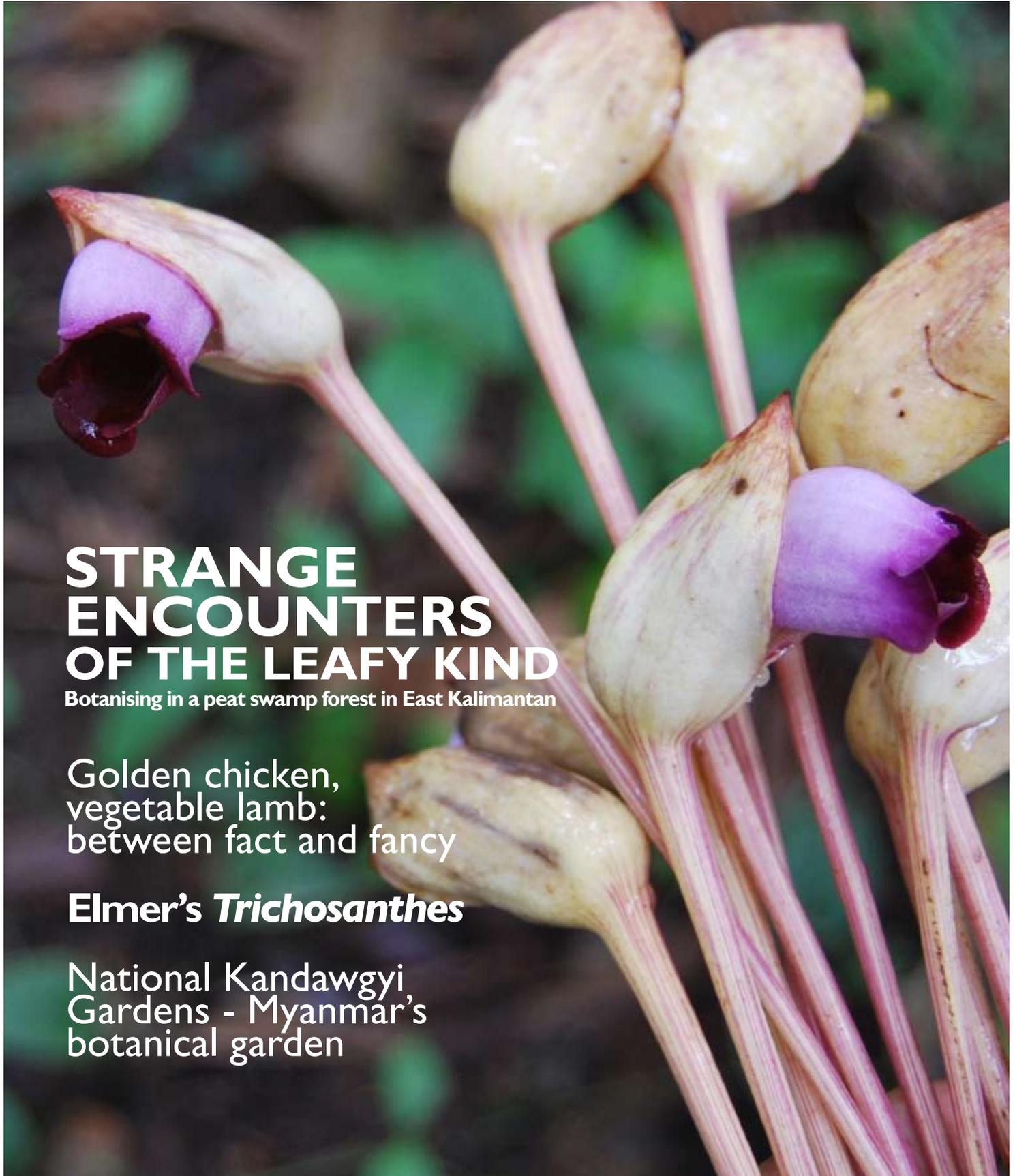


Gardenwise

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STRANGE ENCOUNTERS OF THE LEAFY KIND

Botanising in a peat swamp forest in East Kalimantan

Golden chicken,
vegetable lamb:
between fact and fancy

Elmer's *Trichosanthes*

National Kandawgyi
Gardens - Myanmar's
botanical garden



Cover
Agenetia indica from
 East Kalimantan.
 Photo by Paul Leong

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MESSAGE FROM THE DIRECTOR

The Singapore Botanic Gardens (SBG) has played a multifaceted role since its beginning. In its early years, recreation was a primary role but it quickly took on new ones in the 1870s and 1880s. A herbarium and library were started, and active collection of plant material from the region took place, building up the herbarium and living collections. Plant exchange with other institutions, and experimentation and research on economic plants also began. When the government became concerned with the rapid loss of forest, the Gardens'

see the re-introduction of native species into nature reserves, the Gardens and parks. Such efforts will help conserve our native biodiversity, making these plants more familiar to people in Singapore and enrich our living spaces.

Since the last issue of Gardenwise in July 2010, NParks has welcomed a new Chief Executive Officer, Mr Poon Hong Yuen. Dr Wong Wei Har is away, and Dr Chin See Chung has retired. The Gardens is in transition. We are very pleased to welcome Dr Wong Khoon

Preparation is also underway for key events in 2011 like a rainforest exhibition in conjunction with the United Nations' International Year of Forests, the launch of SBG's Healing Garden, and the Trees of the World Light-up. 2011 will be another exciting year.

superintendent was asked to conduct a survey, and the first forest reserves were identified and placed under the Gardens' administration, giving it an early role in forest conservation. The Gardens' staff also started to help supervise tree planting around the city.

Meng who succeeds Dr Benito Tan as Keeper of the Herbarium. He also takes over as Assistant Director of Research, succeeding Dr Lim-Ho Chee Len who has also retired. The Gardens will continue to expand its research activities.

Today, SBG researchers continue the work in the region, in partnership with many specialists and agencies in various countries. Some of their projects are featured in Gardenwise. SBG also offers fellowships for taxonomic studies from other countries to work on projects in our herbarium. We will continue to identify people who can benefit from stints under these fellowship programmes so as to promote taxonomic science.

Meanwhile, the Gardens' development programme continues under Mr Alan Tan's leadership. Preparation is also underway for key events in 2011 like a rainforest exhibition in conjunction with the United Nations' *International Year of Forests*, the launch of SBG's *Healing Garden*, and the *Trees of the World Light-up*. 2011 will be another exciting year.

The Gardens' researchers also contribute to making Singapore a City in a Garden. Dr Tim Yam's research programme for the re-introduction of native orchids will see even more species of native orchids conserved in natural areas and parks, as well as on roadside trees. Dr Jana Škorničková's work on gingers will likewise

Leong Chee Chiew






Photo: Bhannuhong Bongcheewin



PART II

COLLECTING & CONSERVING THAI CONVULVACEAE

As described in an earlier issue (*Gardenwise* 34), there is an ongoing collaboration between the Singapore Botanic Gardens and research institutes in Thailand to better understand the conservation needs for rare species of Thai Convolvulaceae. The partners in Thailand are the Forest Herbarium, Bangkok (part of Thailand's Department of National Park, Wildlife, and Plant Conservation) and the Queen Sirikit Botanic Garden, outside Chiang Mai. With support from these partners we have made three trips to various parts of Thailand in search of rare species of Convolvulaceae.

Our third trip took place in October 2010 with the first week hosted by the Forest Herbarium and the second hosted by Queen Sirikit. In total, we drove more than 4,000 km over 15 days and again had some successes and a few disappointments. Planning as we do over one year in advance, it is impossible to predict conditions on site at the time of the trip; in this case, mega-typhoon Megi brought record-breaking rainfall to Thailand during the first days of the trip, followed by massive flooding for the rest of it. Fortunately, the plants we were seeking were not adversely affected by the downpour and we had, overall, a very successful collecting effort.

From Bangkok we drove eastward to the province of Sa Kaeo, on the Cambodian border. Here we were looking for several

species, the rarest of which, *Argyreia versicolor*, was named based on a single collection made in 1924; the species has never been seen alive again. Because the collecting locality, Wattana, is now a fairly sizable town surrounded by agricultural land, we focused our search on the nearby Pang Si Da National Park, which has sizable tracts of undisturbed natural vegetation. Sadly, despite two full days of botanising in and around the park, we failed to find any plants matching the description of this rare and enigmatic *Argyreia*.

On the bright side, we did locate other species of interest and managed to make a few collections, despite the rainfall. Although few Convolvulaceae were encountered we had better luck with other kinds of plants. On a sheer limestone rock cliff near Khao Chakan Temple, we saw colonies of Gesneriaceae with bright yellow flowers. On closer inspection these were clearly two different species growing in a mixed population. Photos of the flowers emailed to specialists at the Royal Botanic Garden Edinburgh, brought the quick reply that both are species of *Chirita* and one of them appeared to be undescribed. Fortunately we made good herbarium vouchers, collected leaf samples for DNA extraction, and also preserved some flowers in alcohol to share with our partners in Edinburgh.

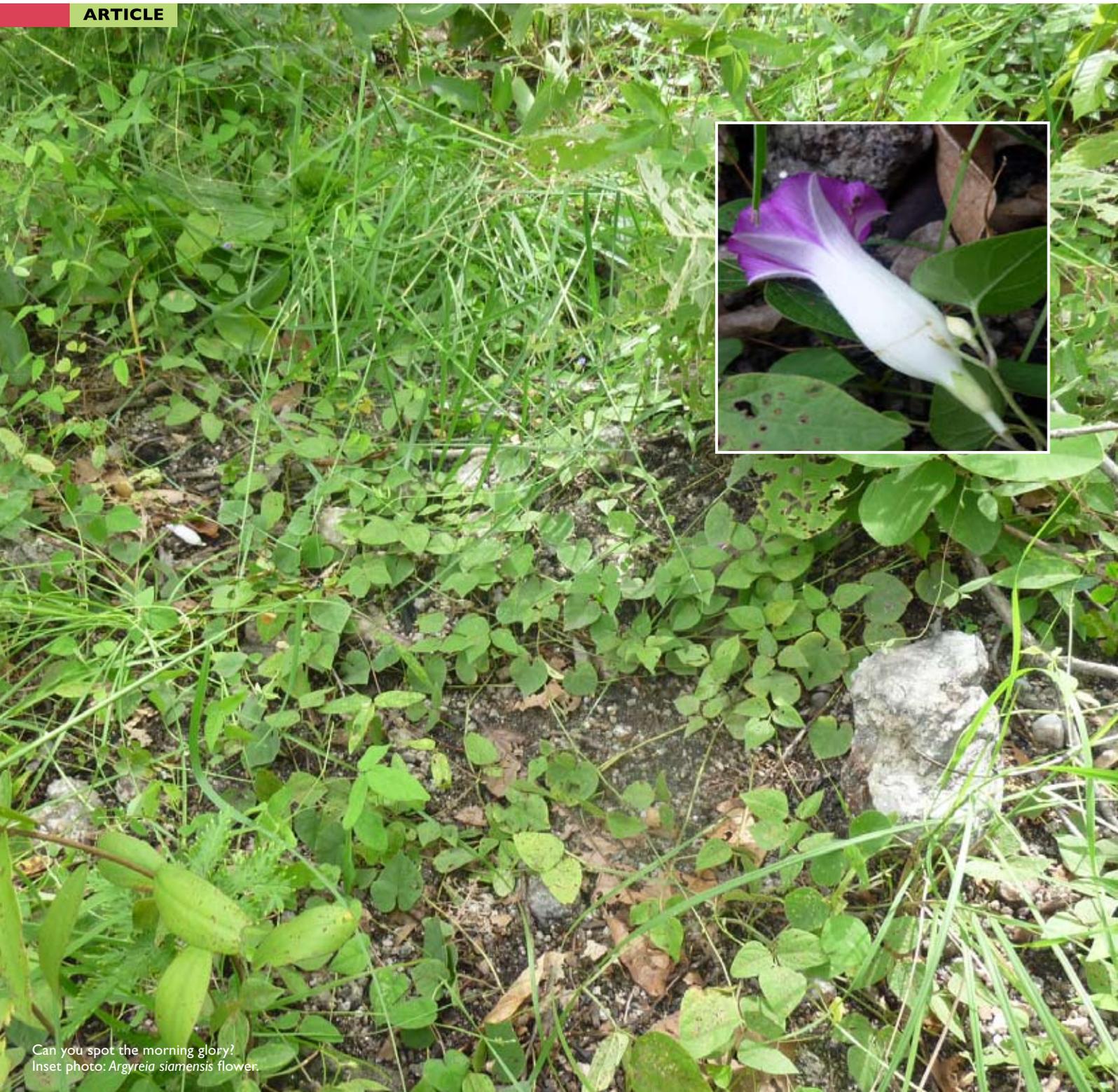
Moving westward across the kingdom to the province of Ratchaburi, we found the

Our third trip took place in October 2010 with the first week hosted by the Forest Herbarium and the second hosted by Queen Sirikit. In total, we drove more than 4,000 km over 15 days and again had some successes and a few disappointments.

Top:
The elusive *Merremia poranoides*, a Himalayan species that just reaches northern Thailand.

Bottom left:
Driving conditions on the southern slopes of Doi Inthanon, 30 Oct. 2010.

Bottom right:
Chirita oculata, growing on sheer limestone cliff, Sa Kaeo province.



Can you spot the morning glory?
Inset photo: *Argyreia siamensis* flower.

forests filled with local people gathering mushrooms, which were popping up in profusion after the atypical late season rains. In our exploration of the Maenam Pha Chee Wildlife Sanctuary our collecting fortunes began to turn and we saw our first exciting Convolvulaceae: *Argyreia siamensis*, which creeps along the ground half hidden in the leaf litter. The flowers are lovely, but hard to spot among the dead leaves and low foliage covering the ground. Later that day I had my first glimpse of *Argyreia variabilis*, a species I described in 2008 which I had

never before seen alive. The deep purple, waxy flowers, hanging like bells below the leaves, are very attractive. The next day when we visited Kaeng Krachan National Park, a bit further south in Phetchaburi province, I was pleased to see *A. variabilis* featured on interpretive signage at the park visitor centre, one of the few plants among a host of animals, wildlife being what makes Kaeng Krachan so famous.

Turning north on 24 October, we spent a long day driving all the way to Chiang Mai province, and the Queen Sirikit Botanical

Garden, our base for the second week of collecting. After changing field teams and getting the supplies in order we set off on a series of three short trips to various areas in the north and northeast of Thailand.

