' efforts in orchid conservation and breeding and it showcases outstanding hybrids from Gardens' breeding programme pioneered by Professor R. E. Holttum in 1928. To-date, NOG houses over 1,000 species and 2,000 hybrids in our collection and more exciting and vibrant hybrids are added regularly for visitors to enjoy.

Plants in the NOG are grouped into four seasonal settings or colour zones. Upon entering the NOG, you are immediately greeted by a pair of bronze cranes standing in the middle of a tranquil fountain. As you meander up the gentle slopes towards **Burkill Hall**, you will pass through the Spring Zone, where various hybrids of *Oncidium* Goldiana or "Golden Shower" and pastel dendrobiums are displayed. The Summer Zone is represented by arrays of red and orange hybrids such the *Mokara* Singa Gold, *Renanthera* Singaporeans, and a range of stunning ascocendas. As you stroll from the end of summer into the Autumn zone, you are greeted by hybrids with rich colours such as purple dendrobiums, brick red ascocendas and arandas with a range of brown hues. Cool colours such as white, violet and blue are obvious choices for the Winter zone; three examples of ever-blooming beauties exhibited here are *Vanda* Lion's Winter Melody, *Vanda* Poepoe 'Diana', and *Vanda* Marlie Dolera.

Several themed displays can be found in the NOG. Located at the highest point of the Gardens, Burkill Hall houses the well-known **VIP Orchid Garden**. It is styled as an English courtyard garden to complement the colonial ambience of Burkill Hall. Displayed here are specially selected hybrids produced in the Gardens named to honour visiting heads of state, dignitaries and other VIPs to promote goodwill and foster closer ties between Singapore and other nations. The first VIP orchid was *Aranthera* Anne Black named in 1956, after Lady Black, wife of former Governor of Singapore, Sir Robert Black. To date, the Gardens has registered over 160 VIP orchids and notable ones incude *Dendrobium* Margaret Thatcher, *Renantanda* Akihito, *Dendrobium* Masako Kotaishi Hidenka, *Dendrobium* Elizabeth, *Paravanda* Nelson Mandela, *Mokara* Laura Bush and *Renantanda* Kofi Annan.

Nestled at the middle of the Autumn zone is the **Celebrity Orchid Garden**. It is dedicated to displaying Gardens' hybrids that are named after visiting entertainment and sport celebrities and renowned scientists. This is a popular attraction for young visitors as well as many overseas tourists. To date the Gardens' has named 17 Celebrity orchids, including *Vanda* Andrea Bocelli, *Renachilus* Ricky Martin, *Dendrobium* Jackie Chan, *Dendrobium* Bae Yong Jun and *Dendrobium* Memoria Princess Diana.

Set above the gentle cascades of the Long Waterfall is the **Heritage Orchid**

Garden. It showcases some of the heritage orchid hybrids of Singapore. These significant hybrids were the foundation and pride of the Singapore orchid industry beginning from the 1950s. These orchids, demanded worldwide for their beauty and longevity, were flown to many parts of the globe and helped to place Singapore orchids on the world map. Some of these hybrids are products of the Gardens' breeding programme and several of them such as *Aranthera* Anne Black and *Oncidium* Goldiana still remain popular in the global cut flowers market. Heritage orchids bred by local breeders displayed include *Arachnis* Maggie Oei, *Aranthera* Beatrice Ng and *Aranda* Noorah Alsagoff. These hybrids are displayed with traditional food plants and artefacts to give the landscape a nostalgic ambience.

The **Tan Hoon Siang Misthouse** is named in honour of the breeder of one of the most well-known local hybrids, *Vanda* Tan Chay Yan. Mr. Tan Hoon Siang named this hybrid in honour of his father and little did he expect that it would be awarded a First Class Certificate, the highest award given by the Royal Horticultural Society, at the Chelsea Flower Show in 1954. The Misthouse exhibits an extensive collection of rare, unique and award winning orchid cultivars, set amidst a lush tropical landscape and interesting artefacts. Taking centre stage in the Misthouse is a section on fragrant orchids, set up to excite the sense of smell of our visitors. Orchids are well known for their long lasting and showy blooms but many will be amazed to realise that more than half of the world's orchid species are scented. Many are delightfully fragrant, but some emit pungent smells to attract specific pollinators such as flies. One fine example of a fragrant orchid is *Vanda* Mimi Palmer, a stunning looking orchid hybrid that emits a very sweet spicy/vanilla fragrance (some say it smells like chocolate!) that is particularly strong in the morning. Do not miss these fragrant beauties!

Situated next to the Tan Hoon Siang Mist House, the **Yuen-Peng McNeice Bromeliad House** features a wide range of exotic bromeliads, a group of often epiphytic rosette plants. The pineapple is a well-known bromeliad which was discovered by Christopher Columbus in 1493 on the Caribbean island of Guadeloupe. Except for one species which occurs in the Guinea region of West Africa, all other bromeliads are found in tropical and warm regions of the Americas. The acquisition of this unique collection from the United States in 1994 was made possible by the generous donation of Lady Yuen-Peng McNeice, a renowned nature conservationist in Singapore and Malaya, and a great friend of the Gardens.

The Coolhouse has a special display of montane flora, which includes many orchids

Devoted to showcase the tropical lowland orchid species of the world, the **Orchidarium** is landscaped to simulate the natural orchid habitat of the tropical rainforest. Plants exhibited here originate from tropical Asia Pacific, Africa and the Americas. Some interesting species exhibited here include *Paraphalaenopsis labukensis*, *Vanda luzonica*, *Angraecum eburneum*, *Sobralia decora*, *Oncidium flexuosum* and *Trigonidium egertonianum*. The Orchidarium also serves to educate visitors about the importance of native orchid conservation, an important project at the Botanic Gardens. Singapore used to be home to over 220 different species of native orchids but more than three quarters of them were lost to development and urbanization. Some of the native orchids on display that have been propagated and reintroduced to many parts of Singapore are *Grammatophyllum speciosum*, *Bulbophyllum blumei* and *Dendrobium leonis*.

The most innovative exhibit of the NOG is the **Coolhouse**. The environmentally controlled cloud forest biosphere houses a special display of montane flora, which includes many orchids. Trees and rocks are draped with a profusion of spectacular orchids, carnivorous plants and other species that thrive in the cool conditions. Orchid species growing on the tree trunks and rock faces are of Asian origin, while those flourishing on the majestic Tasmanian tree ferns (*Dicksonia antarctica*) are of American and African origin. Montane forests of the tropics have a cool climate and high rainfall throughout the year and this is simulated in the Coolhouse through cool air, drifting mist and rushing torrent. In the daytime, the interior temperature is controlled to range between 25-29°C, while the night temperature is lowered to 15-17°C. The large number of carnivorous plants grown in the Coolhouse employ different mechanisms to attract and trap their prey for survival in nutrient deficient habitats such as acidic bogs and rock outcrops. For example, *Nepenthes* (pitcher plants) species use colour, nectar and scent to attract and trap the unsuspecting insects in the pitcher. The slippery inner wall of the pitcher prevents the insects from escaping and the enzymes secreted by special glands digest the insects before the 'insect soup' is absorbed by the wall of the pitcher. Do not miss these menacing plants!

The National Orchid Garden is open daily from 8:30am to 7pm. It certainly is a masterpiece produced by our dedicated horticulturists that can be enjoyed from the still of the morning to the cool of the early evening, all year round!

Yam Tim Wing
Orchid Breeding and Micropropagation Laboratory

Simon Tan
National Orchid Garden

All photos by Yam Tim Wing

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Dendrobium Alois
D. Nilda Tanlass *x D. sutiknoi*

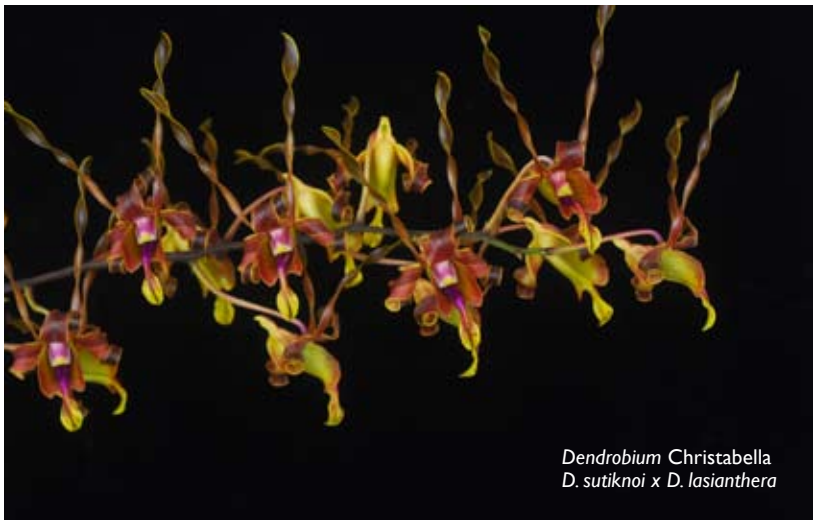
Dendrobium Asian Youth Games
Singapore 09
D. Malayan Orange *x D. sutiknoi*

Flower of *D. sutiknoi* - there are 2 sharp teeth on each side of the column tip

Dendrobium Anand Satyanand Susan
D. Christabella *x D. lasianthera*

GARDENS' HYBRIDS OF *Dendrobium sutiknoi*

Dendrobium hybrids are popular in Southeast Asia because they are free flowering and easy to grow and their attractive flowers are diverse in colour and form. The genus *Dendrobium* has been divided into many sections. Our focus at the Gardens is on breeding hybrids in two sections, namely *Phalaenanthe* and *Spathulata*. Species from the sections hybridise relatively freely, enabling us to make intrasectional as well as intersectional hybrids.



Dendrobium Christabella
D. sutiknoi x D. lasianthera

Plants in the section *Spathulata* are also known as the antelope dendrobiums, so named because their twisted petals resemble the horns of an antelope. Most species belonging to section *Spathulata* get very tall, for example, *Dendrobium lasianthera* can grow to be more than 2 m high. The flowers of many species are long lasting, with some lasting for up to 4 months.

Dendrobium sutiknoi is a large and showy species in section *Spathulata*. Before it was formally described, it was passionately called *Dendrobium raja tanduk* which literally means "king of tusk" due to its very long petals, which measure almost 60 mm. It was described by Peter O'Byrne in the May 2005 edition of the Journal fur den Orchideenfreund.

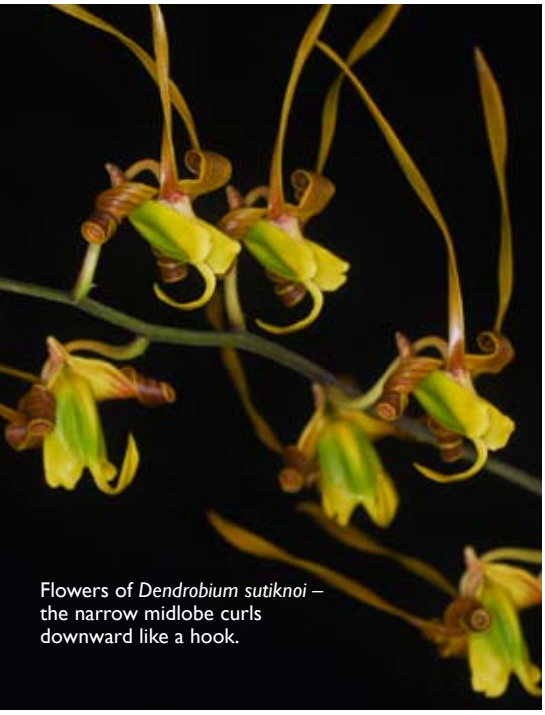
D. sutiknoi is a showy species that is probably closest to the beautiful *D. lasianthera* from New Guinea. Both species are similar in habit, as they have tall stems separated at the base by a short length of creeping rhizome. However, their flowers are very different. Besides the differences in colour, *D. sutiknoi* has longer and more linear petals that are at least 1.5 times as long as the dorsal sepal. There are also 2 sharp teeth on each side of the column tip, and a narrow midlobe that curls downwards like a hook.

The creeping rhizome of *D. sutiknoi* measures 10 mm in diameter, and the stems are 2 cm apart with typically just four internodes. The stems are erect, reaching a height of more than 1 m when mature. The lateral inflorescences are erect to sub-erect, some 35 cm in length, with 8 to 12 flowers. The flowers tend to droop slightly due to their weight and relatively long (30 cm) pedicels. Each flower measures 80 mm in length and is about 30 mm across. The petals are erect, some do not twist and some are only slightly twisted, about 60 mm long and 3 mm wide. They have an excellent texture, slightly waxy and quite thick, and a pointed tip. The lip has three lobes, the mid lobe is 45 mm long, forming a hook pointing downwards, (which resembles that of the midlobe in *D. tobaense*), with a prominent keel. The column is stout, about 8 mm long with two sharp teeth on each side.

As at January 2011, there are a total of nine registered hybrids of *Dendrobium sutiknoi*. The only F2 hybrid is *D.* Anand Satyanand, which is a cross between *D.* Christabella and *D. lasianthera*. The Gardens introduced *D. sutiknoi* into its breeding programme in 2006. Since then, we have flowered and named several of its hybrids.

