GARDENWISE

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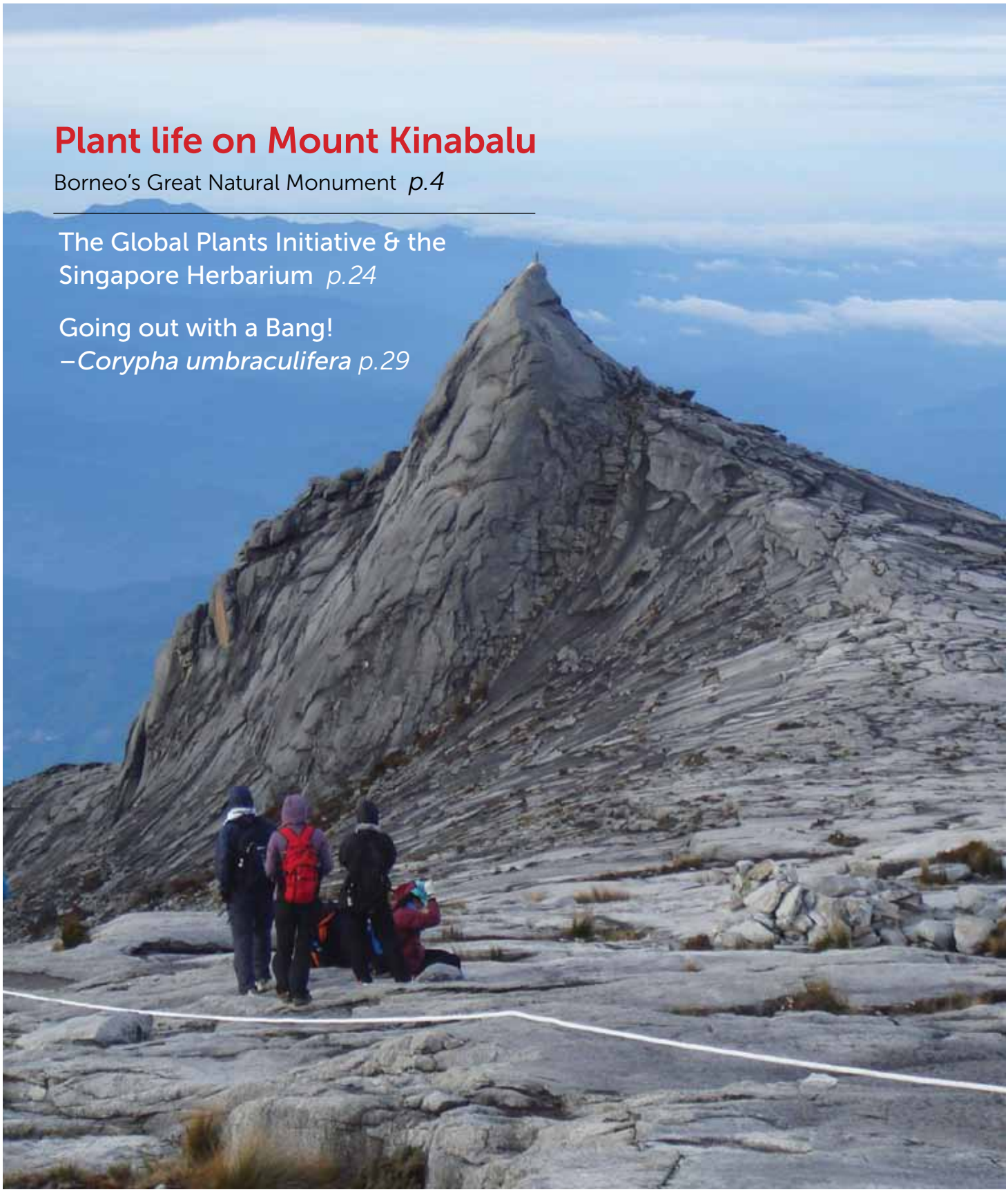

Plant life on Mount Kinabalu

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The majestic South Peak (3933 m) of Mount Kinabalu, Sabah.
Photo by Carl Gruenenfelder

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MESSAGE FROM THE DIRECTOR

Botanic gardens mean different things to their varied users and SBG is no exception. As the Gardens heads towards the completion of another year of record visitation—4.4 million between January and December 2012—I wonder how many that pass through its gates have an inkling of the complex activities that take place daily both on- and off-site. This issue of *Gardenwise* gives some clues. On-site we have activities involving our heritage landscape, historic buildings and "long-cared-for-collections", be these living or preserved. I don't want any of these to be taken for granted, since they are irreplaceable and invaluable, and so they must also be accessible, or at least made more visible, to those who can appreciate and make use of them. A list of staff publications is also a guide to the kinds of unseen research that SBG staff are engaged in (p. 33).

Readers can expect to see regular contributions about SBG's heritage in these pages, such as the short pieces about The Dell and the planning of Burkill Hall in this issue. Another heritage event to be celebrated at SBG and elsewhere in Singapore in 2013 is the 50th anniversary of the island's greening movement and the vision launched by PM Lee Kuan Yew in 1963. In this connection NParks will be holding various events throughout the year, and SBG's role in delivering the Garden City (now City in a Garden) vision, together with the Botanic Gardens' longer history, will be showcased in permanent and temporary museum exhibitions utilising Holttum Hall and the adjacent lawn beside Botany Centre towards the close of 2013.

In the "long-cared-for-collections" slot is an account of the beginning of a glorious exit for the old talipot palm on Lawn D ('What's Blooming', p. 29), which readers may have already seen prominently reported in the Straits Times on 29 December. This is one of the more remarkable biological phenomena that can be observed in a garden setting and we hope will ultimately give us the seeds with which to start a new generation of these great palms. The preserved collections in the Singapore Herbarium, largely unseen by the visiting public, are undergoing digital scanning in order that the most important can be made globally accessible over the internet as high resolution images. This will facilitate botanical research and reveal some of the Gardens' hidden riches without the need to physically visit, thereby saving on our science collaborators' research budgets and the use of climate-changing fossil fuel for air travel. Of a more temporary nature, but a first for SBG, is a collection of land art, arranged by Sotheby's, of 18 large pieces in weathering steel by Israeli artist Zadok Ben-David, now on show until 16 February (extended from 31 January). These are striking pieces with human and nature themes and can be enjoyed both by day and by night, when they are beautifully illuminated. Don't miss your chance to see them in SBG's Bukit Timah Core, easily accessible from the Botanic Gardens Circle Line Station.

Off-site, SBG staff have been busy as always pushing forward the frontiers of botanical science in natural habitats. So, we have an account of the most remarkable of SE Asia's mountains, Kinabalu, home to many endemic species and therefore a site of great importance for plant diversity and its conservation, and where new species continue to be discovered, as the new two-volume work, 'The Orchids of Mount Kinabalu' amply demonstrates—reviewed on p. 35. Elsewhere in this issue, George Staples reports on the rediscovery of the little-known *Decalobanthus*, in the bindweed family (Convolvulaceae), whilst Jana Leong-Škorničková informs us about a curiously sweet ginger relative, *Thaumatococcus*. Another 'natural habitat' of botanic gardens staff is of course the conference venue and two of SBG's team report on their experiences attending recent specialist international congress symposia on education (Mexico) and gingers (India).

Last but certainly not least, we report on the sad and sudden passing of an esteemed colleague who worked at Gardens by the Bay, Harry Luther. Harry was quiet and unassuming, yet a world expert on the pineapple family and someone it was an honour to have known. Ada Davis notes his achievements in this issue.

Nigel P. Taylor

HAJI SAMSURI BIN AHMAD RETIRES

Sam (right) with his childhood friend, Prof. Jose Furtado (left), in the Singapore Herbarium on 12 December 2011. (*Photo credit: Low Yee Wen*)

In his entire career with the Herbarium, Sam made about 3,000 collections, and these specimens are routinely cited in research publications even today.

Haji Samsuri bin Ahmad, fondly known as Sam, clocked in for the very last time at the Botanic Gardens on 29 August 2012, at the age of 76. He rendered his service to the Gardens for 45 years, with the core of his attachment to the Herbarium for 29 years.

His colleagues and friends from the Herbarium of the Singapore Botanic Gardens are thankful for Sam's lifelong contribution to botany, and wish him and his wife Siti Zainon binti Sarbon many happy years to come.

A background on Sam

Sam was born in the Botanic Gardens' staff quarters (located off Dalvey Road) on 11 December 1936. He spent most of his childhood in the Botanic Gardens where his father, Ahmad bin Yusof, was employed as a gardener. Perhaps it was his early exposure to the environment of the Gardens that helped him to sustain an interest in the living world. His mother, Som binti Hassan, was at one time employed as a cook for Dr C.X. Furtado, one of the Gardens' leading taxonomists. Sam received his early education at the Tanglin Besar Malay School, where he completed up to Level 7. It was during this period that Sam befriended the young Jose Furtado, who later became an ecologist (he is the son of Dr C.X. Furtado and is now a Visiting Professor at Imperial College London, and residing in the United Kingdom). As children, the two climbed fruit trees together within the Gardens. Professor Furtado paid Sam a visit recently at the Herbarium, to reminisce on some of their unforgettable shared experiences.

Sam married Siti Zainon binti Sarbon on 10 April 1964, and they had three sons together, one of whom has passed on. Sam and his wife now reside at Clementi, together with their youngest son.

Sam's career with the Botanic Gardens

Sam started working for the Gardens on 16 April 1952, at the age of 16, taking over his father's position as a gardener shortly after his father's death. The Director of the Gardens then was Mr H.M. Burkill, of whom Sam has the fondest memories. During 1952–1968 (a 16-year stretch), Sam was assigned to look after the Bandstand Lawn; this time period also included a short attachment to the library for three years. Sam was transferred to the Herbarium in 1968, where he took up the position of Plant Collector, a post he held for 14 years before resigning on 1 March 1982 to join the Department of Botany at the National University of Singapore (NUS). He worked at NUS until his retirement on 1 Jan 1997, at the age of 60.

After his retirement from NUS, Sam returned to the Botanic Gardens in May 1997, and became employed on a yearly contract basis to serve with the Herbarium, where he was attached until 29 August 2012 (a 15-year contract employment stint). During his time with the herbarium, he contributed to the learning of A.T. Gwee, Serena Lee, and Paul Leong in the sometimes difficult and tedious skill of plant identification, and in the initial phases of this task, he brought them out to the field for collection.

During his early development in the Herbarium, Sam worked under the guidance and supervision of the late Mohamad Shah Bin Mohd Noor, who was in charge of field support and the general collecting programme for the Herbarium, and later for its curation (he retired as Assistant Curator). Throughout his work for the Herbarium, Sam joined numerous fieldwork activities in Singapore, Peninsular Malaysia, Sabah, and Sarawak. One of his most memorable experiences (being furthest away from Singapore and his longest field trip ever) was with Professor E.J.H. Corner and Dr Chew Wee-Lek at Mount Kinabalu, on a Royal Society expedition in 1961 that lasted for five months. As his age caught up with him, Sam stopped going to the field after 2003.

Sam's Achievements

Sam can identify a great many local plants with ease. His plant identification skills were largely self-taught or gained through interaction with specialists whom he assisted in the field—a remarkable achievement attributable to sheer interest and hard work. As someone knowledgeable in identifying many plants of Singapore and the region, he participated in a number of local botanical surveys, and his collected material and results have contributed to many scientific publications. In his entire career with the Herbarium, Sam made about 3,000 collections, and these specimens are routinely cited in research publications even today.

Here we see a fine example of a steady career, sustained by a deep interest, which spanned more than 60 years; over the course of his life's work, Sam developed his own profile as a veritable specialist.

Low Yee Wen
Herbarium

THE PASSING OF HARRY LUTHER (1952-2012)

Harry Luther, affectionately known as "Mr Bromeliad", passed away on 17 October, at the age of 60. His absence is felt by his colleagues and the friends he made over a botanical career spanning more than 40 years. The last years of his life were spent here in Singapore, working in the position of Senior Researcher at Gardens by the Bay. Dr Kiat Tan (CEO of Gardens by the Bay), speaking of his friend and colleague of more than thirty years, describes Harry as 'one of those individuals you meet in life whom you grow to know, like, respect and care for. He becomes intrinsically woven into your fabric of life, and when he leaves, your fabric is rent. You become that bit less.'

Harry in the nursery of Gardens by the Bay.

Vriesea lutheriana, a bromeliad that was named after Harry Luther.

Harry grew up in St Petersburg, Florida, and started working with plants at a young age. By 19, he was already managing a local commercial nursery. The early days of his career saw him breeding, sourcing, and collecting plants for introduction into the local horticulture trade. Although he was an all-around plantsman, knowledgeable about many plant groups, it was his preeminent knowledge of the Bromeliaceae for which he later became internationally-recognised. It was perhaps during his early plant explorations that this family, consisting of terrestrial and epiphytic species mainly native to the tropical Americas, really captured his attention. He published his observations from the field early in his career; for instance, he wrote of his findings on the *Bromeliads in Honduras*, published in the *Journal of the Bromeliad Society* (1975), while still in his early 20's.

In 1978, Harry was hired by the Director of the Marie Selby Botanical Gardens in Sarasota, Florida (USA) to direct its Bromeliad Identification Center (BIC). Two years later, in 1980, he was also appointed Selby's Curator of Living Collections, and was responsible for managing the growth and propagation of the enormous diversity of species there. Harry worked at Selby for 32 years, during which time he devoted much of his attention to building the bromeliad collection and studying the family. He took frequent trips to Central and South America in search of new species with ornamental qualities to bring back to Selby's greenhouses to propagate and later distribute to hobbyists.

In 2010, Harry moved to Singapore to join Gardens by the Bay, bringing his library and research files along with him. As a member of the senior staff there, he directed horticultural research, helped to build up their collection of bromeliads and epiphytic species, and provided guidance on the incorporation of these plants into the displays, focusing his efforts in particular on their spectacular vertical gardens. During nearly three years with Singapore's Gardens by the Bay, Harry continued to render research and advisory services to the international bromeliad community, describing many new species during this productive period. He also increased his circle of friends and extended family, and all who came to know and care for him in Singapore were enriched by the association.

Over the course of Harry's career, he made major contributions to the field of systematics within the Bromeliaceae, and was considered one of the most knowledgeable people in the world on bromeliad taxonomy. He studied bromeliads in various herbaria, in cultivation, and in the field, ranging from his native Florida through Mexico, Ecuador, Peru and Brazil, and described more than 200 taxa in total. His contributions to the field are reflected in several species being named after him, including *Cryptanthus lutherianus*, *Vriesea lutheriana*, and *Vriesea harrylutheri*.

Harry published over 200 articles in scientific journals and hobbyist publications, and served as an editorial advisor to a number of journals, including *The Cryptanthus Society Journal* and the *Journal of the Bromeliad Society International*. Harry also compiled *An Alphabetical List of Bromeliad Binomials*, first published in 1991 by the BIC and then updated by Harry on a biannual basis, with his last compilation published in 2008. This latest edition lists 3,172 bromeliad species from 58 genera and 2 nothogenera. One of his last publications was an article which he co-authored on bromeliad phylogeny and evolution, published in 2011 in the *American Journal of Botany*.

