Gardenwise

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Tan Wee Kiat, Executive Director, with the Gardens' staff in 1999.

An Issue to Celebrate the 140th Anniversary of the Gardens

James Murton, Superintendent, with the Gardens' staff in 1877.

Message *from the* CEO

The first phase of the rejuvenation of the Singapore Botanic Gardens commenced in 1989 during its 130th anniversary celebration. This phase is reaching a close along with the present millennium. While the primary thrust was to upgrade and secure the necessary infrastructure to enable the Gardens to perform its key roles efficiently and with distinction, less visible but no less important was the re-evaluation of its role as a modern botanic institution. The Singapore Botanic Gardens must remain relevant to the people of the nation in the new millennium, and do justice to its history and geographic situation as a star in the constellation of botanic gardens on earth. Towards this end, the quartet of fiduciary functions of a botanic garden, namely research, recreation, education and conservation must be accorded new priorities, enlivened with new programmes, and performed with passion, creativity and commitment.

In a young nation without a firm grounding and tradition in gardening and appreciation for things green and growing, education must be the key function of the Gardens. Since the audience is by no means a captive one, the Gardens must serve as lure and captor of clients for its educational outreach. It must be a gorgeous living catalogue of the plant kingdom and its potential for enriching the lives of all. The educational message, both subtle and overt, must make evident that the quality of the environment we live in depends on the presence of plants and how we use them. Residents of Singapore must be convinced that the cost of incorporating plants in our living environment is one that must be borne, for the alternative is far more costly.

With the entire Gardens serving as a vital resource in the education process, the specific tools of learning and knowledge gathering, namely the School of Horticulture, the research facilities, the Library and the Herbarium must be given new honing.

The completion of phase I of the rejuvenation process culminated in the successful opening of the new Visitor Centre and NParks HQ. The staff can now concentrate on the re-development of the Heritage Core at the Tanglin end of the Gardens. This is where the School of Horticulture, Herbarium and Library of the Gardens are currently located, along with the research offices and laboratories. When the Re-development Master Plan for the Gardens was first mooted, a key concern was the provision of proper herbarium, library, research and educational space and facilities. The Visitor Centre complex was developed initially for this purpose. Course of events superceded the move, and the complex was adapted to house the headquarters of the newly re-constituted National Parks Board. The Singapore Botanic Gardens is the flagship among parks of the Board, so it is fitting that the Parks Headquarters should be situated within the Gardens.

The Heritage Core of the Gardens must now be re-developed to provide purpose-built facilities to house one of the world's most important herbaria, a library of botany and horticulture, the research laboratories and the School of Horticulture. Such a synergistic grouping should result in a dynamic enclave of botanic and horticultural activity and learning. At the same time, needed amenities for food and beverage, restrooms, parking, and public function spaces can be planned for. With the prospect of entering into this exciting new phase of the Gardens' rejuvenation, the Gardens' staff must feel like everything is coming up, not roses, but orchids for the Singapore Botanic Gardens.

As the flagship of the National Parks Board, the Singapore Botanic Gardens is under the purview of the Minister for National Development. In the last decade or so, Minister Lim Hng Kiang had charted the course of the National Parks Board and the Singapore Botanic Gardens. He personally launched the construction of the Visitor Centre project, and officiated at the dedication of the complex upon its completion. Minister Lim has left the Ministry of National Development to take up the dual portfolios of Minister for Health and Second Minister for Finance, but his mark on the Gardens is an enduring one.

The Gardens will celebrate its 140th Anniversary with a new Minister at the helm. Minister Mah Bow Tan, who masterminded the land transportation policies and systems for the nation as the former Minister for Communications, is the current Minister for National Development. The road ahead for the Singapore Botanic Gardens in the new Millennium with Minister Mah promises to be an exciting and rewarding one. It should lead to the completion of the Master plan for the re-development of the Gardens that began with the anniversary celebration ten years ago.

Dr Tan Wee Kiat

CONTENTS

Front Cover : From the Archive; insert, Ali Ibrahim

NATIONAL PARKS

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KEEPING BOTANICAL GARDENS RELEVANT:

The Singapore Botanic Gardens Experience

INTRODUCTION

The intrinsic value of botanical gardens is constant, but their perceived value fluctuates when buffeted by the winds of the economic climate. During such times, garden administrators must go back to the basic formula for the administration and development of botanical institutions and adjust relative weights of the components of the formula. This is necessary to keep the botanic garden relevant in catering to the current needs, aspirations and demands of the target clients of the gardens concerned. These components are:

- **Recreation**
- **Research**
- **Conservation**
- **Education**

By adjusting the weightage of the above components in response to the demands of the times, a botanic institution can remain important to a nation and its communities through its vital contributions to national development, health, education and economic growth.

Let me illustrate this with the example of the Singapore Botanic Gardens experience.

IN THE BEGINNING

The history of the Singapore Botanic Gardens began on Government Hill in 1819 when Sir Stamford Raffles laid out a botanical and experimental colonial garden near his official residence. This was for the purpose of cultivating ornamental plants as well as for the study of useful revenue-earning crops from the region. The Gardens was re-established in its current site in 1859 by an agri-horticultural society as an amenity for the enjoyment of its members. This society ran into financial difficulties, and in 1875, handed over the maintenance of the Gardens to a government appointed committee.

The failure of the gardens under the management of the amateur society was our first lesson in relevance. The role of the Gardens as a purely recreational park could not justify its existence. Under the government, this role was expanded to include botanical research and scientific experimentation. A superintendent trained in botany and horticulture was recruited from the Royal Botanic Gardens in Kew, England. A herbarium and a library were started. A programme of exchange of herbarium and living specimens and publications was begun with similar institutions around the world. The scientific staff carried out laboratory and field experiments on crops with economic potential.

Today, the story of the Hevea Rubber Industry and the role played by the Singapore Botanic Gardens is well known. In 1877, 22 seedlings of *Hevea brasiliensis* arrived in Singapore. Eleven of the seedlings were nurtured in Singapore while the rest were sent to gardens in the Malay Peninsula. These 22 seedlings were to become parents to an industry that changed forever the economic history of South East Asia.

Henry N. Ridley, appointed the first Director of the Singapore Botanic Gardens in 1888, was the visionary who showed how the bark of the Hevea rubber tree could be tapped for latex without permanent damage to the tree, thereby setting in place the foundation of the modern rubber plantation. He also showed how latex could be made into coagulated sheets to facilitate transport, and was tireless in persuading plantation owners in the Malay Peninsula to grow rubber instead of other tropical crops. The economic garden he established in the Botanic Gardens grounds was to yield over 17 million seeds for the fledgling rubber industry.

The success of the Gardens under Ridley firmly validates the research and educational roles of a botanic institution.

From these early years to recent times, the Singapore Botanic Gardens remains a leading centre for botanical research in this part of the world. Its programme of scientific publications in the form of a house journal, *The Gardens' Bulletin*, and numerous landmark books on flora and horticulture continues to the present. It was its reputation as a valuable cultural and scientific institution that saw the Gardens through the darkest phase of Singapore's young history. During the war years, the Gardens' holdings were protected by Professor Hidezo Tanakadate, and later, secured under the enlightened administration of Director Kwan Koriba of the University of Kyoto from 1942-45.

THE GREENING OF SINGAPORE

In 1963, the first "Tree Planting" campaign was launched, followed by the "Garden City" campaign in 1967. The objective was to create a city-state with a garden environment consisting of parks, gardens and open spaces linked by a matrix of tree-lined roads and park connectors for cyclists and pedestrians. The architect of our Garden City was then Prime Minister Lee Kuan Yew. Since expertise for this campaign resided in the Singapore Botanic Gardens, its focus was re-defined from that of a largely research-oriented organisation to one that would spearhead the national 'greening' effort.

To meet the need for trained personnel to maintain the greenery, the School of Ornamental Horticulture was opened in the Gardens in 1972. In the following year, the Singapore Botanic Gardens merged with the Parks and Trees Branch of the Public Works Department to form the Parks and Recreation Department. National needs for maintaining the Garden City programme took priority over the traditional roles of the botanical institution. In the following two decades, the greening programme matured, and Singapore gained international repute for its clean and green environment.

The Singapore Botanic Gardens Experience,
Continued from page 3

The Singapore Botanic Gardens had achieved its mission to provide the botanical and horticultural direction and expertise needed to develop Singapore into the Garden City. It was time again for the Gardens to re-assess its vision and mission as a tropical botanic institution.