Dendrobium Asian Youth Games Singapore 2009 (*Dendrobium* Malayan Orange × *Dendrobium sutiknoi*)

This vigorous hybrid produces upright inflorescences that are about 30 cm tall, each bearing 10 to 17 flowers arranged like trophies along the stalk. The golden hued flowers with a touch of lime-green are about 4 cm across. On each flower, the three sepals which curl backward are decorated with fine brown stripes.
The two upper petals are long and slightly twisted, and are held upright like arms in victory. The central lip is prominent with strong side lobes and three straight, white ridges in the middle. This orchid was named on 4 June 2009 to commemorate the 1st Asian Youth Games held in Singapore.



Flowers of *Dendrobium sutiknoi* – the narrow midlobe curls downward like a hook.

Our focus at the Gardens is on breeding hybrids in two sections, namely Phalaenanthe and Spathulata. Species from the sections hybridise relatively freely, enabling us to make intrasectional as well as intersectional hybrids.

Dendrobium Alois (*Dendrobium* Nilda Tanlass × *Dendrobium sutiknoi*)

This free flowering hybrid bears upright flower sprays that are up to 45 cm long with about 16 flowers each. Each flower is about 5 cm across, with both sepals and petals being gracefully twisted and chestnut brown with fine cream-coloured margins. The two petals are prominently upright. They are complemented by an attractive yellow-green lip. There are many other richly-coloured varieties of the hybrid. This orchid is named after His Serene Highness Hereditary Prince Alois von und zu Liechtenstein of the Principality of Liechtenstein, on the occasion of his visit to the Gardens on 3 September 2010.

Dendrobium Anand Satyanand 'Susan' (*Dendrobium* Christabella × *Dendrobium lasianthera*)

This is a robust and free flowering hybrid and bears upright flowering sprays that are up to 45 cm long bearing 10 to 18 flowers each. Each flower is about 5 cm across, and also with sepals and petals being gracefully twisted and chestnut-brown with fine cream-coloured margins. The two slender petals are upright and parallel. The distinctive lip is reddish brown with a purple throat. Its elongated tip is yellow and distinctively curved. The female parent of this hybrid is *Dendrobium* Christabella (*Dendrobium sutiknoi x Dendrobium lasianthera*). This beautiful 'Antelope' *Dendrobium* bears numerous sprays that are 32 cm long, each displaying 12 to 15 spirally arranged flowers. There are several varieties of the hybrid, and the colour of the flowers varies among the varieties. Individual flowers measure 8.5 to 9cm long and 3.5 cm across. Petals are 6.5 cm long, the upper half being green brown, gradually becoming red-purple towards the base. The sepals are brown and gradually become white towards the base. The lip is intense red-purple on a yellow green background, with an attractive yellow green tip. This orchid is named after His Excellency Sir Anand Satyanand, Governor-General of New Zealand and Lady Susan Satyanand, Spouse of the Governor-General of New Zealand, on the occasion of their visit to the Singapore Botanic Gardens on 17 May 2010.

Characteristics of hybrids of *Dendrobium sutiknoi*

The first two hybrids of *Dendrobium sutiknoi* are *Dendrobium* Christabella (*D. lasianthera x D. sutiknoi*) and *Dendrobium* Kimberli (*D.* Oriental Star *x D. sutiknoi*). Both were registered on 13 Feb 2006. It is obvious that three of the most outstanding characteristics of *Dendrobium sutiknoi* are passed on to its progenies. First, the large flower size; second, the long petals; and third, its unusual lip. Many of the progenies have large blooms, long slender petals and an attractive lip, especially the distinctive midlobe.

Although flowers of *Dendrobium sutiknoi* are not as colourful compared to other *Spatulata* dendrobiums, when the species is crossed with other colourful antelope dendrobiums, they result in progenies with many exciting and beautiful colour combinations. Many of the hybrids have lasting flowers too.

As expected, *Dendrobium sutiknoi* also passes on some of its negative traits to its progenies. For example, hybrids of *D. sutiknoi* tend to have short sprays. Most inflorescences bear less than 20 flowers. This can be improved by crossing it with species with long inflorescences such as *D. mirbelianum, D. discolor* and *D. lineale.* Second, the long petals of the hybrids have a tendency to droop, therefore it will be an advantage to cross it with species which produce flowers with good substance and firm, upright petals such as *D. lasianthera*. Lastly, hybrids of *D. sutiknoi* are tall. Crossing it with vigorous growing parents with stout pseudobulbs could improve this aspect. The hybrids of *D. sutiknoi* give us a range of very large, colourful, and beautifully shaped blooms. At the Gardens, the species continues to create new and exciting directions for orchid breeding.

Yam Tim Wing
Orchid Breeding and Micropropagation Laboratory

All photos by Yam Tim Wing

The orchid flora of Myanmar is very rich but poorly known compared to neightbouring countries. Orchids play an important part in everyday life in Myanmar and have an enormous potential in horticulture and ecotourism. The exploitation of orchids for medicinal purposes is also significant. A great deal of information is available on the orchids in other parts of continental Southeast Asia where detailed Flora projects have either been completed recently or are currently underway, but Myanmar is sometimes regarded as a 'black hole' in our understanding of the native orchids.

COLLABORATIVE RESEARCH ON MYANMAR'S ORCHIDS


Myanmar Himalayas

In a time of increasing destruction of our living environment, conservation issues are another reason why we need to know more about the plant life of Myanmar. The forest cover of Myanmar is currently still greater than in some other countries of the region, but sadly, these natural environments are disappearing fast and effective protection requires a better understanding of the flora.

During the British colonial time the emphasis in botanical work was on forest trees as these are economically useful, but nevertheless some collections of orchids were also made. Famous names at this time were Rev. C.S.P. Parish and, much later, F. Kingdon-Ward. Both of them accumulated an enormous number of specimens which were sent to British herbaria where the leading orchidologists of the time described many new species based on these collections, often named in honour of their collectors. Those of us who grow orchids or search for them in the wild are very familiar with the many species named *parishii* or *wardii*. Collections of orchids were also made by several Burmese collectors, such as U Mg. Gale, U Po Khant, U Chit Ko Ko and U Tha Hla. A comprehensive orchid flora treatment was published by B. Grant in 1895 but is now well over 100 years old; it is rather outdated and includes less than half of the species that we think occur in the country. Since then there have been many new species described, but a comprehensive inventory of all orchids that are found in the country has not been compiled yet.

Myanmar's orchid flora

Myanmar is the largest country in continental Southeast Asia, stretching from the Myanmar Himalayas in the north to the Andaman coast in the south. The country borders Bangladesh and India in the northwest, China in the north and northeast, and Laos and Thailand in the east. Climatic conditions are consequently varied and range from tropical rainforest to savanna, seasonal monsoon forest, temperate pine forest and alpine forest. Tidal forest, beach and dune forest and swamp forest occur in much of the Ayeyarwaddy delta.

The flora of the country comprises Indochinese elements, Himalayan elements (particularly in the north) and Malayan elements (particularly in the south). The interior regions of the country receive relatively little rain, and only dry deciduous forest and thorn-scrub grew here; these parts of the country are now densely populated and, where irrigated, have been converted to farmland. The northern areas of the country are partly still in pristine condition; the largest undisturbed area is the 'Northern Forest Complex'.

Dendrobium pulchellum

Dendrobium nobile

Cymbidium eburneum

Savanna near Myitkyina in Kachin State

There are between 700 and 800 orchid species currently known in Myanmar which is a fairly low number compared to other countries of the region (e.g., Thailand and India with about 1,200 each), and we therefore think that many species still await discovery. All major Asian orchid genera are represented (e.g., *Dendrobium, Bulbophyllum, Habenaria, Cymbidium, Coelogyne, Paphiopedilum, Phalaenopsis*).

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Our collaborative project

Proceeding from the fact that a better knowledge of Myanmar orchids is required, the authors decided several years ago to collaborate on Myanmar's native orchids. The basis for any further botanical studies and for a sustainable utilisation of the Myanmar orchids is a complete floristic inventory which we are hoping to achieve with our survey work.

Fieldwork is the first step in our work. The exploration of Myanmar is somewhat limited for the first author of this article who is not a Myanmar citizen, as large areas of the country are still out of bounds for foreigners. Also in most other areas travel is only possible with permits from the Government, and our co-operation with the Myanmar Forest Department has been very successful. While most areas in the country are accessible by motorised transports, there are very few roads in the Myanmar Himalayas in the northernmost part of the country and getting around on foot is the only way to travel there; the use of porters is essential in these areas to carry heavy equipment. Most of our fieldtrips so far have been in Kachin State in the north. Orchids are plentiful in many parts of Myanmar, both terrestrial and epiphytic. We make use of local tree climbers to help collect epiphytic orchids. We take photographs of flowering specimens in order to document their flower colour and to obtain photos for publications. As is usual in tropical countries less than 20% of the orchids are encountered in the flowering state, and we therefore collect living specimens of all of the non-flowering ones, so that they can be identified later once they flower in cultivation. The processing and documenting work of our material in the evenings involves preserving flowers in spirit to retain their structure, pressing flowering specimens and writing accurate notes (during the day we write only very brief field notes). On these survey trips we have already found several species new to Myanmar, including a new genus record (*Taeniophyllum*).

Obviously we also take existing information into account which has been accumulated over the last few centuries. This includes literature data and data from previously made herbarium collections. There are about 1,600 herbarium sheets of Myanmar orchids housed in the herbarium of the

Main:
Eria clavicaulis

Inset, from left:
During a survey trip in the Myanmar Himalayas

Myanmar lady carrying bamboo orchids as offering to Buddha in Kan-pet-let (Chin Hills)

Herbarium of the Myanmar Forest Department in Naypyitaw

Royal Botanic Gardens, Kew, London (UK) which we have already examined, and we are also planning to study many other previously made herbarium specimens. Other large herbarium collections are held in the British Museum, Edinburgh, Paris, Calcutta and Dehra Dun. Furthermore, we have already examined the herbarium collection of the Myanmar Forest Department in Naypyitaw, the country's new capital city.

We are not only planning to study Myanmar orchids in order to write scientific publications for orchid researchers around the world, but our work is also aimed at improving the knowledge of the orchids for the benefit of local communities. Mechanisms to further this goal are, for example, training of local Forestry Department Officials during joint survey trips, popular lectures during orchid training courses, writing popular articles in Myanmar newsletters or newspapers, etc. Our work, though essentially taxonomic and floristic in nature, has also conservation implications. On two previous occasions we have made recommendations to the Myanmar Forest Department regarding the preservation of particular areas, and we will continue to do so in the future.

We are planning to compile an annotated checklist of all orchids recorded in Myanmar so far. Proceeding from this checklist we are aiming to produce a popular illustrated fieldguide to the orchids of the northern parts of the country for the benefit of local foresters, botanically interested hobbyists, university staff and students, and tourists. The latter four groups may be local as well as foreign. To assist Myanmar nationals who are not so fluent in English, we are also planning to write a bilingual (English-Myanmar) guide to the orchid genera found in the country – something that has been rather successful in neighbouring Thailand. The first author of this article has been asked why Singapore should be involved in biodiversity research in Myanmar. There are many reasons and benefits, here we just mention a few. Our joint work needs to be understood as collaboration in general, like there is also collaboration between the Singapore Botanic Gardens and the Royal Botanic Gardens, Kew. The collaboration with Myanmar should also be seen as a form of capacity building, i.e. developing people skills in Myanmar, and as a leader in the region Singapore is very well positioned to do this. Exploring ways of sustainably utilising Myanmar's orchids will also be of benefit for the Singaporean market; for example, orchid species introduced in cultivation in Myanmar nurseries may eventually also be introduced in Singapore, both as pot plants and as parents of hybrids. Myanmar is currently opening up to foreigners, and as such it is a good time to be amongst the first to get involved in biodiversity research in Myanmar.

Hubert Kurzweil
Herbarium

Saw Lwin
Myanmar Floriculturist Association
Yangon

All photos by Hubert Kurzweil and Saw Lwin

Main:
Flowering of *B. alticola* is sudden, simultaneous and gregarious

Inset:
An aerial photo shows the extent of the damage caused by the storm.

National Biodiversity Centre and Singapore Polytechnic

Yam Tim Wing

UNVEILED BY A STORM: *BROMHEADIA ALTICOLA*

A large localised storm occurred over the Mandai forest patches north of the Upper Seletar Reservoir of the Central Catchment Nature Reserve on the evening of 11 February 2011. Vegetation within 30 ha of forest was severely damaged; some trees were uprooted, others were left with snapped trunks and branches. There were broken trees, climbers, shrubs all over the forest floor in the parts of the reserve affected by the strong winds. An aerial view of the storm damage taken by National Biodiversity Centre and Singapore Polytechnic shows the extent of the damage.

On the 15 February 2011, a survey was organised to assess the damage to the forest from the storm. A boat was arranged with the Public Utilities Board and taken around the edge of the Upper Seletar Reservoir. An epiphytic orchid was spotted growing on a fallen tree trunk, and a specimen of the plant was brought to the Herbarium. Its vegetative morphology, epiphytic habit and inflorescence arrangement led us to a preliminary conclusion that it was *Bromheadia alticola*, an orchid which is thought to be locally extinct. On the 22 February, we made a second trip to the same area to collect more specimens, and fortunately we saw one fading flower enabling us to confirm the identity of the species as *B. alticola*. A third trip was made on the 24 February, and as the plant was over-exposed to light, a decision was made to bring the entire clump back to our Nature Reserves Ranger Station office at MacRitchie.