Harry was active in a number of bromeliad societies. He was an honorary member of the Brazilian Bromeliad Society, the Japanese Bromeliad Society, and the Florida Council of Bromeliad Species, and his contributions to the bromeliad world earned him the position of honorary trustee of the Bromeliad Society International. He was the recipient of the *Wally Berg Award of Excellence*, the highest award given by the Bromeliad Society International. In September, just over one month before he died, Harry travelled to Australia to serve as a special guest speaker at an event held by the Cairns Bromeliad Society, and planned to return in June 2013 for a subsequent event.

Harry's life was closely tied to the plants that he loved, and he developed perhaps some of his closest relationships with the members of the many plant societies in which he participated. His mark on the lives of these fellow plant enthusiasts is evident in the numerous tributes and eulogies that have been written since his passing, all grieving the loss of a dear mentor, colleague and friend.

Harry was a quiet and shy individual who hid beneath a gruff exterior, but anyone who took the time to get to know him knew that his was a kind and gentle spirit. He was enthusiastic about plants and committed to his research, but always made the effort to impart his knowledge onto anyone with shared interest. These are the qualities for which he will be remembered, and his life is celebrated not just by the scientific contributions that he made during his career, but the personal connections that he made along the way.

Ada Davis
Communications and Community Engagement

All photos from Gardens by the Bay

PLANT LIFE ON MOUNT KINABALU—BORNEO'S GREAT NATURAL MONUMENT

Mount Kinabalu massif. (*Photo credit: Carl Gruenenfelder*)

Mount Kinabalu, a rugged granite massif situated in the East Malaysian state of Sabah towers high above the tropical rainforest. At an altitude of 4095 m, Mount Kinabalu is the highest mountain between the snow-capped peaks of the Himalayas and New Guinea. It is one of the world's richest biological sites, with an estimated 5000 to 6000 species of plants recorded.

The species found on this mountain of only about 1200 km^2 comprise more than 10% of the plant species found in the whole of Malesia (a huge phytogeographical region comprising Singapore, Brunei, Indonesia, Malaysia, Papua New Guinea, the Philippines, and Timor Leste). The mountain has become world famous as a botanical paradise. There are several reasons for its remarkably high level of plant diversity, including its location in SE Asia (generally one of the world's richest plant regions), the great altitudinal and climatic range of the mountain, and the diverse geology resulting in a variety of soil types. In addition, the precipitous topography and severe El Niño-related droughts and other catastrophic events have influenced evolution. Mount Kinabalu is a prime example of active plant speciation, and can be considered the perfect natural laboratory for anyone who wants to study this process.

Much of the vegetation on the upper slopes of Mount Kinabalu shows little or no sign of disturbance, since most of the massif is part of Kinabalu National Park, a UNESCO World Heritage Site. However, this status gives the wrong impression that all of Kinabalu's plant life is very well protected. On the lower slopes near or outside the park boundaries, logging and other forms of habitat destruction continue to pose a severe threat to the survival of many lowland species. Human settlements and agricultural areas are encroaching higher up the slopes on parts of the mountain, partly because some areas have been de-gazetted and are no longer part of the park. Over-collecting of some plant groups further adds to the problem. Large numbers of orchids are on sale in villages below the mountain, and it is difficult to ascertain if any have been illegally collected. The need for conservation of the orchids on the lower slopes has therefore become a major issue.

Kinabalu National Park is Sabah's premier tourist destination. Mount Kinabalu attracts many visitors who intend to climb its easily accessible highest point, Low's peak (named after the early explorer Sir Hugh Low, the first to make botanical collections on the mountain and ascend to the summit plateau in 1851). However, an increasing number of visitors also come with appreciation of the mountain's diverse plant and animal life in mind.

The Park Headquarters is within easy reach of Sabah's state capital, Kota Kinabalu, and is a focal point of the national park. It is situated at an altitude of about 1500 m, and the climate is typically tropical montane and pleasantly cool. Apart from administration buildings, a large resort has been built there, with overnight accommodation ranging from hostels to more up-market chalets, a well-stocked shop and three restaurants. The Park Headquarters is also the start of the main path to the highest peak, called the 'Summit Trail'. Much of the remainder of the mountain is not accessible to the public.

On the summit plateau. (*Photo credit: Carl Gruenenfelder*)

High altitude forest.

Inside the upper montane forest.

Kinabalu National Park is not only significant for its recreational value, but also plays an important educational role. Regular slide shows and guided walks are conducted for tourists, and there is a botanical garden to introduce visitors to some of the plants which they may encounter in the park. An extensive network of foot paths, leading through lower montane forest, gives visitors an opportunity to experience the amazing diversity of plant and animal life found on the mountain. Scientific research is also being undertaken there, both by Sabah Parks staff and foreign visitors. All plant specimens collected in the park (or duplicates thereof) are deposited in the herbarium of Sabah Parks, which is situated inside the Park Headquarters.

Traversing through different zones

Like other mountainous areas of the world, the plant life covering Mount Kinabalu is not uniform, but rather has a varied appearance and species composition at different levels of altitude in response to climatic factors. Several zones of similar vegetation can be recognised; however, within these zones, vegetation is also dependent upon other

It is one of the world's richest biological sites, with an estimated 5000 to 6000 species of plants recorded. The species found on this mountain of only about 1200 km^2 comprise more than 10% of the plant species found in the whole of Malesia (a huge phytogeographical region).

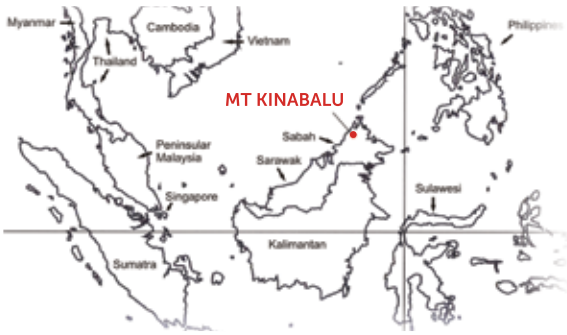
The endemic conifer *Dacrydium gibbsiae* is one of the dominant plants in the high-altitude forest.

High altitude forest along the 'Summit Trail' dominated by *Leptospermum* and *Dacrydium*.

factors (such as soil and exposure), and therefore is not entirely homogenous.

Lowland rainforest is found on the lower slopes of Mount Kinabalu, from about 450 m up to approximately 1200 m, and is the area of highest tree diversity. Due to the low altitude, the climate is hot and humid. Most of the dominant trees belong to the dipterocarp family. Trees are often 50 m tall, and have a dense canopy so little light reaches the forest floor. There are also many lianas which climb up the trees in search of light. Apart from dipterocarp trees there are also many wild fruit trees, such as durian, rambutan and fig. They are an important source of food for a large number of animals, such as monkeys, civets and birds. Another popular resort, Poring Hot Springs, was built in the southeastern part of Kinabalu National Park in this lowland rainforest zone. There, visitors can relax in hot sulphur baths (many climbers come to this resort to recover after having ascended the summit). A large orchid conservation centre and modern micro-propagation lab has been established in the Poring Headquarters, and many orchids from Mount Kinabalu and other parts of Sabah are cultivated there. Two species of the parasitic plant genus *Rafflesia* occur in this lowland rainforest. *Rafflesia keithii* flowers measure up to a metre across while those of *R. pricei* are significantly smaller, only about 30 cm.

Lower montane forest occurs up to about 1800-2000 m, and is dominated by oaks and chestnuts. This is the vegetation that most visitors will come across, as it is found around the Park Headquarters.



Other common trees in this forest type are members of the myrtle and tea families, as well as conifers such as *Podocarpus* and *Dacrydium*. Temperatures are significantly lower than in the rainforest below, and many of the plants belong to temperate groups. Trees are not as tall as those in the lowland rainforest, and seldom reach more than 30 m in height. Because more light gets to the ground, there is also a thicker ground cover in the lower montane forest. Ferns are abundant; a common species is *Dipteris conjugata*, a broad-leaved terrestrial fern that is widespread in tropical Asia.

The upper montane forest extends from here up to about 2800-3000 m. The soil is shallower and the trees have more stunted growth. This high-altitude cloud forest is only about 7-15 m tall and is dominated by *Leptospermum* (a member of the myrtle family) and *Dacrydium*. Although they are dwarf-like, trees of these two genera are often hundreds of years old. Because dense mist often covers the mountain at this altitude, there is a profusion of moisture-loving mosses and lichens. The lichen known as "old man's beard" (*Usnea* sp.) is frequently seen hanging from tree branches. High-altitude rhododendrons thrive here as well as many different orchids. *Nepenthes villosa*, the highest growing pitcher plant on Mount Kinabalu, can also be found here.

In the subalpine zone, roughly 3000-3400 m, a community of tall shrubs or low trees has developed, dominated by rhododendrons, *Leptospermum* and conifers. At this altitude they are even more stunted and the stems are often strangely gnarled. The climate here is harsh, with low temperatures at night, intense sunlight


Rhododendron ericoides.


Thrixspermum triangulare in upper montane forest.


Alpinia havilandii.


Rhododendron javanicum.


Rhododendron rugosum.

during the day and frequently fierce winds. Open and boggy places have patches of subalpine meadow, where plants from groups often associated with the European Alps are found, like the endemic Low's buttercup (*Ranunculus lowii*) or the eyebright (*Euphrasia borneensis*). The white-flowering shrub *Schima brevifolia* (a member of the tea family) can also be found here. At this altitude, visitors begin to see occasional areas of bare granite without vegetation.

Dwarf forest disappears almost completely above 3400 m. At about 3700 m, where the ground begins to frost, the upper limits of both trees and orchids on the mountain occur. An alpine rock desert, present on what is sometimes referred to as an 'eerie moonscape of stone', is found on the summit plateau and adds to the unusual, stark beauty of this mountain. The summit plateau consists mainly of compact and rather rough granite, but is not entirely devoid of plant life. Grasses, sedges and even dwarf shrubs (*Leptospermum* sp., *Rhododendron ericoides*) are found in crevices protected from wind, sunlight and rain. Recent evidence shows that rather than a volcano, Mount Kinabalu is a geologically young pluton, a plug of igneous rock which was pushed upwards in the earth's crust only about one and a half million years ago. During the glacial period Mount Kinabalu was covered by an ice cap, and the subsequent deglaciation has played a major role in shaping its summit area.

Life on the mountain

In terms of plant diversity, Mount Kinabalu exceeds most other Asian tropical mountains. The mountain hosts plant species which are generally SE Asian or exclusively Bornean in distribution, and others which have affinities for temperate climates. Of particular interest are the endemic species, those that are found there and nowhere else in the world. The level of endemism is remarkably high on Mount Kinabalu, particularly at higher altitudes. However, perhaps to a small extent, this is due to the fact that the full distribution of some plant species is not yet fully known (once discovered elsewhere, a species would no longer be considered endemic to Kinabalu).

The underlying rock also influences the plant life in an area. While soil derived from sandstone is the dominant soil type on Mount Kinabalu, large areas have soil derived from ultramafic rock, particularly serpentine soil. This soil is low in potassium but high in iron, magnesium and some other metals. It is toxic to some plant species, while others have adapted to it. This has resulted in the evolution of a unique flora with many endemic species (examples of endemic species that are entirely restricted to ultramafic soil include the conifer *Dacrydium gibbsiae*, the orchid *Paphiopedilum rothschildianum* and the pitcher plant *Nepenthes villosa*). The forest on ultramafic soil covers about 16% of Kinabalu National Park.

Due to the moist climate, many species thrive on the lower slopes of Mount Kinabalu, including fungi, mosses and ferns. Some reach enormous sizes, like the giant moss *Dawsonia*. There are over 600 species of ferns, including delicate small ones and giants like the bird's-nest fern or the tree ferns. However, visitors will likely be most attracted to the huge array of flowering plants. Among the more showy ones, melastomes (Melastomataceae), gesneriads (Gesneriaceae), and *Impatiens* are noteworthy. About 50 species of gingers (Zingiberaceae) are found on the mountain, in well-known genera like *Alpinia*, *Amomum*, *Globba* and *Etlingera*. There are also 25 species of *Rhododendron* which grow on the mountain. Many attractive and large-flowered species are found in the lower and upper montane forests. A peculiar high-altitude species is the endemic *R. ericoides*, with needle-like leaves and small red flowers.

Nepenthes lowii.

Paphiopedilum rothschildianum.

Spathoglottis microchilina.

Orchids are the largest plant group on Mount Kinabalu; with 866 species, subspecies and varieties in 134 genera, it comprises well over a tenth of all plants on the mountain.

Pitcher plants of the genus *Nepenthes* are more interesting for their foliage than their flowers. The pitchers, cup-like containers which fill with rainwater, are actually part of the leaves. These plants are capable of digesting insects (or very rarely small mammals) which fall into the water and drown because they cannot get out. This mode of obtaining additional nutrients enables the pitcher plants to survive in very poor soil. Ten species of pitcher plants have been recorded on the mountain so far.

Orchids are the largest plant group on Mount Kinabalu; with 866 species, subspecies and varieties in 134 genera, it comprises well over a tenth of all plants on the mountain. Orchids are prominent in all vegetation zones except the rocky summit plateau. As in most of tropical Asia, the genera *Bulbophyllum* and *Dendrobium* are particularly well represented, but *Coelogyne*, *Dendrochilum*, *Liparis* and *Calanthe* are also very speciose. The greatest diversity of orchids is found at around 1500 m. Most Kinabalu orchids grow on rocks or trees. A few high altitude species in primarily epiphytic genera also thrive on the forest floor, rooted in well-aerated moss. There are a number of terrestrial orchids, with common species including *Arundina graminifolia* (the bamboo orchid) and *Spathoglottis microchilina*, both of which can be seen near the Park Headquarters. Seventeen of the terrestrial orchids are myco-heterotrophic (i.e., their nutrient-getting is assisted by a relationship with fungi, and they are often lacking in green tissue). These are small, pale yellow, brown or whitish plants found in the forest undergrowth. Ninety orchid species, about 12% of the total on the mountain, are endemic.

Over 350 of the Kinabalu orchids occur on ultramafic substrates and some of these are entirely restricted to them. The genus *Dendrochilum*, comprising epiphytic, lithophytic and terrestrial species, is one of the dominant orchid genera at high altitudes of the mountain. Although they have small flowers, species of this genus are likely to be noticed by climbers as they can be fairly abundant. The most famous orchid on the mountain is the Rothschild's lady slipper orchid, *Paphiopedilum rothschildianum*, with attractive flowers that measure up to 30 cm across. This terrestrial species is endemic to Mount Kinabalu, where it is only known from a few populations within the park boundaries. Luckily, it can be artificially propagated quite easily and has therefore become a popular horticultural object. While the plant life of Mount Kinabalu has generally benefitted from detailed studies, the orchids in particular are rather well researched. A revision of the orchid flora of Mount Kinabalu has just been published and is now on sale in the bookshops of the Singapore Botanic Gardens.

The animals of Kinabalu National Park are also very diverse, but are normally difficult to see. Many are shy and live in trees or are nocturnal, and often only their calls indicate their presence. As with its plants, the highest diversity of the Park's animals is found in the lowland rainforest. Animals found on the slopes of Mount Kinabalu include over 100 different species of mammals (including squirrels, shrews, rats, mice, bats, monkeys, badgers, deer, bearded pigs, and clouded leopards), over 320 bird species, more than 100 species of reptiles, just under 70 species of amphibians, some freshwater fish, and thousands of species of insects. The level of endemism in the animals of Mount Kinabalu is also very high.