THE NATIONAL PARKS BOARD

In 1990 the National Parks Board was formed and the original role and functions of the Botanic Gardens were restored. Besides the Singapore Botanic Gardens, this board was also charged with the administration and development of the nature reserves of Singapore as well as Singapore's historic Fort Canning Park. On 1st July 1996, the National Parks Board was merged with the Parks & Recreation Department to form the new National Parks Board. Now, the management and maintenance of the roadside greenery and of all the other parks of Singapore under the former Parks and Recreation Department also comes under the purview of this re-constituted National Parks Board.

The Singapore Botanic Gardens again re-defined its roles and goals, and forged a new vision. It now strives to become a premier tropical botanic garden that would remain relevant into the new millennium. To achieve this, the Gardens embarked upon an ambitious master plan to re-develop the entire Gardens. The following key projects were completed:

- The road bisecting the garden was expunged, and the two halves united. This allowed a "triple-core" strategy for developing the Gardens to be realised. The cores are:
  a. The southern Heritage Core which retains the original administrative and research buildings and reference collections of the Gardens and the precious four hectare remnant of Singapore's primary forest,
  b. The Central Core which is being developed as the tourist zone,
  c. The northern Bukit Timah Core which is designated as the recreational and educational zone.
- The Central Core, the National Orchid Garden, Palm Valley, Symphony lake and the Visitor Centre Complex which includes the Headquarters of the National Parks Board, restaurants, gift shop and a public car park.

THE ROLE OF THE GARDENS IN THE HISTORY OF NATURE CONSERVATION IN SINGAPORE

In 1883, the Government, alarmed by the depletion of forests in the Straits Settlements, which comprised Malacca, Penang and Singapore, commissioned Nathaniel Cantley, the Superintendent of the Singapore Botanic Gardens, to survey the extent of the forests of the three Settlements. This was an initial effort at arresting the wasteful trend of deforestation. In the report, the recommendations stressed that "the first important step... is to secure the preservation of such forests as are worth retaining ..." There were nine specific measures listed, including a) the prevention of the felling and clearing of forests, b) a call for the preparation of good and reliable maps produced as a result of field surveys by the Survey Department, c) the formation of local forest reserves for the supply of wood and riverine reserves for protection, d) the establishment of a Forest Department, and e) the collection of seeds of the best indigenous timber trees and the setting-up of nurseries for the propagation of these seeds.

The principles of nature conservation with an integrated strategic approach were, indeed, well expounded in this report. On the basis of Cantley's report, the first forest reserves were identified in the Straits Settlements. These were administered by the newly established Forest Department of which the first Director was Cantley. The Forest Department was established under the administration of the Gardens.

- At the Bukit Timah Core, the seven hectare Economic Garden including the one-hectare Eco-lake and the Plant Resource Centre and nursery.

THE ROAD AHEAD

RECREATION:

The Gardens will embark upon the second phase of infrastructural up-grading to further enhance its recreational value not only for the people of Singapore, but also for visitors to the Republic. This includes providing better visitor facilities in the Heritage Core of the Gardens, new and improved horticultural displays, and a lighting programme that will extend the period of leisure time for visitors in the Gardens into the cool hours of the night.

CONSERVATION:

By virtue of the Gardens' Nature Conservation Branch and its specialist scientific expertise, NParks as the parent organisation, was designated Singapore's Scientifc Authority on Nature Conservation. The Nature Conservation Branch in the Gardens formulates pragmatic and responsible policies on nature conservation for Singapore and is the vehicle for the nation's involvement in regional and international activities on nature conservation and biological diversity.

The term of H. N. Ridley as the Director of Botanic Gardens and Forests witnessed the designation of forest reserves in Malacca, Penang and the Dindings. Ridley's interests were not confined to plants as he was a naturalist in the true sense of the "great pre-specialised age of scientific natural history". Keen ornithologists still refer to Ridley's paper on birds in the Botanic Gardens.

The Forest Department remained under the Gardens' administration until 1895 when forest matters were officially transferred to the Land Office. By this time, 88,336 acres (35,776 hectares) had been designated as forest reserves in the Straits Settlements. In 1935, the Forest Reserves in Singapore were deleted but R.E. Holttum and E.J.H. Corner kept the nature conservation flag flying by recommending that those at Bukit Timah, Kranji and Pandan be placed under the Gardens for the purpose of the conservation of indigenous biodiversity. These three areas were reinstated as forest reserves again under the Forest Reserves Ordinance and reverted back to the control of the Director of the Gardens, who held concurrently the position of Conservator of Forests, in 1939. The objectives of the forest reserves explicitly spelt out this time that the forest reserves were not for commercial exploitation but for "absolute protection to provide areas for research, education, recreation and as samples of the country's biographic history and heritage" and this remained the guiding policy of nature conservation to present times.

H. Tanakadate and K. Koriba, the Japanese Directors of the Gardens during the Second World War, were instrumental in ensuring that the reserves survived the war.

When granite-quarrying interests came into conflict with the conservation of Bukit Timah, the Government set up a commission to resolve this issue. The report recommended that legislation be enacted to protect the reserves. The three above-mentioned reserves together with Labrador Cliff and the Municipal Water Catchment area became legally protected under the Nature Reserves Ordinance 1951. This legislation is the predecessor of the existing National Parks Act.

In the early 1990s, the National Parks Board (NParks) was designated Singapore's Scientific Authority on Nature Conservation with the responsibilities of policy formulation on nature conservation and the management of Nature Reserves.

The Ministry of the Environment spearheaded the drafting of the Singapore Green Plan in 1993. The Nature Conservation Branch of the Gardens serves as the Secretariat for the Working Committee on Nature Conservation. This Working Committee is entrusted with the identification of representative ecosystems followed by the monitoring of the health of these designated nature areas. It is also responsible for establishing faunal and floral corridors, linking up the nature areas so that the biodiversity of the designated sites would be enhanced. Activities promoting nature appreciation are also under the purview of this Committee.

On a regional level, the Nature Conservation Branch represents Singapore in the ASEAN Working Group on Nature Conservation and Biodiversity. Two biodiversity networking and biological database projects involving ASEAN countries are the ASEAN Regional Centre for Biodiversity Conservation (ARCBC) and the Southeast Asian Loop of Bionet International (ASEANET). Both of these projects require country co-ordinators. The Nature Conservation Branch serves as Singapore's National Biodiversity Reference Unit for ARCBC and Singapore's National Co-ordinating Institute for ASEANET.

Singapore signed and ratified the Convention on Biological Diversity on 10th March 1993 and 21st December 1995, respectively. NParks was designated the national coordinating agency, with the Nature Conservation Branch handling the administration and keeping a watching brief on the issues raised by this forum.

With the increasing national, regional and international commitments to nature conservation, the Gardens is primed to lead nature conservation efforts through to the next millennium.

Lena Chan
Nature Conservation Branch

RESEARCH:

The Gardens will build upon its traditional strengths in Plant Taxonomy, Orchid Breeding and Micropropagation programmes. The Herbarium and Library will be housed in new purpose-built quarters. New laboratories and lecture rooms are planned.

A strong publications programmme will support on-going and new floral studies projects in the region.

EDUCATION:

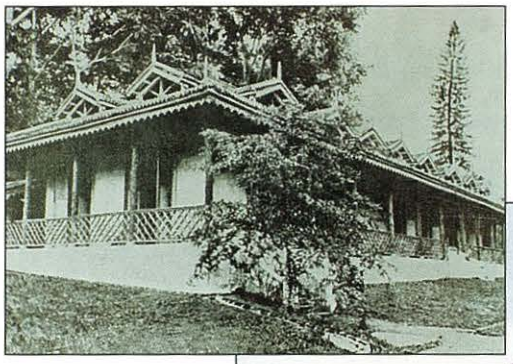
The School of Horticulture of the Singapore Botanic Gardens, founded in 1972, will continue to provide programmes that lead to awards of technical Certificates and Diplomas in tropical horticulture and landscape management and design. The School also provides outreach programmes designed to inform, educate and create awareness and appreciation for nature and gardening.

CONCLUSION

During its 140-year history, the Singapore Botanic Gardens has played various roles dictated by circumstances. In recent decades, this has resulted in erosion of its identity as a botanic and horticultural institution. Since 1990, under new leadership and with a re-defined vision and mission, our Gardens is back on track in charting its course as a premier institution for tropical botany and horticulture. As administrators, we must keep nimble to make sure that our Gardens stays relevant. We stand ready to reconfigure the basic formula for defining the goals of our Gardens in order to keep it a vital and progressive botanic garden for the new millennium.