The forest where the orchid was found is mature secondary forest, consisting of canopy species such as *Garcinia parviflora*, *Syzygium incarnatum*, *Litsea* sp., *Ixonanthes* sp. among others, with saplings of primary forest species under the tree canopy, such as *Gonystylus confusus*. The orchid was found growing on a *Rhodamnia cinerea* (silverback tree) at the forest-reservoir boundary. The silverback tree suffered a snapped trunk from the storm, and the epiphytic orchid was exposed on the broken horizontal main trunk, which led to its discovery when we passed by on our survey.

Bromheadia alticola

The genus *Bromheadia* was first described in 1833 by the English botanist John Lindley. In 1912, the German orchid taxonomist Friedrich Richard Rudolf Schlechter subdivided it into two sections which are distinguished vegetatively as having leaves which are dorsiventrally flattened in section *Bromheadia*, and leaves that are laterally flattened in section *Aporodes*. This

genus is placed in the subfamily Epidendroideae and in the tribe Cymbidieae based on the presence of a Cymbidium-type velamen. It is however, a monophyletic genus with one distinctive uniting character, the shape of the stipe of the pollinia and its closest relative seems to be the genus *Claderia*. In Singapore, six species of *Bromheadia* are recorded to be native. One of these is the common but pretty terrestrial orchid, *Bromheadia finlaysoniana* which can be found at the edge of secondary forests as well as in abandoned rubber plantations. The other five species were listed as extinct in Singapore, until our recent rediscovery of *Bromheadia alticola* - unveiled by the storm!

B. alticola belongs in section *Bromheadia*, which has dorsiventrally flattened leaves, a character it shares with the terrestrials *B. finlaysoniana* and *B. borneensis* (nationally extinct), however unlike these, it is epiphytic. *B. alticola* is quite a widespread species; known to occur from Myanmar to Laos, Thailand, Peninsular Malaysia, Singapore, Borneo and the Philippines. In Peninsular Malaysia, there are collections from Terengganu, Perak, Pahang and Malacca up to 860 metres altitude. Our herbarium has only one other specimen collected in Singapore, from Bukit Panjang in October 1889 made by the first director of the Gardens, Henry N. Ridley. This is rather a mystery as Ridley (1891) cited the Singapore localities Bukit Timah, Jurong and Mandai as well as Kuala Lumpur and Selangor in his description of this species. These specimens are all syntypes, but strangely they are not located here in Singapore nor in Kew.

Ridley (1891) wrote that *B. alticola* "frequents the loftiest and most inaccessible trees, usually Dipterocarpeae, growing on the highest branches or on the trunk, where it forms masses of four or five feet in diameter." Hence maybe we should scrutinise our tall Dipterocarps for more of this and other orchid species.

The first thing that we noticed when we approached the fallen plant was the bushy mass with a messy network of rhizomes, sprouting at intervals, and stems of about 60 cm long hanging pendulously from the branch of the tree. These are quite firmly attached such that in order to obtain some cuttings one would have to yank with a certain amount of force. The stems are very numerous and somewhat flattened with 5 to 10 leaves each. Leaves are narrowly oblong, stiff and unequally bilobed at the apex and articulated with a green sheath at the base that ages brown. A distinguishing character even without the flowers is the terminal raceme with a 10 cm or more flexuous, laterally flattened rhachis which arises from the leafy apical tip, quite unlike *Bromheadia finlaysoniana* and *B. borneensis* that have a long leafless scape. Inflorescences can be branched and the rhachis has broad curved cup-shaped bracts that subtend one or two flowers. Flowering is sudden, simultaneous and gregarious and the racemes are long-lived; hence if there are large clumps in the vicinity, it can be quite a show. Unfortunately, the flowers are evanescent, opening early in the morning and begin to close up when the sun is high in the sky. Hence you could term this species as a 'one day wonder'. It has been reported that the stimulus of a sudden drop in temperature


Yam Tim Wing

Flower of *B. alticola*. The mid-lobe of the lip has a yellow thickened papillate band


Yam Tim Wing

The plant is a bushy mass with a network of rhizomes, sprouting at intervals.


Yam Tim Wing

Ants are found 'guarding' the seed capsules.

such as during a thunderstorm stimulates flowering, and *B. alticola* purportedly flowers one day later than the similarly induced pigeon orchid, *Dendrobium crumenatum*.

The sepals and petals are creamy white; the dorsal sepal 2.8 by 0.8 cm, the lateral sepals a little shorter and wider, asymmetric at the base, keeled near the tips. The petals are about 2.5 by 0.9 cm and the lip is about 1.8 cm long with the tip turned a little downwards. The side-lobes of the lip are cream in colour, the mid-lobe has a yellow thickened papillate band which extends from the base to near its tip. The margin of the lip is fringed purple and so is the column. The flowers are sweetly scented.

Ants and *Bromheadia alticola*

The *Bromheadia alticola* removed from the fallen tree is being grown at MacRitchie Reservoir Park Nature Reserve Visitor Centre. We have observed the plants for a few months and find that ants crawl all over them. After the seed capsules are formed, the ants are found guarding the capsules. It is possible that ants and *B. alticola* live in a symbiotic relationship. Ants are found to associate with some other Southeast Asian orchids such as *Grammatophyllum, Vanda, Dendrobium, Coelogyne, Vandopsis, Vanilla , Arundina and Spathoglottis*. It is possible that ants are attracted to these orchids due to the presence of sugar-containing exudates. We suspect that sugar exudates are also secreted from various parts of *B. alticola*, which is why ants are found on the stems, flowers and seed capsules. Having the ants crawling over the entire plant is of distinct advantage to the orchid, as they serve to protect the plant from herbivores and other pests.

B. alticola flowered the first time on 14th April 2011 at MacRitchie Reservoir Park Nature Reserve Visitor Centre. We arrived around 09:30 that day, and after photos were taken, several flowers were pollinated. The same plant flowered again two weeks later, on 28th April 2011, this time producing many more flowers. By the time we arrived just after 09:30, many ants were already on the flowers. While trying to pollinate the flowers, we were surprised to observe that while the anther cap was around, the pollinia were not present. Therefore, it was not possible to carry out any pollination. However, one week later, many seed capsules had formed. There are three possibilities: First, the seed capsules were formed by self-pollination; second, the ants could have pollinated the flowers of *B. alticola*; and third, that pollination was carried out by a vector we have yet to observe.

Conservation

We are trying to propagate the species by vegetative propagation and from seeds. Healthy rhizomes with 3 to 5 vegetative nodes were cut from the mother plant and planted with small pieces of coconut husk (2- 4 cm cubes) wrapped in plastic netting and hung in an upright position. They are grown in a semi shaded, airy and humid environment. Watering is done regularly to keep the coconut husk moist. Rooting and shoot growth is rather slow. As part of an ongoing reintroduction project undertaken by the Gardens' Orchid Breeding and Micropropagation Laboratory, seed capsules will be collected and brought back to the laboratory for propagation. If the seeds are viable and germinate successfully, we should be able to reintroduce the species back into the wild in two to three years time.

Yam Tim Wing
Orchid Breeding and Micropropagation Laboratory

Paul K F Leong
Herbarium

Derek Liew
Chew Ping Ting
Sunia Teo
William Ng
Central Nature Reserve, Nature Conservation

Derek Liew standing next to *B. alticola*.

Chew Ping Ting climbing onto the fallen trunk to remove a cutting of *B. alticola*.

The whole plant of *B. alticola* was removed from the field to be grown at the MacRitchie Ranger station.

APPLYING FORENSIC SCIENCE TO BOTANY

Is it possible to obtain DNA from century old plant specimens? This author set out to determine just that.

A specimen of *Vanda teres* collected in 1893 and archived in the Gardens Herbarium.

What is DNA?

Deoxyribonucleic acid (DNA) is present in every living cell. It is the substance in which genetic information is encoded and is therefore the 'manual' which directs almost all aspects of growth and development. DNA is made up of small basic units called nucleobases: adenine (A), thymine (T), cytosine (C) and guanine (G). Each base is coupled with a pentose ring (deoxyribose in the case of DNA) and 3 phosphate groups to form a deoxynucleotide triphosphate (generally known as dNTPs, specifically detailed as dATP for adenine, dTTP for thymine, dCTP for cytosine and dGTP for guanine). Millions of dNTPs linked by phosphodiester bonds form a long strand of DNA. The bases also pair up in a specific way: A with T and C with G. DNA exists as a double strand that twists in a helical manner. The two strands are held together by hydrogen bonds between the complementary nucleotide pairs. When stretched out, the length of DNA in a single human cell exceeds 2 metres! This is amazing, considering that a single cell is too small to be seen with the naked eye and DNA is contained in an even smaller cellular compartment called the nucleus. A segment of DNA encoding information is called a gene. Many genes make up a chromosome and many chromosomes make up the entire genome.

DNA amplification

Segments of DNA can be synthesised *in vitro* by a process called Polymerase Chain Reaction (PCR). It was developed by Kary Mullis in 1984. This technique revolutionised molecular genetics by enabling scientists to make multiple copies of a gene of interest for purposes such as cloning or mutagenesis. Using this technique, any desired segment of DNA can be copied and replicated many times over, producing more than 10 million copies of the sequence.

A PCR reaction mixture includes dNTPs, a pair of primers (short single stranded DNA) that act as starting points for DNA synthesis and mark the boundaries of the DNA segment to be amplified, and a polymerase (a catalytic protein complex which synthesises DNA). A typical PCR involves a reversible denaturation step at about 95°C, an annealing step at between 40°C to 68°C and a synthesis step at 72°C. The denaturation step causes the double stranded DNA to separate into single strands, the annealing step allows the primers to find and anneal to the start or end of the gene and the synthesis step is when the polymerase begins adding nucleotides complementary to the template, lengthening the new DNA strand. The process of denaturation, annealing and synthesis is repeated another 30-50 times. A thermal cycler is used to produce the appropriate temperatures.

Amplifying DNA from Herbarium Specimens

DNA is a very stable molecule which can withstand desiccation and even boiling. Even so, it is not indestructible. Certain chemicals, the passage of time and contact with human saliva, hair, skin and nails can degrade DNA. Thus, obtaining DNA from fossils and old specimens is usually a hit-and-miss venture. However, certain techniques can be employed to increase the chances of obtaining DNA from preserved specimens.

This author set out to obtain DNA from a *Vanda teres* specimen, from the Gardens Herbarium, collected in 1893. To do so, a 'nested PCR' procedure was employed. Nested PCR is a technique which is used when low amounts of template DNA are available. A first round of PCR is done with primer pair 'A'. Usually, the annealing temperature for the first round of PCR is set a little lower so as to increase the chance that a primer will anneal to the template DNA. But a lower annealing temperature might also lead to non-specific binding of the primers to the wrong regions of DNA. Thus a second round of PCR is done with another primer pair 'B' which is designed to anneal to a region nested within that amplified by primer pair 'A'. For this second round of PCR, a more stringent annealing temperature may be employed. It is assumed that the first round of PCR would have increased the amount of template DNA to a more detectible level. A small amount of tissue from the herbarium specimen was crushed and added to a PCR mix to undergo a first round of amplification. One microlitre of the PCR product was used as the template for the second round of PCR. The PCR products were visualised on an agarose gel. A red band indicates a successful reaction. And it was indeed successful! The *Vanda teres* specimen from 1893 yielded the desired PCR product and the nucleotide sequence of the gene amplified will subsequently be analysed.

Gillian Khew
Orchid Breeding & Micropropagation Laboratory

Hoya pandurata from Thailand

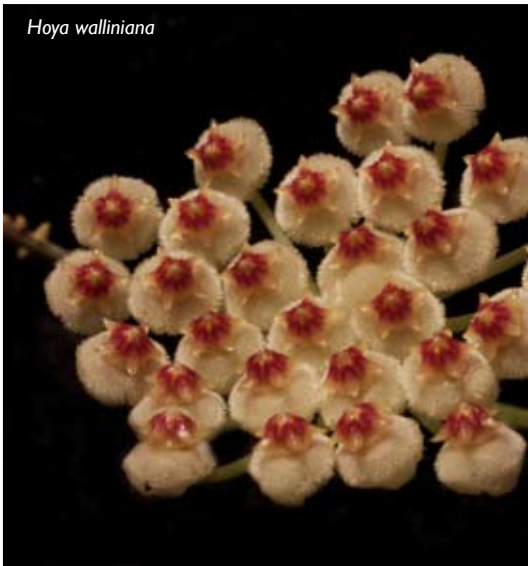
H. micrantha closeup

The leafless hoya, *H. spartioidese*

Hoya heusckheliana, a Philippine species with urceolate corollas

The huge flowers of *Hoya imperialis*

The Borneo endemic *Hoya danumensis*



Hoya walliniana

HOYA: THE BEAUTY OF THE RAIN FOREST IN OUR GARDENS

In tropical forests, trees are commonly richly draped with a lush growth of epiphytic plants (plants that use other plants for mechanical support). In Asia, ferns and aroids are commonly observed epiphytes. Where conditions are optimal, for example in primary forests (forests that have never been logged) epiphytic plant communities are dominated by orchids. However, a myriad of other plants are found growing amidst the dominant epiphytes but can be easily overlooked unless they are mass-flowering; examples include members of the families Apocynaceae, Gesneriaceae and Rubiaceae. The most common Apocynaceae found as epiphytes are the diminutive species of the genus *Dischidia,* that can even be found draping rain trees (*Samanea saman*) in central Singapore (*D. nummularia*) and present very small urceolate (lantern shaped) flowers. Much more showy are the species of the genus *Hoya*, but these are far more scarce. Only a careful observation of the tree canopy reveals their presence and if not flowering *Hoya* are easily overlooked or even confused with *Aeschynanthus* or *Ficus* species. Even flowering hoyas are not easy to spot in the forest since they usually grow very high in the tree canopy. Fortunately *Hoya* flowers can be indirectly detected by their sweet scent, produced more intensely during the evening and at night. Sometimes dropped flowers can be found on the forest floor and by carefully checking the trunks and branches of nearby trees, the original plant can be traced. Some *Hoya* species do not grow on trees but are lithophytes (they grow on rocks) but usually are found only in very inaccessible places on steep or nearly vertical rock faces. Just a handful of species in section *Eriostemma* (commonly called eriostemmas) are terrestrial vines, germinating and establishing on the forest floor but climbing and reaching great heights on trees, producing flowers only if their leaves reach the sun.