The Summit Trail

A well-trodden hiking trail on the southern slope of the mountain has been established for those who want to climb to the summit, the so-called 'Summit Trail' (recently an alternative route to its lower section was also made, the Mesilau Route). The trail takes climbers and naturalists to the upper part of the mountain, traversing through montane forest and high-altitude cloud forest, before finally reaching the mountain's bare granite crown. This steep path is 8½ km long, and at regular intervals small *pondok* provide shelter from the rain. After leaving the closed forest behind and just before arriving at the first major rock face (at about 3350 m), visitors reach a complex of a few overnight huts around the Laban Rata Resthouse. Typically, tourists spend a whole day climbing from the Park Headquarters up to these huts where they spend the night, then very early the next morning they climb to the summit, and then descend all the way to the Park Headquarters. For those interested in the rich plant and animal life a longer stay is of course worthwhile, and some visitors opt to spend several nights on the mountain.

Hubert Kurzweil
Herbarium

All photos by Hubert Kurzweil unless otherwise stated

A 50-year transformation

Singapore's Garden City journey began in 1963, when then Prime Minister Lee Kuan Yew planted a mempat tree (*Cratoxylum formosum*), signifying the start of the greening campaign. Through the dedication and commitment of its pioneers and the community, the city's landscape has transformed to one where greenery is a major feature.

Over the decades, flowering species have been introduced to make our streetscape more vibrant. The pervasive green network of nature reserves, parks, park connectors, tree-lined roads and other natural areas has made living in the city more pleasant. Efforts to conserve natural heritage have seen four areas gazetted as nature reserves and an increase in wildlife.

As Singapore continues to urbanise, the support of the community is essential as we evolve into a City in a Garden.

To commemorate this significant milestone, we invite you to join us in the exciting events and activities we have lined up for you, such as:

Playsets of Yesteryears

From mid-March till December, you will be able to view a roving exhibition of past playsets at the following locations:

- Raffles Place Park (mid-March to mid-May)
- East Coast Park (June to end-July)
- Bishan-Ang Mo Kio Park (mid-August to mid-October)
- Singapore Botanic Gardens (November to December)

irememberParks

Contribute your stories and memories of Singapore's parks and gardens from March onwards. You can write your stories or memories on postcards available at major parks or via **www.nparks.gov.sg/50years**.

Launch of the Commemorative NETS FlashPay card

From 16 March, you can purchase limited edition commemorative "Heritage Trees" NETS FlashPay cards from TransitLink ticket offices at $5 a card.

1963 Commemorative Tree Planting

To commemorate 50 years of greening Singapore, 1,963 trees have been set aside for the public to plant from June to November. Funds raised will be used to enhance the biodiversity and heritage value of the Singapore Botanic Gardens.

Visit **www.nparks.gov.sg/50years** for more activities, updates and information, and find us on **www.facebook.com/nparksbuzz**.

NATIONAL PARKS
LET'S MAKE SINGAPORE OUR GARDEN

(RE)DISCOVERING *DECALOBANTHUS*

First contact with the golden beauty. Flowers were not open yet at 10 a.m. (*Photo credit: Ana Rita Simões Razafimahefa, Reading University, UK*)

The single specimen (the holotype) in Bogor was the only known collection, and though I looked diligently in many herbaria having botanical collections from Sumatra, I never found anything that resembled the figure illustrating Van Ooststroom's genus and species.

There are few things as exciting for a plant taxonomist as discovering a species that is new to science, previously unknown and unnamed. Southeast Asia is still rich in opportunities for discovering new plant species, even after centuries of botanical exploration. A close second to discovering a totally new species is re-discovering a species that already has been named, but hasn't been seen alive for a long time. This is a story about one such rediscovery.

In 1925 the Dutch botanical collector O. Posthumus was working near the village of Bangko, in what was then known as Djambi province on the island of Sumatra. He collected a single specimen (under number 571) on 18 July of a yellow-flowered Convolvulaceae with an unusual corolla. The specimen was later lodged in the herbarium at Buitenzorg (now Bogor) on the island of Java. Years passed, and in 1936 Dr Simon Van Ooststroom at the Leiden herbarium, in the Netherlands, borrowed all of the Convolvulaceae specimens from Buitenzorg for his preparation of the family account to be published in the *Flora Malesiana*.

Van Ooststroom soon recognised that the Posthumus 571 specimen was something unique and in 1936 he published a scientific description of a new genus, *Decalobanthus*, and a new species, *Decalobanthus sumatranus*, based on this single specimen. The unique feature of the corolla is that it is divided into 5 lobes, and each lobe is again 2-lobed, so in total there are 10 lobes on the bright yellow corolla. At the time, this was an unusual and seemingly unique feature that set this Sumatran plant apart from all other known members of the Convolvulaceae.

For the next 80-plus years nothing happened. I began working on SE Asian Convolvulaceae in 1983, and at several points I tried to locate specimens of the enigmatic *Decalobanthus sumatranus*, without success. The single specimen (the holotype) in Bogor was the only known collection, and though I looked diligently in many herbaria having botanical collections from Sumatra, I never found anything that resembled the figure illustrating Van Ooststroom's genus and species.

Then in 2009 a graduate student in the UK undertook the first revisionary study of the Merremieae, the tribe in which

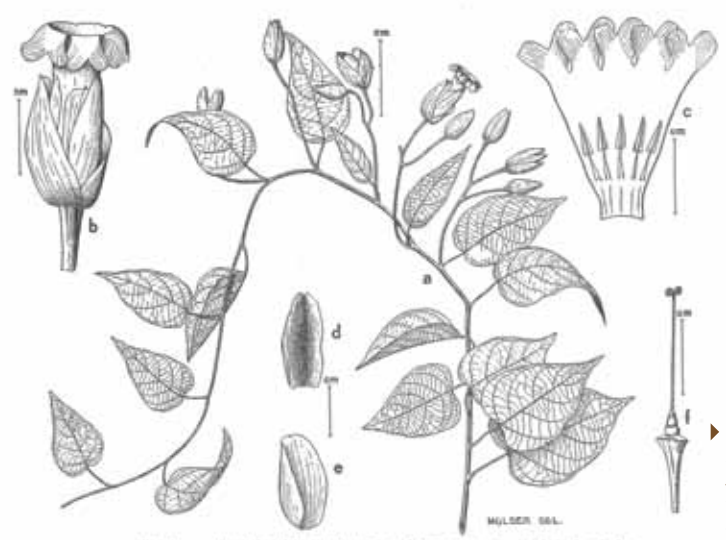


Fig. 1. — *Decalobanthus sumatranus* v. Ooststr. n. sp., *a*: branch of the type-specimen, Poeteraeus 871; *b*: flower (I am not sure whether the corolla lobes are spreading or reflexed); *c*: corolla, laid open, schematically; *d*: sepal 1, inside; *e*: sepal 2, inside; *f*: pistil.

Illustration of *Decalobanthus sumatranus* reproduced from the original description (with kind permission of the editor, *Blumea*, Nationaal Herbarium Nederland).

A single flower bud, just before opening; the corolla has a thick, waxy texture quite different from the usual thin diaphanous morning glory flower.

The open flower with the 10-lobed corolla that gives this genus its name.

First glimpse of *Decalobanthus*, high in a roadside tree.

Decalobanthus has been classified. Over the past three years Ana Rita Simões Razafimahefa has been able to study all the genera and more than 70% of the known species in this tribe, with the noteworthy exception of *Decalobanthus sumatranus*. The lack of material meant this enigmatic genus and species would not be included in a phylogenetic study of the tribe, a study which would finally answer many basic questions about the classification to be followed, particularly how to recognise genera based on sound scientific principles. So it became increasingly critical to get material of *Decalobanthus* for Ana's study.

Further specimens were borrowed from herbaria that might have Sumatran plants, but none of them had any specimens of *Decalobanthus*. So a plan was made: during a visit to Singapore, Ana would accompany me to Sumatra, in order to try to locate and study this rarity, either in the herbarium or alive in the field.

And, with a great deal of luck, we found it! Although the herbarium of Andalas University in Padang did not have a single specimen of *Decalobanthus*, its curator and director were sympathetic to Ana's need to get material that could make her PhD dissertation as complete and thorough as possible. So on short notice, we decided to hire a car and driver and go to Bangko, the area where the plant was first found in 1925, to see if we could find it for ourselves.

The three-day road trip was long and tedious, with only the beautiful Sumatran landscape to relieve the boredom of the 12-hour days spent driving. But the boredom shifted to intense excitement when, on the morning of day two, we spotted a yellow-flowered climber on the roadside just outside Bangko. After a U-turn we sped back to the location and piled out of the car to investigate. The plant proved to be the first glimpse of the enigmatic species in 87 years! The unusual corolla lobes are just as Van Ooststroom depicted them. And now that voucher specimens, leaf material (for DNA extraction), flowers in spirit, whole fruits, and seeds have been collected, this mysterious species from Sumatra will soon yield up its secrets and be an enigma no more.

George Staples
Herbarium

All photos by George Staples unless otherwise stated

WAIWAI HOVE COMBINES A LOVE OF ART AND PLANTS TO CREATE BEAUTIFUL BOTANICAL PAINTINGS

Waiwai Hove

The art of botanical illustration has a long history, becoming particularly important with the development of herbal medicines around the 1st century BC, when paintings of plants were included in medical reference books. Later, botanical art became less focused on medicinal purposes, and more preoccupied with capturing the beauty of plants. The popularity of botanical paintings grew particularly during the 17th and 18th centuries, when plant exploration necessitated highly accurate depictions of new species.

Today, despite advances in digital technology, the art of botanical illustration continues to be relevant. Photographs are limited in the level of detail they are able to capture, and can therefore be somewhat flat in presentation. In contrast, a botanical artist is able to apply his or her artistic judgement to capture light, shadow and texture to create renderings that have a multi-dimensional feel. Colours and details are also better represented in paintings and certain other forms of illustration than photographs, making them particularly useful to botanists and plant taxonomists. Despite this, few artists today specialise in the skill of botanical painting. Waiwai Hove is one of this diminishing group.

Waiwai's childhood set the foundation for her remarkable talent in botanical illustration. As a child in Malaysia, Waiwai loved the tropical plants that surrounded her and often explored the family garden with her elder brother. Although her father was an artist, it was her brother who encouraged her, allowing her to tag along while he occupied himself with Chinese painting. Years later, while based in Hong Kong as a flight attendant, Waiwai sought out opportunities to fulfil her artistic interests, taking pottery classes in her spare time and teaching herself the basics of painting through reference books that she came across. Using plants as her subjects, she saw improvement with each piece that she painted, fuelling an interest in botanical illustration and encouraging her to further pursue this art form. *(Continued on p17)*

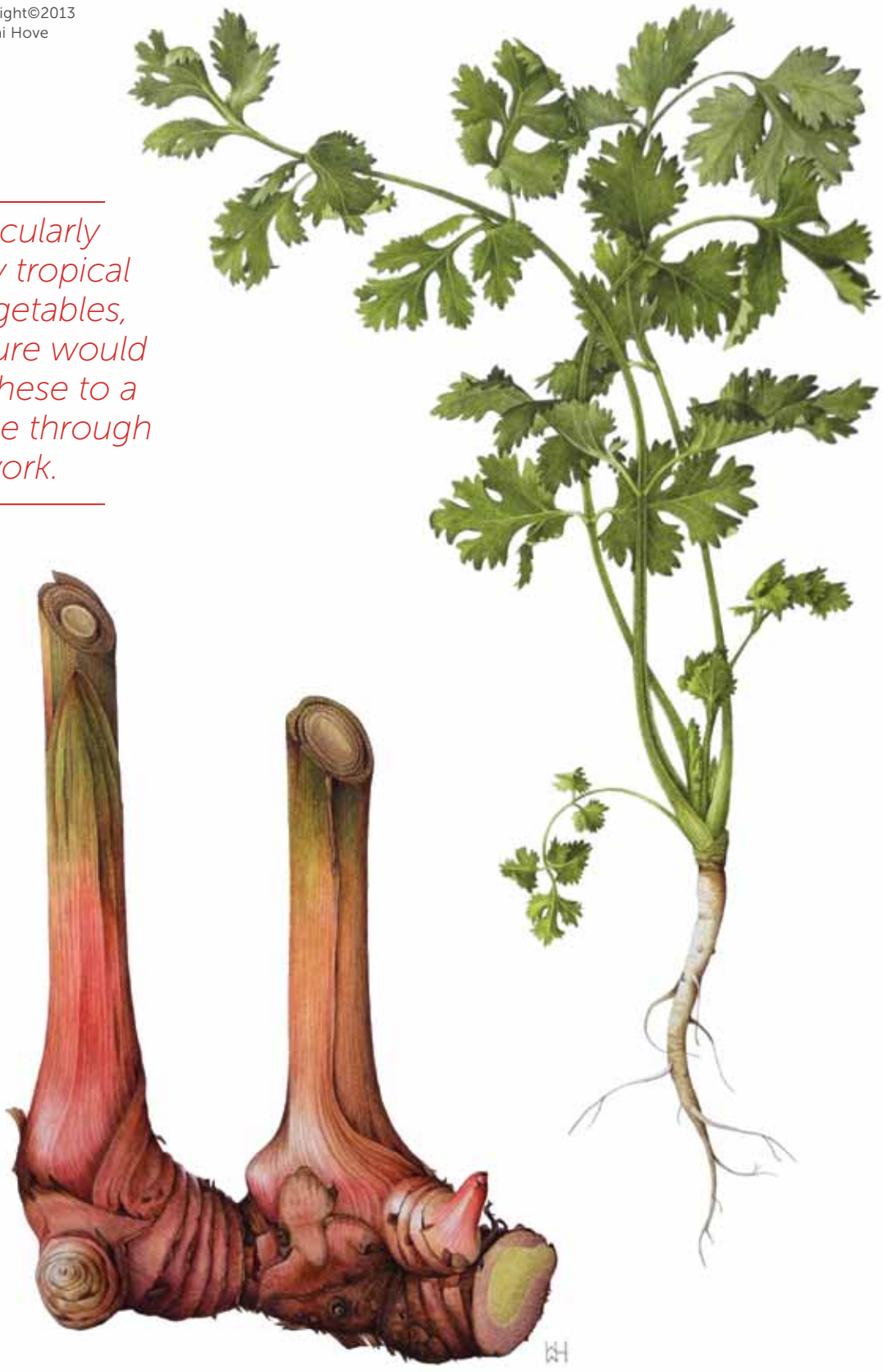
As a child in Malaysia, Waiwai loved the tropical plants that surrounded her and often explored the family garden with her elder brother.

Momordica charantia (bitter gourd)

Mixed study:
Alpinia purpurata (red ginger)
Alpinia purpurata 'Pink' (pink ginger)
Heliconia x *nickeriensis*
Aeridachnis Bogor 'Apple Blossom'

Dendrobium 'Dawn Maree'
x *Dendrobium lowii*

She is particularly captivated by tropical fruits and vegetables, and in the future would like to bring these to a larger audience through her artwork.