By now fortune was smiling on us and we made some exciting discoveries every day. First off was *Argyreia melvillei*, followed later that same day by *A. confusa*, two more species that are known from rather few Thai collections and are poorly understood as a result. But the next day

Gradually our knowledge base about the population size and abundance for the rarest Thai species is improving and our next goal is to prepare conservation assessments for these 20+ rare Thai Convolvulaceae species, using IUCN criteria.

was even better: the enigmatic *Merremia poranoides*, known from a single Thai specimen collected in 1979, was found in two localities. In my first trip to search for rare species, we totally failed to locate *M. poranoides*, despite an entire day spent in the Mae Tuen Watershed Improvement Station, so finding thriving populations in other areas was very encouraging. This rare species seems to be thriving in the few spots where it occurs in the Kingdom, but at least two of the populations are surrounded by agricultural fields and the wild plants could be destroyed at any time.

In a small patch of oak-pine forest at 1200 metres elevation, we came across a remarkable species, yet another *Argyreia*, that had beautiful pure white flowers. The vines were creeping among the waist-high grass in the partial shade under the trees, a lovely setting with a cool breeze blowing and hawks crying overhead. This species couldn't be immediately recognized and may prove to be undescribed. Further research is needed to decide whether the species has a name or not. It is certainly under threat from land clearing at the sites where we found it, and grows in tiny patches of forest surrounded by cabbage fields.

As the trip wound down, the rising water levels in rivers throughout northern Thailand were causing damage to roads, bridges, and villages we passed by. We crossed over a bridge one day; the very next day it had collapsed and we made our return journey via a temporary bridge erected overnight by the army. On our final day, on the lower slopes of Doi Inthanon, we nearly got the vehicle stuck in mud and had one or two close calls negotiating the unpaved road, which was barely passable because water running down the mountain side

had saturated the soil. Still, when all is said and done, the number of rare species we were able to study and collect was significant and our Thai partners have continued to search for rare species, with some exciting discoveries after our trip ended on 30 October. Gradually our knowledge base about the population size and abundance for the rarest Thai species is improving and our next goal is to prepare conservation assessments for these 20+ rare Thai Convolvulaceae species, using IUCN criteria.

Top:
Dr Piyakaset Suksathon (left) and Miss Sunisa Sangnirotjanapat collecting *Argyreia melvillei* on the north slopes of Doi Inthanon.

Centre:
An unidentified *Argyreia* species in a patch of evergreen-pine forest, Om Koi district.

Bottom:
The beautiful hanging flowers of *Argyreia variabilis*.



George Staples
Herbarium

Photos by George Staples
unless otherwise stated



Dark red when ripe, the fruits of *Trichosanthes elmeri* contain numerous slimy, dirty green seeds.

Their fleshy jackets removed, *Trichosanthes elmeri* seeds have their smooth, dark brown seed coats exposed.



Dried for seven days and ready for mounting as herbarium specimens, the collapsed, shriveled fruit walls no longer resemble their original state or colour.



Trichosanthes is the genus of cucurbits (Cucurbitaceae) to which a number of wild gourds, and the cultivated Indian snake gourd *Trichosanthes cucumerina* var. *anguina*, belong. It is one of the old plant genera set up by the botanical grandmaster Linnaeus himself in 1753.

ELMER'S *TRICHOSANTHES*



Collector Lua Hock Keong with a string of ripe *Trichosanthes elmeri* fruits that would make a trophy.

Many of the 100-odd species, however, produce typically rounded to ellipsoid fruits rather than the long ellipsoid, coiled fruits seen in the snake gourd, which can reach 100 cm long.

Encountered in lowland forests in Singapore, *Trichosanthes elmeri* was first collected here by H.N. Ridley in 1892, and the Herbarium has since archived only six other specimen records of the species. It is named after A.D.E. Elmer, a botanist and collector who worked for the Bureau of Science in Manila and who collected in north Borneo in the early 1920s. Elmer collected what was to become the type specimen from Sandakan, and a duplicate of this collection is housed in the Gardens herbarium. The species was named in honour of Elmer by his contemporary, the great E.D. Merrill, a botanist who devoted much energy to Asian floras, especially Philippine and Bornean plants, and had taken important positions in botany in early 20th-century Manila and at the University of California, New York Botanical Garden and the Arnold Arboretum of Harvard University.

Our Singapore specimen, photographed here with one of its collectors, came from Nee Soon swamp forest during a vegetation survey by the National Biodiversity Centre. As is the case with all cucurbits, this is a tendrilled climber. The cucurbits of the Malay Archipelago, a region botanically known as Malesia, were recently revised by Netherlands-based

botanists W.J.J.O. de Wilde and B.E.E. Duyfjes, the 342-page publication (Flora Malesiana, volume 19) just out in print in 2010. Elmer's *Trichosanthes* is one of 43 known species in Malesian forests, which have fruits ripening variously orange-red or green and sometimes with pale stripes. One feature of interest that came to mind when fruit specimens were being dried for the Gardens Herbarium was the drastic change in shape before and after drying, something for botanists to note as they decipher plant characters using both dried material and collectors' notes made from fresh material. This species has masses of smooth, compressed, ovate to rounded, even triangular, dark brown to black seeds.

Several *Trichosanthes* species have active biochemical compounds. Snake gourd itself has peptides that function in its use as an abortifacient in China, while *T. borneensis* is used in local folk medicine. *Trichosanthes dentifera* from Vanuatu and New Guinea has edible seeds when cooked, and *T. edulis* fruit is also cooked in New Guinea.

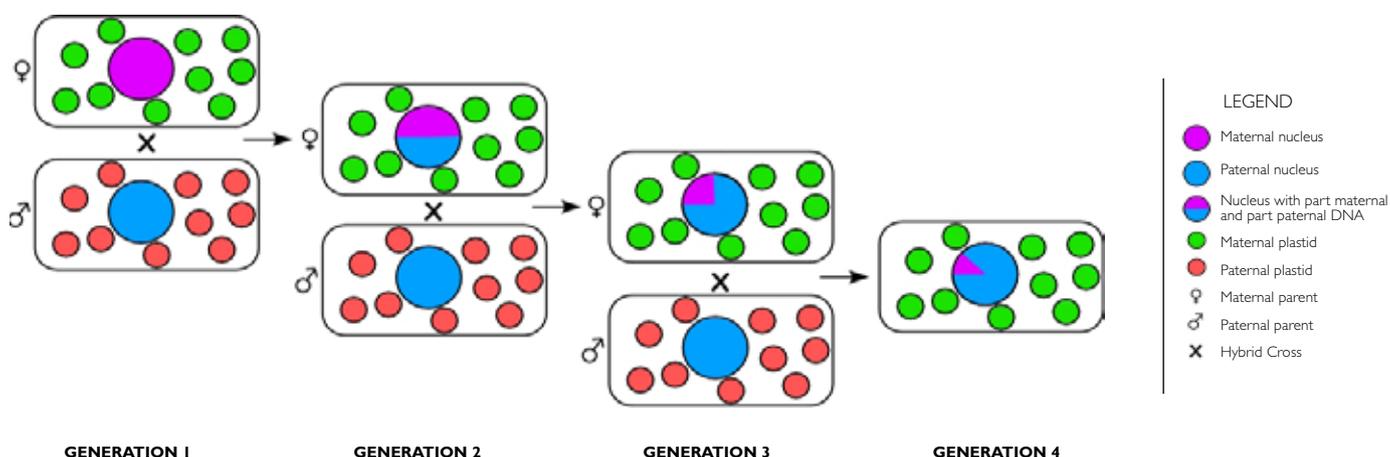
Serena Lee
Khoon Meng Wong
Herbarium

Lua Hock Keong
National Biodiversity Centre

Photos by the authors

FORENSIC BOTANY:

CAN WE RESOLVE THE IDENTITY OF VANDA MISS JOAQUIM'S MOTHER?



The maternal inheritance of plastids, from the mother to all progeny.

In 1893 Miss Agnes Joaquim, an Armenian lady residing in Singapore, showed an orchid to Henry N. Ridley, then director of the Gardens. This orchid was the result of a cross between *Vanda hookeriana* and *Vanda teres*. Ridley named this plant *Vanda Miss Joaquim*, in her honour. The plant would soon grow in stature by winning a First Class Certificate at the London Royal Horticultural Show in 1897 and the first prize at the 1899 Flower Show in Singapore for the rarest orchid in the show. On 15 April 1981, *Vanda Miss Joaquim* was selected as Singapore's national flower; a status which no other hybrid orchid has ever achieved. *Vanda Miss Joaquim* is Singapore's first orchid hybrid to be registered with the Royal Horticultural Society and is the first registered hybrid *Vanda* in the world.

Despite its exalted status as a national flower, two important aspects of the hybrid are unclear:

- Which of the parents contributed the pollen? As Ridley stated in *The Gardener's Chronicle* (1893), "... Miss Joaquim... succeeded in crossing *Vanda hookeriana* Rchb. f., and *V. teres*... Unfortunately, no record was kept as to which was used as the male." According to RHS records, *V. hookeriana* is listed as the pod parent, while *V. teres* is listed as

the pollen parent. In herbarium records at the Singapore Botanic Gardens, the *Vanda Miss Joaquim* specimen, filed by Ridley in 1893, is recorded as *Vanda Agnes Joaquim* and its parentage described as (*V. teres* × *V. hookeriana*).

- Is *Vanda Miss Joaquim* the result of a deliberate cross by Miss Agnes Joaquim (an artificial hybrid) or the work of insect pollinators (a natural hybrid)? Popular opinion is currently still divided over the matter.

With molecular technology, it is possible to answer the first question. This is done by analysing DNA sequences of the hybrid and both its parents. Alas, no scientific means exist to resolve the second question of the hybrid's origin. Miss Agnes Joaquim died in 1899, and as John Laycock, founder and president of the Malayan Orchid Society (now OSSEA) lamented in 1949, "... the hybrid whether made by Miss Joaquim or is the result of the work of nature must now forever remain unanswered".

So how does DNA sequence analysis help us establish parentage? One method is to zero in on plastid genes. All cells contain DNA which encodes proteins necessary for cellular function. All eukaryotic cells contain subcompartments

called organelles. Most of a cell's DNA is contained within an organelle called the nucleus. But some additional DNA exists within other organelles such as the mitochondria and chloroplasts – the latter are the organelles in plant cells which conduct photosynthesis and are also known as plastids. In most plants, plastids are passed from the mother to all progeny. The male parent only contributes half of the nuclear DNA content. Repeated backcrosses to the same male parent will enrich the paternal component of nuclear DNA in the progeny but the plastid genes will continue to be passed down the maternal line. Thus, the DNA sequence of plastid genes should be identical between mother and all progeny.

In the case of *Vanda Miss Joaquim*, we should be able to identify the maternal parent by sequencing the plastid genes of both parents and looking for an identical match in DNA sequence to the hybrid. The parent which matches *Vanda Miss Joaquim* in plastid gene sequence would undoubtedly be her mother and by inference, the other parent would be her father. This research is currently underway at the Gardens and soon we hope to be able to provide an answer to the century old mystery of *V. Miss Joaquim's* parentage.



Gillian Khew

Vanda Miss Joaquim



Vanda hookeriana



Vanda teres, an engraving by J. Watts

In the case of Vanda Miss Joaquim, we should be able to identify the maternal parent by sequencing the plastid genes of both parents and looking for an identical match in DNA sequence to the hybrid.

GOLDEN CHICKEN, VEGETABLE LAMB: BETWEEN FACT AND FANCY



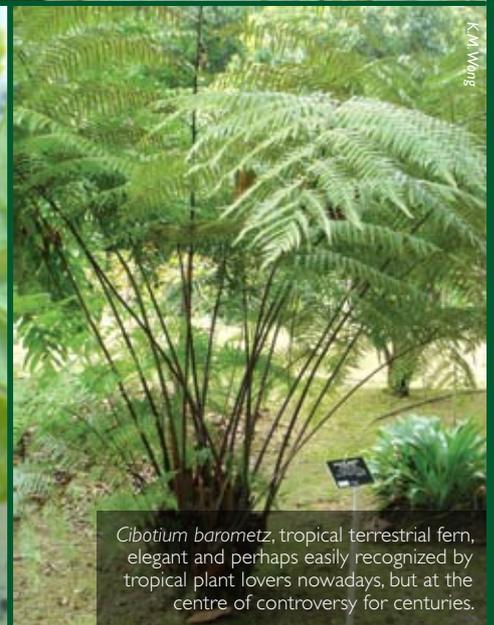
Golden chicken ferns lined up for sale (upper row, behind the bamboo shoots) at a wayside stall along the road to the Cameron Highlands, Peninsular Malaysia.

Haji Mohamed



Haji Mohamed

Orange sporangia (spore sacs) carrying millions of tiny spores within, arranged in pocket-like structures, each called a sorus, on the lower surfaces of fertile fronds.



K.M. Wong

Cibotium barometz, tropical terrestrial fern, elegant and perhaps easily recognized by tropical plant lovers nowadays, but at the centre of controversy for centuries.

If one were to visit the Brinchang market in the Cameron Highlands of Peninsular Malaysia or some *pasar malam* (Malay: night market) in the towns, it is sometimes possible to see unusual objects offered for sale that are irregularly shaped and covered in thick golden-brown hair.

These items are variously claimed to be effective in the role of an air conditioner, crystal ball, medical doctor and witch-doctor! Each may sell for amounts up to S\$10. Potential buyers are often told that these are the 'golden chicken tuberous plant', as well as other facts, beliefs (e.g., it is effective in prevention of evil and all black magic; a high shelf is the proper place to put it) or embellishments (only found in the jungle north of Thailand!).

The so-called 'golden chicken' is the rhizome apex of the fern *Cibotium barometz* (L.) J.Sm. (in its own family Cibotiaceae) which used to be common in the montane forests of the Genting Highlands, Cameron Highlands and other hill stations in Peninsular Malaysia. It is often claimed that the golden chicken fern can only be obtained from mountains, but in fact it occurs in the lowlands as well, including in disturbed sites, and is distributed from northeastern India to south China and much of the Malay Archipelago. According to Burkill's *Dictionary of the Economic Products of the Malay Peninsula* (I.H. Burkill had succeeded H.N. Ridley as Director of the Singapore Botanic Gardens in 1912), the golden brown hair covering the rhizome, which gives the plant this particular name, has long been used as a styptic (a substance used to stop bleeding). It was one of the earliest objects of trade from the Malay



'Scythian Lamb' chewing up the surrounding vegetation, a plate from the *Histoire Admirable des Plantes* by Claude Duret, 1605. "Of all the strange and marvelous trees, shrubs and herbs which Nature, or rather, God himself has produced, or ever will produce in this Universe, there will never be seen anything so worthy of admiration and contemplation as these Barometz of Scythie or Tartarie, plants which are also animals, and which browse and eat as quadrupeds."