Dr Tan Wee Kiat

THE HERBARIUM

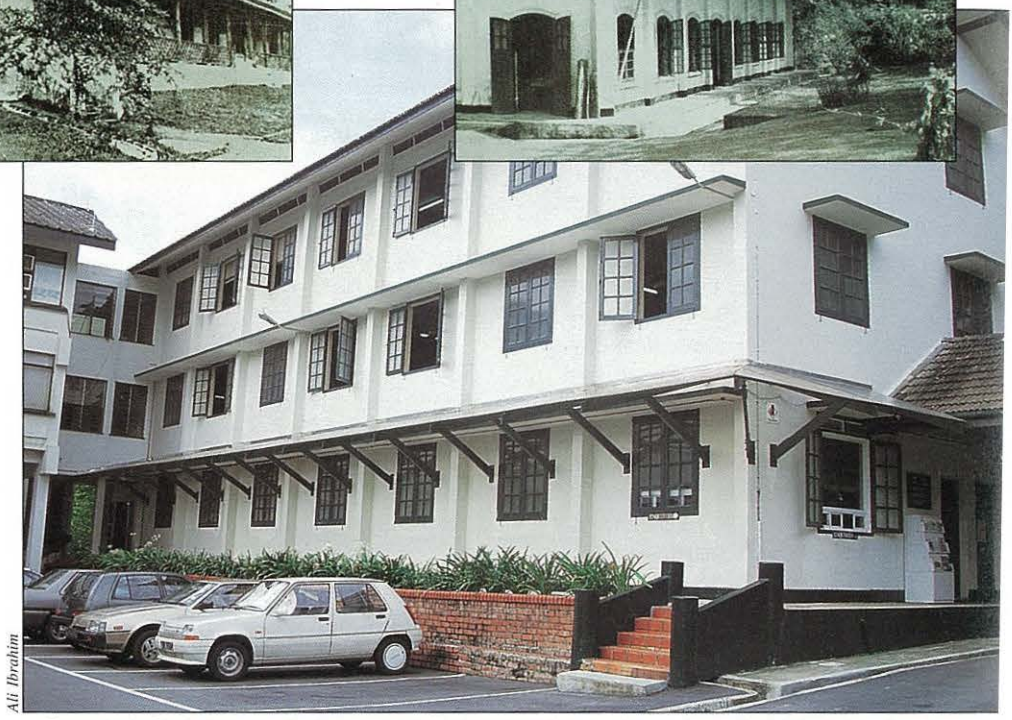


Ridley's new Herbarium built in 1905.

Archive

The Herbarium as it was in 1952.

Archive



Ali Ibrahim

Presently the Herbarium occupies the upper two floors and another floor in the wing to the left (not shown).

The Herbarium dates back to the establishment of the Botanic Gardens on its present site. By 1875, H. J. Murton already had a collection of dried specimens, which was temporarily housed in his office until the proposed herbarium building was erected and from the start he established a library having ordered from England a 'good collection of standard botanical works.' He reported that by 1879 the herbarium comprised 3000 named specimens. Most of his collections were made from Singapore and Perak but he acquired valuable old herbarium specimens, mostly of Indian and Nepalese plants, that had been in J. Collin's possession in Singapore but which had originally been part of Ward's herbarium held by the Linnaean Society in London. These include the oldest specimens in our herbarium, those collected by Moravian Missionaries in 1790.

When N. Cantley was in charge of the Gardens, a new Office and Herbarium was erected in 1882 at the cost of $ 1,500. This Herbarium occupied 650 sq ft with a further 200 sq ft for a drying room. (Drying specimens was always a problem in the humid tropics until the advent of hot air drying ovens.) In 1884, a herbarium keeper was employed to cure and mount specimens as well as to look after the library. From the efforts of Cantley and his collectors, such as M. V. Alvins who made an interesting collection of ethnobotanical specimens from the Malacca and Negri Sembilan region, the herbarium collection was fast expanding and filled 18 cabinets. In addition, a small stove had been acquired to 'keep away the damp from the books, as well as the herbarium specimens.' Duplicates were already being sent to Kew. Even at that early date, Cantley reported in 1885 that 'The collecting of herbarium specimens, in order to afford material for scientific investigation... had not been forgotten.'

H. N. Ridley took over the Herbarium in 1888 but his efforts were hampered by the lack of a herbarium keeper. By then, the Herbarium was regularly receiving specimens from C. Curtis, Superintendent of the Botanic Garden in Penang; in 1892, Dr G. King of the Calcutta Botanic Gardens presented a valuable gift of 5000 specimens of early collections from Peninsular Malaysia, such as those of Father B. Scortechini, Kunstler (often referred to on herbarium labels as 'King's Collector') and L. Wray; in 1895, the British Museum gave over a thousand specimens collected by Wallich and Hance; as well as specimens sent from Kew.

Ridley's plans for the Herbarium were ambitious: 'I am... attempting to get specimens of every plant for each of the States [of the Malay Peninsula], and the similarity of the flora induces me to add those of Sumatra, Borneo and adjacent islands.' He therefore set about an ambitious collecting programme to many parts of the Peninsula, then very remote. Many collecting trips were made when he was on leave and could be free of his duties as Director. In addition, he collected in Sumatra, Borneo, Java, peninsular Thailand and Christmas Island (the last was at that time under the jurisdiction of Singapore). He collected literally tens of thousands of specimens and is credited with discovering more than a thousand new species.

In addition to his own collections, he continued to receive duplicate specimens from the British Museum, Calcutta and Kew, as well as many collections made by Europeans living locally, who were attached to museums, the geological survey or were planters. He also regularly received specimens from G.D. Haviland and G. F. Hose in Sarawak. (Indeed, it was extremely

125 Years of History

fortunate that Bishop Hose gave Singapore a duplicate set of his collections as, on returning from home leave, he discovered his personal collection had been totally consumed by termites.) Later Ridley regularly received specimens from the Philippines and Java. In addition, he built up a collection of wood, especially important in those days when the timber trees were not well known, as well as a collection of the less durable or more fragile specimens, which were preserved in spirit.

And so the Herbarium grew. In 1890, the large quantities of plants that Ridley was collecting required a specially constructed drying room where specimens were dried on a corrugated iron platform heated from beneath by chatties full of charcoal. In 1892 it was necessary to spend $500 to enlarge the Herbarium. In 1889 Tassim Daud was employed as herbarium keeper followed by Ahmad Kassim in 1895. With a herbarium keeper, the specimens could be sorted into folders and the Herbarium to be rearranged to Ridley's satisfaction following the system used in *The Flora of British India* (which included the Malay Peninsula). In addition, Ridley was able to report that 'The vermin which were very abundant have been destroyed.'

By 1900, Ridley was boasting that the Herbarium was 'now without doubt the finest for the Malay Peninsula plants in the world and contains many types and cotypes of plants from the Peninsula, Borneo, Sumatra and Siam.' In 1910, the Herbarium was further strengthened with the addition of Curtis's collection when the Herbarium of the Penang Botanic Garden was transferred to Singapore.

In 1904 and 1905, the Herbarium moved to a new building, but Ridley noted that it was not satisfactory as 'the whole building was very leaky and damp for a great part of the year.' In 1907, the Herbarium was invaded by termites. Fortunately, their tunnels were discovered before they had got into the cabinets. In haste the whole collection was re-poisoned taking four men from the Public Works Department four months to complete.

In 1913, specimens collected from the Botanic Gardens of Penang and Singapore were removed from the general collection and kept separately. This 'Gardens Herbarium' was important for checking that the names of plants grown in the Gardens were correctly identified and could also be used as a basis for compiling a

Ali Ibrahim

Jasminum sambac, collected in 1790, is one of the oldest specimens in the herbarium.

Ali Ibrahim

The Herbarium is extremely rich in type specimens of the region.

catalogue of plants grown in the Gardens. This was very important for, as Cantley had scathingly commented in 1882: 'A catalogue purporting to be a list of plants contained in the Gardens was published in 1879 and a supplement in 1880. But on my referring to the catalogue for the names of the trees they could not be found. I next sought for the plants contained in the list, and with the exception of a few was equally unsuccessful.' However, although he began to catalogue the plants it was not until 1912 that the first reliable Garden Catalogue was produced. (The next catalogue, *The Checklist of Cultivated Plants, Singapore Botanic Gardens*, appeared very much later in 1995.)

Due to Ridley's efforts, the collection was sufficiently comprehensive to embark on taxonomic revisions for the 'Materials for the Flora of the Malay Peninsula' project under Sir George King at Calcutta. For this purpose large quantities of specimens were sent as duplicates or on loan to specialists who revised particular families. For example, O. Beccari in Naples revised the palms. Ridley himself undertook to revise the Monocotyledons. After Ridley retired, he continued to work indefatigably at Kew to produce the five-volume *Flora of the Malay Peninsula*.