Alpinia galanga (greater galangal)
Coriandrum sativum (coriander)

Seven flowers:
Top, from left to right:
Hibiscus schizopetalus 'Pagoda'
Dendrobium sp.
Spathiphyllum 'Petite' (petite peace lily)
Centre, from left to right:
Clitoria ternatea (blue pea vine)
Etlingera elatior (torch ginger)
Bottom, from left to right:
Heliconia x nickeriensis
Allamanda cathartica (golden trumpet)

The aspect that Waiwai loves most about botanical painting is the opportunity to work closely with the plants that she loves. In the process of feeling and dissecting its parts, in recreating its colours and capturing every minute detail, she develops a special relationship with her subject.

(Continued from p12) Waiwai moved to Singapore with her husband and young twins in 2010. After her sons entered preschool, Waiwai found that she had some free time on her hands and sought out opportunities to develop her botanical artwork. She found a Diploma course offered by the Society of Botanical Artists (SBA), a UK-based organisation dedicated to the perpetuation of botanical art. The SBA offers a 27-month distance-learning course that is accessible to students from around the world.

The aspect that Waiwai loves most about botanical painting is the opportunity to work closely with the plants that she loves. In the process of feeling and dissecting its parts, in recreating its colours and capturing every minute detail, she develops a special relationship with her subject. Later, when she encounters a plant that she had once painted, she feels that she is seeing an old friend.

Waiwai recently completed her last assignment, and following submission of three final works, will complete her course with a Diploma in Botanical Illustration. She is particularly captivated by tropical fruits and vegetables, and in the future would like to bring these to a larger audience through her artwork.

Ada Davis
Communications and Community Engagement

Gillian Khew
Conservation and Molecular Biology

Heliconia x *nickeriensis*

Mokara 'Chao Praya Gold'

THE DELL, A HISTORIC FEATURE OF THE GARDENS

Almost hidden by exuberant vegetation, and accessible only by narrow paths between Swan Lake and the Ginger Garden, lies the Dell. Nearly as old as the Gardens, this shady, secluded corner of curved paths and rockeries covered by lush plants has been a faithful companion to other renowned and iconic tracts of the Gardens for 130 years.

Despite its absence from the current map of the Gardens, the Dell can be easily accessed, either from Lawn F (between Swan Lake and Tyersall Avenue), or from two almost hidden paths along the appropriately named Dell Lane. The early history of the Dell is documented and illustrated in I.H. Burkill's *The Botanic Gardens, Singapore: Illustrated Guide* (1927) and *A Note Relating to the History of the Dell in the Gardens*, published in 1927 in *The Gardens' Bulletin*.

Swan Lake was completed in 1866. A stream which collected water from the adjacent Tyersall Estate fed the Lake. At the time, the Gardens occupied only 23 ha, and this area, now known as Tanglin Core, was its original heart. Shortly after Nathaniel Cantley was appointed Superintendent of the Gardens in 1882, he decided that this area was ideal for the cultivation of ferns, which was very fashionable at the time. This is where the Dell was constructed. Straight paths and three simple mounds were shaped to better display the delicate-looking ferns, and in order to maintain a reliable supply of water, a hidden triangular water tank was built. However, Cantley did not live to see the Dell completed; rather, that task was accomplished by Ridley, the Gardens' first Director.

Under Ridley, changes were made to the Dell's structure. The newly-built tank did not hold water so it was transformed into a leaf mould pit. The shape of the mounds and the simple paths built by Cantley were also modified into a series of irregular rockeries accessible by two more elaborate, concentrically curved paths. The Dell was then planted with palms, ferns and a few trees to provide shade. In 1915 and 1916, after Burkill became Director, the structure of the Dell was further modified. The outer path was shortened to accommodate four sedimentation pools that were constructed to purify the runoff water coming from Tyersall Avenue before entering the lake. Two ornamental pools were built in the center of the Dell, with two small brick tanks to maintain their water levels. By 1927 the two ornamental pools were merged into one, and a new path was built across it. At that time, the rockeries were also allotted new varieties of plants with different growing requirements, mostly begonias, aroids, acanths and ferns.

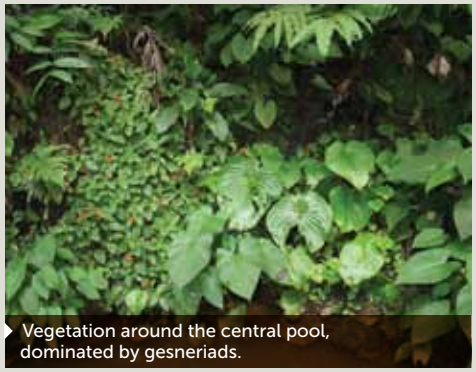
Swan Lake before 1925. (Photo I. F. Rock)

Swan Lake today, nearly unchanged.

Ornamental pool, about 1925. (Photo I. H. Burkill)

Ornamental pool, 2012.

Shady paths of the Dell.



Vegetation around the central pool, dominated by gesneriads.

Despite the major changes to the features of the Dell in its early history, from 1927 onward very few modifications were made to its structure. Over time, though, the vegetation has changed dramatically and the rockeries have slowly lost their carefully-selected plantings, which have been replaced by mixed vegetation. Today, the Dell is dominated by the African *Dracaena fragrans* and its rockeries are adorned by a wealth of ferns, aroids, gingers and gesneriads. However, not only are the paths, rockeries and the single pond still present from its early days, but also Ridley's leaf mould pit and Burkill's sedimentation pools and brick tanks, making the Dell one of the Gardens' historical treasures.

Michele Rodda
Herbarium

IMPROVISED EFFICIENCIES FOR A PLANT SHARING PROGRAMME

It has been often said that "the best way to keep a plant is to give it away".

Volunteer Bettye Douglas and Seedbank Coordinator Judy Kay pack seeds for distribution every two weeks. (*Photo credit: Tracy Magellan*)

Botanic gardens keep plants for conservation, education, research, and for appreciation. Working to propagate and share these treasured plants helps further all of these important goals. In recent years, Montgomery Botanical Center (MBC) has developed methods to efficiently and precisely perform this critical garden work, engaging common and not-so-common tools for plant propagation.

Montgomery is a 120-acre botanic garden with an extensive collection of palms and cycads, including 434 palm taxa, 256 cycad species and 638 other types of plants. Montgomery's mission is to advance science, education and conservation of tropical plants through living collections. Distribution of living plant material is key to advancing MBC's mission, and the Seedbank Program is a central part of this work. Since most seeds grown at MBC are recalcitrant, the Seedbank does not store seeds like most temperate seedbanks. Instead, the seeds are distributed to botanic gardens, researchers and the horticultural community—up to one million seeds per year.

In the past year, seed and plant exchange was initiated with Singapore Botanic Gardens by MBC's Dr Chad Husby and SBG's Dr Nigel Taylor. Dr Husby and Dr Nura Abdul Karim of SBG have since been exchanging a substantial number of taxa as seeds, plants and cuttings to build both collections. Visits of garden staff between institutions are also enriching the scientific, horticultural and educational value of both collections.

Seedbank Coordinator, Judy Kay, using a medium-sized "Nut Wizard" to pick up *Zombia antillarum* seeds. (*Photo credit: Tracy Magellan*)

The concept of the Seedbank Program was initially developed by John DeMott of Redland Nursery, a longtime supporter of MBC. In 1998, collaboration between MBC and the Florida Nursery Growers Association (FNGA) led to the establishment of the MBC Seedbank Program. FNGA's objectives were to preserve rare palms for future generations and to expand the variety of flora used in South Florida landscaping. They also wanted to use the monies from seed auctions to support key goals, such as agricultural scholarships, community projects and member education.

Operation of the MBC Seedbank involves multiple stages, from pollination to cleaning and distribution. The Seedbank team is made up of one part-time Seedbank Coordinator and a team of volunteers. To make the laborious process of seed harvesting and preparations more efficient, novel approaches have been developed since the Seedbank was founded. Begun as a volunteer-led operation, the Seedbank is now developed into an externally-funded, sustainable programme, helped in no small way by the efficiencies detailed here.

Harvesting Seeds

Palms: Aside from the normal clippers, pruners, loppers and saws used in the harvesting of seeds, the tool that is most efficient for us is the "Nut Wizard". This device comes in various sizes designed to retrieve anything from walnuts to brass casings. The large-sized tool is perfect for

The Seedbank team is made up of one part-time Seedbank Coordinator and a team of volunteers. To make the laborious process of seed harvesting and preparations more efficient, novel approaches have been developed since the Seedbank was founded.

Intern, Patrick Meus-Caris, using a dog-waste scooper to gather *Bismarckia nobilis* seeds. (*Photo credit: Tracy Magellan*)

Volunteer, Bernard Scherban, using a pool net to harvest *Zombia antillarum* seeds. (*Photo credit: Tracy Magellan*)

Fruits of *Chorisia speciosa* bagged to protect seeds from green parrots. (*Photo credit: Tracy Magellan*)

the larger seeds of palms such as *Bismarckia nobilis*, *Veitchia* spp., *Syagrus oleracea* and *S. cearensis*, while the medium size is used to collect the seeds of *Hyophorbe lagenicaulis*, *Syagrus coronata*, *Dypsis decaryi*, and *Zombia antillarum*. The small tool is perfect for harvesting the seeds of *Copernicia* spp., *Hyophorbe verschaffeltii*, *Gaussia* spp. and any other small seeds. For very large seeds, a dog waste scooper helps to eliminate the need for bending over and also reduces back strain.

While the infructescence is still green, very small seeds, such as those of *Hemithrinax ekmaniana*, are wrapped in nylon stockings and sealed with electrical ties so they are easy to find and collect when ripe. Mesh laundry bags were successful at protecting *Polyandrococos* seeds the first year that we used them, but the squirrels quickly learned to chew through them. Wire cages are efficient, but labor-intensive. In 2013 we plan to try window screening for protecting the seeds.

In 2010, there was a mysterious problem with our *Pseudophoenix vinifera* which caused entire infructescences to fall off prematurely, and as a result, we were only able to harvest 100 seeds that year. Since the bracts started falling off (especially in high winds or rain around the month of June), in 2011 we tried several methods to strengthen them, including duct tape, burlap, and pruning to reduce the weight. We even tied one directly onto the trunk for support. These methods were successful and when the seeds were ripe in September we were able to distribute 4,990 seeds of this beautiful palm.

A pool-cleaning net was first used to retrieve the seeds of *Nypa fruticans* from MBC's Nypa Lake, as they dehisce viviparously (fully-sprouted) and float. Later it was used to entrap very small seeds (that would otherwise scatter in the process of removing the infructescence) or to consolidate *Zombia antillarum* seeds which can get lost in the spines of the trunk. For any plants located near hardscape, we have found that a broom and dust pan does the job quickly.

Flowering trees: Pods of *Brownea* spp., *Colvillea racemosa* and *Barringtonia racemosa* are covered with socks, so when they fall off into the mulch or split open, the seeds are easy to recover. *Chorisia speciosa* pods are protected from parrots by bagging them with plastic bags and sealing them with electrical ties; holes are punched in the bottom to let moisture escape.

Cycads: Female *Encephalartos* spp. cones are harvested as soon as they begin dispersing seeds at the apex. A large bucket is placed over the cone and when weight is applied it will snap off into the bucket. The bucket can then be stored until all the seeds are easily removable from the cone. This avoids the need to return to the cone every day to pick off the loose seeds, and also keeps animals from eating them. Care must be taken, by wearing rubber gloves or other type of protection, when harvesting some cycad seeds because of the potential presence of toxins. Other challenges that we commonly encounter while harvesting the seeds of cycads include the presence of large ant nests in our *Dioon mejiae* and *D. spinulosum*, and scorpions in the *Cycas*. We find large and heavy forks and spoons useful to pry the seeds loose and prevent stings. Every time a cone is harvested it is logged on a cone removal data sheet and the information is recorded into the plant records system. Seeds from the rare *Microcycas calocoma* are gathered every day as they mature.

Harvesting Pollen

Cycads: Once male cycad cones begin to shed pollen, they are harvested. *Stangeria eriopus* is one exception, as delaying harvest by one week yields more pollen. The cones are placed on waxed butcher paper and tapped with a mallet to release the pollen. The pollen of *Dioon* is very fine and abundant, so a mask is worn to avoid inhalation. If the pollen is not used immediately on a receptive female cone, it is processed for storage so it is ready when the female cones become receptive. The pollen is cleared of debris, sealed in small envelopes, labeled, and placed in sealed glass jars containing desiccant. The pollen is refrigerated for several days with the desiccant to complete the drying process, and then is frozen. A colder storage temperature is linked with better preserved viability (Osborne 1989, *Encephalartos* 17:25). Thanks to National Science Foundation funding, MBC now stores pollen in a -80ºC freezer, but for many years used a -20ºC freezer. Even with that original freezer, though, our viability experiments found that *Encephalartos* pollen remained viable for three years, *Cycas* for four years and *Dioon* for five. Although we always try to use fresh pollen, these reserves are used quite frequently at MBC and also sent to other botanical gardens and researchers. A current pollen availability log is accessible to all staff, with colour-coded jar labels for each genus. Viability is determined with an aniline blue stain, which displays viable pollen as dark blue.

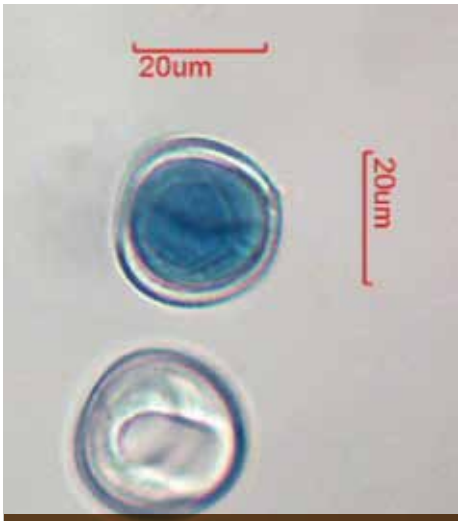
Pollination

The pollination programme at MBC places its major emphasis on cycads. Two methods of pollination, wet and dry, are used at MBC. We record the method of pollination used in the field, the date of pollination, and other information such as degree of receptivity of the cone, freshness of pollen, and weather

Wet pollination by volunteer Larry Krauss. (*Photo credit: Vivian Jordan*)

Pollen from a male cycad cone being processed for storage. (*Photo credit: Claudia Calonje*)

Dry pollination by volunteer Larry Krauss. (*Photo credit: Vivian Jordan*)



Aniline blue pollen viability stain displays viable pollen as dark blue. (*Photo credit: Lan Nghiem-Phu*)

conditions. When possible, we pollinate within the same population.

Dry pollination: The genera *Zamia*, *Microcycas*, *Macrozamia*, and *Ceratozamia* are pollinated using the dry method. We use a syringe and a bulb to blow the pollen into the cracks of the receptive cone.