Peninsula to China. The dried rhizomes were also re-exported to Europe via Russia. While the hairs have been used to stop bleeding in China, those of similar species in the Pacific region (called *pulu* in Hawaii, similar in meaning to the Malay word *bulu*; woolly or hairy) have been used as stuffing for mattresses and pillows. Mark Twain, on one of his visits to Hawaii, mentioned hotels proclaiming, "We use genuine *pulu* for our mattresses and pillows".

Early European scientists had believed it to be some kind of creature halfway between plant and animal, which had the stem attached to its navel. This uncertainty was promoted by legends regarding a 'Vegetable Lamb of Tartary', or 'Scythian Lamb', which also give the fern its specific name *barometz*. Very early 17th century belief had recorded that when the vegetable lamb grew up and came to life, it would eat all vegetation growing around it before dying. In the late 17th century, even the German natural historian Kaempfer; a surgeon of the Dutch East India Company, believed that the Scythian lamb came from the skins of aborted Karakul lambs! Thus, whereas in Malaysia racketeers may have perpetrated the legend of the golden chicken fern, in Europe, trade in this fern had given rise to the fanciful legend of the Vegetable Lamb of Tartary. In fact, its status as a plant was not properly clarified until the 18th century.

When the story of this plant-animal reached academic circles, the learned

fraternity of the day began their speculations, arguments, counter-arguments and investigations. Girolamo Cardana of Pavia (Italy) argued that such a phenomenon was impossible, because if it had blood it must have a heart and that the soil could not supply the heart with the proper movement or warmth. Dr. Kaempfer had even journeyed to Persia in quest of the creature but did not find it. By 1725, however, the celebrated physician and botanist Sir Hans Sloane was able to offer corroboration from Johann Philipp Breyne, a surgeon, of his earlier identification of the Scythian lamb as a fern rhizome.

The origin of the fable of the vegetable lamb could have arisen as a traveller's tale but the earliest written record of this plant-animal is perhaps that in the Talmudical books. Rabbi Jochanan "in the year of salvation 436" mentions this plant-animal having the shape of a lamb attached like a gourd to the soil. In 1235 a commentator wrote that this creature is the Jedoui mentioned in the Scriptures, and that witchcraft is practiced with its bones. No creature can approach within its range, for it will devour them, but arrows carefully aimed at the stem will cause it to rupture and kill the animal. An early written account of plant curiosities, *Histoire Admirable des Plantes*, by Claude Duret, has a chapter on plant-animals existing in Tartary – a place "filled with heavy and dense air".

Cibotium barometz is a terrestrial fern, reaching a height of 3 m and producing a most attractive rosette of large, outcurved fronds. The rhizome and the base of the fronds are covered in long tawny golden hairs. Visitors to the Gardens may encounter this elegant fern at the Fernery. It is truly amazing how this plant has, in history, given rise to so many legends.

Haji Mohamed Abdul Majid
Universiti Brunei Darussalam
and University of Malaya

Khoon Meng Wong
Herbarium



Pagoda Island in one of the lakes. The Nan Myint Tower in the background.

NATIONAL KANDAWGYI GARDENS

MYANMAR'S BOTANICAL GARDEN



Because of its warm-temperate four-season climate that enables many plants to bloom all year round, Pyinoolwin is sometimes called the 'City of Flowers' or 'City of Cherry Blossoms'.



Two little boys admiring one of the lakes

The small town of Pyinoolwin (often spelt Pyin-Oo-Lwin), situated about 69 km north-east of Myanmar's second largest city Mandalay, boasts a major tourist attraction as the famous National Kandawgyi Gardens are located here. During the British colonial period this town, known as 'Maymyo' at the time, was developed as a hill station. Due to its elevation at about 1000 metres above sea level the climate here is pleasant throughout the year, with night temperatures in summer often dropping to 18 degrees or below. Because of its warm-temperate four-season climate that enables many plants to bloom all year round, Pyinoolwin is sometimes called the 'City of Flowers' or 'City of Cherry Blossoms'. The many colonial-style red brick-buildings and the comparatively cool climate make Pyinoolwin very unusual among Myanmar towns.

Situated on the outskirts of Pyinoolwin are the National Kandawgyi Gardens, Myanmar's only botanical garden. The Gardens, originally known as 'Government Botanical Gardens, Maymyo', were established in 1915 by forest officer Alex Rodger. With the help from Lady Cuffe, an amateur gardener, the Gardens were modelled after the Royal Botanic Gardens Kew. Official government recognition was given two years later, and in 1924 the Gardens were declared a Forest Reserve. At the time, the Gardens were managed by the Ministry of Forestry. The name was

officially changed to the current name 'National Kandawgyi Gardens' by Sr. Gen. Than Shwe in the year 2000. In 2008 one of Myanmar's giant private companies, Htoo Trading Co. Ltd., leased the Gardens from the Ministry of Forestry. Visitors can enjoy the beauty of the Gardens while walking around on foot, but there are also golf carts available for rent to drive them around if they so wish. While locals have always enjoyed the Gardens, they have now also become popular among Western tourists as the rolling lawns and the temperate environment somehow remind them of England, and for many they are therefore the perfect setting to find peace, rest and relaxation.

As in other botanical gardens of the world the objectives of the Gardens are many-fold. Above all the Gardens are aimed at providing a pleasant environment for the recreation and enjoyment of local as well as foreign visitors. The Gardens are also acting as an 'ex situ' conservatory for rare and endangered plants which is underlining its role in plant conservation. Botanists and researchers, both locally and from abroad, can also make use of the collections of the Gardens in order to obtain specimens for their study. The garden also has an important educational function, namely to teach visitors in the appreciation of trees, forests, birds, and the environment in general. An attractive Ecotour Center provides knowledge



Bamboo garden



for local and overseas ecotourists and promotes ecotourism in Myanmar. Collaboration in botanical garden management and conservation exists with foreign organisations (e.g. Botanical Gardens Conservation International).

In its area of 437 acres (177 hectares), the National Kandawgyi Gardens offer vast lawns interspersed with neatly arranged beds of colourful flowers, including tulips, lilies, irises, freesias, pansies and petunias. Extensive dahlia gardens, rose gardens and rock gardens further enhance the scenery. Over a third of the area of the Gardens is occupied by natural swampy areas and artificial lakes, with a golden pagoda standing on an island in one of them. Various kinds of water birds can frequently be seen in these lakes, among them mandarin duck, mute swan and black swan. Tree lovers can find nearly 600 different tree species, many of them indigenous in Myanmar and c. 75 foreign. Some of the foreign tree species cultivated here are European in their origin which does not

In its area of 437 acres (177 hectares), the National Kandawgyi Gardens offer vast lawns interspersed with neatly arranged beds of colourful flowers, including tulips, lilies, irises, freesias, pansies and petunias. Extensive dahlia gardens, rose gardens and rock gardens further enhance the scenery.

come as a surprise in this climate. There is a bamboo garden with over 75 species of wild bamboos, and plans are currently underway to increase the bamboo collection further. In the croton garden more than 75 different species of crotons are on display. Over 400 indigenous plant species which are used in the production of traditional Myanmar medicines are also cultivated. The newly developed Orchid Garden gives visitors the opportunity to admire more than 300 different species of Myanmar's wild orchids. Both terrestrial and epiphytic species are grown here,

and most have been collected in different parts of Myanmar. During one of our visits in May 2010 a large number of plants of *Renanthera imschootiana* with their striking red flowers as well as *Eulophia spectabilis* were in flower. A major attraction is also the 12-storey Nan Myint Tower not far from the Orchid Garden, from where one can have a splendid view over Pyin Oo Lwin, the Gardens and further afield. A large part of the Gardens was left in natural condition and is dominated by natural deciduous forest and well-established



Tending the formal planting beds



Swamp walkway



Inside the petrified wood museum

pine plantation. In another natural part of by the Gardens the 'Swamp Walk Way' was built, a raised board-walk through a swampy area which allows visitors to experience the ecology of a swamp without getting their feet wet.

A few rare and endangered animals are also kept in enclosures in the National Kandawgyi Gardens, including the Takin which is a cow-like and dark-skinned animal from the Myanmar Himalayas near the Tibetan border. A number of native as well as foreign birds are kept in an aviary. Further attractions are the three modern museums of the Gardens. The well-organised 'Fossil Museum' which mainly houses mammal, reptile and invertebrate fossils, and the 'Petrified Wood Museum' (with a large collection of plant fossils) educate visitors about Myanmar fossils, and provide information on the evolutionary history of the plant and animal life on earth in general and in Myanmar in particular. Opened only very recently, the 'Butterfly Museum' contains mounted specimens of various species

of butterflies from northern Myanmar; different parts of Asia as well as from South America. In all of the three museums the labelling is bilingual (Myanmar and English), very informative and easy to comprehend.

There are obviously also the usual tourist facilities that are always found in a botanical garden, like souvenir shop as well as refreshment and eating places. The open-air 'Kandawgyi Garden Café' serves seasonal fresh juices and other drinks, and there is also a tea house in a different part of the Gardens. The renovated colonial-style 'Club House' caters for lunches, and can also accommodate groups for meetings and other events. Right next to it is a large swimming pool for the use of visitors which can be quite welcome on a hot summer's day. Kids can be entertained in the children playground. 'Kandawgyi Lodge' just outside the Gardens, a renovated colonial-style building with several attached bungalows, is a fitting kind of accommodation in this town.

Hubert Kurzweil
Herbarium

Saw Lwin
Myanmar Floriculturist Association,
Yangon

All photos by Hubert Kurzweil



A strangely pretty parasitic plant, *Apenetia indica*.

**BOTANISING IN A PEAT SWAMP
FOREST IN EAST KALIMANTAN**

STRANGE ENCOUNTERS OF THE LEAFY KIND

The strange, mystifying charm of the
peat swamp



As our outboard-motorised boat, known locally as *ces* (pronounced 'chess') approaches our destination, our eyes are drawn to several discretely spaced huts ahead that looked like weather-beaten sheds built just above the tea-colored water. The huts are surrounded by scattered trees, which are mired more than a metre deep in this waterlogged forest.

The setting has a certain strange and mystifying charm about it- almost surreal, conjuring a scene not unlike one from a dark and diabolical Tim Burton movie. This is Mesangat peat swamp, which is an hour's boat ride from Desa Kelinjau Hulu in Muara Angcalong district where the office of our collaborator, the Yayasan Ulin (Ironwood Foundation of Kalimantan) is located. The purpose of our visit was to provide botanical inventories of the peat swamp, along with a herbarium collection. The office is another four hours car ride from the coastal town of Samarinda in East Kalimantan.

The Mesangat peat swamp is roughly 4000–6000 hectares in size; almost one-tenth the size of Singapore or roughly twice the size of our largest island, Pulau Tekong. Our hut, affectionately known as the 'Rakit' (Raft) is located at Mesangat's downstream edge, leading to one of its tributaries, the Mesangat Hulu river; and it served as our abode at night while we botanised the surrounding forest by boat during the day. Immediately across the 'Raft' stood a 25m tall tree installed with a water-level marker that read 1.2m submerged in water and a brown stain mark that reached up to 2.85m, indicating that the water level had risen to that level before. This is the strangest mango tree that I have encountered. *Mangifera gedebe* has flat disc like yellow-green fruits measuring about 10cm or more in diameter with a unique labyrinthine seed. The young fruits of this species are eaten in some cultures, added into a 'rojak' dish as a salad. The fruit is dispersed by water and perhaps also by animals such as hornbills and flying foxes as well.

The vegetation at the centre of the peat swamp is low in species diversity—besides the mango tree, the main characteristic fertile tree species encountered are *Mallotus sumatranus*, the commonest tree found here, with interesting three-angled fruits; the beautiful *Barringtonia acutangula* subsp. *acutangula* with pendant inflorescence of red flowers; *Homalium caryophyllaceum*, *Dalbergia* and several *Ficus* species. Also relatively common here are shrubs such as *Nauclea* and an *Ixora* with pinkish-white flowers. The tree canopy is about eight to ten meters tall, denser at the centre of the peat swamp, becoming more scattered and open towards the waterways. Upon closer examination, many of the trees, especially in the denser part of the swamp, develop fluted trunk bases with some amount of stilt roots and stand on slightly elevated mounds of mudcakes; each mound could find some three to four species of trees and/or shrubs huddling together, sometimes with climbers scrambling



Mormodica cochinchinensis flower



The black calyx of the flower



over them as if to share a certain comradeship in this hostile environment where nutrients are deficient and the water currents swift (we realised that when we jumped into the water to take our bath). The climbers encountered were *Oxyceros longiflora*, *Uncaria acida* and a *Hoya*. Epiphytes are surprisingly few, most of which are ferns such as *Asplenium*, *Pronephrium*, *Microsorium* and two species of *Dendrobium* orchids of the section *Aporum*. These epiphytes were found on brighter areas. In these areas, sporadic occurrences of tall trees (20m and above) of the Anacardiaceae family and *Artocarpus* species were also encountered. Herbaceous plants growing in the water include large sedges of the

shops and could have been introduced for this purpose.