The genus *Hoya* was dedicated by Robert Brown to Thomas Hoy, gardener for the Duke of Northumberland in England. As we know it today 200 years on, *Hoya* is a moderately large genus comprising at least 300 species distributed from India to Samoa and from China to Australia.

Hoya are highly sought-after houseplants in Europe and North America, and are commonly found as garden plants in tropical and sub-tropical countries. A few *Hoya* species can easily be found in most florist shops, markets and plant nurseries across the globe, and most people interested in plants would immediately recognise the around ten common species due to the fleshy leaves and waxy flowers producing a very sweet scent. Some species are so widespread in cultivation to be known by their common names such as wax plant or honey plant (*H. carnosa*) and shooting star (*H. multiflora*). Most *Hoya* species are not commercially mass produced but since they are easily propagated by cuttings they are easily exchanged between hobbyists.

The genus *Hoya* was dedicated by Robert Brown to Thomas Hoy, gardener for the Duke of Northumberland in England. As we know it today 200 years on, *Hoya* is a moderately large genus comprising at least 300 species distributed from India to Samoa and from China to Australia. Great Hoya diversity is observed in New Guinea, Philippines and in the so far little investigated Borneo. Since no complete taxonomic revision has been completed the actual number of species is very dubious and may far exceed this estimate.

Morphology

As introduced before, most hoyas are epiphytic vines with a few exceptions: *H. multiflora, H. cumingiana* and *H. platycaulis* are small epiphytic sub-shrubs, *H. australis*

Hoya micrantha in its natural habitat in Peninsular Malaysia

subsp. *rupicola* is a terrestrial shrub, *H. bella* and *H. linearis* are pendulous subshrubs. The climbing species do not possess tendrils and climb by twisting their stems around any kind of support and producing adventitious roots that cling to any rough surface. White latex, sometimes toxic, is present in most tissues of nearly all species.

Plants can vary considerably in size, ranging from the tiny *H. microphylla* that can easily fit in a tea cup to the huge *H. ariadna* and *H. imperialis* that can cover whole trees in favourable conditions. Plants can be glabrous but many possess simple, multicellular hairs on leaves and stems. Apart from *H. spartioides* that at maturity is leafless and relies on the many green flowering peduncles to perform photosynthesis, all *Hoya* species have leaves. These vary from small and thin in *H. microphylla, H. pulchella* and *H. venusta* to large and leathery (e.g. *H. clemensiorum*, *H. glabra*, *H. macrophylla*). Some species have chartaceous leaves (e.g. *H. multiflo*ra) and some possess true succulent leaves with well-developed water storage tissue (e.g. *H. australis* subsp. *sanae*, *H. australis* subsp. *rupicola*, *H. pachyclada*). Leaf shape is tremendously variable and depends not only on the species but also on the environmental conditions. Only a few *Hoya* such as the subspecies of *Hoya australis* can be separated by leaf characters alone. Venation patterns on the leaves are often very evident and rather showy. Leaves are either penninerved (like a bird feather) or palminerved (veins radiating from a single point). A few species present very unusual foliage such as the plate-like leaves tightly appressed to tree trunks of *H. lmbricata*; the linear leaves of *H. linearis* and *H. Teretifolia*; or the bullate leaves of *H. darwinii* and the cabbage-shaped leaves of *H. mitrata* that provide shelter for ant nests. Ultimately the leaves of *H. lambii* develop into collection cups for leaf debris where roots can develop and provide nutrients for the plant.

The *Hoya* inflorescence comprises a short- or long-lived peduncle and a one- to many-flowered pseudo-umbel. Some species always have short-lived peduncles that are shed after fruiting or after flowering when pollination does not occur, e.g., *H. lanceolata* and *H. linearis*; others have short-lived peduncles, lasting for just a few flowerings, such as most eriostemmas and H. multiflora. The majority of species have long-lived peduncles that progressively get longer and longer in successive seasons, regularly producing flowers every year. It is therefore important to avoid cutting the peduncle off after flowering otherwise future flowering will be delayed till new peduncles are produced. Inflorescences have various shapes and be positively geotropic concave umbels, positively geotropic convex umbels or negatively geotropic convex umbels. The size of the inflorescence varies greatly, from the massive *H. imperialis* and *H. gigas* whose inflorescences may exceed 25 cm in diameter to *H. minutiflora*, whose umbels may be less than 1 cm across. Flowers are pentamerous and radially symmetrical, composed of a calyx, a corolla and a corona. The calyx is deeply divided and comprises five lobes that are variously shaped from lanceolate to ovate or obovate. These lobes may have some hairs and glands at the sinus. The corolla is one of the most variable and consequently diagnostically important morphological feature of the genus *Hoya*. It is also the most striking feature of many species and the different shapes and bright colours ranging from pure white to dark red or maroon, but more commonly pink, yellow or red, are largely responsible for the horticultural interest in the genus. The most common corolla shapes are revolute, reflexed, flattened-campanulate or campanulate, however urceolate or funnel shaped flowers are also present. The corolla lobes are mostly ovate, lanceolate or obovate. Corollas often present hairs, only rarely are they glabrous. Hairs can be the reason for the attractivenes of Hoya species such as in *H. caudata*, *H. erythrostemma*, *H. mindorensis* and *H. lasiantha*. The staminal corona

Plants can vary considerably in size, ranging from the tiny *H. microphylla* that can easily fit in a tea cup to the huge *H. ariadna* and *H. imperialis* that can cover whole trees in favourable conditions.

Recently interest in *Hoya* has been increasing and now *Hoya* are very popular among hobbyists both in cold climates and in the tropics. This is because many more species have been introduced into cultivation (ca. 200) and they can easily adapt to grow indoors behind a well lit window or even in terraria under artificial light.

which is the star shaped fleshy structure found in the centre of the flower comprises five lobes that are fused to the side of the staminal column on the back of each anther. Their variation in size, shape and colour is of great interest to botanists since it provides valuable characters to separate species within the genus.

Specialists are also interested in the morphology of anther appendages and the pollen-carrying structures, called pollinaria, which are composed of two pollen masses, the pollinia, connected via two caudicles to a central retinaculum. The retinaculum isusually dark brown, and together with the yellow pollinia can be seen by naked eye on species bearing big flowers such as *H. imperialis*. In flowers with minute flowers the pollinia have to be painstakingly extracted with a needle and studied with the aid of a microscope. Flowers can last from just a few hours in *H. spartioides* to up to a month in *H. multiflora* but more normally flowers last about one week. *Hoyas* are supposedly insect-pollinated but so far very little is known about the pollinators. Fruits in Hoya are follicles, produced singly from each flower. The follicles may be rather short (2 cm) and thin, or massive, like in eriostemmas, where banana-sized follicles are common. Seeds are wind dispersed and present a long sericeous (silk-like) hairs that makes the seeds float in the wind.

Species in cultivation

Hoya are mostly cultivated for ornamental purposes. In cold climates *Hoya carnosa* has been long grown as a house plant since it thrives even if neglected and during warmer months it produces a magnificent display of fragrant flowers. Recently interest in *Hoya* has been increasing and now *Hoya* are very popular among hobbyists both in cold climates and in the tropics. This is because many more species have been introuced into cultivation (ca. 200) and they can easily adapt to grow indoors behind a well lit window or even in terraria under artificial light. Most species can also be easily grown outdoors in tropical climates. Apart from species originating from high mountains or from the Northern extremities of the distribution area, most species will adapt to the Singapore climate, but only lowland species will thrive and flower constantly. Among the most showy lowland species are *H. imperialis* with 5 cm wide flowers from dark red to white in colour, *H. erythrostemma*, *H. coriacea*, *H. danumensis* and the shrubby *H. lasiantha* and *H. multiflora*. Other species may have smaller flowers but constantly produced in great quantities: *H. memoria*, *H. bilobata*, *H. kentiana, H. lacunosa*, *H. walliniana*. These are not rampant climbers adapt well to growing in hanging baskets. Some species produce short lived flowers far surpassed by the beauty of the leaves. Among these are: *H. finlaysonii*, H. *macrophylla*, *H. glabra* and H. *callistophylla*. *Hoya sigillatis* produces beautiful orange flowers displayed among stunning maroon leaves covered in gray speckles.

Among a few very odd species, usually appreciated by *Hoya* collectors only are *H. spartioides*, a leafless species that bears flowers opening at night only and dropping the following morning and *H. minutiflora* with minuscule red and yellow flowers. Other species are suitable for dedicated collectors only. For example *H. fuscomarginata*, *H. lucardenasiana*, *H. myrmecopa* and *H. graveolens* flowers present a scent that may not be pleasant for most people.

Exciting new species are introduced into cultivation every year, and the author looks forward to presenting a selection of these in forthcoming issues of Gardenwise.

Hoya manipurensis with funnel shaped hairy flowers and heart shaped leaves

Hoya finlaysonii, short lived flowers but beautiful foliage

Michele Rodda
Herbarium

All photos by Michele Rodda

BY THE FLOWING WATERS

Rheophytes, the fascinating plant life adapted to the flood zones of swift-flowing streams

The term rheophyte is formed by the Greek components *rheo-*, pertaining to rivers, and *-phyton*, or plant. Rheophytes were defined by the late Dutch Professor C.G.G.J. van Steenis as "plant species which are in nature confined to the beds of swift-running streams and rivers and grow there up to flood-level, but not beyond the reach of regularly occurring flash floods". Professor van Steenis was the founder of the Flora Malesiana project that consolidated the concept of the Malay Archipelago and some adjacent territories as a distinct botanical province that came to be called Malesia. Today, we know that this is one of the most species-rich regions on earth, where very many different life forms and ecologically specialised groups abound, and new species continue to be unveiled by scientific research.

Clear waters and boulder-strewn banks are frequent correlates of the swift-flowing stream environment that harbours many rheophytes.

K.M. Wong

van Steenis was the first to promote consistent use of the term rheophyte through his well-known book *Rheophytes of the World: An Account of the Flood-Resistant Flowering Plants and Ferns and the Theory of Autonomous Evolution*, published in 1981, and its sequel, *Rheophytes of the world: Supplement*, published posthumously in 1987 in the journal *Allertonia*. Before that, other terms that were less well-defined had been employed, such as 'stenophyllous plants', which merely referred to the typically narrow leaf-form in such plants but which also occurred in other dryland plants far away from flowing water. The focus provided by van Steenis, accompanied by his treatise of the wide distribution and significant diversity of this interesting group of plants, has brought on increased scientific inquiry into the biology and ecology of rheophytes. Rheophytes occur in both the Old and New Worlds, particularly in tropical regions of high rainfall. This specialised ecological grouping includes a sprinkling of representatives from many different plant families, although in a few cases, whole genera or families appear to have evolved as rheophytes. Rheophytes can be 'obligate', restricted to the swift-water environment, or 'facultative', i.e., not exclusive to the typical rheophytic environment of swiftly flowing waters and also growing, for example, in dryland forest or in slow-moving water that is occasionally overwhelmed by fast floodwaters.

The environment of rheophytes

Rheophytes are restricted to the flood zone of rivers. They are ecologically adapted to a rather unpredictable environment where fast-moving water currents prevail and flash floods bring sudden rises in water level, submergence, and an amount of force that causes sheering and tearing damage by currents and debris. Such currents often move at speeds of 1–2 meters per second, and flash flood episodes can bring inundation of several meters, and occasionally even over ten meters higher than average stream levels. In the wet tropics, such as in Borneo, extreme flood events can mean inundation of whole plants for days, at times even over a week. Such flash floods occur when rainfall upstream is intense, bringing more water into the system than can be drained at usual rates. The floodwater carries much debris and soil eroded by runoff and so is muddy and murky. For plants submerged during such episodes, their light environment is also drastically reduced.

Along wider stretches of streams and rivers, rheophytes are frequently exposed to high light intensities and temperatures, although a number of them also grow along deeply shaded creeks and tree-lined banks of rivers. They root in a typically harsh substrate that is often

rocky or sandy, frequently without much soil and devoid of much nutrient and organic matter accumulation. In some cases, opportunities for root holdfasts are restricted to small crevices in exposed bedrock or on boulders.