Wet pollination: For wet pollinations, the pollen is mixed with water until evenly suspended, taking on a milky appearance. Originally, we filled a syringe with the liquid and injected it into the separations of the receptive cone using hospital tubing. Although *Stangeria eriopus* would ideally be dry pollinated, it yields such a small amount of pollen that we mix it with very little water and squirt it in with a syringe to obtain maximum dispersion. We have found that *Dioon* and *Encephalartos* are most efficiently pollinated using a different wet method. The loose top is pried off the cone and the pollen solution is poured in. If the pollen drips out the bottom, the cone is fully receptive. This was first tried on *Encephalartos ferox* and has since saved much time producing results equal to the syringe method. We now use this method for pollination of the entire *Encephalartos* genus.

Large heavy cones, such as those of *Encephalartos gratus*, *E. bubalinus* and *Microcycas calocoma*, should be supported with wooden braces after pollination so that they don't break off prematurely due to weight or wind. Hand-pollinated cones are marked with a blue ribbon. Even with permanent ink, the writings on the ribbons fade eventually in the sun and rain, so when we have multiple cones on the female cycad, we tie knots in the blue ribbon to distinguish the cones (for example, the second cone on a plant would have a ribbon with two knots). The cones can become receptive simultaneously or at different times.

For all species, an unpollinated control cone is consistently set aside to make sure no introduced pollinators have infiltrated MBC. Over the years, results from experiments have shown no open pollination (by insects, wind or other natural mechanisms) of *Encephalartos*, *Microcycas calocoma*, *Stangeria eriopus* or *Ceratozamia*.

The cone of an *Encephalartos umbeluziensis*, ready to be broken off in a bucket and stored until it disperses seeds. The blue ribbon signifies that it has been hand-pollinated. (*Photo credit: Larry Krauss*)

Cement mixer used at MBC to clean *Encephalartos* seeds. (*Photo credit: Tracy Magellan*)

Scarified *Encephalartos ferox* seeds in a crockpot set on warm increases the effect of the pectinase enzyme, decreasing the soaking time. (*Photo credit: Tracy Magellan*)

Several different types of "scratchers" and dog and horse grooming gloves used for the final stage of cleaning cycad seeds. (*Photo credit: Tracy Magellan*)

Encephalartos ferox seeds showing suspensor cords are cut open to test for viability. At this stage they should be stored for a couple of months before sowing. (*Photo credit: Larry Krauss*)

In contrast, up to 75% of viable seeds in *Cycas* and 20% of viable seeds in *Dioon* result from open pollination. There is a native Florida pollinator insect for *Zamia* which often causes hybridisation. After three years of experimenting with ways to exclude pollinators, we found success with the following method: the peduncles are covered with an insect-trapping adhesive and the cones are covered with cloth (we use infant's leggings) and closed with electrical ties. When this method was used, no seeds were pollinated, while the control open-pollinated cones each had 200–300 viable seeds.

Cleaning Seeds

Cycads: Our first method for cleaning *Encephalartos* seeds involved abrasion with a screen over a sink and then placing the seeds in an enzyme for eight days to soften the outer coat, and finally finishing the process by scouring with abrasive pads. However, for the last ten years, a cement mixer has made the job much simpler. The mixer is filled with water, small sharp rocks and the seeds, and then run for about 3 hours. This method works for all but *Encephalartos ferox*, the seeds of which are squeezed by hand to remove the outer coating and placed in a pectinase enzyme to remove the rest of the coating. The enzyme works better in warm conditions. During cold weather, we use an electric crock pot (very clearly labeled that it is not for food use). This device must be set to the 'warm' setting, as its 'low' or 'high' setting will cook the and kill the seeds. Dioon seeds can simply be slit with a knife and peeled. Alternatively, we sometimes use a hand potato peeler. The finishing step of cleaning all cycad seeds is best done using coarse metal mesh while wearing horse or dog grooming gloves for protection.

After cleaning, cycad seeds are cut open to determine viability by checking for suspensor cords or embryos. *Dioon* seeds require over two years to ripen, and they are usually sprouting by the time the cone is ready. *Encephalartos* seeds usually need to be stored for a couple of months so embryos have a chance to mature before sowing. The seed coats of *Microcycas calocoma* and *Zamia* seeds are not removed because these seeds are especially subject to dessication during shipping.

Flowering trees: Cleaning the seeds of flowering trees first involves removal of the seeds from the fruit. The seeds of *Garcinia spicata*, *Rheedia aristata*, and *Diospyros blancoi* are quickly expelled by smashing the fruits between two bricks in a container or sink. The seeds are ready to sow immediately or can be stored briefly in damp media.

Distribution

Labeling: All seeds are counted before distribution. If the size and shape are uniform, their number can be estimated by weight. Seeds are placed in bags and labeled with the taxon name, accession number, number of seeds, and date collected. All this is entered into the plant records database along with the parents' accession numbers and information such as pollination method.

Packaging: Seeds are generally sent out within two weeks of harvest to ensure freshness. If the seeds are in danger of drying out during storage, they are packed in plastic zipper storage bags with slightly damp, sterilised palm fiber. If the seed bags are too moist, holes are punched in the bags and perlite is added.

From 1998 to 2011, the Seedbank distributed between 140,000 and 950,000 seeds yearly, depending on availability and demand. In recent years seed distribution numbers have been consistently high. Seeds produced at MBC are shared with the FNGA, other botanical gardens, educational institutions, scientific researchers and plant societies. With deforestation causing loss of natural habitat and poachers gathering plants for collectors, many of these plants are imperiled in the wild. The MBC Seedbank gives collectors an opportunity to purchase rare seeds legally, thus reducing the demand for wild-collected plants (Kay et al. 2011, *HortTechnology* 21: 474–481).

Judy Kay (Seedbank Coordinator)
Montgomery Botanical Center

THE GLOBAL PLANTS INITIATIVE AND THE SINGAPORE HERBARIUM

In January 2012 the Singapore Herbarium (SING) was awarded funding from the Andrew W. Mellon Foundation in New York, USA to join the Global Plants Initiative (GPI). Thanks to this funding, staff at SING began digitising its type specimen collections in September 2012. The process, which is planned to last for a total of 18 months, will allow the collections to be shared electronically via the GPI platform.

Out of Africa

The GPI began in 2004 as the African Plants Initiative (API). At the time, the community of plant taxonomists working on African flora recognised that there was an enormous gap between those researching biodiversity in Africa and the repositories that store the type specimens, botanical literature, and associated unpublished information needed for their research. The lack of access to basic taxonomic resources posed an impediment for scientific research on African plants and biodiversity.

Following a meeting of the *Association pour l'Etude Taxonomique de la Flore d'Afrique Tropicale* (AETFAT) in Addis Ababa, Ethiopia in 2003, the Andrew W. Mellon Foundation decided to try and bridge this gap via the internet. Through the use of information technology, high resolution digital scans of type specimens and associated information could be made available to the people who needed it the most. At the time, numerous herbaria were scanning their specimens and placing the images online as "virtual herbaria" (with varying degrees of success), but such a concept had not been tried on a continental scale. During 2003–2007, more than 60 partner institutes from over 20 countries digitised upwards of 200,000 type specimens, proving that a broad-scale approach was workable. The API database was launched at the next AETFAT meeting, in Yaoundé, Cameroon, in 2007, and was declared a resounding success.

One of the technological innovations brought about by the API digitisation efforts was the invention of the HerbScan equipment. Previously, images of herbarium sheets were often taken through the use of photocopy machines. However, curators often frowned upon this method because it required the herbarium specimen to be turned upside-down, potentially causing damage as the fragile structures could break in the process, and any loose pieces could fall off and become lost. In contrast, the HerbScan machine has been configured with an inverted scanner, allowing the specimen to rest upright while the image is taken from above. Thus, it is now possible to produce excellent high-resolution images of a type specimen with much less risk

Bazilah Ibrahim and Paul Leong unpacking the HerbScan machine.

Project staff member Bazilah Ibrahim using the HerbScan machine. The type specimen is placed face-up, with the scanner above it.

of damage. Although this technological development may be simple, it is a significant advance in the herbarium world, and has revolutionised the management of herbarium specimens in very short order. Some herbaria have actually stopped making loans of their types, because the high resolution images have made it possible to resolve taxonomic queries remotely, eliminating the need for packing specimens and sending them abroad.

API expands to LAPI

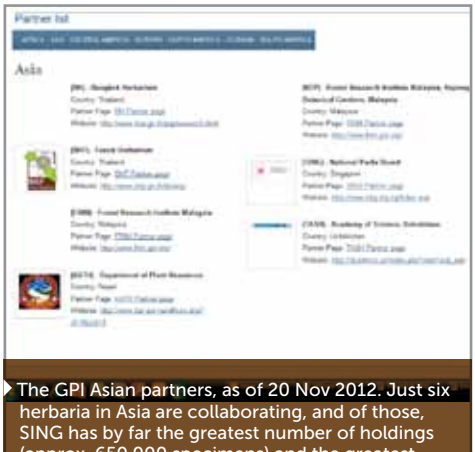
The idea was mooted by the Andrew W. Mellon Foundation at the Latin American Botanical Congress in 2006 to expand the API to include tropical America. The offer by the Mellon Foundation was enthusiastically received by plant scientists working on tropical American plants, and by 2007 the Latin American Plants Initiative (LAPI) was born. In addition, a significant decision made by the Mellon Foundation at that time was that all type specimens held by partner herbaria would be eligible for digitisation, not just those originating from Africa or tropical America. Thus, while API and LAPI were the acronyms in use at the time, the concept was already in place to make this a truly global effort. Partner herbaria were encouraged to begin digitising all their type specimens, regardless of geographical origin.

The GPI expands to include Asia

During the Flora Malesiana Symposium held at SBG in 2010, representatives from the GPI, on behalf of the Mellon Foundation, approached plant scientists from several Asian herbaria about joining the GPI effort. Soon after, SBG was invited to apply for support to digitise the SING type specimens.

Prior to 2006 or so, all the SING type specimens were digitised using the best technology available to us (a Nikon D100 camera, which produced an image of 4 MB). The images were then made available online via the BRAHMS (Botanical Research and Herbarium Management System) database. However, digital technology has improved rapidly and dramatically since then, and scans of higher resolution and better image quality are now possible, as are the production and storage of much greater file sizes (150–200 MB). By the time SBG was approached, the Mellon Foundation had also coordinated the creation of, and provided initial funding for, a not-for-profit electronic platform, the JSTOR Plant Science website (http://plants.jstor.org), which hosts the type specimen images for free, and at a technical standard suitable for scientific and scholarly research. So the time seemed ripe for SBG to join the GPI collaboration, and for SING to begin scanning its type specimens at the new international standard adopted by the GPI.

Map showing partner herbaria around the world.



The GPI Asian partners, as of 20 Nov 2012. Just six herbaria in Asia are collaborating, and of those, SING has by far the greatest number of holdings (approx. 650,000 specimens) and the greatest number of type specimens (approx. 8,000).

SING and its role in the GPI

SING is one of just six herbaria located in Asia to participate in the GPI consortium, and with more than 650,000 specimens, approximately 8,000 of which are type specimens, it has by far the largest number of holdings of these six. Among all herbaria in the Malesian/SE Asian region, SING is second only to Herbarium Bogoriense, Bogor, Indonesia, in terms of size and the number of type specimens it holds. SING began scanning its type specimens in September 2012, and aims to complete the project within 18 months. The digital images will be shared on the JSTOR Plant Science website on a quarterly basis, after rigorous data checking to verify that the information present on each specimen is accurately recorded in the database that accompanies the scanned images.

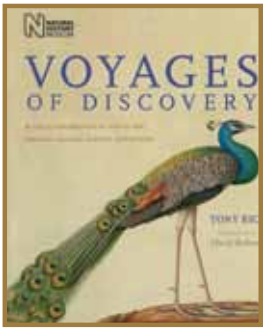
In 2013, the Mellon Foundation will move on to other projects and cease to provide new project funding, leaving the future direction of the GPI uncertain. This matter will be discussed at the sixth and last annual meeting of GPI partners, to be held in January 2013. Given that the largest herbaria in Asia (those in China, India, and Indonesia) have yet to join the GPI consortium, it is unclear whether or when their type specimens will be added to the incredible digital image database accessible on the JSTOR Plant Science website (where more than 1,500,000 type specimen images are already available). This would leave SING in the unique position of being the most significant Asian herbarium to share its type specimens via this digital format for the foreseeable future.

To complete the project in a timely manner, a single project staff member was engaged full-time to embark on the scanning and data capture. The HerbScan machine dedicated for SING use has arrived, and has been set up and calibrated for accuracy. After a short three-day training session at Royal Botanic Gardens, Kew (one of the official training centres for the GPI project), digitisation has begun in earnest. The first SING type specimen images will be available via the JSTOR Plant Science website by the middle of 2013. SING will also keep copies of the images, to be made available for research needs separate from the JSTOR Plant Science website.

When completed, all 8,000 type specimens from SING will be available online. This will greatly enhance the capacity of plant science researchers anywhere in the world to resolve queries about identification, taxonomy, and nomenclature, without the need to borrow specimens or make a trip to Singapore to study the types in person. Ongoing international projects, such as the Flora Malesiana and the Flora of Peninsular Malaysia, will benefit because fact-checking and question resolution can be done in minutes. This will hasten the progress on these floristic projects while helping to protect and preserve the type specimens in SING for the long term.

George Staples & Serena Lee
Herbarium

NEW IN THE LIBRARY SHOP



Voyages of Discovery: A Visual Celebration of Ten of the Greatest Natural History Expeditions
by Dr Tony Rice, with an introduction by Dr David Bellamy ($42.00)

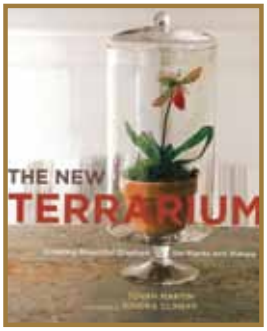
Are you hungry for historical adventures that come with superb illustrations? Look no further than the book *Voyages of Discovery*: *A Visual Celebration of Ten of the Greatest Natural History Expeditions* by Tony Rice. The author is a former curator of crustaceans at the Natural History Museum, London, a repository for some of the most exciting and comprehensive collections of natural history literature and artworks to be found anywhere in the world. It holds half a million artworks, comprising one of Britain's largest art collections, and over one million books, including rare and richly illustrated antique volumes. The beautifully illustrated hand painted artworks and photographs included in this book were handpicked from the vast archives of the Natural History Museum, most of which have never been in the public eye before.

This book describes the adventures of pioneers such as James Cook, Charles Darwin and Alfred Russel Wallace. So grab a copy and a cup of tea, and read about the adventures of Sir Hans Sloane, who voyaged to Jamaica from 1687 to 1689, recording and collecting plant specimens, cocoa among them. Then follow the story of Maria Sibylla Merian, a specialist on moths and butterflies, who spent from 1699 to 1701 in the jungles of Surinam in search of new species and studying metamorphosis. Here are some of the other adventures that can be found in the book:

Hermann, Loten and de Bevere in Ceylon (1672–1757)
William Bartram in North America (1753–1777)
Cook's Pacific Crossing (1768–1771)
Cook in the South Seas (1772–1775)
Flinders & Bauer Down Under in Australia (1801–1805)
Charles Darwin's Voyage of the Beagle (1831–1836)
Wallace & Bates in the Amazon (1848–1862)
HMS Challenger Expedition (1872–1876)

This book is a fascinating study of human achievement and natural wonder. For students and lovers of art, this book has much to offer, and the stories of how some of the fantastic pieces were acquired are worth the purchase price alone.