Downstream from the peatswamp, in Mesangat Ulu river, which is also peaty, the plant species become more diverse. Trees which are common in the centre of the peat swamp, such as *Mallotus sumatranus* and *Dalbergia petersii* peter out. The trees here grow on the bank of the stream rather than in the water although occasionally, the water may rise to flood the bank. The commonest tree here is the horticulturally pretty *Kleinhovia hospita* with pinkish purple flowers. Other tree species include *Barringtonia acutangula* subsp. *acutangula* (which is more common here than in the centre of

Downstream from the peatswamp, in Mesangat Ulu river, which is also peaty, the plant species become more diverse. The trees here grow on the bank of the stream rather than in the water although occasionally, the water may rise to flood the bank.

genera *Hypolytrum*, *Cyperus* and *Scleria* as well as grasses such as *Panicum* and *Leersia* species. Nestling amongst these are several species of water plants of the genera *Persicaria* and *Ludwigia* as well. In shadier conditions, we encountered two species of *Nymphaea* (waterlilies) and in more open water, large clumps of *Hanguana malayana* could be seen. Unfortunately, the waterways at certain areas are choked with alien weeds such as *Salvinia* and *Eichhornia crassipes*. The latter, at times, are so densely packed that maneuvering our boat through the waterway became a mammoth task. It is suspected that the weeds could have been inadvertently introduced with fish or vegetables and have since proliferated in the conducive environment. Fish is an important diet for the people who live here and besides the native fishes; toman, tilapia and sucker catfish have been introduced. A non-native water plant, *Limnocharis flava* was sold as vegetable in the local

the peat swamp) and trees of the genera *Lepisanthes*, *Ficus*, *Aphanamixis*, *Diospyros* and *Lagerstroemia*. The tree canopy is about 15 metres high and many of the taller trees are laden with epiphytic ferns such as *Asplenium*, *Microsorium* and *Ophioglossum* species. Small trees and shrubs found here include the beautiful *Cratevia religiosa*, *Memecylon lilacinum* and several genera in the Rubiaceae family such as *Hypobathrium* and the wonderfully peach-scented *Gardenia tubifera*. Along the bank, there are clumps of the herbaceous *Donax canniformis* and *Schumarianthus dichotomus* of the Marantaceae family and a stoloniferous fern of the family Thelypteridaceae that scramble over shrubs to dominate large swathe of the bank at certain areas. The common climbers include *Tetracera* and several lianes such as *Poikilospermum* species and *Uncaria cordata* as well as two strangely attractive Cucurbitaceae climbers: *Trichosanthes elmeri* with 12 cm long ovoid red melons and *Momordica*



The flat disc-like fruits.

Daud climbing up the 25m tall *Mangifera gedebe*.

The wonderfully peach scented *Gardenia tubifera*



Close up of *Gardenia tubifera*



View of tree stand with fluted trunks in the inundated forest where *Gardenia* also occurs.



Botanising on board the ces (from front to back: Daud, Serena, Paul and Iwan).

I am thankful for the opportunity to botanise the vegetation, experience the local way of life and to observe the animals encountered during the fieldtrips, which afforded me a glimpse into the web of life that binds the plants, animals and people who reside here to the peat swamp.

cochinchinensis, the spiny bittergourd, the fruits of which look like a miniature durian. The fruit is orange-yellow ripening orange-red and measures about 10 by 8 cm in size and has brittle short spines. The plant is dioecious (male and female flowers occurring on separate plants) and the interesting large flower has pale yellow petals with contrasting black spots at its centre and black sepals. Another curious climber is *Gymnema siringaefolium* with fruits that dangle like bunches of 10 cm long green chillies with tufted-haired seeds that are windborne, typical of the family Apocynaceae. We also collected three species of rattans, which in some areas are particularly dense. This occurrence is probably due to the result of a great fire that broke out around 1997, allowing these scramblers to quickly take hold.

Along the Sungei Kelinjau, the main river where the tributaries of the peat swamp merge, a *Lagerstroemia* species with beautiful lilac-purple petals dominates the landscape. Other trees that could be found here include the kapok tree, *Ceiba pentandra*, *Ficus racemosa*, *Octomeles sumatrana* and *Dracontomelon dao*. Also very common here is a 4 m tall grass of the genus *Phragmites* that forms large clumps along the riverbanks. A strangely pretty parasite, *Aeginetia indica*, that

parasitises many grass species was found growing at ground level amongst the bases of the herbaceous plants. It is about 20 cm high with purple-red flowers. The roots and flowers of this species are used in traditional medicine for treating scurvy.

In total, we collected 121 plant specimens, which represent 94 species from 51 families. The family with highest number of specimens was Rubiaceae with 11 species in eight genera followed by six species each of Gramineae, Cyperaceae and *Ficus* (Moraceae). Although the plant species diversity in the peat swamp forest is rather low, it is a unique ecosystem that is home to many endemic flora and fauna and its protection also serves to maintain environmental stability. As an example, the *Dalbergia* tree, which is relatively common here, has generated an interest by an expert studying this family and could prove to be something unusual. We collected six species of *Ficus* and noted several more that were not collected, as they were not fertile at the time of collection. *Ficus* species are typical keystone species whose figs are food for many pollinators and dispersal agents such as monkeys, birds and insects, some of which form symbiotic and evolutionary relationships. On one occasion, we chance upon a proboscis monkey nibbling on the young leaves of a *Ficus* tree and

on another, I saw a hornbill feasting on some figs of *Ficus racemosa*. Some plant species, although wild here, are cultivated for food, medicine, useful products and/or horticultural plantings and these wild plants could serve as a useful gene pool. An example of usage as food and medicine is the spiny bitter gourd, *Momordica cochinchinensis* where the red arils of the seeds are used to prepare a glutinous rice dish in Vietnam and the seeds are used in traditional medicine in China; stem of *Donax caniniformis* and rattans are used for weaving into mats and basketry (I saw a local collecting rattan in the forest); *Kleinhovia* and *Lagerstroemia* are horticulturally utilized as plantings in parks.

Many of the locals living in the peat swamp vicinity eke out a living selling fishes caught in this water. Our boatman told us that he invested an equivalent of S\$700 for the ces to make a living using it as a means of transport as well as catching and selling the catch from the swamp. I am thankful for the opportunity to botanise the vegetation, experience the local way of life and to observe the animals encountered during the fieldtrips, which afforded me a glimpse into the web of life that binds the plants, animals and people who reside here to the peat swamp. Hopefully, these will be conserved and not be consigned, irrevocably, to yet another verdant memory.

Paul K F Leong
Herbarium



Female proboscis monkeys (*Nasalis larvatus*) feeding on young leafy shoots.

REAYU staff

BOTANISING IN A PEAT SWAMP FOREST IN EAST KALIMANTAN

A BOTANIST'S JOURNAL



Sarena Lee

Stepping back into the life of a traditional *kampung* can be quite an upheaval after being steeped in the everyday hustle and bustle of daily life in Singapore. Several days prior to my departure for any field expedition I am filled with a nagging reluctance. Surrendering all I know, to be in unfamiliar territories, to experience a whole new way of living (albeit just for about a week) ... in no time I was hurtling towards the peat swamps of Kalimantan Timur.

The journey to Balikpapan by air was routine and a driver was waiting for us at the airport. We stayed the night in Borneo Hotel in Samarinda, a short two hour ride from the airport, soaking up a last bit of luxury before we dived into the unknown. Our adventure, so to speak, began in the morning with a modest six-hour drive to Muara Ancalong ("Moo-ahrah An-chalong"), to the Yayasan Ulin (Ironwood Foundation) office. We were told from the outset that we would be staying in "the raft" following a semi-comfortable night at the office. Our host was exceptionally thoughtful to us city types, and kept reminding us that if conditions were not suitable at "the raft" we could always come back to the office every night to sleep whenever we pleased.

This did not allay our overworked sense of unease, as we had already imagined



'The Raft', our temporary floating home and research station.

ourselves pressing specimens, eating and sleeping on a large long boat of some sort... and (by the way!) what of our daily ablutions??

Knowing the massive amount of gear and supplies we had to lug over, and the inconvenience to the team if we chose not to stay, we 'played it safe' and decided to end the next day back at the office after an initial recce collection trip to the "facility". Nevertheless, Ibu Soeimah (the YU Field Coordinator) prepared a sumptuous lunch for us at what turned out in actual fact, to be a floating (though anchored!) house. It had two main areas, one of which was a cluttered storage shed, and the other the main house with a single living space. For the next two nights we processed our specimens, ate and slept here. Cooking took place at the downstream end, and the downstream-

most unit is the doorless (oh, joy!) toilet. Rest assured though if someone came upstream towards the house, he would not be able to see you doing your 'ablutions'. 'The raft', we assessed, was just about manageable for us to process specimens, but more critically, allowed for trips further upstream; an hour or two journey back every night to the office just wasn't possible.

After lunch on the first day, we headed back downriver towards Muara Ancalong and the office, the specimens were processed and I had a refreshing 'shower' (an open air bucket-bath actually) at the toilet behind the office. It may not be unusual for anyone living in a Kampong but for me, it was a true – if mildly terrifying – novelty! Water at this Kampong came on only on alternate days so a reserve for this purpose was

stored in three huge oil drums. We went for dinner at a near by 'restaurant' and had *gado gado* (or noodle soup) for dinner. Post dinner we went back to the office to try to get some work done but a cloud of savage mossies soon overwhelmed us and we ran to our individual rooms to seek refuge under our mosquito nets!

After breakfast the next morning we returned again up Sungei Kelinjau, the main waterway, and this time took a different end of the loop into Mesangat Hulu. Here we caught a glimpse of some female proboscis monkeys (*Nasalis larvatus*) feeding on young leafy shoots - what a treat! Along the way, a small fish trap (*bubu*) was spotted. This we were told was just for catching small bait fish; larger fish were caught via a grounded fishing line or 'rawai'.



We stopped by the raft for lunch and continued further up Mesangat Hulu where we came upon an area with semi-submerged ferns and giant Hanguana plants, a scene reminiscent of some prehistoric era.

We also witnessed the partnered conservation work of YU and REA Kaltim Conservation with the Asiatic softshell turtle (*Amyda cartilaginea*) - listed as 'Vulnerable' by the IUCN. There was a sudden flurry of activity at the raft when the turtles arrived from the fishermen, for weighing, measuring, tagging, picture taking and finally releasing. REA uses a "compensate, tag and release programme" in which the local fishermen sell the turtles to REA for a small "reward" and do not slaughter them. Repeat capture of tagged animals

provides a means of gauging abundance, and assessing possible levels of sustainable harvest.

My first bath at 'the raft' behind a modesty curtain made me a little uneasy ... I felt exposed and watched ... and when I slowly looked up, sure enough, there was a White-throated Kingfisher (*Halcyon smyrnensis*) perched on a branch in front eyeballing me for a good ten minutes before deciding that I was not his cup of tea and flying off. Meanwhile I was also careful that each scoop of water I took to pour over myself did not contain any little fish that were darting about in the water. The guys had it easier. They simply lathered themselves all over (clad only in their shorts) and then just jumped into the river – bath over.



The flooded forest was reminiscent of a prehistoric scene.



REAYU staff

An Asiatic softshell turtle, tagged and about to be released back into the murky waters.



The sleeping area was basic, but a welcome refuge from the mosquitoes.

We also witnessed the partnered conservation work of YU and REA Kaltim Conservation with the Asiatic softshell turtle (*Amyda cartilaginea*) - listed as 'Vulnerable' by the IUCN.

Most of our protein nutriment was derived from the *baung* (*Mystus micracanthus*), *haruan* (*Channa striata*) and *ikan patin* (*Pangasius* sp.) straight out of the water into the cooking pot. All made great eats.

Later in the evening having processed the specimens for the day and dinner done, I badgered the men folk into volunteering for a night foray to see fireflies. Fearing the mosquitoes that were at their peak of activity, only Pak Ing, Daud and I ventured out. The full moon was high in the sky and shone brightly on the maroon river. The experience was magical and the mosquitoes could almost be forgotten for a time. The long boat was partially lodged on the thick growth of water hyacinth (*Eichhornia crassipes*) and we sat or stood on it unsteadily, speaking only in whispers

trying not to break the spell of nature wrapping us in her cocoon. Fireflies were all about us, gentle yellow-green blinks aggregating on the trees out of our reach, with some flying right by us. Within arm's length of the boat, faint glows from the firefly larvae could also be seen as they perched on the plants that surrounded us.

One late afternoon just as we arrived at the raft following the day's collections, it started to rain sheets. With a hot mug of tea in our hands and gazing out across the landscape dripping greenery, there was for me a temporary sense of my small place in nature.

By the way, did I neglect to mention something? Oh, yes! My buddy on this trip, Paul Leong, toppled out of the boat

and with a dramatic sploosh into the river: Unbeknownst to us at the time, the Mesangat area abounds with Siamese crocodiles (*buaya badas hitam*; *Crocodylus siamensis*) and the Sunda gharial (*Buaya supit*; *Tomistoma schlegelii*), which were in fact undoubtedly lurking in the vicinity. Some of these crocs reach four to five meters in length, or so said the YU staff. So, if Paul had been forced to wrestle a croc, there would have a much better (and longer) story to tell!

Serena Lee
Herbarium



Benjamin Aw

THE 8TH INTERNATIONAL FLORA MALESIANA SYMPOSIUM 2010

The Gardens, a long established botanical institution devoted to the study, documentation and conservation of plant diversity, was greatly honoured to host the 8th International Flora Malesiana Symposium from the 23 – 27 August 2010. The Flora Malesiana Symposium, held once every three years, is the most important platform for the exchange of the latest taxonomic information, new ideas and original research on the plant diversity and distribution in the Malesian floristic region.

A total of 362 professional botanists and post-graduate students in Malesian botany from 28 countries, including Singapore, gathered at the Symposium. This is the highest attendance ever achieved in the long history of Flora Malesiana Symposia. The largest contribution of foreign participants came from the following countries: Malaysia (75), Indonesia (45), United Kingdom (27), the Philippines (25) and the Netherlands (15).

During the 5-day symposium, a wide range of topics, from taxonomy and systematics, evolution and phylogeny, morpho-anatomy and economic botany, to ecology and plant conservation, were covered. In total, 193 oral presentations were given over the four meeting days, each day with two to three simultaneous lecture sessions. Fifty-two posters were also presented for public viewing. In addition, special workshops were offered, one on the preparation of e-floras and another one on the red-listing assessment of plant species following IUCN criteria. The proceedings of the 8th FM Symposium will be published in the Gardens Bulletin Singapore in 2011.

The theme of the symposium was *The Past, Present and Future of the Flora Malesiana Project*. The opening speech was effectively delivered by the Vice-Chairman of the

Flora Malesiana Foundation, Prof. Dr. Eric Smets from Leiden University, on the first day of the conference, who suggested a new electronic publication direction for the flora project for prompt and wide circulation. The opening ceremony was so fully attended by the record-breaking audience that they overflowed the large conference room and spilled into the walkway, which was set up with several TV screens and an additional sound system.

Five other world-renowned botanists were invited as plenary session speakers. They included Prof. Dr. Peter Crane from Yale University who spoke on the latest findings in plant fossils, shedding light on the origin of flowering plants; Prof. Dr. Robert Hall from the University of London on new information of the plate tectonic history of the islands in SE Asia; Dr. Robert Morley of Palynova in UK on the past formation of peat swamp forests and the changing wetlands in Sundaland based on latest pollen and spore analyses; and Prof. Dr. Jan Sliikerveer of Leiden University, reporting last, on the recent study of medicinal plants and usages, or *Jamu*, in Indonesia to show the importance and progress of economic botany.