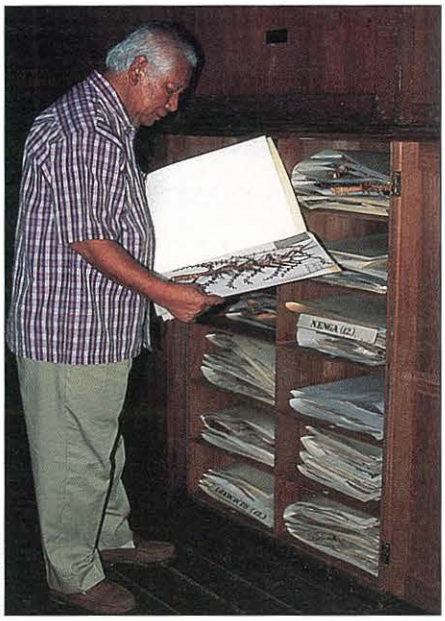
He was succeeded as Director by I. H. Burkill, best remembered for his two-volume *The Economic Products of the Malay Peninsula*, for which the herbarium collection with notes on local uses recorded on the herbarium label was an important source of information. In addition, Burkill laid a sound basis for the scientific investigation of the Malayan flora by creating the post of Curator of the Herbarium and employing several talented botanists.

After the hiatus of WWI, when paper for mounting specimens was not available, three women were employed to mount specimens and by 1924 the backlog was cleared. In 1922, an active collecting programme started and continued up to the Japanese Occupation. Burkill made extensive collections from both Taiping Hills and Fraser's Hill, E.J.H. Corner collected all over the Peninsula for his book on Wayside Trees, as many of the village fruit trees were still improperly known, C.X. Furtado specialised in and made collections of aroids and palms, M.R. Henderson concentrated on the limestone flora and visited many hills, mountains and islands to collect, R.E. Holttum specialised in ferns and monocots, particularly orchids and made collections notably from Mount

Herbarium, Continued from page 7

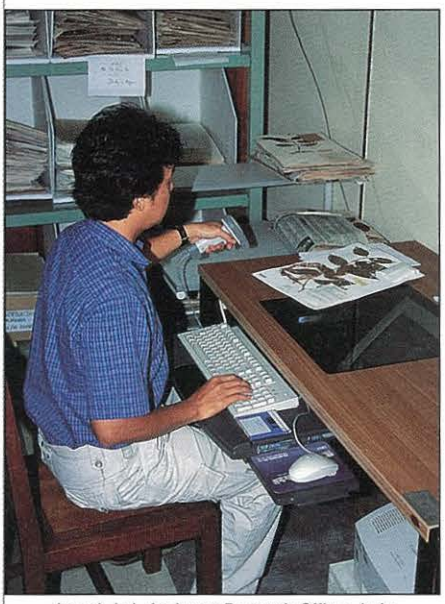
Ali Ibrahim

The specimen cabinets reflect the history of the Herbarium from the old solid teak cabinets, to the modern plywood ones, to the Leiden-type boxes that accommodate the overflow.



Ali Ibrahim

Mohd. Shah Mohd Nur, Reserch Officer, in the Herbarium.



Ali Ibrahim

Jospeh Lai, Assistant Research Officer, is in charge of the databasing and bar-coding of the Herbarium collection.

Kinabalu and several mountains in the Peninsula. In all these expeditions, the plant collectors employed in the Herbarium played an important part. Corner started a dried collection of macrofungi having successfully experimented with methods to keep them free of mould and beetle attack. Corner is also famous for using pig-tailed macaque monkeys to collect botanical species.

C.E. Carr, a planter by profession, built up an excellent collection of orchids, not only from the Peninsula but also 800 specimens from Mount Kinabalu. Not only did he give duplicates to the Herbarium but, after his early death in New Guinea, the Botanic Gardens bought in 1936 his personal herbarium, which included over 3000 orchid specimens as well as many flowers in spirit, invaluable for the study of orchid taxonomy.

Thousands of specimens were collected each year and large quantities of duplicates were sent to regional and European herbaria; similar quantities were received in exchange. Henderson's task as Curator was to arrange the Herbarium following Ridley's *The Flora of the Malay Peninsula*, the folders following the Flora's numbering of the families, genera and species. In the course of this work, species not recorded in the Flora came to his attention and he published a series of papers entitled 'Additions to the Flora of the Malay Peninsula.'

The Japanese Occupation brought an end to active collecting and exchange of specimens. Both Corner and Holttum were interned in the Gardens and, freed from administrative duties, devoted their time to research, which turned out to be an extraordinarily productive time resulting in taxonomic revisions and even a new theory of tropical botany — Corner's Durian Theory.

A notable addition to the Herbarium during this time was the acquisition of 5000 specimens from the personal collection of Z. Teruya, a Japanese planter.

After WWII, collecting in Penisular Malaysia was severely restricted by The Emergency. The second Curator of the Herbarium, J. Sinclair continued to collect in Singapore and Johore. Soon regular collecting trips were made to Sarawak, first by the Director, J.W. Purseglove, then by Sinclair, Chew Wee Lek, Chang Kiaw Lan and Geh Siew Yin. Chew was an active member of both Royal Society Expeditions to Gunung Kinabalu. H. M. Burkill was the first algologist to be employed by the Gardens and he built up a comprehensive collection of seaweeds.

After Independence, the Forest Departments of Peninsular Malaysia, Sabah and Sarawak began to build up their own herbaria and regularly send duplicates to the Herbarium. In contrast, the collecting activities by staff in Singapore declined and the SFN (Singapore Field Numbers) series, which was started in 1924 and used by all staff to number their collections, was discontinued at the end of 1958.

By the late 1960s, the herbarium building had become derelict. Through H.M. Burkill's energies, a new three-storey herbarium building was completed in 1964, to which was added in 1968 a new two-storey wing, which also housed the library. In 1972, a third storey was added to the wing. The Herbarium has remained little changed since then, apart from experiencing an ever-increasing shortage of space as more specimens are added to the collection. At that time, the Herbarium ranked in size second in Asia and tenth in the world.

In 1967, with the launching of the Garden City Campaign, the botanists attached to the Herbarium were directed to apply their research to more practical ends. On several occasions, H.M. Burkill deplored this change, which was based on the misconception that a botanic garden could function to international standards without the backing of a strong botanical research programme. He pointed out that the applied fields of economic botany, education and conservation all need a strong botanical base.

In 1973, the Botanic Gardens came under the administration of the Parks and Recreation Branch of the Public Works Department. The stated aims for botanical work included maintenance of the Herbarium and library, collection of plants for the Herbarium, identification, botanical publication and the preservation and maintenance of Nature Reserves in Singapore. However, as the botanists' posts were transferred away (see box), the Herbarium was just able to tick over.

Curators/Keepers of the Herbarium

The post of Curator of the Herbarium was created by I. H. Burkill in 1924 for M.R. Henderson whose post in Kuala Lumpur had been abolished in a government reorganisation. Henderson held the post (except during the war years when he was in South Africa) until 1946, when he became Director of the Botanic Gardens.

In 1948, J. Sinclair was appointed Curator, a post he held until his retirement in 1963. He was then re-employed until 1965 to cover the duties of local staff overseas for higher studies, continuing in an honorary capacity until 1967. It was during his time in 1955 that, according to the Annual Reports, there was a change in name from Curator to Keeper of the Herbarium but the reason for this was not stated.

In 1959, posts were re-graded so that Assistant Director, Keeper of the Herbarium and Botanist were all on the same salary scale so that in 1960 the post became Botanist (Keeper of the Herbarium).

In 1956, Chew Wee Lek was the first local graduate to be appointed as Botanist, and, in 1965 on his return with a PhD from Cambridge, he took on the duties of Keeper.

Chang Kiaw Lan, the second local graduate to work in the Herbarium, was appointed as botanist in 1959 to take charge of the collection of fungal specimens. In 1970, when Chew became Director, she took over his duties as Botanist (Keeper). On her retirement in 1987, there were no taxonomists employed in the Herbarium and the Keeper's post effectively became defunct. Mrs Ng (nee Geh Siew Yin) then took on the duties of Keeper in addition to her own as Assistant Commissioner of the Botanic Gardens.

Under the aegis of NParks, the post of Keeper of Herbarium and Library was revived and held by Chin See Chung from 1993 until 1996 when he became Director of the Gardens. In 1997, Ruth Kiew was appointed.

Flora Malesiana

M.R. Henderson, Curator 1924-1942, 1946.

Archive

J. Sinclair, Curator/Keeper 1948-1965.

Archive

Chew Wee Lek, Botanist (Keeper of Herbarium) 1965-1970.