Another, perhaps less frequently observed, aspect of the rheophytic environment appears to have eluded the attention of most ecologists. In drier times, when stream levels are low, whole rheophytic communities on boulders or high banks may be left quite dry. During such droughts, many rheophytic plants experience 'water stress' even though they would normally be in a water-abundant environment.

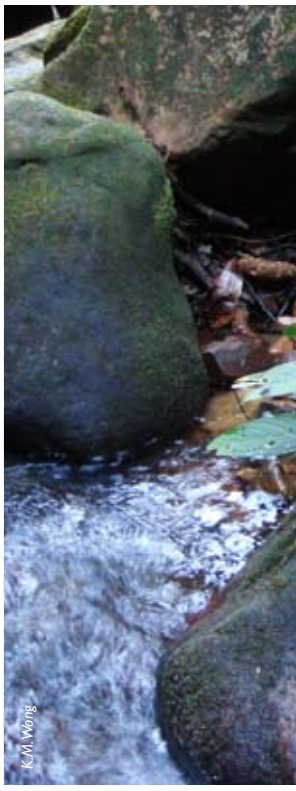
Characteristic adaptations of rheophytes

The shared morphological features of this interesting biological group are easy to interpret as adaptive features that grant survival advantage in this harsh and unpredictable environment.

Many rheophytes are low bushes with flexible stems and branches and have small or narrow, relatively pliable, willow-like leaves or leaf-segments. This characteristic narrow leaf form has been called stenophylly but, as van Steenis noted, is not at all restricted to rheophytes, i.e., stenophyllous plants are also found in dryland environments away from streams. These features would minimise resistance to swift currents that break and tear stiffer branches or broader leaves. Professor Masahiro Kato's group in Japan has investigated the leaf form and internal structure of rheophyte leaves compared to that of their dryland non-rheophytic close relatives. In general, they found that riverine individuals of the facultative rheophyte *Farfugium japonicum* (Asteraceae) have narrower leaves with thicker surface cuticles. This is perhaps an adaptation that protects against excessive water loss with increased light exposure or leaf tissue damage in the rheophytic environment.

Also comparing this rheophyte with its non-rheophytic form, Dr Naofumi Nomura's team confirmed in 2006 that light adaptation resulted in smaller leaves, but riparian adaptation was accompanied by narrower leaves (stenophylly). They found that there were larger and more mesophyll ('packing') cells in the leaf tissue of the rheophyte than was required for efficient photosynthetic gaseous exchange. As a higher cell density enhances leaf toughness, this suggests that stenophyllous leaves with a tougher structure are "selected for" by strong water currents placing a mechanical constraint caused by physical stress.

Rheophyte survival depends on fast and strong root development that provides firm anchorage. Rheophytes often have



widespread root systems as well, which probably give better anchorage as well as nutrient foraging. In some rheophytes that are wholly aquatic, bottom-creeping, flattened stems with leaves appressed against the substrate exhibit an extreme adaptation.

Beyond these easily observable features, it goes without saying that rheophytes should also be physiologically tuned to their environment. Some tolerance to exposure to high light (or, conversely, to lower light intensities for shade-adapted rheophytes) and submergence during floods; rapid growth and tissue repair; efficient sequestration of nutrients, often in a rapidly changing rooting environment; and even a degree of drought resistance that helps tide a plant over drier, low-water episodes would be prerequisites to survival in the risk-filled environment of rheophytes.

Do rheophytes beget rheophytes? Facultative rheophytes, gene flow and adaptation

As explained by van Steenis, facultatively rheophytic species have a wide ecological tolerance and can survive normal floods. They are washed away only during extreme flood events. He hypothesised that they "can well have served as a source from which true rheophytes have developed and specialised".

Studying different populations of *Farfugium japonicum* adapted to sun and shade conditions on dryland (both with characteristically broad leaves) compared to the riparian habitat (where only the narrow-leaf form persisted), Dr Naofumi Nomura's team discovered in 2007 that gene flow (genetic exchange through reproduction) among these populations was not restricted, as they freely interbred. This in turn implied that selection for the narrow leaf form in the rheophytic population may act directly on the survivorship of young seedlings. Subsequently, a 2011 study (Dr Yuki Mitsui and colleagues) of gene flow between riparian and forest species of *Ainsliaea* (Asteraceae) suggested that adaptations to these different habitats can lead to sufficient differentiation and failure to interbreed. Such "reproductive isolating barriers" form the basis for the emergence of the rheophytic form as a newly evolved species.

Separate studies by Mitsui and co-workers (2008) of the genetic ancestry of *Ainsliaea* in the Sino-Japanese region indicate that separate lineages with rheophytes have evolved in different places. This implies that rheophytic species have evolved by adapting to the rheophytic environment present (i.e., riverbanks subject to periodic flooding) and have probably evolved from non-rheophytic ancestors.

> The census by van Steenis revealed that in Southeast Asia, the diversity of rheophytes is particularly notable in Sarawak and Brunei, where many of over 80 species he listed for Borneo may be found.

On the other hand, van Steenis emphasises the interest around entire genera or families of plant species that are rheophytic, implying, obviously, that some lineages are predisposed to a life with fast-flowing waters and floods. The Podostemaceae and Hydrostachyaceae, mostly submerged herbs clinging to stream bottoms as green encrusting structures, for example, are specialised rheophytic families, with some representatives in Malesia but more characteristic of Africa, Madagascar and the New World.

The rheophytes of Malesia

Professor Kato has pointed out that there are still many species of rheophytes not yet recognised. For example, his research group has found about 60 species of fern rheophytes from Bomeo, much more than the 12 species recorded in 1981 by van Steenis. In some territories, such as New Guinea, so much exploration still remains to be done and plant distributions and habits are so little documented that we

may certainly expect many more records of rheophytes.

The census by van Steenis revealed that in Southeast Asia, the diversity of rheophytes is particularly notable in Sarawak and Brunei, where many of over 80 species he listed for Borneo may be found. Widespread rheophytes in the Malayan-Borneo region include the fern *Dipteris lobbiana* which has creeping stems and finely dissected fronds; the tough-stemmed shrubs *Homonoia riparia* (Euphorbiaceae) and *Phyllanthus chamaepeuce* (Phyllanthaceae); and even the dipterocarp tree *Dipterocarpus oblongifolius*, in which only seedlings, saplings and low-hanging branches of big trees show stenophylly (the adult leaf form being much broader).

Some rheophytes are endemic (i.e., restricted in distribution) to Borneo but not uncommon, including the slender-stemmed palms *Pinanga rivularis* and *P. tenella*, the shrubs *Myrmeconauclea strigosa* (Rubiaceae) and *Osmoxylon borneense* (Araliaceae), and the trees *Antidesma linearifolium* (Phyllanthaceae), *Fagraea stenophylla* (Gentianaceae), *Sandoricum borneense* (Meliaceae) and *Syzygium rejangense* (Myrtaceae). There are also endemic rheophytic species of more restricted distribution, such as *Aglaia rivularis* (Meliaceae; east Sabah only), *Antidesma stenophyllum* (Sarawak), and *Schismatoglottis gillianae* (Araceae; Brunei's Temburong district). The diminutive palm *Areca rheophytica* is a rheophyte known only from streams over ultramafic rocks in Sabah.

Their conservation can only be guaranteed by maintaining the pristine nature of streams and river systems. Often, when forests are disturbed, river systems are also impacted, with streambank vegetation being eroded away or taken over by more weedy forms, so that rheophyte environments are altered.

Rheophytes in the garden, the 'odd plants out'

Many rheophytes, because of their different structure and leaf form compared to dryland plants in general, are attractive and deserving of horticultural trial. In the artificial landscape of cities and generally away from streams and rivers, rheophytes are indeed removed from their natural habitat. However, a few, such as the shrub *Osmoxylon lineare* from the Philippines, have become successful garden plants, especially in hedging, because of their prolific bushy growth, attractive linear leaf divisions and tolerance to exposed conditions. Popular from a longer time past, the *Thevetia peruviana* (Yellow Oleander, New World) and *Nerium oleander* (Oleander, North Africa to South Asia) (Apocynaceae), both rheophytes but containing toxic latex, have already made their way into, and largely out of the gardens of Southeast Asia.

Rheophytes are therefore a potential horticultural resource for a number of 'inbuilt' features. Adapted to an essentially harsh environment that mainly selects for fast growth, well-developed root systems with firm anchorage, tolerance to open conditions and a degree of inundation, tough pliable stems and branches, and small or stenophyllous leaf forms that impart an elegant look, rheophytes could be explored for more candidates for worthy garden plants. Whether they are considered to have been 'fished out' of their highly specialised (and risky, if not exciting) natural environment when raised in gardens, or to have distinctively elegant foliage compared to many other plants, they are simply the 'odd plants out'.

Extreme left:
Elatostemma (Urticaceae) has a number of distinctive rheophytic species.

Second from left:
The rheophytic tree *Saraca cauliflora* (Leguminosae) develops prolific root systems that can cover and bind streambeds.

Centre:
Ooia grabowski (Araceae) in a creek in Sarawak's Kubah National Park.

Second from right:
Phyllanthus balgooyi (Euphorbiaceae) at a streambank, Sabah.

Extreme right:
High cascades provide for a 'splash' environment that sustains some rheophytes.

Khoon Meng Wong
Herbarium

RE-DISCOVERY OF A RARE GREEN GEM –

PLANCHONIA GRANDIS

The Gardens' Rainforest is a wonderful 6 ha remnant rainforest that has stood the test of time and still holds many treasures. In late 2009, a comprehensive survey of the area was undertaken by the Plant Records Unit of the Gardens along with the assistance of the Herbarium, Arboriculture, Living Collections, and also a Plant Records volunteer.

The distinct vertically grooved bark of *Planchonia grandis*.

The inventory was initiated as the rainforest collection has never been fully documented in the Gardens' plant records. This survey is still on-going and is expected to be completed by the end of 2011. During this survey, a few 'green gems' of the past have been unearthed. One of the re-discovered rare treasures is *Planchonia grandis* Ridl.

The important status of this species almost escaped recognition if not for a recent enquiry by Dr. Ruth Kiew, from the Forest Research Institute of Malaysia. The type was first designated by H.N. Ridley in 1912 based on a specimen collected from the Gardens' Jungle (currently known as the Gardens' Rainforest). Dr. Kiew was curious and enquired if there was any chance of the type tree still existing in the Gardens' Rainforest near the Potting Yard. As luck would have it, there was a tree located near where the type had been collected and recently identified and accessioned as *Planchonia grandis*. On checking the status of this species in the *Checklist of Total Vascular Plant Flora of Singapore* (2009) compiled by the National University of Singapore, it was discovered that this species had been considered extinct in Singapore. The importance of this newly accessioned tree was highlighted as it became apparent this may be the last of its species in Singapore! A rare green gem has been re-discovered!

Ridley, in his account of *Planchonia grandis* in the Flora of the Malay Peninsula described it as a huge buttressed tree, 80 ft (approx. 25 m) tall with a 6-ft (approx. 1.8 m) girth at the base. He mentioned there was only one tree in the Gardens. It must have been one of the many majestic residents in the rain forest of the Gardens during his time. The tree that provided the specimen described by Ridley in 1912 is, of course, no longer alive in the forest. The tree discovered during the 2010 rainforest survey is a medium-sized tree, about 12-15 m high with a girth of about 0.7 m. It seemed most probable that this tree is indeed an offspring of the type tree described by Ridley so long ago.

Planchonia is a very small genus of trees of the family Lecythidaceae, found throughout the Malay Peninsula, Borneo and Sumatra. *Planconia grandis* is a mid-canopy tree that can grow up to 36 m tall and with a diameter of 100 cm. It is normally found growing in undisturbed mixed dipterocarp and coastal forests up to 400-600 m altitude. In secondary forests, it is usually present as a pre-disturbance remnant tree. The species epithet *grandis* refers to the tree's large habit. Locally, this species is commonly known as *putat* or *kawi*. *Planchonia grandis* can be easily spotted by the vertically grooved bark on the trunk with a smooth and spongy inner bark. Its branches are reddish brown in colour. The leaves are dark green, obovate oblong, short-acuminate and very coriaceous. The leaf base narrows and runs down the stalk, drying dark reddish brown. The leaf margin is finely, regularly toothed, with prominent nerves. From the literature, it seems *Planchonia grandis* is a rare species and little known in Peninsula Malaysia. *Planchonia* is used as a timber tree in the region, but apparently it is not durable enough for export. In Pahang, the young leaves and shoots of *Planchonia grandis* are eaten as a salad with rice or steamed with fish.

Apart from occasionally cultivated specimens in botanical gardens, there are no records of *ex situ* conservation of *Planchonia* species. Several species are rare and may easily become endangered by destruction of their habitat. This fact alone will undoubtedly intensify the significance of the re-discovery of our *Planchonia grandis* and will no doubt prompt necessary care to ensure its continued survival in Singapore.

Nura Abdul Karim
Md. Fadli Bin Baharudin
Living Collections

All photos by Lim Yaohui unless otherwise stated

Planchonia grandis with a *Freycinetia* twining around its trunk.

The type specimen lodged in the Gardens Herbarium, collected by H.N. Ridley in 1894 in the Gardens Jungle.

Herbarium Archives

The hidden *Planchonia grandis* tree deep in the Gardens' Rainforest.

Merremia umbellata in the wild in Thailand.

Merremia subsessilis being visited by a bee, Uttaradit province, Thailand.