A special talk on the life and work of the famous 17th century European botanist, G.E. Rumphius, and his masterpiece work on the flora of Ambon Island in Indonesia, was given by Dr. J.F. Veldkamp from Leiden University Herbarium.

The third day of the symposium was a break for the participants to choose to go on a half-day excursion to visit the Bukit Timah Nature Reserve, Sungei Buloh Wetland Reserve or to have a guided tour of Singapore Botanic Gardens. Many chose, instead, to spend the free time and energy into examining the herbarium specimens kept at the Gardens

and then perhaps a spot of shopping in Orchard Road.

The five-day symposium witnessed the renewal of collaborations and building of fresh contacts among the participants over the more than 30 talk sessions and workshops, during the field excursions, and at the sumptuous meals and coffee breaks provided daily. Consequently, many “long lost friends” and “colleague known only in emails” were reunited and revealed in person at this symposium. Most of all, the symposium proved to be an effective venue for timely exchanges of new taxonomic ideas and information in addition to the whirlpool of networking activities.

At the closing ceremony before the issuance of the hundreds of certificates of symposium attendance, we quoted a Chinese saying that all happy feasts in this world must come to an end. Indeed, the participants can be seen to leave the Gardens and the symposium with big satisfaction, and they all look forward to attending the 9th Flora Malesiana Symposium to be held at Bogor of Indonesia in 2013.

The Flora Malesiana Foundation, Gardens administration, organizers and members of the various committees of the 8th FM Symposium, the invited plenary session speakers, and all participants are to be congratulated for the successful holding of the 8th Flora Malesiana Symposium in Singapore, a truly memorable milestone event of the FM Symposium and also in the history of Singapore Botanic Gardens.

Benito C. Tan
National University of Singapore

Serena Lee
Herbarium



A CURTAIN OF ROOTS

A new feature in the Tanglin Core of the Gardens is a trellis located between Ridley Hall and the old Plant House. Covering a paved path, this open-frame structure provides support for a climber that has quickly developed a thick curtain of hanging reddish roots.

Inspired by a planting in a Bangkok hotel, which had roots trailing a full four storeys from a verandah planting to just above the level of the swimming pool at ground level, the idea was born to create something similar at the Gardens. The concept was adapted for the site conditions by Gary Nai, section head for Living Collections, who sourced the plants and made an initial trial on two sections of trellis. The idea was well received by visitors to the Gardens and a further four trellis sections were added. The complete vine curtain now occupies a trellis more than 50 metres long.

It is fascinating to watch people's reaction to walking along this path through the roots. Some enjoy the tactile sensation of roots brushing their faces and shoulders. Children especially seem to enjoy the roots' touch and will get quite excited by the experience. So much so that some want to pull on the roots, sometimes perhaps a little too enthusiastically. The arbor is even the subject of a YouTube video [go to <http://www.youtube.com/watch?v=gyZZ5C9cSI0> to view] Other visitors dislike having the roots touch them and will walk on the grass beside the path to avoid contact. In the short time it has been part of the Gardens, this root curtain trellis has brought new meaning to the Gardens mission to 'connect people and plants.'

The climber on this new trellis, *Cissus verticillata* [synonym *Cissus sicyoides*] is a member of the grape family, Vitaceae. It has a number of common names, the one most often used in English is princess vine. Native to tropical parts of the Americas, including

the Galapagos Islands, this climber has been widely transported around the world as an ornamental for gardens. The habit of sending forth long dense growths of slender reddish aerial roots seems to be the main reason people grow this plant. However the glossy dark green foliage, creamy white flowers and black berries like miniature grapes are all attractive features that make it worthy of cultivation.

Why would a plant produce such a profusion of aerial roots? The reasons are not immediately clear. In the *Flora of Java*, a classic reference about plants of that island, the authors point out that *Cissus verticillata* is naturalized on Java and is nearly always found along watercourses. In this setting, the vines climb high into trees that spread out above the water, sending down their aerial roots to the water below. When the thread-like roots reach the water, they branch and become brush-like. So from this observation, it seems that the aerial roots are tapping a source of water for the climber, in a somewhat unusual way.

A horticultural reference, *The New York Botanical Garden Illustrated Encyclopedia of Horticulture*, says that in cultivation *C. verticillata* produces the best root development in a consistently warm and humid environment, which fits the Gardens site perfectly. Although there is no water body underneath the vines, the root development on the trellis feature is luxuriant anyway.

Cissus verticillata has other interesting features and properties, some of which will become visible as the plants on the trellis grow to maturity. In the Caribbean, where *C. verticillata* is native, the stems are often attacked by a fungus that deforms them into a witches' broom. In fact, the type specimen for the botanical name was a monstrosity caused by the fungus (yet it remains the type specimen all the same). In healthy plants, the young stems and leaves produce tiny glistening

bodies called 'pearl glands' that are eagerly collected and carried away by ants. *Cissus verticillata* has been used for the study of the structure and function of pearl glands, which appear to be food for the ants. Stinging or biting ants are known to form symbiotic relationships with plants that provide them with a source of food or shelter, and that seems to be what is happening here: pearl glands are known to be rich in proteins, fats, and/or sugars, depending on which species produces them.

In addition to these fascinating biological relationships with other species, humans have a number of traditional medicinal uses for *C. verticillata*, especially in the American tropics. In Mexico, an infusion of the leaves is used for relieving pain and inflammation. Among traditional Mayan remedies, the plant is used for *vientos malos*, or 'bad winds that blow on you and cause your neck to twist and ache'. The plant is currently under intense pharmacological study in Brazil to determine whether any of the folk medicines in use there have genuine therapeutic value. Called *cipopuca* in Brazil, *C. verticillata* is used to treat epilepsy, rheumatism, stomachache, gastric ulcer, and as a treatment for diabetes mellitus. Based on the latter use, *cipopuca* has been referred to as 'vegetal insulin'. However, current phytochemical studies show that it does not have antidiabetic properties. Surprisingly though, the plant does have two compounds, isolated from the aerial parts, which have potent antibacterial activity.

So while we hope our vines will not be afflicted with a witches' broom, nor will they be overtaken by swarms of ants, the curtain of roots they produce offers a new and tactile experience for visitors to the Gardens. Do check out the root curtain trellis the next time you visit.

Dina Gallick
Living Collections

George Staples
Herbarium

VOLUNTEER OUTING TO PULAU UBIN



On 30 October 2010, we decided to take our volunteers away from their usual routine of guiding and gardening as a 'thank you' for their valuable contributions to the Gardens. We went on a field trip to Pulau Ubin, and followed the Sensory Trail. This trail, which has been adopted by the Singapore American School and the Singapore Association of the Visually Handicapped, was developed to allow visually handicapped people a chance to experience what life was like on the island using their sense of touch and smell.

We started off on our adventure at Changi Point Ferry Terminal. Even before the boat ride to Pulau Ubin, our eager volunteers were seen sharing their knowledge and exchanging information of plants they see at the ferry terminal! Once we arrived at Pulau Ubin, we were met by Jacky and Alan, Conservation Officers based on the island. They gave us an excellent introduction to the rustic and natural character of Pulau Ubin. At the start of the trail, we were greeted by the nice and familiar fragrance of pandan leaves. Everyone started getting excited, talking about their uses and wondering what was in store for them as we got further into the trail. One particular plant that got our stomachs turned was the 'fishy' plant – it did indeed have a fishy scent! In just over two hours, we were able to see, smell and even taste the spices and herbs used for cooking and in traditional remedies, and native plants of the mangrove forest. We also managed to catch a glimpse of the rustic lifestyle of the residents of the island.

All in all, the trip was a very successful one. All of the 20 volunteers who turned up clearly showed that they enjoyed themselves, and they definitely have their hands full with all the extra information they have gathered from the trip!

Rahimah Yusof
Visitor Services

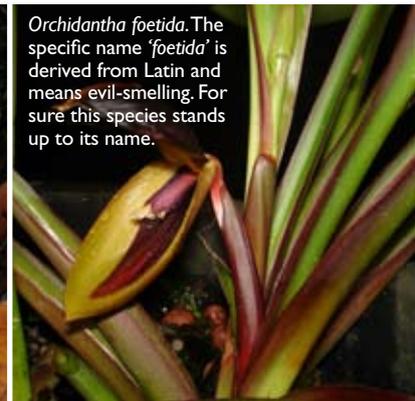


Orchidantha siamensis. This species is native to southern Thailand. Its labellum is covered in layer of transparent mucus, similar to that seen on some species of puffball fungi.

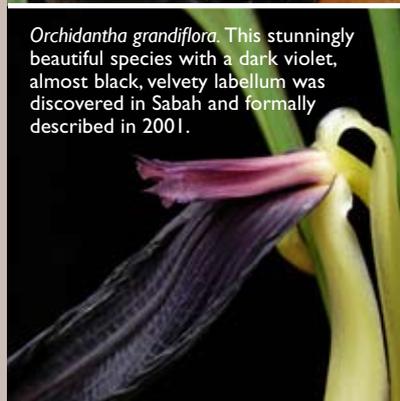
Orchidantha fimbriata. Native to Peninsular Malaysia, this species has been cultivated in the Gardens since 1926. The flowers smell of bed bugs and coconut oil at first, progressing to a fungus-like smell a day later.



Orchidantha foetida. The specific name 'foetida' is derived from Latin and means evil-smelling. For sure this species stands up to its name.



Orchidantha grandiflora. This stunningly beautiful species with a dark violet, almost black, velvety labellum was discovered in Sabah and formally described in 2001.



Orchidantha maxillarioides. This pretty species has the smallest flowers of all Lowiaceae, which emit a very faint smell. It flowers profusively in the National Orchid Garden's Mist House.



Orchidantha stercorea. The newest family addition described in 2010 is the third species of Lowiaceae recorded from Indochina. Its specific epithet relates to the dung-like smell.



Orchidantha vietnamica. Described from herbarium material, our recent re-collection of this species from the type locality in South Vietnam improved description and provided valuable details on flower morphology.

LOWIACEAE: ADORABLE STINKADORES!

The family Lowiaceae is the smallest and least known family of the Ginger Order, the Zingiberales, which consists of eight plant families including for example heliconias, bananas, prayer-plants and true gingers. It was named in honour of the English colonial administrator and keen orchidologist Sir Hugh Low, who spent over 30 years in Labuan (a small island off the north west coast of Borneo) and the Malay Peninsula. It is native to Southeast Asia with so far only one genus *Orchidantha* and about 20 species described from China, Thailand, Laos, Vietnam, Malaysia and Borneo. The species tend to have rather small areas of distribution. The highest diversity is found in Borneo, with seven species described from Sabah, Sarawak and Brunei. A number of new species are, however, expected from Kalimantan as botanical exploration proceeds.

Lowiaceae are mostly small or medium sized herbs, only rarely exceeding one metre in height. They thrive in shady areas of lowland evergreen forests and sometimes also in clearings. Even though it not at all obvious from their look, the closest relatives to Lowiaceae are the Bird-of-Paradise family (Strelitziaceae) and bananas (Musaceae). While all the other seven families in the Ginger Order have species that are used for various purposes, be they food, ornamentals or some practical uses like rope or paper manufacture, so far there have been no uses recorded for the Lowiaceae. Only very recently and rather slowly, a few species have started to appear in the horticultural market as suitable plants for heavily shaded areas.

Unlike other members of the Ginger Order, which generally stand out among other similar plants, *Orchidantha* plants are hard to find in the forest as they look like several other monocot genera. They grow in clumps and, when not in flower (which is unfortunately most of the time!), only close examination of the arrangement of the leaves near the ground, which are in two opposing rows, and a close look at the leaf venation, will reveal their identity as *Orchidantha*. It does not help that their flowers are hidden right at the ground level and are often covered by leaf litter. To make things worse, the flowers last only two days on most species.

It is a matter of personal taste whether to regard the flowers as beautiful or weird, but one thing is for sure—they stink a lot and their structure is puzzling! The bisexual flowers are quite large, in some species up to 25 cm long, resembling an orchid and hence the name *Orchidantha*. There are three sepals, which spread 120° from each other and may be reflexed (turned backwards) (e.g., *O. siamensis*) or in some species the two lower sepals overlap and form a boat shape structure that supports a labellum (e.g., *O. foetida*). The labellum is well developed and usually reticulate or with some ridges; it may be white, pinkish-cream, yellow, brownish or dark violet. It emits an array of unpleasant odours ranging from rotten fungi to rotten meat and worse, with the odours being specific to each species. Opposite the basal part of the labellum, there are two petals forming a tunnel more-or-less covering the five fertile stamens and stigma. The stigma has three deep funnel-shaped lobes with a hairy or fimbriate margin to receive pollen. On the basal surface of the stigma facing the labellum, where the three lobes join, there is a tissue (called the viscidium) producing a transparent sticky secretion.



Because of the unpleasant odour, R.E. Holttum, who published his study on Lowiaceae from collections of the Singapore Botanic Gardens in 1970, suggested that *Orchidantha* species are perhaps fly-pollinated, but no serious studies were done on this subject until much later. In 1999, Japanese botanists Shoko Sakai and Tamiji Inoue observed populations of *Orchidantha inouei* in Sarawak over extended periods and reported that the only flower

visitors that crawled under the lateral petals, where the stigma and stamens with pollen are hidden, were dung beetles! This was rather breath-taking news as beetle pollination is not at all common in the ginger order. In 2003, Danish botanist Louise Pedersen, elaborated even more on the pollination of *Orchidantha* in her PhD thesis. She studied three Bornean species with dark purple labella emitting a dung-like scent, and two species from the Malay Peninsula with white to cream coloured labella and a fungus-like smell. She found out that, unlike Bornean species, the Malayan species are pollinated by fruit beetles, which are normally associated with puffball fungi. What is even more interesting is that both studies concluded that there seems to be no obvious rewards for the beetles performing the pollination job. This is quite unusual as the majority of plants including all other gingers offer some kind of reward to their pollinators, be it a nectar or at least a safe place for mating. Lowiaceae are the only family in ginger order, which do not produce nectar, and cheat their pollinators by emitting a smell identical to dung or fungus attractive for a particular beetle. This is known as deceit pollination.