Year Published: 2009
ISBN: 978-0-307-40731-3



The New Terrarium: Creating Beautiful Displays for Plants and Nature
by Tovah Martin ($48.00)

This new how-to book is for indoor gardeners looking for a fun and easy way to green their home. After a long spell of unpopularity, terrariums are now back in favour. A terrarium conjures up the image of a garden in a bottle, but almost anything can be used to make a terrarium, from a sawed-off clear plastic soda container, glass vase or mason jar, to a test tube, glass cloche or miniature glasshouse. Martin offers new ideas for materials to create terrariums, such as aquariums or canning jars that are not in use, and also covers the garden tools and materials needed for a terrarium project. The book lists appropriate plants to use, including peperomias, pileas, and unusual orchids, as well as suitable mosses.

The book also includes a chapter on the history of the Wardian case, an invention of Nathaniel Ward, an English surgeon and amateur botanist whose experiments in 1829 focused on enclosed mini-ecosystems. His discovery that plants could live in a tightly-closed jar led to the use of sealed glass containers for long-distance transport of exotic plants. His Wardian cases were the predecessors of today's terrariums.

The New Terrarium is the perfect way to spark your creativity while helping you to bring your favourite plants into your home and giving them a place to thrive.

Year Published: 2009
ISBN: 978-0-307-40731-3

How to Grow Fresh Air: 50 Houseplants that Purify Your Home or Office
by Dr B.C. Wolverton ($32.00)

Have you ever wondered how pure the air that you breathe is? This book (formerly called *Eco-friendly Houseplants*), written by Dr B.C. Wolverton, may enlighten you. The U.S. Environmental Protection Agency has found that indoor air can be up to 10 times worse than the air outside. Dr Wolverton was formerly a Senior Research Scientist at NASA's John C. Stennis Space Center. In the late 1980s, NASA began studying how plants can help filter toxins from the air. Wolverton discovered that houseplants are the best filters of common pollutants such as ammonia, formaldehyde, and benzene. These poisonous chemicals can be released by furniture, carpets, and building materials, and then be trapped by closed ventilation systems, leading to a host of respiratory and allergic reactions. This book identifies 50 houseplants that can help to purify the air in your home or office, making it a more pleasant place to live and work. Each plant has been rated for its effectiveness in removing pollutants, its ease of growth and maintenance, and its resistance to pests.

Year Published: 2008
ISBN: 978-0-297-84477-8

Christina Soh
Library

THAUMATOCOCCUS: NATURE'S SWEETEST SECRET

The light purple flowers near the ground are often overlooked.

Habit.

Thaumatococcus is an African genus from the prayer-plant family, Marantaceae (in the order Zingiberales). It naturally occurs in the humid tropical rainforests and coastal zones of Central and West Africa, stretching from Guinea to Congo, where it is known by local names such as *katemfe, ego, ewe eran*, and *adundunmitam*. The widespread *Thaumatococcus daniellii*, described in 1855, had long been considered the only species of the genus until a second species, *T. flavus* (endemic to Gabon), was described in early 2012 by Alexandra Ley, a German specialist in African Marantaceae.

Thaumatococcus daniellii is a robust rhizomatous herb forming large clumps that reach up to 3 m in height in its natural habitat. Inflorescences with pretty purple flowers arise near the ground, directly from the rhizome. However, the amazing feature of this plant is not its flower, but rather its bright red triangular fruit, which harbours the sweetest secret in the natural world.

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Often nicknamed miracle berry, the fruit has three chambers, each capable of housing one large almost black seed (not all three seeds may develop to full maturity). The seeds are enclosed in a transparent, glossy, sticky gel-like layer, which apart from being mildly sweet, is almost tasteless. In contrast, the cream-coloured aril is incredibly sweet, so sweet that it is nearly unbearable. Its taste lingers for an hour or so. The aril is a raw source of thaumatin, a protein that is regarded as the sweetest naturally occurring substance in the world. It has been estimated to be 2000 to 3000 times sweeter than sugar. Thaumatin is non-toxic and stable at high temperatures, making it suitable for use in the pharmaceutical industry and in food production. Local people in Central and West

Rare fruit-set in Singapore, observed in 2012.

Africa use the arils for sweetening fermented palm wine and foods such as corn breads. They also make use of the leaves, which on large plants can be as big as 60 cm long and 40 cm wide. The leaves are commonly sold in local markets for wrapping and boiling food.

Thaumatin is highly prized in international markets, with a price starting around S$700 per kilogram for regular consumption grade, but running up to a breathtaking S$1,700 per gram (!) for the purest quality. Thaumatin has been harvested by local people for many years, but with increasing demand for the substance and a decrease in forested areas due to human-related activities, impacts to naturally occurring populations of *Thaumatococcus* will be unavoidable in the near future. Research into sustainable cultivation of this crop has been conducted over the last decade, but more is certainly needed. As the aril represents only about 1% of the entire fruit, the remaining 99% (the seeds and pulp) commonly ends up as waste. However, a recent study has suggested that this waste is a potential source of protein and energy for livestock.

Even though its flowers are not particularly conspicuous, its dark green, glossy leaves and ability to grow in fairly dense patches makes *Thaumatococcus* an interesting landscape plant in tropical cities like Singapore. It seems to be rather resilient and can thrive even along roadsides, although during the drier parts of the year and in windy paces, the leaf margins may become unsightly, turning brown and drying up. Humid places with light shade are best, though it may tolerate full sun as well as fairly deep shade. In our Singapore climate, *Thaumatococcus* produces ample amounts of flowers regularly, but fruiting is extremely rare, presumably due to lack of a pollinator. Over the last five years of regularly checking various clumps across the island, and several pollination attempts in the Singapore Botanic Gardens, only once have I found a fruiting clump, growing on the outskirts of one of our nature reserves.

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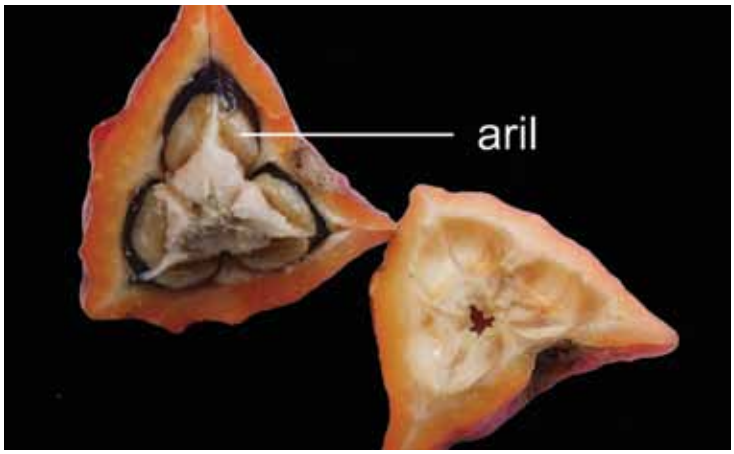
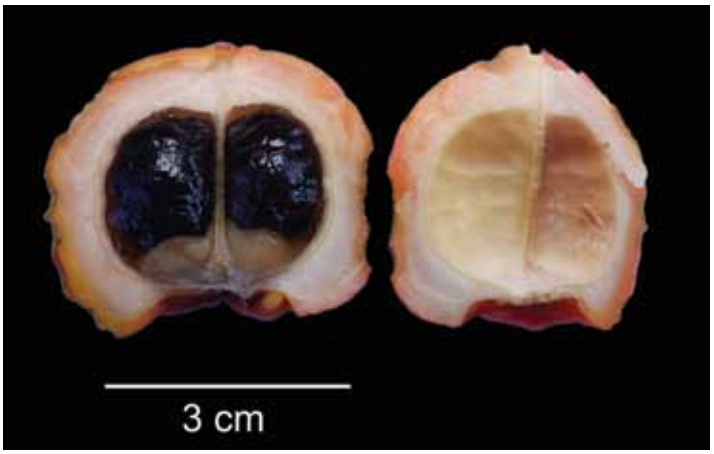
Jana Leong-Škorničková
Herbarium

All photos by Jana Leong-Škorničková



Three seeds are seen in this fruit, of which the basal part has been removed. Only the beige-coloured aril has a high content of thaumatin.



Fruit with one side removed, exposing two seeds embedded in a sticky layer and with the beige arils at the base.

GOING OUT WITH A BANG!— *CORYPHA UMBRACULIFERA*

The majestic *Corypha umbraculifera* in full bloom, 21 December 2012. *(Photo credit: Nick Baker)*

The end is nearing for a stately palm that has silently graced the lawn near Holttum Hall for years. Few visitors and staff notice its presence and even fewer know how rare it is, but this is about to change, as it will soon make its spectacular exit from the world. This palm is *Corypha umbraculifera*, commonly known as the talipot palm.

The upcoming spectacle is not a first for the Gardens. In January 2005, two talipot palms, introduced in 1920 from the Royal Botanic Garden, Calcutta, simultaneously produced an amazing display of humongous inflorescences at the end of their lives.

Corypha is a genus of five or six species with distribution ranging from tropical Asia to northern Australia. *Corypha umbraculifera* is native to South India and Sri Lanka. Along with *Corypha taliera, C. umbraculifera* holds two world records: it has the largest branched inflorescence of any plant on Earth, and the largest palmate leaf (reaching 6–8 m across!). According to literature, its immense floral candelabra reaches 8 m in height, bears an estimated 24 million flowers, and the combined length of the many branches of its inflorescence is estimated to exceed 9 km!

Corphya umbraculifera is a massive, moderately slow-growing, solitary palm with a monocarpic type of growth (the plant dies after a sole occasion of setting seed). It has been programmed by nature to live for approximately 30 to 80 years without producing any inflorescence. Upon reaching the end of its life, it begins its "last rites". The process commences with its large palmate leaves gradually senescing and dying, leaving a terminal panicle to flourish atop its tall trunk. The panicle grows rapidly (within weeks) before bursting open to exhibit an enormous plume of tiny cream flowers. After the flowers are pollinated, the plant can produce hundreds of dull green golf-sized fruits that rain down for months as they ripen. The fruits take about a year to mature.

In 2005, when we had our last bumper flowering, our talipot palms produced only a handful of fully-formed fruits, perhaps indicating an absence of the right pollinators. It is hoped that this talipot palm will produce far more fruits, with viable seeds that will give rise to new plants. Thus, all may not be lost with the sombre news of the dying palm!

In the past, the talipot palm was very popular because of its many uses. The leaves have been reportedly used for making umbrellas, baskets, mats, fans, and for thatching, and in ancient times, were also used as paper. Many sacred Hindu and Buddhist texts and ancient medical manuscripts were engraved onto talipot leaves, which were then coloured and bound into books. Some of these ancient books can still be found in temples and in the households of traditional scholars and "medicine men" in India, Sri Lanka and Indochina, and also in museums and archives around the world.

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It has been mentioned in literature that over 250 kg of edible starch can be extracted from the pith of a fully grown mature palm. The light brown starch once formed an important food source for thousands of people in South India, mainly tribal forest dwellers and those living in poor coastal dwelling communities. The starch was normally cooked into gruel or used to make a flatbread, and was once used for making gulal, a red-coloured decorative powder used during Hindu festivals (it has since been replaced with maize starch and synthetic coloured powder).

The hard endosperm of the talipot seed was once employed as a substitute for ivory. The polished seeds were used for making buttons, beads and miniature carvings, and were even exported out of India and Sri Lanka. The sap or juice can be tapped from the palm top or from the inflorescence and used to make palm wine, sugar, alcohol or vinegar. The young fruits are said to be edible, but the nearly-ripe fruits are toxic. The fruits have been pounded into a paste and used as fish poison by coastal dwellers. A decoction and juice from the roots and young plants have traditionally been used medicinally.

In its native lands, the status of *Corypha umbraculifera* as a source of livelihood and food has sadly diminished, as its population has decreased due to unsustainable uses and loss of habitat. It is therefore crucial that this wonderfully majestic palm be conserved quickly.

The impending deluge of seeds possible from the Gardens' blooming talipot palm will be cultivated here, and may even find homes overseas as our Gardens share the potential bounty with other botanical institutions, helping to ensure conservation of the diminishing species. This will hopefully guarantee that the end is just the beginning for this *Corypha umbraculifera*!

Nura Abdul Karim
Plant Records

The various developmental stages of the talipot inflorescence:

(A) Emergence of the inflorescence, 22 October 2012.

(B) Development of the lateral branches of the inflorescence, 15 November 2012.

The tiny flowers give off an unpleasant urea scent and are pollinated by blowflies, wasps and bees. *(Photo credit: Nick Baker)*

(C) The Inflorescence beginning to bloom, 17 December 2012.
(Photo credits: (A, B) Koh Sin Lan; (C) Nick Baker)

CULTIVATING INTEREST IN NATURE THROUGH THE LENS

Parents and children enjoyed themselves watching the short film *Small Potatoes Rock*. *(Photo credit: Shereen Tan)*

Using seeds from annatto (*Bixa orellana*), young participants created beautiful drawings. *(Photo credit: Shereen Tan)*

"For ourselves, and for our planet, we must be both strong and strongly connected—with each other, with the earth. As children, we need time to wander, to be outside, to nibble on icicles, watch ants, to build with dirt and sticks in the hollow of the earth, to lie back and contemplate clouds and chickadees." These are the words of Gary Paul Nabhan and Stephen Trimble in their book, *The Geography of Childhood: Why Children Need Wild Places*.

Perhaps those from Generation X and even from Generation Y easily connect with the quote from Nabhan and Trimble. However, instead of engaging in outdoor activities, it is now all too common to see children as young as two years old being occupied by video games and shows on smart phones and tablets. While these gadgets are highly appealing to the younger generation, they may be leading to a disconnection from nature. Engaging children in environmental education and exploring alternative platforms for outreach have therefore become more challenging than ever.

For decades, film and animation have been important media for engaging all generations. The impact of these media is notable and effective in outreach, particularly education. With this in mind, from 7 to 15 June 2012, SBG's Education Branch partnered with Paperbear Productions to host *Wiggles and Giggles*, a special educational programme combining nature-themed films and guided tours at the Jacob Ballas Children's Garden, as part of the second annual *Big Eyes, Big Minds—Singapore International Children's Film Festival*.

Targeting children from three to nine years of age, the Film Festival aimed to cultivate interest about nature through short film screenings. The programme also provided busy working parents the opportunity to bond with their children, allowing families to come together to appreciate nature in an outdoor setting.

The collection of short films was carefully selected by Paperbear Productions, to raise awareness on topics ranging from nature and wildlife to conservation and environmental issues. Produced by filmmakers worldwide (some even by children), each film is unique and associated with a moral.

Nature Guide Loo Wei Lun showing the larval shell of a cicada during the *Let's Discover Plants and Animals guided tour. (Photo credit: Shereen Tan)*

Two guided tours, *Let's Discover Plants and Animals* and *Pond Life Discovery*, were offered on alternate days to reveal interesting facts and stories about terrestrial and aquatic plants and animals found in the Children's Garden.