Archive

Ng Siew Yin, Assistant Commissioner, who took on the duties of Keeper between 1987 and 1993.

Ali Ibrahim

Chang Kiaw Lan, Botanist (Keeper of Herbarium) 1970 –1987. Photo taken in May 1999.

Taxonomists in SBG

Until the end of WWII, the Director and Assistant Director were both taxonomists, and all who filled these positions were illustrious botanists who produced a wide range of excellent publications including monographs, floras, and texts that are still used by professional and amateur botanists today.

In 1923, C.X. Furtado was appointed Assistant Botanist, a post that he held until his retirement in 1952, when he was re-employed as Botanist until 1964. Even after this second retirement he continued to work in the Herbarium.

As a result of the re-grading of posts in 1959, there were three botanists posts. In 1963, Hardial Singh joined Chew and Chang as the third botanist and in 1970 Geh Siew Yin replaced Chew, who resigned that year

In 1973, Geh moved to the Parks and Recreation Branch as Assistant Commissioner, followed in 1975 by Hardial Singh, leaving only Chang in the Herbarium. After 1970, for twenty years no new taxonomists were recruited.

With the formation of NParks, three taxonomists' posts (the Keeper's being one) were created. From 1990 to 1996, Tay Eng Pin held one post and in 1998, I.M Turner filled another. The third is expected to be filled soon.

The formation of the National Parks Board (NParks) in 1990 as a statutory board under Tan Wee Kiat, Executive Director of NParks and Director of the Botanic Gardens (the first for 18 years!) brought a wind of change as Tan sought to restore a proper balance between research, education, conservation and recreation and to revive systematic botany. New posts for taxonomists were created, the post of Keeper of the Herbarium and Library was revived and a new building for research, which included a spacious new Herbarium, was planned. The last was overtaken by events when NParks was enlarged with the merger with the Parks and Recreation Division, and the research building was transformed into the new headquarters for NParks.

So it is that at present the Herbarium still occupies the old buildings although some improvements have been made in airconditioning the library, office and type collection. The Herbarium holds at least 600,000 specimens of which more than 4000 are types and specimens are constantly added through staff collections and by exchange. Space increasingly is a constraint as the sturdy cupboards, many of solid teak from the days before plywood, are filled to bursting, the overflow being accommodated in Leiden-type boxes that double as cupboard space. Computerisation of the collection is proceeding slowly using BRAHMS for databasing, label generation and barcoding. Concurrently plans are afoot for a new building that will take the Herbarium into the new millennium, so with modern facilities, adequate staffing and funding, the Herbarium aims to recapture its former reputation as a centre of excellence in tropical taxonomy.

Ruth Kiew
Herbarium & Library

The author is grateful to Chin See Chung and Ng Siew Yin for helping to fill gaps in the records. Most information was gleaned from the Annual Reports.

The Botanic Gardens and the Changing Vegetation of Singapore

Corner's composite picture of the swamp forest at Jurong taken while the forest was being cleared in 1932.

Lallang (*Imperata cylindrica*) — lallang grasslands covered much of Singapore at the end of the 19th century.

When the Singapore Botanic Gardens was founded on its present site 140 years ago, Singapore was experiencing a rapid change in its vegetation cover. At the founding of Singapore as a trading colony by Sir Stamford Raffles in 1819, all but a small fraction of Singapore Island and its smaller neighbours was covered with primary tropical forest. Fifty years later, when the Botanic Gardens were first laid out, much of that forest had already been cleared. The Gardens site itself was a miniature reflecting the larger picture of Singapore's landscape. It consisted of abandoned cultivated land with one little patch of remnant forest, that was fortunately preserved as the Gardens' Jungle — now known as the Gardens' Rain Forest. Over its history, staff of the Botanic Gardens have played an important role in documenting the natural vegetation of Singapore and helping to conserve these important habitats.

The pre-1819 vegetation of Singapore was lowland tropical rain forest of three main types. At the coast, particularly near the mouths of the rivers, there was mangrove forest. Inland there was the typical lowland dipterocarp forest of the region. In some of the shallow river valleys, this gave way to freshwater swamp forest. Most of Singapore was deforested in the first half century of its modern era. This clearance was largely conducted by squatter farmers attempting to make a living from growing cash crops. Pepper (*Piper nigrum*) and gambier (*Uncaria gambir*) were the economically most successful, and ecologically most disastrous, of these crops. The forest was cleared and crops grown for a few years before soil fertility was lost and the farmers moved to new forest sites. By the latter half of the 19th Century much of Singapore was covered by lallang (*Imperata cylindrica*) grasslands kept open by frequent bush fires in dry spells. The Botanic Gardens site on Cluny Road was probably mostly covered with lallang grassland in 1859, but some of the large tembusu (*Fagraea fragrans*) trees, now so characteristic of the Gardens and other parts of the Tanglin district of Singapore, may already have established in the grassland.

Ali Ibrahim

Flowers of gambier (*Uncaria gambir*), a woody climber that was grown extensively in 19th century Singapore for the tannins in its leaves.

Probably the best place to see mangrove forest in Singapore today is Sungei Buloh Nature Park, which like the Singapore Botanic Gardens, is managed by the National Parks Board. Even here though most of the mangrove is regrowth on the bunds around the old prawn and fish ponds. However, some better stands can be viewed from the boardwalks on the Visitor Centre bank of Sungei Buloh.

Henry Ridley, the Director of the Singapore Botanic Gardens for the period 1888-1912, pointed out in his *Flora of Singapore*, published in 1900, how the historical abundance of forest was reflected in the many Singapore place names which are derived from the vernacular designations for trees. For example, Kranji (*Dialium* spp.), Tampines (*Streblus elongatus*) and possibly Changi, though *Neobalanocarpus heimii*, more correctly known as chengal, has never been confirmed as a native of Singapore. Fragments of the original dipterocarp forest remain, the biggest being at Bukit Timah Nature Reserve with other patches scattered through the Central Catchment Nature Reserve. The Botanic Gardens' Rain Forest is another tiny remnant of 4 ha, but it manages to maintain something of its primary character and contains many species of the native flora.

Primary lowland dipterocarp forest at Bukit Timah Nature Reserve.

Nepenthes rafflesiana climbing over *Adinandra dumosa* in secondary forest on Kent Ridge.

Ian Turner

The freshwater swamp forest in Singapore was the subject of research, in tandem with several sites in Johore, conducted by E.J.H. Corner in the 1930s while he was Deputy Director of the Gardens. Unfortunately, his studies proved to be documentation prior to destruction. The swamp forest at Jurong was destroyed for industrial and housing development, and the Mandai Road site was flooded under Seletar Reservoir. The last true freshwater swamp forest in Singapore is found near the Singapore Armed Forces rifle firing ranges at Nee Soon. This area is closed to public access, but the edge of the swamp can be viewed from Seletar Reservoir Park.

Singapore has a lot of forest other than the scattered primary patches. These represent regrowth on areas that were cleared of the virgin stands, mostly by the farmers of the 1800s. Much of the Central Catchment Nature Reserve is of this secondary type. The secondary forest is quite varied in the sorts of species found and in the height and size of trees. One characteristic type of belukar, the Malay word for secondary forest, was called adinandra belukar by R.E. Holttum, another former director on the Gardens and the first Professor of Botany in Singapore. Adinandra belukar is so called because the commonest tree is tiup-tiup (*Adinandra dumosa*). It grows on sites where the soil is very poor, often as a result of a topsoil erosion during and after the farming period. Good examples of adinandra belukar can be seen in Kent Ridge Park and the Upper Pierce Reservoir area of the Central Catchment. Adinandra belukar is a good place to see pitcher plants (*Nepenthes* spp.), three species of which can be found growing wild in Singapore, together with some natural hybrids.

Currently, staff of the Singapore Botanic Gardens continue the tradition of studying the natural vegetation of Singapore. Personnel from the Nature Conservation Branch and Herbarium make frequent fieldtrips in order to inventory and monitor Singapore's biodiversity. These data are then used to advise land managers and planners.