GOLDEN GLORIES:

THE GENUS *MERREMIA* AND ALLIES IN SOUTHEAST ASIA

In the minds of many people, morning glories typically come in colours ranging from purple, lavender, pink, and red to pure white. A few are genuinely blue. Yellow is rare, orange is almost unheard of. In this article we will meet some of the species that have colours in the yellow to orange range. While rather few are grown as ornamentals at present, many are very showy plants that would make fine additions to the tropical garden.

Flower colour is a variable characteristic in Convolvulaceae and it is not trustworthy for recognising species or even genera on a consistent basis. Still, that being said, there are some general trends in corolla colour that are worth mentioning. This is especially true of yellow shades. Although the largest genus in Convolvulaceae is *Ipomoea*, with 500–600 species, very few of these (less than 10 or so) have yellow corollas. Among the common species of *Ipomoea* most likely to be encountered by gardeners, there are just 4 species that have yellow, cream, or gold-coloured flowers.

On the other hand, *Merremia* and its close allies *Hewittia* and *Operculina* have a high proportion of species with cream, yellow, or golden corollas. So when confronted with an unidentified Convolvulaceae here in tropical Asia, if the flowers are in the yellow shades from pale cream to vivid lemon yellow or bright butter yellow, then *Merremia* and its close allies are the place to begin searching for a name.

Perhaps the most widespread *Merremia* in cultivation is the wood rose, *M. tuberosa*. Originally native in tropical America, this species has been spread around the world as a cultivated flowering climber and the species often escapes from gardens to become a naturalised alien everywhere it is planted. The expansive vines thrive in moist soil and will cover buildings, drape tall trees, or get up into overhead wires, so this is not a climber for small spaces. Besides the great masses of butter-yellow flowers, the papery fruits are collected for use in dried arrangements, giving rise to the common name.

Here in Southeast Asia there are many attractive species of *Merremia* with lovely flowers in various shades of yellow that could be grown in gardens. Some are as large and rampant as *M. tuberosa*, but others are much smaller plants that would adapt better to small urban gardens. Here are a few of them. Among the smaller species are several widespread from Southeast Asia and Malesia to other parts of the Old World tropics. *Merremia hirta* is one such abundant species that often grows prostrate and sprawling on the ground, or twining to a meter or so up in grasses and low shrubs. The flowers are pale

Merremia tuberosa, with palmately-divided leaves and butter yellow flowers is perhaps the most widely cultivated species in the genus. Photographed in Hawai'i, where the species is naturalised.

Hewittia malabarica, a vividly coloured African strain grown in cultivation in France.

yellow to almost white. It is not particular about soil and growing conditions and would be easy to grow in gardens.

Rather similar to it, but much rarer, is the Thai-Indochinese *Merremia thorelii* with larger flowers and fuzzy-hairy leaves and stems. This species is found on sandstone substrates and is decidedly seasonal: the plants grow vigorously during the rainy season, then die off completely during the dry season. The flowers are a lovely pale yellow and larger than those of *M. hirta.*

Another of the smaller plants with showy flowers from the Thai-Indochina peninsula is *Merremia subsessilis*. These rather delicate twiners are just 1 to 2 meters high, often growing through low grasses and shrubs or even sprawling on the ground. The yellow flowers are large in relation to the plant and a lovely medium yellow in colour. This is another species from the seasonally dry forests that requires a dry period during which plants die off.

Two genera closely related to *Merremia* also offer medium-sized plants suitable for gardens with attractive yellow flowers. *Hewittia malabarica* has a very large geographical range, from tropical Africa across the whole of Asia to the western Pacific and as far south as New Guinea. As one might expect when one species is distributed across such an enormous geographic region, there is considerable variation in plant size and flower colour, as well as more technical features. For example, *H. malabarica* plants from Africa have more vividly coloured flowers than those from Thailand, though both have the deep wine-red center. *Operculina petaloidea* has flowers varying from pale yellow to almost white. This plant can grow to a large size, if space permits, and in the wild it often grows around lakes, streams, or other water bodies, where the plants sprawl on the ground and twine up into vegetation bordering the water. However, it can also be fairly compact and this tendency recommends it for garden cultivation. The species ranges from eastern India across Myanmar and Thailand into the Indochina area.

And among the larger climbers in Merremia there are many species with attractive yellow flowers, but the lack of space prevents them being grown in home gardens. One particularly beautiful species is *Merremia umbellata*, which like *Hewittia* has a vast geographic range, with one subspecies found in tropical America and west Africa (subsp. *umbellata*) and another (subsp. *orientalis*) in Asia, Malesia, and northern Australia. The Southeast Asian plants have flower colours ranging from pure white to pale yellow or apricot, whereas the tropical American plants are more often a vivid shade of yellow. Because of these attractive flowers, *Merremia umbellata* subsp. *umbellata* has been cultivated in a few places and it tends to escape gardens wherever it is planted.

Another species native throughout tropical Asia (and extending as far west as Africa and Madagascar) is *Merremia peltata*. This is a liana found in rain forest where it can reach the crown of the tallest trees. It is immediately recognisable because the leaf attachment is peltate: the stalk attaches to the leaf blade away from the margin, towards the center of the blade. And the saucer-shaped flowers are not only large in size, they have tufts of long hairs on the anthers, a peculiar condition known in only one other species. Colours vary from pure white through pale yellow to vivid butter-yellow.

These few species are merely an introduction to the diversity in genus *Merremia* (with more than 100 species) and its close relatives. While not all species have yellow flowers, particularly among the tropical American ones, there are enough Asian species that do to warrant the name 'golden morning glories'. Many of these have potential to be attractive ornamentals if they were introduced to the commercial trade.

George Staples
Herbarium

All photos by George Staples

OF ART AND FRIENDSHIP

The Gardens had the honour of receiving two sculptures during April this year. One was donated by Asia Pacific Breweries (APB) in celebration of their 80th Anniversary and the other was presented by the Embassy of the Republic of Korea in Singapore.

The APB sculpture is titled Chang Kuda, a popular game played by children in the 1950s and 60s. Mr Chong Fah Cheong, the sculptor, is known for his many public sculptures in Singapore, notably "The First Generation" which depicts a group of children jumping into the Singapore River near the Fullerton Hotel. Here in the Gardens, three pairs of boys of different races are seen horsing around and racing against each other on Lawn E. To invite the public to enjoy and view the sculpture, APB organised a mass picnic with free breakfast sets on 30 April 2011.

Conversation – From Nature, the Korean sculpture was first displayed in the Gardens in 2009 during the Nature Borne Exhibition, a joint exhibition between Singaporean and Korean sculptors. Symbolising the warm amity between the two countries, the sculpture shows *Vanda* Miss Joaquim and the Rose of Sharon, the national flowers of Singapore and Korea respectively, springing from the same centre. The unveiling ceremony of the sculpture was held on Friday 15 April at Heliconia Walk, now the permanent home of this striking sculpture.

Celebrating art and friendship, both gifts were dedicated to the people of Singapore.

Mak Sin Chang
Visitor Services

Top:
The unveiling of *Conversation – From Nature*.

Bottom:
The delightful Chang Kuda sculpture takes pride of place on lawn E.

FOR YOUR EYES ONLY
NEW MEDIA ROOM!

A new feature in The Library of Botany and Horticulture, The Media Room offers an audio-visual experience for the whole family. Children especially will be able to enjoy hours of edutainment fun in this uniquely furnished room, jointly designed by our very own horticulturist Keith Lin and Library executive, Margaret Tan.

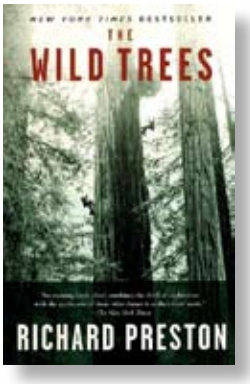
We would like to thank our sponsors Esmond Landscape & Horticulture Pte Ltd, Samsung C&T Corporation and Samsung Electronics for making this place possible. Library visitors are now able to place bookings for the usage of the room on a first-come-first-served basis, with over 300 natural history DVDs to choose from.

The Media Room is available for all to use during the following hours:

Mon – Fri: 9am to 5pm
Sat & Sun: 9am – 1pm
Eves of Public Holidays: 9am – 12.30pm
Closed on Public Holidays

Rahimah Yusof
Visitor Services

NEW IN THE LIBRARY SHOP



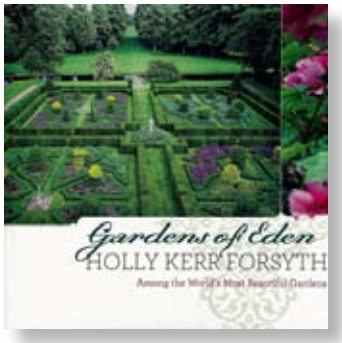
The Wild Trees
by Richard Preston
Price: $34.00

The Wild Trees chronicles the unusual and at times surreal escapades of four young voyagers in the enchanting yet treacherous vertical Eden of the giant redwood forests of northern coastal California.

While most American college students would choose to be at the warmer southern beaches, Steve Sillet – who was once chronically acrophobic – and his buddies traded their fall break for a rendezvous amongst lichens, ragbags and liverworts. And for years to come, this great conifer terrain would be their sanctuary; where Taylor sought comfort over his messy divorce, and where Sillet and Antoine eventually exchanged marriage vows – 300 feet above the ground.

Page after page, Preston keeps you enraptured with his vivid storytelling complete with breathtaking details of these magnificent giants. A true story of botanical wonders and their idiosyncratic relationship with humans.

Year Published: 2007
ISBN: 978-1400064892

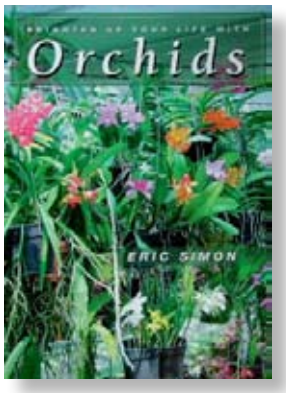


Gardens of Eden: Among the World's Most Beautiful Gardens
by Holly Kerr Forsyth
Price: $96.00

A globetrotting columnist gifted with an eye for taking wonderful photographs, Holly Kerr Forysyth delights with this lavish pictorial showcase of the 50 finest gardens around the world.

From the resplendently reclusive gardens of Ninfa to our very own Singapore Botanic Gardens, this 330-page book is an effervescent gem for garden lovers with budget constraint. You will get a wonderful armchair tour of some of the best gardens in the world. Forsyth also brings you into the inner sanctuaries through her interviews with the owners and creators gardens peppered with her own astute observations. Get ready for a wonderful journey, fasten your seatbelt, Eden air is set to take off!

Year Published: 2009
ISBN: 978-0522856057

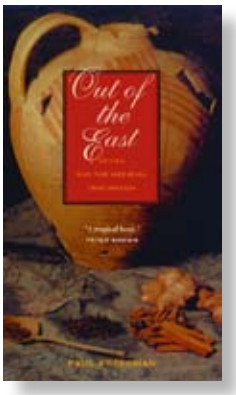


Brighten Up Your Life with Orchids
by Eric Simon
Price: $26.75

Orchids, one of the world's most diverse plant families and the most important plant group in the international floriculture industry, have become amongst the most popular cultivated flowers in the world. It does not take much to realise why – orchids have such a huge range of sizes, shapes, colours, flowering and growing habits. While orchid growing can be challenging for a new gardener, many orchid enthusiasts are ready to wager that once mastered, the art of orchid cultivation will reward the grower with immeasurable pleasure.

If you are thinking of starting your very own collection of orchids and are not too sure where to begin, Brighten Up Your Life with Orchids will put you in good stead. Packed with intuitively arranged content and illustrations, Eric Simon has made this both an entertaining and extremely informative publication.

Year Published: 2008
ISBN: 978-9834188313



Out of the East: Spices and the Medieval Imagination
by Paul Freedman
Price: $51.36

A thousand years of courtship – that is how long Europeans have been fascinated with spices. Fascination with spices in the West reached a peak in the late 17th century, and they were much coveted not only as culinary condiments but also as an indication of social status.

The quest for spices was driven by a desire so strong that the Europeans were prepared to venture to the edges of the world for these extravagant commodities. Out of the East traces the consequences resulting from the medieval demand for spices on the whole trading system of the Mediterranean region.

Year Published: 2008
ISBN: 978-0300111996

Margaret Tan
Library

Strelitzia species have opted for a bright orange 'hairdo' for their seeds.

Traveller's palm rarely flowers in Singapore. It seems to do far better in northern Thailand, where it not only flowers freely but also happily produces fruits.

Strelitzia reginae, the bird-of-paradise known also as the crane lily, has orange purple flowers, which are commonly sold as cut flowers.

Ravenala ripe fruits split in three parts and revealing seeds embedded in an electric blue aril.

NEITHER BIRD NOR PALM

The bird-of-paradise family (Strelitziaceae) is the smallest of the eight families of the Ginger order, with only seven currently recognised species falling into 3 genera, *Strelitza, Ravenala* and *Phenakospermum*. The Strelitziaceae were previously classified as a part of the banana family (Musaceae), but recent molecular evidence shows that its closest relative is actually the Orchidantha family (Lowiaceae, see Gardenwise vol. 36, January 2011). Most of the species are medium to large with some having woody stems and reaching over 15 metres in height. A distinctive feature of this family is the banana-like leaves, but these are often of more leathery texture than in bananas, arranged in two opposing vertical rows (known as a distichous arrangement), sometimes with long petioles. Unlike bananas, the fruits are woody capsules splitting into three parts when mature, exposing black or dark brown seeds endowed by colourful orange, red or blue arils. Nearly all species of this small but beautiful family are now cultivated across the tropics, some for cut flowers and others as prominent landscaping elements. The leaves of *Phenakospermum* are among the largest of any plants and are used by indigenous people for roofing.