It is hard to find *Orchidantha* flowers, but it is even harder to find the fruits. The fruit is a capsule, which in some species develops underground and upon ripening splits in three parts, exposing round seeds with a simple white hair-like aril. Shoko Sakai in her study noted that setting fruits is rather rare and that the deceiving pollination system seems to be less successful than the more common reward-based system. But she also pointed out that dung beetles are excellent in flying long distances in search of particular dung, which may provide long-distance pollen transfer and that in turn may provide certain genetic advantages to the plants.

Jana Leong-Škorničková
Herbarium

Photos by Jana Leong-Škorničková



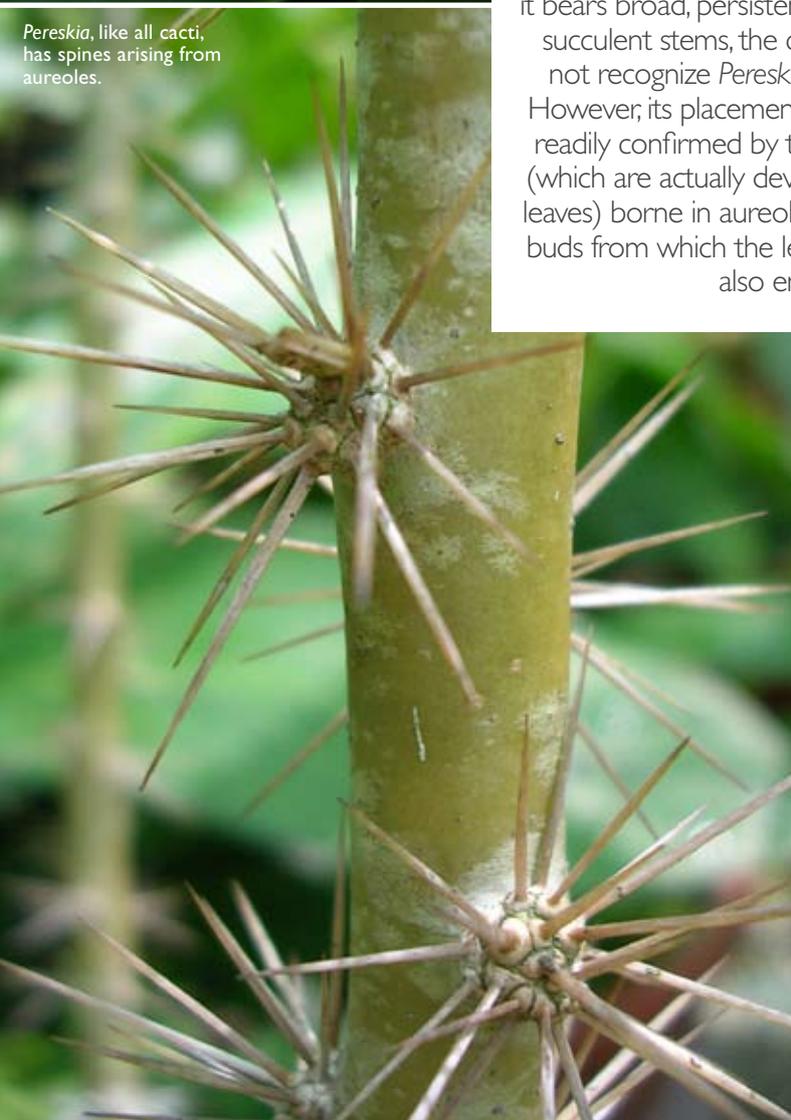
The flowers of *Pereskia grandifolia* are densely clustered.



The remarkably coloured flowers of *Pereskia bleo* are usually solitary or in small clusters.

SPINY CONFUSION: THE CULTIVATED *PERESKIAS*

The genus *Pereskia* – named for the French scholar and scientific patron Nicolas-Claude Fabri de Peiresc (1580–1637) – consists of 17 species in the Cactaceae (cactus family). Since it bears broad, persistent leaves and lacks thick succulent stems, the casual observer might not recognize *Pereskia* as a type of cactus. However, its placement in the cactus family is readily confirmed by the presence of spines (which are actually developmentally modified leaves) borne in aureoles – specialized axillary buds from which the leaves, flowers, and fruit also emerge.



Pereskia, like all cacti, has spines arising from aureoles.



Pereskia aculeata is a climber with smaller, fragrant flowers.

Pereskia flowers are quite attractive, with ruffled overlapping petals and numerous stamens, giving them a rose-like appearance and leading to the vernacular name rose cactus. Relatively easy to grow and free flowering year-round, there are three species of *Pereskia* that are widely cultivated as ornamentals in gardens throughout the tropics and subtropics. In Southeast Asia *Pereskia* has gained prominence as a medical herb, reputed to treat a number of maladies. The various species are frequently misidentified, especially on the internet, and some of the therapeutic benefits remain unsubstantiated. This article is intended to provide characteristics for identification of the three commonly grown species of *Pereskia*, as well as review the documentation of their medicinal properties.

The species most frequently cultivated in Singapore, *Pereskia bleo*, is known as the orange rose cactus or wax rose in English, *jarum tujuh bilah* in Malay, and *qi xing zhen* in Mandarin pinyin. Native to Panama and Colombia, it is a shrub or small tree to eight metres tall. When grown in strong sunlight the new leaves are a very attractive pinkish-bronze color. The leaf margin is wavy and the leaf blade is depressed along the secondary veins, giving it a corrugated appearance. The spines, which are 0.5 to 2 cm long, are arranged in groups of 5–40 all along the length of the stem. The flowers, borne singly or in small clusters at branch tips, are a luminous reddish-orange and have no fragrance. The fruit are top-shaped and slightly angled, measuring 2–3 cm in diameter, and are deep golden yellow at maturity. On the internet, *Pereskia bleo* is frequently misidentified as *Pereskia sacharosa*, a pink-flowered species that is relatively uncommon in cultivation. Synonyms (old names no longer accepted) for this species include *Pereskia corrugata* and *Pereskia panamensis*. The epithet *bleo* is derived from the old English word for “colour” or “hue”, in reference to the remarkable colouration of the flowers.

Pereskia grandifolia, the pink rose cactus, is a shrub or small tree to five metres tall native to Brazil. The spines are typically longer than those of *P. bleo*, measuring up to 6.5 cm in length, and are borne in denser clusters of 25–90. The leaves are somewhat thicker in texture and have a less corrugated appearance compared to the leaves of *P. bleo*. The flowers are pale pink to purplish-pink in colour, lacking fragrance, in dense clusters of up to 50. The fruit

are pear shaped and angled, up to 7 cm wide and 10 cm long, often in clusters, and maturing yellowish-green. This species is often misidentified as *Pereskia grandiflora*, a name of no botanical standing. The epithet *grandifolia* is Latin for “with large leaves”.

Pereskia aculeata, commonly known as the Barbados gooseberry or lemon vine in English and *mu qi lin* in Mandarin, is a climber native to the Caribbean and northern South America. The stems bear clusters of up to 25 short (0.1–0.5 cm) straight spines, as well as pairs of recurved (claw-like) secondary spines that help it to climb. The leaves are usually smaller than those of *Pereskia bleo* or *Pereskia grandifolia*, and the venation is not as prominent. In addition to the typical form with solid green leaves there is a cultivated variety ‘Godseffiana’, which has leaves that are golden yellow with copper highlights above and reddish-pink below. The flowers of *Pereskia aculeata* are borne in terminal or axillary racemes, white to pale yellow in color, ageing to pale pink. They are smaller than the blossoms of the other two cultivated species, and they are quite fragrant, reported by some to be reminiscent of lemons or jasmine but regarded by others as malodorous. The fruit are edible, spherical in shape, 1–2 cm in diameter, with spines when immature, maturing to yellow or orange with a smooth, leathery somewhat translucent skin. The pulp is juicy with a subacid to tart flavour. The epithet *aculeata* is Latin for “sharp” or “prickly”.

The leaves, flowers, and fruit of all species of *Pereskia* are edible, though not always particularly tasty. *Pereskia aculeata* is the only species in the genus that is routinely cultivated for its fruit, and because of their tart flavour these are more often stewed or made into preserves rather than eaten raw. The leaves and young shoots of all three of the commonly cultivated species of *Pereskia* may be eaten raw or cooked and have a slightly metallic flavour reminiscent of spinach or beet greens. They are a good source of dietary fiber, vitamins, mineral, and amino acids, but they also contain calcium oxalate crystals, so should not be eaten in excess, particularly by individuals prone to kidney stones. Within its native range, the leaves of *Pereskia bleo* are sometimes used to clarify water.

Because of their reputed medicinal benefits *Pereskia bleo*, and to a lesser extent *Pereskia grandifolia*, have gained prominence

in Singapore and Malaysia. The leaves (consumed raw or brewed as a tea) are regarded as a treatment for cancer, high blood pressure, diabetes, rheumatism, other forms of inflammation, headache, gastric pain, ulcers, and as a general tonic for the body. A recent study by a team of Malaysian researchers has demonstrated that, even at very high doses, the leaves are not toxic to mice, though long-term toxicity studies in humans have not been conducted. Yemeni researchers have documented the antibacterial activity of *Pereskia bleo*. Multiple studies on the effects of *Pereskia* extracts on cancer cells in vitro have yielded mixed results; proliferation of some cancer lines (notably breast and nasopharyngeal carcinomas) were inhibited by these extracts while other cancer lines were not affected. Scientists have identified at least four different compounds responsible for the plant’s cytotoxic (anti-cancer) activity. Although the effect of *Pereskia* on other maladies has not been documented by medical science, researchers have isolated a number of compounds that may account for its apparent efficacy in folk remedies. These include a variety of sterols, which may be effective in reducing inflammation and lowering blood cholesterol, and antioxidant compounds such as alpha-tocopherol (vitamin E). In short, scientific research seems to indicate that *Pereskia* species are safe to consume and that concentrated extracts of the plant may have some effect on inhibiting the growth of cancer cells in a test tube, but it is unclear if the consumption of leaves actually confers any benefit in terms of preventing or limiting cancer growth in the human body. The other folk medicinal applications for *Pereskia* have yet to be verified by modern medical studies.

If you’d like to have a first-hand look, *Pereskia aculeata* and *Pereskia bleo* can be viewed in the Gardens’ Sun Rockery (cactus and succulent garden). *Pereskia bleo* is also growing at the Jacob Ballas Childrens’ Garden, and in the medicinal plants plot at the Eco Garden. *Pereskia grandifolia* is no longer growing in the Gardens, but we plan to re-introduce it soon.

Marc S. Frank
Living Collections

All photos by Marc S. Frank
unless otherwise stated

URBAN BIODIVERSITY AWARENESS THROUGH NATURE AND ENVIRONMENTAL EDUCATION AT THE GARDENS

Biological diversity, or biodiversity, is the term given to the variety of life on Earth and the natural patterns it forms. Simply put, biodiversity refers to 'All Life on Earth'. To raise public awareness of the importance of biodiversity and the consequences of its loss, The United Nations General Assembly had designated 2010 as the International Year of Biodiversity (IYB).

With this in mind, we set out to address IYB 2010 and urban biodiversity awareness by asking ourselves two simple questions:

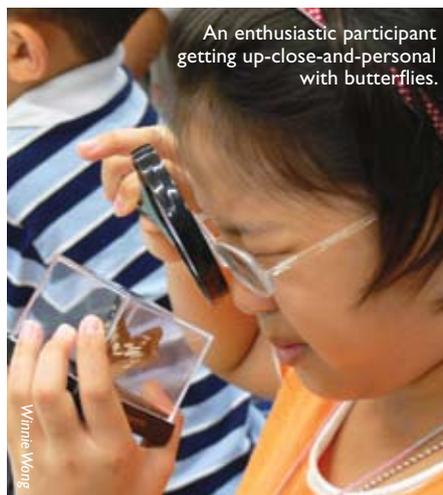
1. How many are aware that our island city-state of approximate 710 square kilometres and a population of 5.08 million people (2010 census) is actually home to 4,180 plant species, 58 species of mammals, 364 species of birds, 102 species of reptiles, 28 species of amphibians, 294 species of butterflies and 117 species of dragonflies?
2. How many realize that despite Singapore's highly urbanised environment and land constraints, we have been able to conserve a good variety of biodiversity across various indigenous ecosystems?

In highly urbanized and competitive Singapore, children and youth that go through the Gardens' educational programmes show very evident disassociation from their environment and the natural world. When asked where chocolates come from, many pre-schoolers very confidently answer, "The supermarket!" Other common misconceptions are that pineapples and sweet potatoes grow on trees. When shown the tapioca and sweet potatoes plants, very few primary or secondary school children know what these plants are - unless they refer to the plant labels. Some may recognize the storage roots but are unable to recognize the plants. Most were actually surprised to see different coloured sweet potatoes.

When it comes to using their senses, some children are not keen to take a whiff and let their olfactory lobes discern the scents and smells from different plants. It is as if they have a pre-conceived notion that smelling these plants will harm them in some way. The more adventurous ones, however, do not need any cajoling to make them smell, feel or touch different textured leaves or

bark. Animals, on the other hand, never cease to interest and excite our visitors of all ages. Compared to plants, animal themes are much easier to tackle as a topic – the general consensus amongst our nature guides is that educating about animals was, without a doubt, much less challenging than educating about plants.

With the above observations, we embarked on designing several new programmes suitable for children and their families to be conducted at the Jacob Ballas Children's Garden (JBCG) – with the sole purpose of introducing them to urban biodiversity and increasing their awareness and appreciation for the plants and animals which can be found in Singapore.



An enthusiastic participant getting up-close-and-personal with butterflies.

A well-used and proven approach in nature and environmental education is experiential learning, where activities are designed for learners to engage actively in sensory, cooperative and empathetic ways with the environment. The aim of this approach is to instill a sense of wonder and appreciation for the natural world. This approach helps learners to re-connect with the environment and the biodiversity in it. It increases motivation, encourages the making of connections between and within disciplines

and develops communication skills through small group discussions, negotiation, listening and the formulation of arguments.

Where existing education programmes were concerned, we put in much conscious effort to incorporate additional biodiversity and environmental messages to not only enhance the Gardens' mission of connecting people and plants, but also to contribute towards implementing major international strategies for biodiversity conservation.