With *Let's Discover Plants and Animals*, young children expressed their creativity by using the seeds of anatto (*Bixa orellana*) and the flower petals of the blue butterfly pea (*Clitoria ternatea*) to make paintings. Participants were also given the opportunity to get up-close and personal with friends and foes of the Botanic Gardens, such as earthworms, beetle larvae and snails. To the courageous little ones, it was a memorable experience to touch and feel the texture of slimy snails and earthworms.

In *Pond Life Discovery*, participants were treated to a visual feast as they toured past beautiful blooms of water hyacinth and colourful dragonflies that graced the pond. Young children were encouraged to explore the aquatic plants by feeling the textures of leaves, stems and roots, and learned how these structures enabled flotation. Even toddlers as young as two years old appreciated the biodiversity of the pond life, and could be heard to say "wow" to their mommy and daddy when they sighted water skaters.

The one-week programme drew over 450 participants. It is our wish to see parents with their young children spending more time outdoors, and hope to encourage them to simply "...watch ants, to build with dirt and sticks in the hollow of the earth, to lie back and contemplate clouds..." It's never too early for a child to embrace Mother Nature!

THE COLLECTION INCLUDED SEVEN SHORT FILMS:

Inch by Inch features a resourceful inchworm that measures a robin's tail, a flamingo's neck, a toucan's beak, a heron's legs, and a nightingale's song to keep itself from being eaten.

Jelly Jeff addresses the impact and consequences of human activities on marine biodiversity.

Olive Branch: Food tells the story of two residents of an olive tree that learn of the importance and joy of sharing.

Sule & the Case of the Tiny Sparks features an "Incy Wincy proverb detective" named Sule who assists a village girl to learn and appreciate the importance of caring for others, with the help of some bees.

Small Potatoes Rock features four small potatoes and their unique personalities through singing and dancing.

Frog's Choir (directed by children at FKVZ Zapresic, Croatia) illustrates an encounter between a bird and a frog during a choir practice.

Recycle Man (directed by children at Wide Angle Youth Media's Baltimore Speaks Out! Program, USA) features a green superhero that plays a big part in saving Mother Earth.

In addition to the short film screening, participants were treated to an informative session in the Jacob Ballas Children's Garden.

Young participants eagerly captured snapshots of an earthworm as they learned fascinating facts about the little hero of the garden. *(Photo credit: Shereen Tan)*

Shereen Tan & Winnie Wong
Education Branch

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Staples, G. *Argyreia*—Silvery Asian beauties. Visitor Service Centre photo exhibit, Singapore Botanic Gardens, Singapore. July-August 2012.

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Záveská, E., Fér, T., Marhold, K., Šída, O. & **Leong-Škorničková, J.** Reticulate evolution of polyploid *Curcuma*? Controversial signals from nuclear low-copy genes. International Conference on Polyploidy, Hybridization, and Biodiversity, Průhonice near Prague, May 2012.

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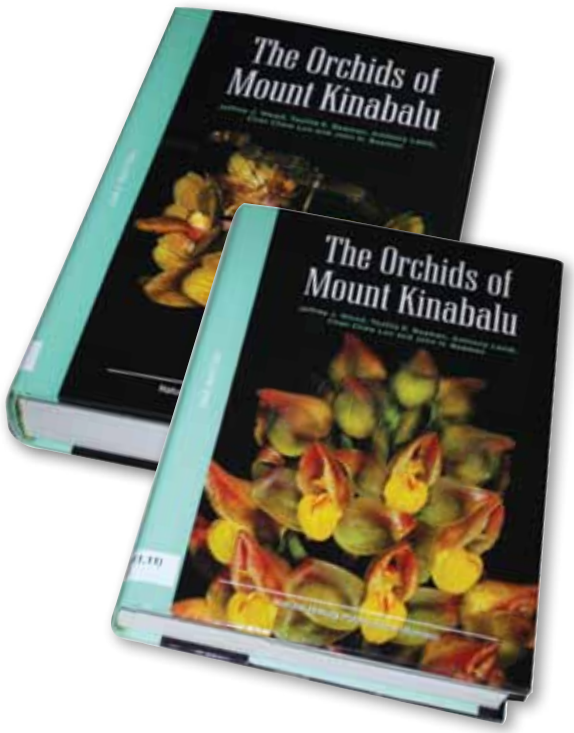
Compiled by Serena Lee & Low Yee Wen
Herbarium

THE ORCHIDS OF MOUNT KINABALU

by Jeffrey J. Wood, Teofila E. Beaman, Anthony Lamb, Chan Chew Lun & John H. Beaman, in collaboration with Reed S. Beaman, Rimi Repin & Jaap J. Vermeulen.



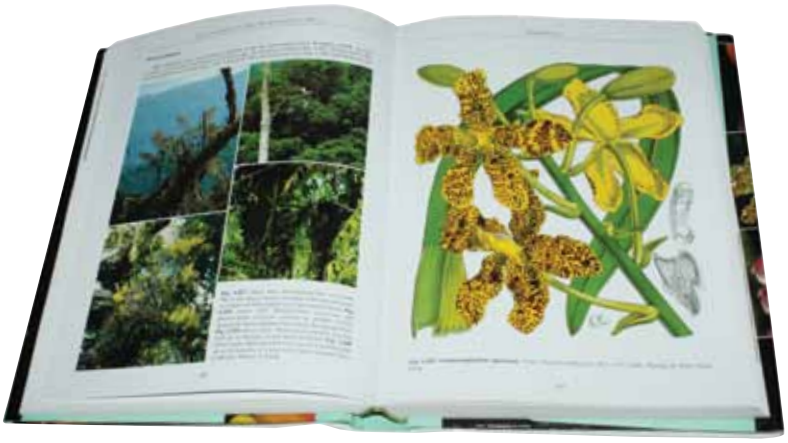
The richly illustrated two-volume work gives a detailed account of the fascinating orchid flora of Mount Kinabalu and enumerates all species that have been recorded so far.

Published in 2011 by Natural History Publications (Borneo), Kota Kinabalu, in association with Royal Botanic Gardens Kew. 436 pp (Volume 1), 726 pp (Volume 2); over 1300 illustrations (mainly colour photos and black-and-white line drawings). Available in the Library Shop of the Singapore Botanic Gardens for $332.00.

The plant diversity of Mount Kinabalu is among the highest in the world. The mountain offers different vegetation zones, from lowland tropical rainforest with a hot and humid climate to montane and subalpine forests on the lower and upper slopes. Higher up on its bare granite crown, temperatures can drop below freezing. Due to its high plant diversity and high level of speciation, the mountain has been of major interest to professional botanists for a long time, and is one of the best examples in the world for active plant evolution. In addition, Mount Kinabalu has become a popular destination for climbers and plant enthusiasts. An astounding array of flowering plants is found in this national park, ranging from forest trees to rhododendrons, pitcher plants and ferns. But by far, the largest flowering plant group on the mountain is the orchid family, with 866 species, subspecies and varieties in 134 genera presently known, and many visitors come largely with these plants in mind.

Extensive research on the Kinabalu orchids has been carried out in the past decade, particularly at Royal Botanic Gardens, Kew (UK), and the authors of this new publication have studied the flora of Borneo and particularly Sabah for many years. The richly illustrated two-volume work gives a detailed account of the fascinating orchid flora of Mount Kinabalu and enumerates all species that have been recorded so far. It is a very much expanded version of the 1993 book on the same subject; apart from being based on a significantly larger number of botanical specimens and other data than its precursor, a key difference is the inclusion of identification keys to the species. Although this 5.4 kg publication is unlikely to be carried up the mountain, it would be an invaluable source of information before and after a trip to Kinabalu. The book also discusses the increasing destruction of many Kinabalu orchid habitats on the lower slopes, as well as the suspected theft of some plants.

Volume 1 of this impressive book provides general information, dealing with aspects like the distribution and endemism of Kinabalu orchids. Its sections describe the habitat and ecology of the orchids,



their life forms, leaf morphology and pollination, and a large number of noteworthy orchid species are examined in detail. These sections are illustrated by numerous magnificent colour photographs. A discussion of taxonomically problematic genera like *Eria, Liparis* and *Crepidium* indicates that more research is still needed. Recent advances in systematics and phylogenetics (partly as a result of molecular data) are discussed, and the currently accepted classification is presented. Included is also a list which cites the orchids named after Mount Kinabalu or after specific localities found on Mount Kinabalu, as well as a key to the subfamilies and genera.

Volume 2 is a complete enumeration of the Kinabalu orchids. For both genera and species, the places of their original description, important synonyms, and distributions are given, and new records are indicated. Species accounts contain the type citation (only if the type is from Mt. Kinabalu), a reference to all of the photographs and line drawings that are found in the book, comments on life form and habitat, as well as a detailed list of material examined. Thirteen species are newly described, and 34 new combinations in different genera are proposed. An index to numbered collections (equivalent to an identification list) that is usually found in comprehensive taxonomic treatments is also given, as well as a glossary, a list of cited literature, a general index (mainly of people and localities) and an index to scientific names. Like the first volume, it is richly illustrated with black-and-white line drawings. A total of 324 colour photos are also included in the volume.

Despite its breadth, the book does not claim to be a 'final answer' to the orchids of Kinabalu, as a number of questions still call for further studies. A large number of orchid collections remain unidentified in the book. Many of these simply belong to orchid genera that are still poorly known, thus underlining the need for future research. Although the orchid flora of Mount Kinabalu is reasonably well known (compared to some other areas in tropical Asia), there are parts of the mountain which are still under-explored, and it is highly possible that further floristic work will lead to new discoveries.

Although our knowledge of the orchid flora of this mountain is not entirely complete, an enormous amount of information is already available, which is excellently presented within the 1162 pages of the new version of *The Orchids of Mount Kinabalu*. With magnificent line drawings and colour photographs, it is certain to appeal not only to the scientist but also the botanically-interested layperson. The impressive treatment will be an invaluable source of information both for professional botanists and orchid enthusiasts for long a time, and, in terms of quality, maintains the very high standard of books produced by the publisher. Despite its fairly high price, it is certainly a publication that no 'orchidologist' or library serious about plants can be without.

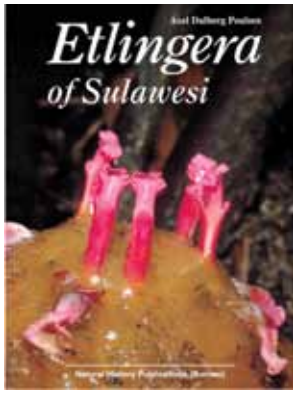
Hubert Kurzweil
Herbarium

Nephelaphyllum pulchrum, an illusive ground dwelling orchid from Mount Kinabalu. *(Photo credit: Hubert Kurzweil)*

ETLINGERA OF SULAWESI

by Axel Dalberg Poulsen

Etlingera orbiculata, a beautiful and unfortunately endangered species from north Sulawesi. *(Photo credit: Jana Leong-Škorničková)*



Published in 2012 by Natural History Publications (Borneo) Sdn. Bhd. in association with Royal Botanic Garden Edinburgh and Natural History Museum, University of Oslo. 278 pp. Soon to be available in the Library Shop of the Singapore Botanic Gardens.

The *Etlingera of Sulawesi* is the second book dedicated to this fascinating ginger genus by the prominent Danish ginger specialist Dr Axel Dalberg Poulsen. It was launched on 10 September 2012, during the opening ceremony of the 6th International Symposium on the family Zingiberaceae, held at Calicut University, Kerala, India.

The genus *Etlingera* comprises some 150 to 200 species, most of which are found in equatorial evergreen forests, growing from lowlands to high altitudes of 2700 m. The genus is distributed eastwards from northeastern India, is richly represented across SE Asia, and reaches its eastern limit on the Pacific island of Tahiti. The magnificent torch ginger, *Etlingera elatior*, is perhaps the best-known representative of the genus, although there are numerous other species which are far more morphologically diverse, and equal to, or even surpassing the torch ginger in its beauty. Other species in the genus are used extensively for a wide range of purposes, including as spices, condiments, medicines or vegetables, and also for mat-weaving.

Sulawesi is an island in the western part of the region known as *Wallacea*, a group of Indonesian islands which have remarkably different flora and fauna from the adjacent Indo-Pacific region. Indeed, when one compares the current book with the previous one by the same publisher, *Etlingera of Borneo* (2006), the only overlapping species inclusion is the widespread and cultivated torch ginger. The rest of the species indeed look very different from those in Indochina, the Malay Peninsula or Borneo. Some are simply spectacular, like *Etlingera acanthodes*, with blood-red spiky inflorescences, or *E. orbiculata* which sports a light yellow, custard-coloured labellum, matched with bright pink-red anthers and corolla lobes. Others, like *E. mucida*, are weird-looking, with inflorescences resembling a slimy egg, from which the most delicate pink flowers stick out (featured on the cover of the book), or *E. tubilabrum* with its large infructescence that resembles a strange pineapple.

Etlingera of Sulawesi is a modern, critical revision based on a solid study of herbarium material, as well as the author's fieldwork. Until recently, only four *Etlingera* species were known to occur in Sulawesi. This current work increases this number by more than ten-fold (!), with a comprehensive treatment of 48 taxa. This includes 36 species new to science, two new subspecies, one new name and six new name combinations, species which were previously recognised as members of other genera (for example, *Amomum*, which in due course of study turned out to belong to the genus *Etlingera*).

The layout and design of this book is nicely done and similar to its predecessor *Etlingera* of Borneo. After an introductory part, 48 taxa are listed alphabetically, each provided with a detailed description, information on local names and uses, etymology, ecology and habitat, distribution, conservation status, mention of material examined, and additional notes. The text is generously complemented by good photographs illustrating important morphological details, line drawings and distribution maps. Professional botanists will surely appreciate the key for identification, citations of herbarium specimens, references, and several indices. The layman can indulge in reading the enjoyable introductory chapters dealing with a wide range of topics, including the history of botanical research in Sulawesi, conservation, ecology, and ethnobotany (describing various *Etlingera* uses), and enjoy flipping through some 250 beautiful photographs, including some previously unpublished historical material.

The author and publisher are to be congratulated on this wonderfully produced book, which is not only a valuable scientific contribution, but makes also a great coffee table book!

Jana Leong-Škorničková
Herbarium

Etlingera alba, a north Sulawesi species with a complicated taxonomic history, which is well-explained in the book. *(Photo credit: Jana Leong- Škorničková)*

6TH INTERNATIONAL SYMPOSIUM ON THE FAMILY ZINGIBERACEAE

The 6th International Symposium on the family Zingiberaceae was held from 10 to 13 September 2012 at the Tagore Nikethan Seminar Hall of Calicut University, Kerala, India. The event attracted approximately 80 Indian botanists and students, and 11 foreign participants representing eight countries.

The first morning started with an opening ceremony that was spiced up by the launch of the book *Etlingera of Sulawesi*, authored by Dr Axel Dalberg Poulsen from the Natural History Museum in Oslo, Norway. It was followed by the opening plenary lecture by Dr W. John Kress (Smithsonian Institution, Washington DC, USA), entitled *Have we made any progress in understanding the taxonomy, classification and evolution of the Zingiberaceae in the last decades?* Of course we have! The second plenary lecture, given by Dr Poulsen, was related to his book and provided insight into the *Taxonomic revisions of the genus Etlingera and the significance of Wallace's Line*. The afternoon was packed with 16 oral presentations covering the topics of taxonomy, molecular phylogeny and systematics.