The genus *Strelitzia* is native to South Africa. In spite of over 20 names published, only 5 species are currently recognised. The generic name *Strelitzia* was coined in 1788 by famous English botanist and naturalist Sir Joseph Banks, who named the first species, *Strelitzia reginae*, after Queen Charlotte Sophia of Mecklenburg-Strelitz, the wife of the then reigning George III of England. Queen Charlotte is well known for bearing 15 children to the King, but she was also an enthusiastic amateur botanist and took great interest in expanding collections of Kew Gardens, where new plants arrived by the dozen from various expeditions. The bizarre orange-purple flowers of *Strelitzia reginae*, which grows between other shrubs along the riverbanks and clearings in the coastal bush of the eastern Cape, gave this genus and the whole family common name bird-of-paradise. Another species which is fairly common in cultivation is *Strelitzia nicolai,* known also as the giant bird-of-paradise. The flowers are cream, white and purple and the plant is far more robust than *S. reginae* with its woody stem, much resembling the traveller's palm. Perhaps the weirdest looking species in this genus is *S. juncea.* While its flowers are fairly similar to those of *S. reginae*, its leaves have reduced leaf blades, looking like porcupine quills. All *Strelitzia* species require full sun to semi-shade, with plenty of water and regular fertilising. They are rather slow-growing plants, which can be propagated by dividing the large clumps or by seeds. While it takes about two years for plants to get established and flower again after dividing, from seeds three to five years of loving care are needed before the patient gardener will be rewarded. *Strelitzia* flowers in their natural habitats are pollinated by sunbirds, which transfer the pollen mostly by their feet, but in commercial production hand pollination is preferred to increase the number of seeds.

The other two genera *Ravenala* and *Phenakospermum* are monotypic which means that only a single species is known. The ubiquitous traveller's palm, *Ravenala madagascariensis*, is native of Madagascar as the name suggests. The common name traveller's palm is believed to be derived from the arrangement leaves, which supposedly always align themselves in north to south. But once there is a clump of the plants growing together, the desire for enough light will win over the altruism towards lost travellers. *Phenakospermum guyannense* is native to Surinam and the eastern Amazon River basin. Due to its resemblance to *Ravenala*, it is known as South American traveller's palm or red traveller's palm reflecting the red aril on its seeds. Both *Ravenala* and *Phenakospermum* are large robust plants reaching up to 15 metres at maturity with woody aerial stems, a feature which is unique in the ginger order and liken them to palms, and hence their common names. The inflorescences of both species are composed of large green bracts and resemble that of a giant *Heliconia*. The pollination of *Ravenala* was obscure until recently and earlier suggestions of bird pollination remain unconfirmed. Several detailed studies by John W. Kress in the 1990's uncovered a peculiar pollination relationship between *Ravenala* and ruffed lemurs, and suggested that *Phenakospermum* is pollinated by nectar-feeding bats.

Jana Leong-Škorničková
Herbarium
Photos by Jana Leong-Škorničková


Benjamin Aw


Winnie Wong


Benjamin Aw


Goh Mei Yi


Benjamin Aw


Chiew Yong Seng

ENVIRONMENTAL EDUCATION 2011 INITIATIVES

In celebration of the United Nations' International Year of Forests, Singapore Botanic Gardens inaugurated new outreach programmes centred on forests and their inhabitants, as well as an Earth Day event to highlight the importance of doing our part for Mother Earth.

Celebrating wildlife and stories about the forest at Jacob Ballas Children's Garden in March and June 2011 school holidays

The 'Celebrating Wildlife' series and 'About The Forest' drama series, developed in partnership with Cicada Tree EcoPlace and Debblinks respectively, are aimed at introducing children to the plants and wildlife that make our gardens, parks and forests their home.

The 'Celebrating Wildlife' sessions in the March and June 2011 school holidays provided our young visitors with the opportunity to get 'up close and personal' with both living and preserved specimens, participate in fun-filled hands-on activities, as well as embark on guided walks to seek out wildlife in the Gardens. Children participating in the 'About The Forest' series found themselves taking on various roles in a play about forests. Using simple props, costume pieces and musical instruments, the children brought to life three stories titled '*I Am Special*' based on Giles Andreae's story *Giraffes Can't Dance*, 'Beware! I Don't Know You' based on Grimm's Fairy Tale *Hansel and Gretel,* and 'I Can Do It!' based on Aesop's Fable *The Tortoise and the Hare*.

A Tribute to Mother Earth

In the spirit of caring for the environment, children from all over Singapore came together to commemorate Earth Day at Jacob Ballas Children's Garden (JBCG) on Saturday 23 April 2011. JBCG was transformed into an ecological, green and environmental wonderland. The wide range of activities ranging from balloon sculpting, guided tours, drama workshops, art & craft workshops and carbon footprint games provided a wonderful opportunity for families to bond while picking up tips on eco-friendly practices.

The highlight of the celebration was the 'My Mini Dish Garden Competition' where young participants not only learned how to create and maintain a dish garden, but also used their creativity to decorate their artpiece with recycled materials. Four young winners were selected for the Most Creative Dish Garden, the Most Colourful Dish Garden, the Best Landscaped Dish Garden and the dish garden with the Best Use of Recycled Materials.

The event also brought together over 100 staff and volunteers who contributed their time and effort. It was a fun way to learn about the 3Rs of conservation – 'Reduce, Re-use and Recycle', so we can all do our part for Mother Earth.

Top left:
Earth Day celebrations at Jacob Ballas Children's Garden: An enthusiastic participant adding a personal touch to her fridge magnet made from recycled materials.

Top right:
Children are provided with the opportunity to study both living and preserved specimens, learning about relationships and connections between treetop biodiversity and forest environments, leading towards the commitment to take action in the investigative 'Celebrating Wildlife' Series.

Centre left:
Nature educator, Andrew Tay, introduced specimens to children and parents in the 'Wildlife Around Us' education talk during the Earth Day celebration.

Centre right, bottom left:
The 'Stories About The Forest' drama series encourages play, expression and dramatisation using simple props, costume pieces, role play and musical instruments

Bottom right:
Proud winners of the 'My Mini Dish Garden' Competition during the Earth Day Celebration at Jacob Ballas Children's Garden.

Janice Yau
Winnie Wong
Education Branch

2010– 2011 BOTANICAL RESEARCH FELLOWS IN THE GARDENS

The Singapore Herbarium (SING) has its beginnings in 1875 and to date holds a collection of more than 650,000 specimens mainly from the Southeast Asian region. It is the Gardens' nerve-centre for botanical research. A 'museum' or 'library' of preserved research plant specimens, it embodies accumulated knowledge and research material spanning two centuries of botanical field exploration, collecting and documentation, attracting the world's scientists and students keen to understand tropical plant diversity.

The Gardens offers, on a competitive basis, a single grant from the H.M. Burkill Research Fellowship and several SBG Research Fellowship grants annually. These are awarded to botanists to carry out research in the Singapore Herbarium. Some Research Fellows are also invited to give public lectures at the Gardens to divulge their discoveries. Profiles and achievements of the 2010 SBG Research Fellows are presented below.

Mr Narin Printarakul (11 to 30 Jun 2010) is a PhD candidate from Chiang Mai University in Thailand. Whilst at SING he worked under the supervision of Dr. B.C. Tan, our past Keeper of the Herbarium and renowned bryologist. He brought 200 duplicate specimen vouchers along to study. All vouchers were identified and the outcome of his studies yielded 84 genera and 141 species. Two were new generic records, namely *Austinia* and *Rhachithecium*, and 18 new species records, for the flora of Thailand. These specimens were presented to the Herbarium at the end of his visit.

Dr Michael A. Sundue (13 Sept to 8 Oct 2010) hails from the USA and is the first recipient of the H.M. Burkill Research Fellowship (See *Gardenwise 34*). His research at SING focused on the circumscription of Malesian genera of grammitid ferns. He also continued his work on the development of a comprehensive data matrix which includes information on 295 taxa and 136 morphological characters. Data for 75 of these taxa was obtained from specimens housed at SING, this accounting for 10,200 data points and each made by direct observation herbarium specimens. The data obtained will then be analysed in conjunction with DNA molecular sequence data as part of his ongoing phylogenetic studies of grammitid ferns conducted by an international consortium of fern systematists. Michael has already published in PLoS Currents: Tree of Life that resulted from this research. Additional publications are expected from this talented young researcher.

Mr Ly Ngoc Sam (28 Jun to 27 Jul 2010) from the Institute of Tropical Biology in Ho Chi Minh City, Vietnam, came to carry out studies on Zingiberaceae specimens collected during numerous field trips in southeast Vietnam. He prepared specimen labels for all his collections and worked on their identification with Dr Jana Leong-Škornicková, our resident ginger specialist. During his stay, Sam paid particular attention to the genus *Curcuma*, where at least three species proved to be new to science and one of them, *C. pambrosima*, has since been published in the Nordic Journal of Botany. Several other exciting ginger discoveries from central Vietnam are also in various stages of publication. Whilst here, Sam also helped to curate collections of Vietnamese origin and learnt from Jana herbarium techniques and management of plant collections with special emphasis on processing plants of the order Zingiberales.

Dr Axel D. Poulsen (28 Aug to 14 Sept 2010) is a Danish botanist from the Royal Botanic Garden, Edinburgh. Axel is the world's expert on the ginger genus *Etlingera*. The revision of the specimens at SING is essential for completing his accounts of the genus *Etlingera* in Thailand, Sumatra, New Guinea and the Pacific. Axel's research is beneficial to an enhanced understanding of the generic delimitation of some problematic genera in the subfamily Alpinieae. SING herbarium benefited from his visit not only by updating of numerous identifications, but also by receiving numerous duplicates of his collections - both for the herbarium as well as the living collections.

Dr Saw Lwin (18 Sep to 1 Oct 2010) from the Union of Myanmar is a collaborator of our resident orchid taxonomist Hubert Kurzweil in his studies on the orchids of Myanmar. During his stay, he examined herbarium and spirit material from Myanmar. His research will eventually result in the publication of a comprehensive annotated checklist of the orchids of the country and an illustrated field guide to the orchids of northern Myanmar.

Mr Do Van Truong (28 Sep to 19 Oct 2010), a young botanist from Vietnam, is a Masters student at the Vietnam Academy of Science and Technology (VAST). His project was the inventory and identification of *Uncaria* (Rubiaceae) in Vietnam. Much of his time here was spent working closely under the supervision of Dr Wong Khoon Meng, our current Keeper and Rubiaceae, Bambusoideae and *Sellaginella* taxonomist. His work here yielded a key to the *Uncaria* species of Vietnam.

Dr Hou Xueliang (9 to 30 Oct 2010) is an Associate Professor from Xiamen University. As SING posses a relatively complete collection of Annonaceae for the Malayan region, Xueliang felt that we provided a good opportunity for him to continue his studies on "A taxonomic revision of *Desmos* and *Dasymaschalon* (Annonaceae)". He discovered and verified 13 type specimens which lay hidden amidst the mountain of our Annonaceae specimens. While studying the 400 over specimens in the collection, he revised the identifications of some, putting names to previously unidentified specimens and in all annotated nearly 200 specimens.

Mr Otakar Šída (20 to 30 Oct 2010) is a collaborator and fellow countryman of Dr Jana Leong-Škorničková, from the Czech Republic. The purpose of his visit to Singapore was to study genome size evolution in the Lowiaceae (a small family in the ginger order) based predominantly on our living collections. Apart of examining all herbarium material at the herbarium, Otakar spent most of his time slaving away in the heat, examining and sampling leaves and root tips of *Orchidantha*. The samples were taken back to the cytology and molecular lab in the Czech Republic. The ongoing analyses aim to test for the presence of suspected polyploidy in certain species, outline genome size evolution within the family and help to clarify the phylogenetic position of some Indochinese species (*O. foetida, O. vietnamica* and *O. stercorea*).

Dr Zhang Xian-Chun (26 Oct to 9 Sep 2010), a Research Professor from the Institute of Botany at the Chinese Academy of Sciences was here to study the tropical Southeast Asian *Selaginella* (Selaginellaceae) deposited at SING. He studied collections of Selaginellaceae from many Southeast Asian localities, concentrating on species from Indo-China and the Malay Peninsula. Xian-Chun mentions that with his knowledge of the East Asian and Indo-Chinese taxa, and using the most recent treatment by Khoon Meng in the Flora of Peninsular Malaysia, a number of confirmed identifications were made. Over 100 sheets of *Selaginella* specimens were re-identified. Among these new identifications he located two new species records to the Malay Peninsula, and also found material relevant to the valid publication of the new species *Selaginella nooteboomii* X. C. Zhang, *ined.*

Dr Hitoshi Neda (7 to 25 Feb 2010) is head of the Mushroom Sciences Laboratory at the Forestry and Forest Products Research Institute in Tsukuba, Japan. His research involves the taxonomic study of agaric fungi in Singapore. While he was with us at SING, we visited a number of the natural areas of Singapore which included Pulau Ubin, MacRitchie Nature Reserve, Bukit Timah Nature Reserve and Dairy Farm making over 200 vouchered specimens of macro fungi. We will continue to collect mushrooms for his attention and identification. Hopefully one day, the end product of this collaboration will be a guide to the macro fungi of Singapore.