Programmes for School Children

As with many other botanic gardens in the world, schools represent a very important audience of our educational outreach. In this respect, our programmes complement the formal school curriculum, especially in reinforcing the outdoor and hands-on content of learning. Some of our much sought after programmes which focus on plants, nature, biodiversity and our environment include:

- Looking at Plants – emphasizes functional parts of a plant; namely leaves, flowers, fruits and seeds.
- Flowers at Work – encourages taking a closer look at flowering plants to increase children's understanding of the forms and functions of flower parts, unfolding the mysterious role of flowers in pollination.
- Pond Life – introduces pond ecology; aquatic, semi-aquatic plants and pond animals. An introduction to food chains and the ecosystem.
- Rainforest Trek - showcases the beauty and characteristics of a tropical rainforest, its unique but fragile ecosystem and its plants and animals.
- Plant and Their Uses - emphasizes the key role that plants play in our lives, through exploration and opportunities to study, smell and feel selected plant specimens. Focuses on the economic uses of these plants to humans.



Winnie Wong

Some very popular programmes with families are the "All About Edible Plants" and "Fruits and Vegetables" tours and holiday workshops for children. These serve as good introductory programmes to provide children with the exposure to plants in their daily life.

In 2010, we introduced "Let's Discover Plants and Animals". This one hour tour takes young participants of five years old and above on a journey of discovery where they learn fascinating facts about plants and wildlife in the Gardens and get up-close-and-personal with some of these specimens themselves. The tour ends with children picking up tips on respecting the plants and wildlife found around us. In its first year alone, this tour has reached out to more than 1,200 children and their accompanying adults.

For pre-school children, noteworthy is the "Sara the Botanicosaurus" series which consists of five activity story cum workbooks suitable for five to eight year olds. These cartoon-illustrated books weave in Sara's story with activities that young readers can do at specific locations within the Gardens. Children are encouraged to use their senses in activities such as smelling flowers, crushing leaves or touching tree barks. Documenting activities include drawing, colouring, bark rubbings and labeling plant parts. Stickers, join-the-dots, crossword puzzles and word search puzzles were also included in the books to add variety.

The books are designed to stimulate children's interest in plants, nature and the environment. The first three books serve as a basic introduction to plants and noteworthy attractions in the Gardens, e.g. the Evolution Garden and the Jacob Ballas Children's Garden. Taking a different twist, the fourth book, "Sara Goes Carbon Footprinting" kept up with global issues and took on a more environmental education role. The fifth book "Sara Goes To The Supermarket Garden" (2010) introduces children to bananas, peanuts, soya beans, sugarcane, sweet potato, corn and many more fruits and vegetables. This book shows children how these fruits and vegetables are grown and what they look like before they end up on our dinner plate. Alongside learning about plants which they can eat, children get to pick up tips on being a nutritional winner too. At the Singapore Garden Festival 2010, this programme

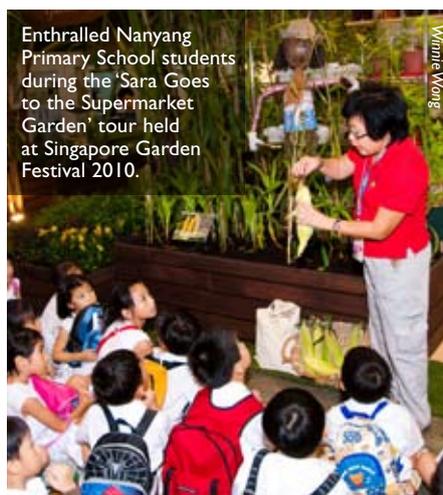
reached out to close to 1,700 children over the 8 day event. The fourth and fifth books were written to suit a wider audience of up to 12 year olds.

As nature and environmental educators, we are heartened to see that however nonchalant some of our young participants may be at the start of the programme, at the end, there is always a bit of information that interests them. Post-tour, many do realize the importance of plants to life on earth, especially after we have taken much effort to explain the various roles plants play for our everyday life. Young participants are made aware that plants not only provide us with sustenance but plants ensure that our environment remains hospitable.

Even the most avid carnivores amongst the group understand that they cannot feast on that luscious piece of steak if they are no plants for the cows to feed on in the first place. It also starts to dawn on them that the t-shirt they wore may have come from a plant, the green/blue/red colour of the local 'kueh' and desserts are from a plant. Likewise, the sweet fragrances in their perfume are also from plants! At the end of the tour or workshop, our strategy is to leave them with something to think about.

Educators as Multipliers

Recognising that teachers hold the key to success for the Gardens' school outreach, our teacher training programmes are an important strategy for strengthening ties with schools and their students. With the



Enthralled Nanyang Primary School students during the 'Sara Goes to the Supermarket Garden' tour held at Singapore Garden Festival 2010.

Winnie Wong

opening of each new attraction in the Gardens, invitations are sent to schools, targeting their heads of departments. Having gained an appreciation of the relevance of the Gardens' programmes, we know that we can rely on these key personnel to enthuse the teaching staff of their respective departments or schools. They spread the message about the many possibilities and benefits of using the Gardens' resources to enrich school-based studies of plant topics and the environment, thus achieving learning beyond the confines of the classroom. Since the opening of JBCG, we have had more than 150,000 student visitors through excursions organized by teachers and parent volunteers.

In order to sustain teachers' enthusiasm and commitment to the public education programmes, we have six thematic teacher training workshops available upon request. Also, by involving teachers in the development of new programmes, the Gardens can be assured of their continued support. Once teachers become more confident and take ownership of programmes, Gardens staff need merely provide background support and facilitate visits. This frees in-house trainers to attend to other aspects of public education, such as further programme formulation and design.

Teacher training workshops have been found to be a rewarding investment and exercise, since every trained teacher in turn passes on the knowledge and experience gained to his/her charges. Hence, the multiplier effect is considerable and our partnership with teachers and schools will go a long way.

Partnerships

Partnerships reach out to wider audiences and bring different skills, knowledge and resources to our environmental education programmes that benefit both the participants and the Gardens. For awareness on wildlife and its

conservation, we are into our 3rd year of partnership with a non-profit NGO, Cicada Tree Eco-Place (CTEP), to run the "MAD (Make A Difference) Lessons" for Wildlife. For IYB 2010, we upped the ante by introducing the "Celebrating Wildlife" Series, more intensive and in-depth sessions, which leads children on half-day investigative biodiversity-themed workshops to facilitate learning about the wildlife in our gardens, parks and forests. Children get up-close-and-personal with both living and preserved specimens, participate in fun-filled hands-on activities and go on guided walks to seek out wildlife that exists in the Gardens. Topics under this series include insects, birds, mammals, amphibians and reptiles and strange plants. The Celebrating Wildlife series has reached out to more than 150 children to date.

In line with Singapore's movement for the Arts, our drama partners provide the expertise required to sow the seeds for love and respect of nature through the use of stories, movement, role play and props to encourage young participants to express their creativity. After each session, participants bring home with them some very important messages on caring for the nature and our environment. For 2010, our "Creatures in Nature" Drama Series centres on animals in their natural habitats, with each workshop in the series featuring a creature (magical seeds, bee, frog, caterpillar, squirrel) and a character building value (good behaviour, good manners, forgiveness, cooperation, responsibility) to educate children to emulate these values in their own lives.

Our partners in the environmental and biodiversity cause become our extensions and support system to spread the conservation message. The ultimate goal is to build lifelong skills that promote a sense of personal responsibility for the environment, and empower action for change.



Nature educator, Andrew Tay, introduces insects and their importance in a 'Celebrating Wildlife - MAD for Insects' half-day workshop.

Challenges for the Future

WIn these times of global warming and climate change, environmental education is key. For nature and environmental education to be effective, an integrated approach needs to be adopted. There is increasing recognition by people working in the field that environmental education as it has been traditionally taught is not enough to stem the current environmental crisis. It needs to embrace a more holistic paradigm, one that incorporates all aspects - ecological, economic, social, cultural and personal - of sustainable development, and their inter-relations, without the constraints imposed by traditional subject barriers. This will allow learners to delight in the connectedness of the world we live in. Environmental educators all over the world face a race against time; to educate, change mindsets and convince people to take action, change lifestyles and live sustainably.

Singapore's efforts in biodiversity conservation and education should not be limited to those of government agencies alone. Our work cannot be complete without the full and active support of the people. The community-at-large, including private, public and people sectors (corporations, schools, academia, conservation groups and passionate individuals), play an instrumental role in safeguarding Singapore's biodiversity. It is only by sharing this responsibility that we are able to conserve and protect our biodiversity for the benefits of future generations.

Janice Yau
Nashita Mustafa
Winnie Wong
Education Branch



Childcare students getting a first-time introduction to the climbing bottle gourd, bitter melon, mango and leafy greens at the Supermarket Garden



Often referred to as the 'king of paphs', *Paphiopedilum rothschildianum* is one of the most desirable species of the lady's slipper orchids in horticultural circles. This spectacular species is extremely rare in nature and wild-collected plants cannot be legally obtained for cultivation, but fortunately artificially raised plants are now readily available from nurseries all over the world. Recently a plant of this species flowered in one of the research greenhouses of the Gardens.

Paphiopedilum rothschildianum was introduced into cultivation in 1887 and named after Baron Ferdinand de Rothschild, a famous Victorian orchid grower. This species is a robust plant with strap-like uniformly green leaves. Its stems bear two to six flowers which are about 25–30 cm wide and rank among the largest in the genus. They differ from those of related species in their widely spreading narrow petals and in the unique shape of their central organs. Flowers are cream but are heavily striped with purple lines, and the pouch-like lip is cinnamon-coloured.

The species is native to the slopes of Mount Kinabalu in Malaysian Borneo, where it thrives on steep slopes and cliffs at altitudes of between 600 and 1200 m. The species is one of the rarest paphiopedilums in the wild. Despite

extensive searches only a total of three populations are known, with one of them apparently already lost.

As also in other parts of the world natural habitats in Borneo are under severe pressure from logging, mining, agriculture and urban development, but fortunately the two sites where this species can still be found today lie within the boundaries of the Mt. Kinabalu National Park which offers at least some kind of protection. In addition, the pressure from illegal collecting activities is now reduced by domestic and international laws and the constant supply of nursery-grown plants.

Of crucial importance for the continued survival of any species is its reproduction. In *Paphiopedilum rothschildianum* it was shown that small flies lay their eggs on the glandular hairs of the staminode (the unfertile organ in the centre of the flower) and in this process some flies slip off the staminode and fall into the pouch-like orchid lip. The only way out for them is to squeeze past the stamens and while doing this, the sticky pollen masses get fixed onto the fly. When visiting another flower of the same species, some of the pollen masses get attached to the stigma, which is very close to the staminode, effecting pollination and the ultimate formation of a fruit and seeds.

Rothschild's SLIPPER ORCHID



Hubert Kurzweil
Herbarium

SAUSAGES ON A TREE!

... is an occasional exclamation one would hear from observant visitors strolling around Lawn H near the Sundial Garden. The cause of this exclamation is *Kigelia africana*, an elegant umbrella-shaped tree that has 'sausages' hanging off its branches. The tree growing in our Gardens is about five metres tall and was introduced here in 1931.

Kigelia africana is an African tree, easily recognised by the large sausage-shaped fruits dangling down from its branches. It occurs throughout tropical Africa from Eritrea and Chad south to northern South Africa, and west to Senegal and Namibia. In the English-speaking world, it is commonly known as the sausage tree for obvious reasons. There are over 400 vernacular names by which *Kigelia africana* is known – a clear indication of the tree's importance and value to communities throughout its geographic range. The generic name *Kigelia* comes from the Mozambican name for sausage tree, "kigeli-keia". Its name in Afrikaans, Worsboom, also means sausage tree. *Kigelia* is now generally considered to be a highly variable monospecific genus of the family Bignoniaceae, although several species have been reported in the past. The sausage tree is a sacred tree for many African communities and is usually protected on farmlands when other tree species are cut down.

Kigelia africana is a reasonably large tree in her native habitat, with heights ranging from three to twenty metres. It usually grows in moist areas, such as riverbanks, throughout the savannah areas of tropical Africa. The bark is grey and smooth early in the tree's life but begins cracking and peeling as it ages. The inner wood is pale brown or yellowish and not prone to cracking. The tree is evergreen where rainfall occurs throughout the year but when there is a long dry season, it tends to be deciduous. The leaves are compound and large. In their native land, the greater kudu (African antelopes), stock and other native animals such as elephants and giraffes eat the foliage.

The flowers are produced in panicles and are large and beautiful, hanging down from branches on long flexible stems (two to

six metres in length), looking very much like chandeliers! The flowers are bell-shaped, dark reddish to maroon with yellow-green veins on the underside, about 10 cm wide and have an unpleasant musky smell. The scent is most noticeable at night when the flowers open indicating their reliance on bats and hawk-moths for pollination. The flowers are short-lived and normally drop off in the morning. The amazing pendulous sausage looking fruits are woody berries with lengths ranging from 30 to 100 cm long and up to 18 cm broad. The fruit can easily weigh between five and ten kilogrammes, and hang down on the long peduncles. However, in Singapore, the fruits develop to a modest size and are not very heavy as compared to fruits from mature trees growing in Africa.

The fruit pulp is fibrous and pulpy, and contains numerous seeds. In Africa, the ripe fruits are eaten by several mammals, such as baboons, monkeys, bush pigs and porcupines. The seeds are then dispersed in these animals' dung.

For many African tribal communities, *Kigelia africana* has a wide range of uses. Both ripe and unripe raw fruits are toxic to humans but the fruits can be dried and fermented,



The inflorescence hanging down off the branch like a chandelier.



The 'sausages' dangling off the branches.

and used along with the bark to enhance the flavour of a traditional African alcoholic beverage similar to beer. The seeds are sometimes roasted and eaten in times of famine.

In African herbal medicines, every part of the tree is used to treat many ailments such as digestive, dermal and respiratory disorders, and also to cure infections and wounds. Currently, the sausage tree is used in a variety of commercial applications to treat various skin complaints, e.g. sunburn, chafing, psoriasis, itchy scalp and nappy rash. Research into its anti-bacterial, anti-fungal and anti-tumour activity is also ongoing. In both traditional and orthodox African medicines, this plant has been used to treat malignant neoplasms such as skin melanoma, tumours and breast cancer. Biochemical extraction has resulted in the isolation of iridoids and naphthoquinoids as important secondary metabolites in this plant along with flavonoids and lignans.

The wood makes good quality timber for fences, planking and boxes. In Botswana, the timber is used for makoros (traditional canoes), yokes and oars. The sausage tree is widely grown as an ornamental tree in tropical regions for its spectacular flowers and unusual fruits. It is also an excellent shade tree, provided you are not directly under the tree when a hard, ripe fruit falls! In spite of this potential hazard, the sausage tree is still a curiosity well worth acquiring by gardeners with a taste for the weird and exotic. Furthermore, considering the many medicinal uses, there is an enormous scope for future research into *Kigelia africana*, and further pharmacological investigations.