I opened the second day's programme with a plenary lecture, presenting the conservation-related topic *On the brink: can we save native gingers in Singapore?* This was followed by a 45-minute-long break for viewing poster presentations, before a session on ethnobotany, pharmacology and phytochemistry, comprising eight talks. After lunch, Dr Piyakaset Suksathan (Queen Sirikit Botanic Garden, Chiang Mai, Thailand) delivered a plenary lecture on *The development of Thai native Dancing Ladies (Globba L., Zingiberaceae) for ornamental purposes*, followed by nine contributions in reproductive biology, ecology and conservation.

In the evening we were treated to a cultural programme. First we enjoyed beautiful traditional dance performances indoors, before being led outside for a real surprise—a simply breathtaking Theyyam performance. Theyyam is an ancient and difficult-to-perform ritual art form from the Malabar region of northern Kerala. It is known for outstanding feats performed by artists dressed in elaborate costumes, jewelry and make-up, and is often accompanied by displays of fire and martial arts.

Theyyam dancer ready for the performance (left) and later seen to jump through the fire (right). *(Photo credits: M. Santhosh)*

The third day we enjoyed a much-needed break in the morning to visit Calicut University Botanical Garden, one of the most beautiful in India. The largest collection of gingers in India is displayed in the Garden's open spaces and several large net-covered houses. We then returned to the Tagore Nikhetan Seminar Hall for the last plenary talk, *Biotechnological interventions for crop improvement in Zingiberaceous crops – Ginger, Turmeric and Small Cardamom* by Dr K. Nirmal Babu (Indian Institute of Spices Research, Calicut, Kerala, India), and the last session dedicated to horticulture and crop improvement before the closing ceremony.

Thirty-one posters covering a range of topics were presented during the symposium. Dr Poulsen, Dr T. Fér, Dr V. Gowda, Dr P.E. Rajasekharan and I, on behalf of the International Association of Plant Taxonomy (IAPT), evaluated and awarded prizes for the three best posters. First prize went to K.M. Prabhu Kumar et al. (University of Calicut, Kerala, India) for their poster *Taxonomic and variability studies on 'hidden purple ginger', a charming ornamental ginger to the tropics*. The second prize was awarded to Keerthi Divakaran et al. (National Institute of Technology Calicut, Calicut, Kerala, India) for their poster on *Variability of terpenoid defense against Pythium myriotylum in cultivated and wild species of Zingiber (Zingiberaceae)*, and third prize went to P. Daimei and Y. Kumar (North-Eastern Hill University, Shillong, Meghalaya, India) for a poster entitled *Ethnobotanical uses of zingiberaceous plants in Tamenglong District of Manipur, India*. The winners received a one-year IAPT membership, inclusive of online access to the international journal Taxon and the book *The Ginger Garden, Singapore Botanic Gardens' Pictorial Pocket Guide*.

The fourth and last day of the symposium was assigned for a field excursion, which took us along winding roads of the Western Ghats to an altitude of some 1000 m above sea level. We first stopped at a plantation focusing on organic production of black pepper, coffee and various cultivars of cardamom before we continued on to the Wayanad Wildlife Sanctuary, where we embarked on a jeep drive in search of tigers and elephants. Luck was not on our side, but we did see several spotted deer and peacocks.

Before we knew it, the symposium was over, leaving us to look forward to the next ginger symposium, which will be organised by Queen Sirikit Botanic Garden, Chiang Mai, Thailand. It will be held in honour of the late Professor Kai Larsen, an eminent Danish ginger specialist who dedicated most of his botanical career to the Flora of Thailand, who passed away in August 2012.

Elettaria cardamomum occurs naturally in the Western Ghats in India and in the western highlands of Sri Lanka, and its dried fruits are known as the true cardamom. Cardamom is one of the most expensive spices in the world and is widely used in cooking and medicine. *(Photo credit: Jana Leong- Škorničková)*

Jana Leong-Škorničková
Herbarium

A photo of the group. *(Photo credit: M. Santhosh)*

BGCI'S 8TH INTERNATIONAL CONGRESS ON EDUCATION IN BOTANIC GARDENS

BGCI's 8th International Congress on Education in Botanic Gardens took place at the Biology Institute UNAM (Universidad Nacional Autónoma de México) Botanic Garden of Mexico City, Mexico, from 12 to 16 November 2012. The Congress is organised once every three years and serves as an important forum for educators of botanic gardens, like us, to network with professionals from plant science institutes, educational and conservation organisations, zoos, museums, national parks and nature reserves worldwide. Over 150 delegates from 33 countries attended the congress.

Leaders of renowned botanic gardens gave plenary addresses and delegates contributed various paper and poster presentations and participated in workshops. These activities allowed educators to come together to examine how botanic gardens can address all 16 targets of the GSPC (Global Strategy for Plant Conservation) through education, and share viewpoints in communicating the importance of plants and engaging people for plant conservation.

At the Congress, representatives from SBG highlighted the topic *Environmental Education among the Young at the Singapore Botanic Gardens—Training and Collaboration towards Community Change*. Education Executive Shereen Tan presented a poster, and I presented a talk to discuss this subject.

Winnie Wong
Education Branch

Field Trip to Xochimilco during the Congress. Delegates travelled through canals on *trajineras* (gondola-like boats) to various *chinampas* (also known as "floating gardens"). Invented by pre-hispanic peoples of the area, the *chinampa* system is still important to local agriculture, but is facing serious threats due to pressures of urbanisation. Delegates came together to discuss potential conservation plans and community outreach programmes which we hope will help to rescue this surviving landscape of the Aztecs. *(Photo credit: Winnie Wong)*

The towering flower stalks of these agaves, at UNAM Botanic Garden of Mexico, could grow up to several metres in height. *(Photo credit: Relle Mott)*

Poster presentation session during the Congress: Education Executive, Shereen Tan (left), with another delegate from Latin America (right). *(Photo credit: Winnie Wong)*

KEY VISITORS TO THE GARDENS

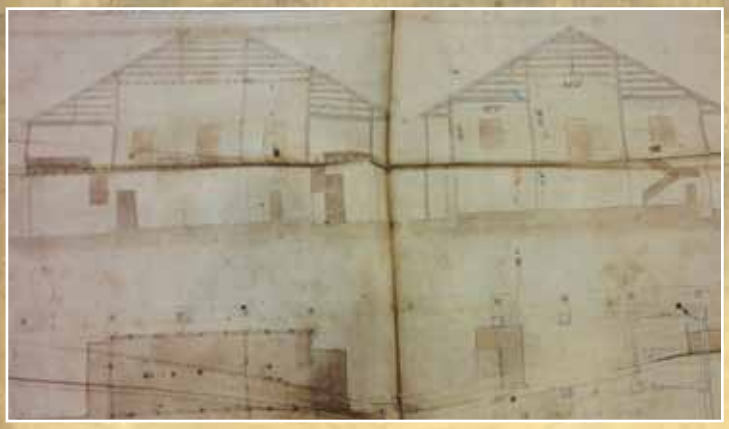
(JULY-DECEMBER 2012)

The Duke and Duchess of Cambridge, with NParks' CEO, Mr Poon Hong Yuen (left) admiring the orchid hybrid newly named after the royal couple, *Vanda* William Catherine.

Mrs Brigitte Ayrault (left), spouse of Prime Minister of the French Republic, His Excellency Jean-Marc Ayrault, assisted by NParks' DCEO, Dr Leong Chee Chiew (right) unveils the orchid hybrid newly named in honour of the French Prime Minister and his spouse, *Ascocenda* Jean-Marc Brigitte Ayrault.

Mr Wichai **AIYAKOOL**	Kasetsart University, Bangkok, Kingdom of Thailand
Dr Marc **APPELHANS**	Smithsonian Institution, Washington, D.C., USA
Dr Marlina **ARDIYANI**	Herbarium Bogoriense, Bogor, West Java, Republic of Indonesia
His Excellency Jean-Marc **AYRAULT** & spouse	Prime Minister, French Republic
Dr Henk Jaap **BEENTJE**	Royal Botanic Gardens, Kew, UK
Mrs Natalie **BRIGES**	Spouse of Minister of Consumer Affairs, New Zealand
His Excellency Felipe de Jesús **CALDERÓN** Hinojosa & spouse	President, United Mexican States
Khunying Puangroi **DISKUL** na Ayudhaya	Executive Director, Doi Tung Development Project, Mae Fah Luang Foundation, Kingdom of Thailand
Dr Gunther **FISCHER**	Kadoorie Farm and Botanical Garden, Hong Kong, PR China
Mr Deden **GIRMANSYAH**	Herbarium Bogoriense, Bogor, West Java, Republic of Indonesia
Prof Dr Charlie D. **HEATUBUN**	Universitas Negeri Papua, West Papua, Republic of Indonesia
Assoc Prof Dr Murray **HENWOOD**	The University Of Sydney, Sydney, New South Wales, Commonwealth of Australia
Mr **KHAW** Boon Wan	Minister for National Development, Republic of Singapore
Dr K.C. **KOSHY**	Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Kerala, Republic of India
Dr Caroline **LAW**	Kadoorie Farm and Botanical Garden, Hong Kong, PR China
Dr **LIM** Phaik Eem	Institute of Ocean and Earth Science, University of Malaya, Kuala Lumpur, Malaysia
Mr Onishi **MANABU**	Associate Director, Planning and General Affairs Division, Kyoto, Japan
Ms Sharon **MAR**	Kadoorie Farm and Botanical Garden, Hong Kong, PR China
Dato' **MIRZA** Mohammad Taiyab	Director General, Tourism Malaysia, Malaysia
Dr Timothy **MOTLEY**	Old Dominion University, Norfolk, Virginia, USA
Dr Pranee **NANGNGAM**	Naresuan University, Phitsanulok, Kingdom of Thailand
Prof Dr Christoph **NEINHUIS**	Technische Universität Dresden, Dresden, Federal Republic of Germany
His Excellency José Maria Pereira **NEVES**	Prime Minister, Republic of Cape Verde
Ms **NG** Poh Kheng	Institute of Ocean and Earth Science, University of Malaya, Kuala Lumpur, Malaysia
Dato' Sri Dr **NG** Yen Yen	Minister of Tourism, Malaysia
His Excellency **NGUYEN** Phu Trong	General Secretary, Communist Party of Vietnam, Socialist Republic of Vietnam
Dr Caroline M. **PANNELL**	University of Oxford, UK
Ms **POONG** Sze Wan	Institute of Ocean and Earth Science, University of Malaya, Kuala Lumpur, Malaysia
Dr Axel Dalberg **POULSEN**	Natural History Museum, University of Oslo, Kingdom of Norway
Mrs Uzi **RABI**	Spouse of the Director of the Moshe Dayan Centre for Middle Eastern and African Studies, Tel Aviv University, State of Israel
Mr Bhakta Bahadur **RASKOTI**	Tribhuvan University, Kathmandu, Federal Democratic Republic of Nepal
Ms Sunisa **SANGVIROTJANAPHAT**	Queen Sirikit Botanic Garden, Chiang Mai, Kingdom of Thailand
Mr Santi **SARAPHOL**	Kasetsart University, Bangkok, Kingdom of Thailand
His Excellency Luis Fernando de Andrade **SERRA** & spouse	Ambassador of the Federative Republic of Brazil to Singapore
Dr Charlotte **SHIU**	Kadoorie Farm and Botanical Garden, Hong Kong, PR China
Ms Nadhanielle **SIMONSSON**	National Research Institute of Papua New Guinea, Papua New Guinea
Mr Bambang Goeritno **SOEKAMTO**	Director General, Agency for the Development of Construction, Ministry of Public Works, Republic of Indonesia
Dr Joeri S. **STRIJK**	Xishuangbanna Tropical Botanical Garden, Xishuangbanna, Yunnan, PR China
Dr Benito **TAN**	National University of Singapore, Republic of Singapore
Dr Paweena **TRAIPERM**	Mahidol University, Bangkok, Kingdom of Thailand
Dr Eduard F. de **VOGEL**	NCB Naturalis, Leiden, Kingdom of the Netherlands
Mr **WANG** Ping Yuan	Xishuangbanna Tropical Botanical Garden, Xishuangbanna, Yunnan, PR China
Dr Jun **WEN**	Smithsonian Institution, Washington, D.C., USA
His Royal Highness Prince **WILLIAM** & Her Royal Highness **CATHERINE**	The Duke and Duchess of Cambridge, UK
Mr **WONG** Hon Wai	Chairman, Town and County Planning, Housing and Art Committee, Penang, Malaysia

1867 Plan of Burkill Hall



Among the Archives of the Botanic Gardens is a large plan outline of the Superintendent's House on calico cloth. Calico is a plain woven textile made from unbleached and often not fully processed cotton. Calico originated in Kozhikode (Calicut), Kerala, India during the 11th century, and plans drawn on this textile tended to last longer than paper.

In his account of *The establishment of the Botanic Gardens, Singapore*, published in 1918 in the *Gardens Bulletin*, I.H. Burkill mentioned that the land for the house was acquired in 1866, and that the purchase of the land exhausted the Society's funds, creating the need to take out a mortgage to finance the cost of construction. Possibly the result of these financing issues, the original plan of the Superintendent's House is not dated until the following year, 1867. This was not only the builder's plan, but it also contained the quantities of materials to be used for construction of the building. The plan also constituted an agreement between two Chinese builders and the Singapore Agri-Horticultural Society, with the latter represented by Mr C.H.H. Wilsone (the Secretary of the Society at the time); these names are all hand-written on the plan. The cost for construction of the building was $2400.

The plan shows a simple building layout, with all the living space upstairs, consisting of two bedrooms, a dressing room and two large verandahs. Nailing and iron bolting were kept to a minimum, and timbers were fixed and joined by pure carpentry. One striking feature of the building is its long, slender timber posts which extend from the ground floor to the eaves of the roof. These posts were made of native *tempinis (Streblus elongatus)* trees. According to Burkill's account, the Government consented to allow the Agri-Horticultural Society project to be supplied with bricks from the Government kilns at cost price. Construction of the Superintendent's House was completed in 1868, although the debt owed by the Agri-Horticultural Society for the construction of the house was outstanding for many years, and ultimately led to the Society's handing over of the Botanic Gardens to the colonial government in 1874.

Lawrence Niven, the first Superintendent of the Gardens from 1860 to 1875, was the first resident of the house.

This classic colonial bungalow was later called the Director's House, when Henry Nicholas Ridley became the first Director of the Gardens in 1888. It was Ridley's home for 23 years, as indicated in Ridley's centenary issue by J.W. Purseglove (1955). In 1971, the Director's House was listed by the Preservation of Monuments Board as one of the Historic Buildings of Singapore, according to the book *Historic Buildings of Singapore* by Edwin Lee.

On 1 October 1992, the Director's House was named Burkill Hall in honour of two Directors, Isaac Henry Burkill, who was Director of the Gardens from 1912 to 1925, and Humphrey Morrison Burkill, his son who became the Director of the Gardens from 1957 to 1969. Incidentally, Burkill Hall was also his birthplace. Today, Burkill Hall is a focal point of the National Orchid Gardens and it commands a spectacular view of the orchid garden. This colonial bungalow has been renovated and is now used as a VIP reception and event hall.

Christina Soh
Library