Mr Abdulrokhman Kartonegoro (10 to 23 Feb 2011) is a Masters student from the Department of Biology, Bogor Agricultural University in Indonesia. His trip to SING was spent examining *Gesneriaceae* specimens, particularly types, from Peninsular Malaysia and Sulawesi. He also consulted the Library of Botany and Horticulture at the Gardens in search for old taxonomic literature, needed for his study on the *Gesneriaceae of Sulawesi: Floristic Study* and *Preliminary Taxonomic Revisions*. Doel, as he is known, also annotated 25 sheets of our Melastomataceae collections.

Serena Lee
Herbarium

All photos by Serena Lee unless otherwise stated.

WHERE BUTTER GROWS ON TREES

Located in the newly developed Healing Garden near the National Parks Board Headquarters is a magnificent old economically important tree, *Pentadesma butyracea,* commonly known as the butter tree, tallow tree or *kanya*. The tree looks incredible when it blooms heavily, which it did recently.

This species was first introduced from Kew and grown in the Singapore Botanic Gardens in 1897. It was one of many economic plants from around the tropics that were trialled in our Gardens during the colonial period, and the tree we have today may be the offspring of the first introduced plant.

Pentadesma butyracea is native to west Africa, from Guinea, Sierra-Leone, Cote d'Ivoire and Togo to the Democratic Republic of Congo, extending eastwards into Tanzania and Uganda, where it is cultivated. The butter tree occurs in tropical rainforest on moist or swampy ground, mostly on river banks. This species is able to develop stilt roots if growing in very moist sites such as riverine and swamp forest. In recent years, the butter tree has been under threat in many areas due to its over-exploitation and unsustainable use.

The butter tree is a medium to large tree belonging to the family Guttiferae or Clusiaceae (Mangosteen family). It can grow up to 35 m tall and may have small buttresses or stilt roots. It has a cylindrical trunk, up to 100-150 cm in diameter, with horizontal and whorled branches. The bark is brownish with fissures presented in small longitudinal rectangles; the inner bark is red-brown to brown. The slash yields a thick yellow sap, which dries to a reddish gum. The leaves are opposite, in dense terminal clusters, simple and entire without stipules. The leaf is easily recognised as it is leathery, glabrous, shiny dark green above and pinnately veined with numerous, parallel lateral veins. The leaves are streaked and spotted with resin glands with glandular canals on the under surface that are visible by reflected light. Glandular dots are clearly visible in young leaves.

Flowers of *Pentadesma butyracea* are large, solitary or in cymes, greenish-white to pink in colour. Flowers are bisexual with 5 bundles of stamens and an elongate stigma that is divided into 5 spreading lobes which give rise to its generic name. The flowers have a heavy fruity odour that has been described as giving off a smell similar to rancid butter, which may attract bats for pollination. The fruit is an ellipsoid to ovoid berry, about 9-15 cm by 6-12 cm, with a persistent calyx, stamens and disk glands. Its apex is pointed and the fruit wall is coarse, brown and leathery. The fruit may have 5-15 seeds embedded in its yellow pulp. Seeds are pyramidal, irregular or with flattened sides, and dark brown in colour; about 3-4 cm by 2.5-3 cm. Each seed has a dark red embryo from which oil is extracted. Flower buds, flowers and fruits can be found on the same individual at one time. An adult tree can produce up to 500 fruits. In its native habitat, the seeds are naturally dispersed by elephants and monkeys.

Pentadesma comprises about 5 species, all in tropical Africa. Although all *Pentadesma* species yield edible fat or oil, only the uses of *Pentadesma butyracea* are thoroughly documented. The butter tree is a multipurpose tree that is important for income generation in rural households in its native land. For this reason, this species is over-exploited and under threat in its natural habitat. The wood of this species is of good quality and is used for construction, ship and boat building, fencing, furniture work and also as fire-wood. The wood is hard and not often attacked by insects. The young stems and roots are used as chewing sticks or as toothbrushes. The sweet yellow pulp of ripe fruits are said to be edible, but unripe fruits are bitter. The leaves serve as a galactagogue vegetable, and are believed to make milk easily digestible for babies and help in teething.

Besides its timber, another most commercially viable product of this tree would be the oil or fat rich seeds. It is a high oil producing species and the oil extracted from the seeds is odourless and does not

Main:
The *Pentadesma butyracea* tree at the Healing Garden.

Inset:
(Top) Clusters of flowers at different stages of dehiscence

(Bottom) The fruits of the butter tree.

become rancid easily. The vegetable fat or oil extracted is named 'kanya butter' or 'vegetable tallow'. Kanya butter is used in cooking fat and has been marketed as margarine. It is also used as a substitute for the well-known shea butter from *Vitellaria paradoxa*. The fresh seeds of the butter tree also act as a substitute for kola nuts from *Cola* species.

Kanya butter is a suitable base for many topical medicines. It has been applied to relieve chest-pain, coughs in children, strains and abscesses. It is also used in cosmetics for the hair and skin. It is a base material for soap making when mixed with other oils and is suitable for illumination. The seed fat is also used as an insecticide for lice. In Africa, the bark is used to treat diarrhoea and dysentery. The tree is also planted for soil conservation; it has good regeneration and regrowth from the stump and is suitable for re-forestation works in its native land. Under natural conditions, the trees may also generate by root suckers.

The butter tree can easily be raised from seed and matures early. The seeds rapidly germinate within the fruit and therefore fruit removal before sowing is not really required. Freshly harvested, mature and healthy seeds germinate well, but seeds are sensitive to desiccation and fermentation. The seeds lose their viability rapidly when stored in a dry place at 25-36°C; at 10-15°C they keep their viability longer but it is difficult to break dormancy. Studies have shown that the best storage for the seeds to maintain high viability is to store in jute bags that are watered regularly.

It would be worthwhile to search out this old beauty with a thousand uses and admire it up close as the butter tree will no doubt be a centre of attraction at the Healing Garden whenever it blooms and fruits.

Nura Abdul Karim
Living Collections
Photos by N. A. Karim

GOLDEN CASCADES OF AN OLD BEAUTY

The recent hot weather followed by heavy rains proved to be a boon to the Gardens and especially so when old beauties showed their best to outshine the youngsters!

Another spectacular blooming show was seen just meters away from the *Pentadesma butyracea* highlighted earlier. This other old beauty is *Horsfieldia irya* that belongs to the family Myristicaceae (Nutmeg family). Locally in this region, *Horsfieldia irya* is known to the Malays as *pianggu*, *lempoyan paya*, *kendarah* and *darah-darah*. This tree is located at Lawn XH, opposite the National Parks Board Headquarters. It cannot be missed when it puts on its annual flowering show and its bright tiny flowers emanate a pleasant sweet citron scent in the early mornings and late evenings.

The tree in the Gardens is a rather tall tree about 20 m high and its bole is fluted. It has a narrow crown and drooping limbs. The leaves are alternate, simple, narrowly oblong, with a tapered apex and are glabrous to sparsely hairy. The flowers are unisexual, with bright yellow tepals, occurring in panicles from along the drooping slender branches. The scented tiny flowers measure around 1.0-2.5 mm in diameter. The fruits are dehiscent capsules that are yellow-orange and glabrous. The fruits are about 17 mm in diameter, and the seed has a red aril much like the nutmeg. The tree exudes a watery sap when slashed. *Horsfieldia irya* is widespread in Sri Lanka, Indo-China, throughout the Malesian region and in the Solomon Islands. It commonly grows by low lying rivers and streams in swampy places. It can also be found in mixed dipterocarp forests up to 300 m altitude.

The wood is locally used for timber. The timber is pretty, close grained, hard and takes a good polish but is not durable. Traditional medicinal uses of *Horsfieldia irya* have been recorded. The leaves are used to draw pus from boils and sores, and the latex from the tree is used to clean ulcers. The root macerated with lime juice is drunk as a remedy for snake bites, whilst a decoction of the bark is used as a gargle for sore throats.

Horsfieldia irya inflorescence

Possibilities of using the pleasantly scented flowers as a perfume had been mentioned by I.H. Burkill, a former director of the Gardens.

Next time you are around the vicinity of the National Parks Board Headquarters in the Gardens, do look out for these old beauties and if you are lucky, they may be in full bloom to stop you in your tracks.

Nura Abdul Karim
Living Collections

Photos by N. A. Karim

KEY VISITORS TO THE GARDENS (JANUARY–JUNE 2011)

Her Excellency Dr Angela Merkel, Chancellor of the Federal Republic of Germany with the orchid Dendrobium Angela Merkel after her visit to the Gardens on 2 June 2011

Mr Abdulrokhman Kartonegoro	Bogor Agricultural University, Indonesia
HE Angela Merkel	Chancellor of Germany
Dr Aruna D. Weerasooriya	University of Mississippi, USA
Dr Assad Kotaite and spouse	Former Secretary General and Council President of the International Civil Aviation Organisation
HE Benigno S Aquino III	President of the Republic of the Philippines
Mr Chalermpol Suwanphakdee	Khon Kaen University, Thailand
Mr Chen Yuheng	Tianjin Municipal Government, People's Republic of China
Dr Ed de Vogel	NCB Naturalis Leiden, The Netherlands
Mr Goh Yong Siang	Temasek Holdings, Singapore
Dr Hitoshi Neda	Forestry and Forest Products Research Institute, Japan
Mdm Ho Ching	Temasek Holdings, Singapore
Dr John D. Mitchell	Institute of Systematic Botany, New York Botanical Garden, USA
Mrs Jomjai Sumransub	Inspector General, Metropolitian Administration, Thailand
Mrs Kanok-orn Ruengsawang	Khon Kaen University, Thailand
Mr Khanit Waengwasit	Khon Kaen University, Thailand
Mr Liu Lianwei	Hainan Provincial Department of Housing and Urban-Rural Development Haninan Province, People's Republic of China
Mr Liu Xiaoguang	Director of Organization Department of Party & Labour Committee of Guangzhou Development Zone, People's Republic of China
Mr Marcus Agius and spouse	Chairman of the Board of Trustees, RBG Kew, England
Mrs Margit Fischer	Spouse of the Federal President of The Republic of Austria
Mdm Phoon Sook Ngoh	James Cook University, Australia
Mdm Rafidah Abdul Rahman	Forest Reseach Institute Malaysia
Dr Saw Lwin	Myanmar Floriculturist Association, Union of Myanmar
Mr Sergery Ignatiev and spouse	Governor of Central Bank of Russia
Ms Skye Duncan	New York City Department of City Planning, United States of America
HE Sukhbaatar Batbold and Mdm Khorloo Otagontuya	Prime Minister of Mongolia and spouse
Ms Tang Wenjuan	Consular Affairs Department, Ministry of Foreign Affairs, People's Republic of China
Ms Tsui Ho-Fun Florence	Chief Leisure Manager, Leisure & Cultural Services Dept, Hong Kong
Ms Wanwipha Chaisongkram	Khon Kaen University, Thailand
Y.A.B. Dato' Seri Dr Zambry Abdul Kadir	Menteri Besar, Perak Darul Ridzuan, Malaysia

A REVISED FLORA OF MALAYA: VOLUME I, ORCHIDS

R.E. HOLTTUM

In the 30 years following the publication of the Flora of the Malay Peninsula by H.N. Ridley (the first director of the Gardens) substantial new knowledge of many groups of Malayan plants continued to be gathered, compelling a revision to some of Ridley's monumental work. Thus in 1953, the first revised volume to the Flora - Orchids of Malaya - was published by R.E. Holttum, who was the director of the Gardens from 1925 to 1949.

Like his predecessor, Holttum was a prolific writer and was renowned for his almost feverish enthusiasm on lowland orchids and their cultivars, which contributed significantly to the flourishing of orchid hybridisation in the region. In the preface written for this volume, Holttum credited C.E. Carr and J.J. Smith - both celebrated botanists of that era - for the impressive published observations and private collections which his research work was built upon. The main body of this work consists of a series of descriptions of Malayan orchids, but also includes the principal cultivated orchids from the Asian and American tropics and their hybrids in local cultivation.

Interestingly, the bulk of preparation work for this book was done during the Japanese occupation. As later reminisced by E.J.H. Corner (then Assistant Director of the Gardens) in his book "The Marquis: A Tale of Syonan-To", interventions from the Japanese-appointed authorities Professor Kwan Koriba and Marquis Tokugawa were instrumental in ensuring that scientific research at the Gardens was undisturbed despite the turbulence and hardship of wartime.

Atypical of most scholastic literature catering to the specialised community of botanists and taxonomists, Holttum wrote with a cardinal resolution for his work to be referenced by schooled naturalists and regular gardeners alike. It opens with a full description of the floral and vegetative structure of orchids in general, introducing and explaining the technical and scientific concepts and terms. This could very well be the result of his constant ground work with the Garden's horticulturists, and his realisation of the need for educating ground staff in order to better preserve the precious species indigenous to the lands of Malaya.

Margaret Tan
Library

Photos by Koh Sin Lan