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



Amorphophallus titanum inflorescence on 11 November 2010, one week after it was first observed in the nursery.



Amorphophallus titanum inflorescence just before anthesis on 4 December 2010.



Amorphophallus titanum inflorescence spadix collapses on 10 December 2010, marking the end of the flower.

A TITANIC EVENT: AMORPHOPHALLUS TITANUM FLOWERS AT THE GARDENS

From mid November to early December, visitors to the Gardens Green Pavilion were greeted by an unusual surprise. Our horticultural staff finally succeeded in bringing *Amorphophallus titanum* into bloom, the first documented flowering of this species in Singapore. The Singapore specimen, which matured at 1.8 m tall, was a source of great excitement and curiosity for the visitors who were lucky enough to see it.

Amorphophallus titanum, commonly referred to as the titan arum, belongs to the Aroid Family, Araceae. Other well-known members of this family include the elephant ear (*Alocasia* spp.), peace lily (*Spathiphyllum* spp.), and flamingo flower (*Anthurium* spp.). All of the Araceae have a distinctive inflorescence, or flowering stalk, which consists of a broad, leaf-like spathe and a fleshy spike called a spadix. The spadix bears numerous tiny flowers, which if successfully pollinated will develop into berry-like fruits. The spathe is a bract (modified leaf) that functions

to protect the developing flowers and to attract pollinators when the flowers are mature.

The titan arum grows from an immense tuber, weighing 50 kilograms or more. It puts out a single tree-like leaf, which may reach heights of 6 meters. The leaf lasts from 9-20 months before it withers and the plant then undergoes a dormancy period of 2-15 months, after which a new leaf emerges. Through photosynthesis, the leaf produces carbohydrates, which are stored in the tuber. When the tuber reaches sufficient size and has stored up enough energy it will produce an inflorescence after dormancy. The inflorescence may reach massive proportions, up to 3 meters tall and 1.5 meters wide, making it the largest unbranched inflorescence in the botanical kingdom (the talipot palm, *Corypha umbraculifera*, which is also in cultivation at the Gardens, has the largest branched inflorescence). From the time that it first

emerges from the soil, the inflorescence takes 4-6 weeks to develop fully. The mature inflorescence lasts only 2-3 days before the spathe closes, the spadix collapses, and the plant returns to dormancy.

When the inflorescence is fully mature, the pale green, frilly spathe unfurls like a skirt around the spadix, revealing a luminous reddish-purple interior. The massive spadix of the titan arum has 3 zones: an upper portion that lacks flowers, a narrow cream-coloured band of male flowers located inside the constricted neck of the spathe, and at its base a broader band of pink-coloured female flowers. The female flowers are mature on the first night and the male flowers on the second night. This separation of female and male flowering phases insures out-crossing (prevents self-pollination). During the female flowering, the spadix releases a powerfully foul odour, which has been compared to that of rotting flesh, while during the male flowering phase the inflorescence heats up to 36–38° C. The heat, strong odour, and colour of the inner surface of the spathe attract nocturnal carrion flies and beetles, which cross-pollinate the flowers.

The titan arum has attracted considerable attention since European botanists first encountered it in the rainforests of Sumatra in the year 1878. The first time it flowered under cultivation was in 1889 at the Royal Botanical Gardens, Kew (UK). It is cultivated at botanical gardens throughout the world as a tropical curiosity but is challenging to bring into bloom. The plants at the Singapore Botanic Gardens were grown from bulbs obtained in 2006 from Huntington Botanical Gardens in California (USA). The Singapore Botanic Gardens now joins an elite group of botanical institutions that have brought this species into flower.

Marc S. Frank
Living Collections
Photos by Lim Yaohui

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The symposium attracted specialists from 17 countries.

2ND SYMPOSIUM OF THE 'FLORA DU CAMBODGE, DU LAOS ET DU VIETNAM'

The 2nd Symposium of the 'Flora du Cambodge, du Laos et du Vietnam' was held from 6 to 8 December 2010 in Hanoi, Vietnam. The symposium attracted more than 180 specialists from 17 countries.

Over 70 oral presentations covered a wide range of topics including taxonomy, biodiversity and conservation, ethnobotany, floristics, ecology, phytochemistry, molecular biology and information technology. The oral presentations were running concurrently in three sessions, with an ample 30 minutes time-slot for each presenter to introduce the audience to the subject as well as to answer numerous questions.

The poster area with 56 posters attracted much attention not only during designated poster session slots, but also during the lunch-time and tea breaks, providing wonderful networking space and atmosphere.

A talk entitled 'What can we expect in the genus *Curcuma* in Cambodia, Laos and Vietnam?' and two posters focusing on the genus *Zingiber* in Indochina and ginger floristic surveys in South Vietnam were presented by the Singapore Botanic Gardens in collaboration with counterparts from the Vietnam National University of Science and Institute of Tropical Biology in Ho Chi Minh City, Vietnam, and colleagues from Charles University in Prague, Czech Republic and Royal Botanic Garden Edinburgh, Scotland.

Many participants also enjoyed post-symposium excursions to various National Parks including Bavi, Cuc Phuong, Tam Dao and UNESCO Natural World Heritage Site Ha Long Bay.

This symposium was jointly organized by the Institute of Ecology and Biological Resources, the Vietnam Academy of Sciences, the National Museum of Natural History in Paris and French initiative Sud Expert Plantes. The organizing committee led by Dr. Sovanmoly Hul from the National Museum of Natural History in Paris has to be thanked for enjoyable and fruitful symposium, which went without a hitch and before we knew it, it was over!



Jana Leong-Škorničková
Herbarium

Photos by author unless otherwise stated

THE 'GLOBAL STRATEGY FOR PLANT CONSERVATION BEYOND 2010' WORKSHOP IN THAILAND

On 23 and 24 September 2010, Queen Sirikit Botanic Gardens (QSBG) generously sponsored and hosted a Southeast Asia Botanic Gardens (SEABG) workshop on the Global Strategy for Plant Conservation (GSPC) beyond 2010. The Singapore Botanic Gardens was invited to attend and was represented by the author. The workshop was attended by participants from Cambodia, China, Laos, Myanmar, Singapore, Taiwan, Thailand and Vietnam.

As the first phase of the current GSPC (2002-2010) was coming to an end, negotiations were underway towards agreeing on a second phase (2010-2020), with revised targets and renewed objectives to help advance the international plant conservation agenda. The revised objectives and targets were to be presented and adopted at the 10th meeting of the Conference of the Parties (COP 10) in Nagoya, Japan, in mid October 2010. With the COP 10 meeting looming, the QSBG workshop was held to communicate, discuss and raise awareness amongst the SEABG network members on current GSPC objectives and the future targets that were to be adopted.

During the discussions, participants agreed that future implementation of the GSPC should more effectively engage all key stakeholders, indigenous and

local communities, business and media. Continued collaborative efforts are needed to tackle the challenges presented by research and knowledge gaps and to provide tools and capacity building with limited resources. In addition it is essential to incorporate local and indigenous knowledge, practices, innovations and technologies in conservation work. Reasons for the loss of biodiversity almost always seem to be related to economics, trade, production, population and poverty. Presently, these are areas that the Convention of Biological Diversity (CBD) and the GSPC do not influence or directly target. Participants agreed that the GSPC objectives ought to be linked closely to sustainable development and sustainability. Having the GSPC objectives mainstreamed into national governmental economic and development policies and plans would create this vital link.

In view of the hurdles of setting and meeting the higher targets of the GSPC second phase, participants brainstormed and focused on specific targets that could be met through immediate cooperation within the SEABG network. Lack of understanding and awareness of the GSPC and how it works to assist in conservation were highlighted by some members and these were discussed and clarified by participants who were more acquainted with the GSPC objectives and targets.

Current and new approaches of demonstrating and communicating to staff, governing bodies, local and indigenous communities about the GSPC targets and the need for conservation of plant biodiversity and how biodiversity is linked to livelihoods and economic status were shared and discussed. Participants agreed to set up an SEABG network website to enhance communication and allow dissemination of information about the region's botanical institutions and their efforts on plant conservation to a wider audience. Laos' Pha Tad Ke General Director, Rik Gadella, has generously volunteered to set up the site with members input. On the site, member countries can have their botanic gardens' information, and highlight conservation projects and provide education about the GSPC for public access.

At the closing of the workshop, it was evident more must be done in order move forward with the GSPC with renewed vigour. Concrete collaborative projects, capacity building and training efforts within the SEABG network were highlighted and are to be discussed further at the next SEABG network meeting in China in 2011. It will be a significant responsibility, opportunity and challenge for each one of the SEABG member institutions to play increasing roles in its implementation.

Nura Abdul Karim
Living Collections
Photos by author



Some of the GSPC workshop participants at the Queen Sirikit Botanic Gardens, Thailand.

KEY VISITORS TO THE GARDENS (JULY-DECEMBER 2010)

2010 was an incredibly busy year in terms of visiting scientists, largely due to the Flora Malesiana symposium. In addition to the dignitaries listed below we acknowledge over 102 botanists from 22 countries who used the Gardens' herbarium to assist with their biodiversity research.



His Excellency Karim Massimov, Prime Minister of Kazakhstan.



His Serene Highness Alois, Hereditary Prince of Liechtenstein.

Dato' Sri Ahmad Fuad	Mayor of Kuala Lumpur, Malaysia
His Excellency Ali Bongo Ondimba	President of the Gabonese Republic
His Serene Highness Alois	Hereditary Prince of Liechtenstein
Mrs Bounkongmany Lengsavad	Spouse of Deputy Prime Minister of Laos
Mr Charm Lee	President and Chief Executive Office of Korea Tourism Organization, Korea
Mr Eduardo Verano de la Rosa	Governor, Atlantic State, Republic of Columbia
Dr Hong Chi-Chang	Former Straits Exchange Foundation (SEF) Chairman Democratic Progressive Party, Taiwan
Mr John Downing	Trustee of San Diego National History Museum, United States of America
His Excellency Karim Massimov	Prime Minister of Kazakhstan
Mr Laping Jawa	Assistant Director of Planning, Land and Survey Department, Sarawak, Malaysia
Ms Li Ziyang	Minister of Organization Department, Tianjin Municipal Highway Administration Bureau, People's Republic of China
Mr Lim Guan Eng	Chief Minister of Penang, Malaysia
Ms Linda Phua	Chief Executive Officer of Hang Tuah Jaya Corporation, Malaysia
Mr Liu Chao	Third Secretary (Diplomat), Ministry of Foreign Affairs, People's Republic of China
Mayor Lucian Ducci	Mayor of Curitiba, Brazil
Prof Ma Kai	Advisor to KMT Legislator, Ms Huang Chao-Shun Campaign Office, Taiwan
Mr Meng Jun	Deputy Director, Beijing Civil Affairs Bureau, People's Republic of China
MICA-YOG Young Reporters	Singapore Youth Olympics 2010, Ecuador, Macedonia, Malaysia, Maldives and Poland
His Excellency Mohammad Nasheed	President of the Republic of Maldives
Dato' Dr Ong Hong Peng	Secretary General, Ministry of Tourism, Malaysia
His Excellency Pál Schmitt	President of Hungary
Mrs Patience Rawadogo and spouse Mr Odrek Rwabwogo	Daughter of President of Uganda
Her Excellency Ms Quentin Bryce	Governor General, Australia
Mr Rashid Masabah Al-Manie	Director of Roads and Infrastructure, Al Ain Municipality, United Arab Emirates
Mr Richard M Rosan	World City Summit Plenary Speaker, United States of America
Mr Song Xiaoyin	Deputy Head of People's Government of Xiuwu County Jiaozou Municipality, People's Republic of China
Ybhg Tuan Haji Mohd Atei Bin Abang Madaan	City Mayor, Commission of the City of Kuching North, Malaysia
Mr Yikui Chen	Deputy Secretary General of the Standing Committee, Guandong Provincial People's Congress, People's Republic of China
Mr Yu In-Chon	Minister for culture Sports and Tourism, Korea
Dato' Zool Azha Yusof	Secretary-General of Natural Resources and Environment, Malaysia

REPORT ON THE CAOUTCHOUC OF COMMERCE

JAMES COLLINS

James Collins was a London chemist with an interest in rubber, and was commissioned by Sir Clement Robert Markham to undertake this report on rubber producing plants. The full title of his work is 'Report on the Caoutchouc of Commerce, being information on the plants yielding it, their geographical distribution, climatic conditions, and the possibility of their cultivation and acclimatization in India', and it was published in London in 1872. Sir Clement Markham was an English geographer, explorer and writer who served as a geographer to the India Office. He was responsible for the collection of cinchona plants from their native Peruvian forests, and their transplantation in India. Markham had argued for the necessity of transporting cinchona trees to India and the need to provide cheap quinine to control malaria. He also became convinced that rubber, though of less medical use, was also worthy of an Indian government project to obtain it.

In his report, Collins concluded that rubber production in Brazil would be unlikely to keep pace with demand, influenced more in his conclusion by the rapid increases in British imports than by market prices. Collins suggested that supplies of labour in Amazonia were irregular and dependent on the strength of other parts of the economy. He also concluded that in order to sustain supply Brazilian rubber trees had to be transported to other countries. Seeds of the Brazilian rubber tree *Hevea brasiliensis* were sent to British Asia by a British planter, Henry Wickham, in 1876. Despite the assistance offered by British botanists, it was some while before rubber became a popular plantation crop.

In 1874 James Collins was employed as an economic botanist for the Government of the Straits Settlement. He also held the position of secretary and librarian of the Raffles Library and Museum, Singapore. Collins handed over control of the Gardens to James Murton from the Royal Botanic Gardens, Kew in 1875, and left Singapore in 1877. His report played a role in the expansion of the rubber industry and its effects in changing the economic face of Asia forever.

REPORT
ON THE
CAOUTCHOUC OF COMMERCE.

INFORMATION ON THE PLANTS YIELDING IT, THEIR GEOGRAPHICAL
DISTRIBUTION, CLIMATIC CONDITIONS, AND THE POSSIBILITY
OF THEIR CULTIVATION AND ACCLIMATIZATION
IN INDIA:

BY
JAMES COLLINS, F.R.S. EDIN.

WITH TWO MAPS, FOUR PLATES, AND FIGURES.
WITH A MEMORANDUM ON THE SAME SUBJECT
BY DR. BRANDIS,

EMPEROR GENERAL OF JERUSALEM TO THE SULTAN OF OTTOMAN.

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