Ian Turner
Nature Conservation Branch

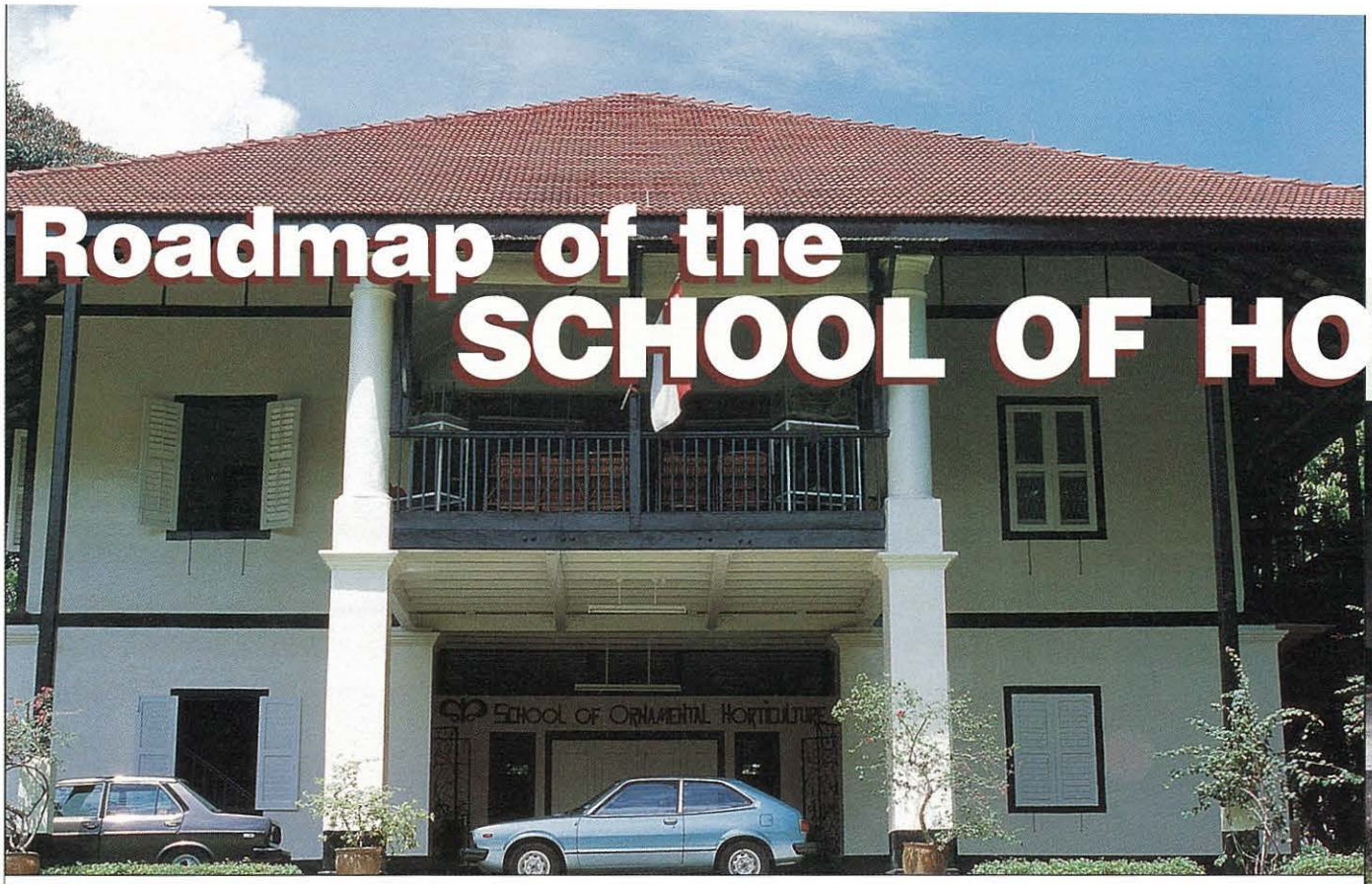
Ian Turner

A large stilt-rooted tree in Nee Soon swamp forest.

Ian Turner

Some of the remaining mangrove forest in Singapore.

Roadmap of the SCHOOL OF HOR



Archive

The School of Ornamental Horticulture, now Burkill Hall.

PROLOGUE

'Horticulture has made me more aware of life and kept me constantly on my toes. The stimulus it offers has opened up a bigger world, where imagination is my playground. I am happy with my choice, and at last I feel creative and free.' — Nazli Anwari, Diploma student of 1981

1972

1972 witnessed the founding of the School of Ornamental Horticulture at the present Burkill Hall in the Singapore Botanic Gardens with the first intake of 16 students. The 2-year full-time study led to the award of the Diploma in Ornamental Horticulture and Garden Design. The objective was to train manpower needed to create and maintain Singapore's 'Garden City', and for the fledgling horticultural and landscape industries.

1978

The first part-time gardening course on basic gardening techniques and cultivation of ornamental plants was conducted for 89 participants. Weekly 3-hr sessions were conducted in the evening for four weeks.

1980

In meeting the demand for a skilled workforce in the Parks & Recreation Department (PRD) and the industry, a new 3-year part-time Diploma was launched to run concurrently with the 2-year full-time course. This proved to be popular with working adults as it accorded them more flexibility in pursuing their studies. The first intake comprised 14 students.

1982

The Certificate in Horticultural Practices was introduced to upgrade the skills of groundsmen. The Trade Certificate has been adopted as a recruitment and promotion criterion by some members in the industry.

1988 – 1990

The period 1988 - 1990 was a watershed for the School of Ornamental Horticulture. Cost-effectiveness of its operation was audited in view of the unpredictable trend in enrolment. New admission was suspended as of 1990 while allowing existing students to complete their studies. The future of the School was in the balance. When the National Parks Board (NParks) came into being in 1990, the Ministry of National Development directed that NParks, as the new owner of the School, re-evaluate the viability and relevance of continuing with its operation. The School was revived, renamed the School of Horticulture (SOH). However, the full-time Diploma in Ornamental Horticulture and Garden Design was revamped into two part-time Diplomas, the Diploma in Horticulture and the Diploma in Landscape Design, to confer greater specialisation in the respective disciplines. The credit system was also introduced. The new format was well received as testified by increased enrolment.

The advisory/policy body of the School also evolved from the School Board to the Research & Education Committee and thence to the SOH Council of today.

Archive

A classroom scene in the SOH Building (now Burkill Hall).

Around 1989, to make way for the re-development of the Burkill Hall and its vicinity into the National Orchid Garden, SOH uprooted its administration to Ridley Hall and shortly to the former 'Garage Building' at the Bukit Timah Core. The classroom and teaching facilities were distributed about the Bukit Timah Core and Tanglin Core

1993

An External Examiner was appointed to strengthen academic standard of the courses conducted by SOH.

SOH formalized its public education portfolio and intensified its public outreach effort to promote nature appreciation and recreational gardening.

TICULTURE: 1972 – 1999

Archive

Past students displaying their design pieces.

Archive

Top student Ms Yong Li Lian receiving a prize from the Guest-of-Honour, Mr Lee Yiok Seng, Parliamentary Secretary of the Ministry of National Development, at the 5th Convocation in 1979. Looking on was Dr Choo Yon Sen, the principal then.

1995

A Memorandum of Understanding with the Ngee Ann Polytechnic of Singapore and Lincoln University of New Zealand was signed to facilitate collaborative training efforts in horticulture and landscape design.

1997

The 2-year, part-time Advanced Diploma in Landscape Studies was launched to provide an avenue for SOH Diplomates to further their professional development. Graduates of this course can pursue a Bachelor in Landscape Architecture by enrolling for the 2-year graduate-entry programme at Lincoln University, New Zealand. The first intake of 19 for the Advanced Diploma is due to graduate in 1999.

1998

The 3-year, full-time Diploma in Horticulture and Landscape Management was launched as a joint programme with the Ngee Ann Polytechnic, targeting 'O' level school leavers as potential recruits for the horticulture and landscape profession.

Marching towards the new Millenium

Development of additional classroom and office facilities for SOH is scheduled for completion in 1999. When completed, the School will be better positioned to meet rising expectations of its students and programme participants by offering them a better learning environment. In appreciation of the Shaw Foundation's kind sponsorship, SOH looks forward to organising a ceremony to dedicate the new facilities to the donor and at the same time mark the graduation of the first cohort of the Advanced Diploma in Landscape Studies.

To contribute to the national training objectives, the School is seeking inclusion of its Trade Certificate in Horticultural Practices under the Skills Redevelopment Programme (SRP). Employers will then have more incentives to send their workforce for the Trade Certificate course.

SOH will continue to forge strategic alliances with recognised and reputable tertiary institutions to widen the scope and opportunities for professional development in horticulture and landscape design/ architecture. It will assess the training needs of the industry and identify suitable trainers from established institutions to conduct technical courses and workshops to enhance local expertise.

SOH has facilitated the partnership between NParks and the Ministry of Foreign Affairs in organising relevant training courses for developing countries under the Singapore Technical Assistance Programme on Sustainable Development (STAPSD) scheme. Positive response was received for the special programme on 'Developing and Managing a Garden City' conducted in March 1999 to pass on to trainees Singapore's 'Garden City' experience.

The School looks to further expand its public outreach especially in areas with latent potential and opportunities. It will identify and develop programmes, and produce resource materials to complement and reinforce the teaching of plant sciences in schools. 2001 will again find SOH in the driving seat, planning and organising the 4th 'Skyrise Gardens Exhibition' — the triennial event aiming to induce highrise dwellers to the fold of the Singapore gardening fraternity.

In the CEO's words:

'A knowledgeable public whose awareness and appreciation for all things green and growing has been aroused and abetted, is a force to power the mission of the National Parks Board — To Make Singapore Our Garden.'

EPILOGUE

Message from Mr Henry Conceicao, the longest serving member on the past and present governing bodies of the School of Horticulture: 'In my address to students on one occasion, I urged them to look at a wider perspective as they entered the working world and seize opportunities to further their studies in time to hold responsible positions. It is heartening to note the good progress made by the School since its revival in 1990 and the vital links it has established to provide academic advancement for its graduates. My congratulations go to the Singapore Botanic Gardens on its 140th Anniversary and for its role in the development and progress of the School.'

Foong Thai Wu
Tan Choon Hooi
Nashita Mustafa
Janice Yau
Education Branch

The LADYBUG of The Gardens

Ladybug larva

It took a decade for the Entomology Unit in the Singapore Botanic Gardens (SBG) to metamorphose into a ladybug, and another to develop skills for devouring even the most menacing bugs.

In 1979, the egg hatched... the ladybug larva's main mission was to munch the pests around it, as much as it could...

The time was ripe for the birth of the Entomology Unit, as pests abounded on the lush vegetation, mostly monocultures, created by the Parks and Recreation Department's (PRD) intense greening programmes.

Hundreds of rain trees, especially 'instant' ones along the East Coast Parkway, were heavily infested with shoot-defoliating caterpillars of a Noctuid moth. Huge and voracious Atlas Moth caterpillars attacked Khaya trees lining a few major roads. Large numbers of *Cinnamomum iners* were also stunted by microscopic gall mites that induced tumours on leafy shoot tips.

These and other pests kept the Unit busy conducting island-wide field investigations and, in the case of the Noctuid caterpillar epidemic, weekly surveillance for more than a year. Advice given on control measures successfully contained the epidemic and suppressed the other pests.

Choo-Toh Get Ten

Ladybug pupa

The pest-hunting activities continued into the night in the newly developed coastal parks, where the nocturnal cockchafer beetles nibbled leaves of hundreds of saplings. Even the mature trees in SBG were not spared — the on-set of wet weather after the usual periodic dry spells triggered off new flushes of leaves which were gnawed by the gregarious night-flying beetles. Apart from advising the field staff on pest control, the Entomology Unit also fielded queries from the general public. Field personnel required for the greening programmes, and students of the School of Horticulture were trained.

Four years later, the dormancy call came... and the ladybug larva pupated.

In mid 1983, pest control research and advisory services were stopped when the Entomology Unit was closed. The field staff were expected to be capable of carrying out pest control work without the help of a specialist. For 6 years, the Botanic Gardens field staff routinely sprayed every pest-prone plant every week. The intensive preventive spray programme kept the plants free of insect bites but created a sterile, in actual fact polluted environment, harsh for the survival of beneficial insects.

Dormant for six years, the pupa escaped unscathed and the ladybug emerged... into an environmentally friendly atmosphere in the redeveloped Botanic Gardens conducive for developing its pest-feeding capabilities to the full.

In mid 1989, the Entomology Unit was restored in recognition of the need

Choo-Toh Get Ten

Atlas moth caterpillar and cocoon

Choo-Toh Get Ten

Galls induced by mites on *Cinnamomum iners*

Choo-Toh Get Ten

Sapling with leaves riddled by cockchafer beetles

Choo-Toh Get Ten

Autoserica sp. gnawing *Cassia* leaves

Choo-Toh Get Ten

Scale insects on *Dracaena* sp.

Choo-Toh Get Ten

Leafhoppers and aphids on *Hibiscus* leaf

Choo-Toh Get Ten

Psyllids on *Thespesia*

Choo-Toh Get Ten

Coconut hispid on palms

Choo-Toh Get Ten

Ladybird adult

for specialist advice on pest control. A laboratory was set up and furnished with insect storage cabinets and basic entomological equipment.

The Gardens' 130th Anniversary Exhibition manifested the impending change in its policy pertaining to entomological research and advisory activities. A plant clinic was staged to provide visitors advice on pest and disease control. This was the start of an outreach public service that the Entomology Unit actively pursued thereafter.

In 1990, coming under the new management of the National Parks Board (NParks), the Entomology Unit undertook a greater variety of activities and research projects.

The Gardens' spray programme was changed from being a prophylactic one to a curative pest control measure with minimal chemical pollution of the environment. Toxic pesticides were replaced with less hazardous, more environment-friendly or harmless products such as Bacillus thuringiensis, organic soap or plant extracts. By 1993, beneficial insects had returned to SBG.

Entomology research in the nineties was centred on pest problems of established plants. It covered a wide range of insect pests found on shrubs like *Hibiscus* and *Ixora*, trees like *Angsana* and *Thespesia*, different types of palms, plants in skyrise gardens and the Botanic Gardens Nursery, Bromeliads in the National Orchid Gardens and recently even herbarium specimens. Research findings were disseminated in both local and international publications.

Studies on insect biodiversity brought the entomologist into the nature reserves and the SBG Rain Forest. Relevant exhibits were set up.

Education on pest control previously targeted for horticultural students and NParks staff were extended to the general public. The outreach programmes included courses and talks, radio and television programmes, and plant clinic activities during 3 skyrise gardens exhibitions in 1992, 1995 and 1998. These activities were aimed at raising public awareness of plant health care.

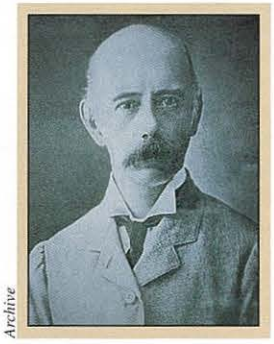
The Entomology Unit has regular contacts with other entomology institutions in ASEAN, New Zealand, Australia and United Kingdom. These links have helped NParks tackle a recent beetle epidemic that seriously affected thousands of palms in Singapore.

As the Singapore Botanic Gardens enters a new era on reaching its 140th year, its decade-old ladybug is also headed for a new direction in its research journey. It will look into making biological control a component of a more eco-rational integrated pest management strategy for NParks. This will be done through the conservation and use of natural enemies of pests. The strong support of NParks management has been, and will continue to be, an important factor for its flight to success.

Choo-Toh Get Ten
Chaw Siang Long
Entomology Unit

ORCHIDS in the Gardens

Orchidaceae are one of the most diverse and largest of flowering plant families in the world with some 25,000 species. On the 633 km² island of Singapore, 179 species of native orchids belonging to 58 genera have been recorded. Their diversity and beauty make them one of the earliest plant families to be collected and grown in the Gardens.



Archive

Henry Ridley.

In the mid 1870s, when Mr. H. J. Murton was the Superintendent, the Gardens began to cultivate orchid species in an Orchid House. The Gardens gradually became an important centre for species cultivation and exchange with other botanical institutions throughout the world. Orchids which are native to the region, such as those in the genera *Vanda*, *Dendrobium* and *Paphiopedilum*, were exchanged for the South American epiphytes such as *Cattleya*, *Catasetum* and *Oncidium*.

In 1888, Mr. Henry Ridley, a trained orchidologist, became the Director of the Gardens. During his tenure, the orchid programme was further improved and expanded. Many species were introduced from the region as well as from all over the world.

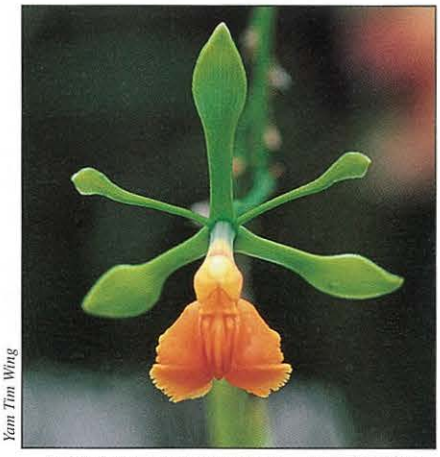
An important event occurred in 1893. While gardening in Tanjong Pagar, Miss Agnes Joaquim discovered a beautiful plant. Agnes immediately took it to Mr. Ridley. After comparing the newly discovered flower with those of *Vanda teres* and *Vanda hookeriana*, Ridley concluded that it was a hybrid between the two species. Subsequently, the plant was registered by Mr. Ridley under the name *Vanda* 'Miss Joaquim', after Miss Agnes Joaquim. Agnes gave some plants to the Gardens and *Vanda* 'Miss Joaquim' has proven to be exceptionally vigorous and free flowering. *Vanda* 'Miss Joaquim' was named the National Flower of Singapore in 1981.

The orchid programme in the Gardens entered a new era when Professor R. E. Holttum came to Singapore in 1922. He was extremely enthusiastic about finding more free-flowering plants for the tropical lowlands. One obvious choice was the orchid. His vision of producing free flowering orchid hybrids sprang from observing the ever-flowering habit of *Vanda* 'Miss Joaquim'.

Holttum used the new method of asymbiotic orchid seed germination developed by Professor Lewis Knudson that grew seeds in sterile culture media. By the end of 1929, he reported that he was able to germinate seeds of *Dendrobium crumenatum*, *Phalaenopsis violaceae*, *Vanda hookeriana*, *Vanda teres*, *Spathoglottis plicata*, *Vanda* 'Miss Joaquim' and one dozen other hybrids.

Holttum flowered *Spathoglottis* 'Primrose' (*Spathoglottis aurea* X *Spathoglottis plicata*), his first hybrid, in 1931.

Other important hybrids that were flowered during Holttum's time



Yam Tim Wing

Epidendrum pseudepidendrum — an interesting species from Thailand.

Yam Tim Wing

Vanda 'Miss Joaquim', the National Flower of Singapore.

included *Aranthera* 'James Storie' (*Arachnis hookeriana* X *Renanthera storiei*) which became an important cut flower for many years and *Arachnis* 'Maggie Oei' (*Arachnis hookeriana* X *Arachnis flos-aeris*). The latter dominated the orchid cut-flower market and became the symbol for Singapore orchids.

In 1939 *Oncidium* 'Goldiana' (*Oncidium sphacelatum* X *Oncidium flexuosum*) was flowered. This hybrid, commonly known as the Golden Shower or the Dancing Lady orchid was a great success and its popularity still extant. It can be found in almost every flower shop throughout the world.

Besides the orchid breeding programme, Holttum also contributed to orchidology of the region as author to

Yam Tim Wing

Ansellia africana — an attractive species introduced from Afric

Dendrobium thysiflorum — a beautiful species from Burma.

Orchid Tissue Culture in the Gardens

SEED GERMINATION OF ORCHIDS

The Singapore Botanic Gardens started research work on orchids in 1928 when Professor R.E. Holttum was the Director. The early work was mainly on hybridization and seed germination. In 1933, Professor Holttum adopted the Knudson asymbiotic method for germination of orchid seeds. He discovered that the contamination rate of cultures could be greatly reduced by using pods harvested prior to dehiscence. A number of orchid species including *Phalaenopsis violacea*, *Vanda teres*, *Spathoglottis plicata*, *Vanda hookeriana* and the natural hybrid of *Vanda* 'Miss Joaquim' were successfully germinated from seeds.

Research effort slackened during the Japanese Occupation. After the war, the Singapore Botanic Gardens initiated research on the improvement of germination media. A modified Vacin and Went formula, with the addition of coconut liquid endosperm and banana was developed for seed germination. As the seed germination programme developed, and became able to germinate more seedlings than required for internal use, the Gardens began offering orchid seedlings for sale to the public. Later, attention was turned towards the propagation of high demand varieties for cut flowers such as *Arachnis* 'Maggie Oei', *Aranthera* 'James Storei' and *Oncidium* 'Goldiana'.

In 1980, the seed germination programme was absorbed into the Tissue Culture Laboratory. With judicial choice of culture media and germination procedures (including the right timing of harvesting the seed pods), the seed germination programme has improved the germination rate for Vandaceous orchids from 13% in the mid-1970s to 40% nowadays, and for *Dendrobium* hybrids from 30% in the mid-1970s to 80% nowadays.

TISSUE CULTURE OF ORCHID

Following the success in tissue culture of orchids by G.M. Morel in 1960 in France, the Gardens decided to take up this new line of research. A tissue culture laboratory was established in the early 1970s and gradually took off. In due course, several hybrids of *Dendrobium*, *Aranda*, *Aranthera*, and *Burkillara* were successfully mericloned. After many attempts, *Dendrobium antennatum* and *Oncidium lanceanum* were also successfully mericloned in 1977. Until then, only apical and axillary buds were used in tissue culture techniques and the medium was mainly Vacin and Went basic salt fortified with naphthalene acetic acid (NAA) and 2,4-dichlorophenyl acetic acid (2,4-D).

From 1980 onwards, a wider range of experiments were initiated to support the orchid breeding programme of the Gardens. Choice orchid hybrids were mass produced by tissue culture techniques for display at the Orchid Enclosure (the predecessor of the National Orchid Garden).

In addition to apical and axillary buds, tissues such as roots, young leaves and lateral buds of flower stalks have all been successfully mericloned. The most significant work of the laboratory has been the successful micro-propagation of orchids from flower buds in 1984. Two species of *Mokara* and a few species of *Spathoglottis* have been produced by flower-bud culture. The success of flower-bud culture opened up new avenues for orchid production. Mass propagation of a choice species or hybrid has become possible even when only a flower bud is available. The method has also enabled tissue culture to be carried out at practically no risk to the parent plant.

Phua Lek Kheng

Orchid seedlings derived from one seed pod growing profusely on agar medium

To a large extent, the progress was made possible by the development of a comprehensive list of culture media based on Vacin and Went, Murashige and Skoog, Knops, and Knudson basic salts. The effects of various hormones and plant extracts on the different stages of growth of a large variety of orchid species/ hybrids were closely observed. The most versatile and effective media

Continued on page 19

Orchids, Continued from page 3

Archive

Dr. Richard Eric Holttum.

Orchids of Malaya, in which he described more than 750 Malayan species in 110 genera.

In 1952, *Vanda* 'Tan Chay Yan' flowered in the Gardens. This famed hybrid was the result of a cross between *Vanda* 'Josephine van Brero' and *Vanda dearei*. It was awarded a First Class Certificate (FCC) in the Chelsea Flower Show in England. Today, it is still considered one of the most outstanding hybrids ever produced in Singapore.

The Gardens started naming new hybrids after VIPs and visiting dignitaries. In 1956, the first VIP orchid *Aranthera* 'Anne Black' was named after Lady Black, wife of the former Governor of Singapore, Sir Robert Black. To date, the Singapore Botanic Gardens has named more than 110 VIP orchids.

In the early 80s, cognizant of the constant demand for new varieties of orchid hybrids, the Gardens' orchid programme, spear-headed by Dr. Tan Wee Kiat, once again geared itself towards breeding exclusive hybrids for display in the Gardens and for the local orchid industry.

In 1995, the three hectare National Orchid Garden was opened. The products of our breeding programme and our species collection are now showcased in a beautifully landscaped environment. Some of the plants displayed include our more recent hybrids such as *Dendrobium* 'Masako Kotaishi Hidenka', *Dendrobium* 'Memoria Princess Diana', *Renanthopsis* 'Dhanabalan', *Dendrobium* 'World Peace', *Dendrobium* 'Singapore Mint', *Dendrobium* 'Rotary International', *Renantanda* 'Mary Robinson', *Renantanda* Keating, *Vandaenopsis* 'Nelson Mandela', *Mokara* 'World Trade Organisation', *Renanthera* 'Tan Keong Choon', and *Vanda* 'Overseas Union Bank'.

Our orchid species collection comprises many genera, *Dendrobium* being the best represented, followed by the vandaceous

Yam Tim Wing

Dr Tan Wee Kiat in the National Orchid Garden.

Yam Tim Wing

Vanda 'Tan Chay Yan'.

Vandaenopsis 'Nelson Mandela', a VIP orchid named after Mr Nelson Mandela.

Yam Tim Wing

Dendrobium 'Fairy Wong' x 'Candy Stripe' – this hybrid won the Award for 'Best *Dendrobium* with stripes' at the 1999 World Orchid Conference in Vancouver.

species, such as *Arachnis*, *Vanda*, *Renanthera* and *Phalaenopsis*. There are also numerous species from the genera *Bulbophyllum*, *Paphiopedilum* and *Oncidium*. Other interesting genera include *Arundina*, *Spathoglottis*, *Cymbidium*, *Ansellia Epidendrum*, *Catasetum*, *Cattleya* and *Vanilla*.

A cool house is being constructed to enable the cultivation and display of orchids from the higher altitudes of the tropics and those from the cooler regions.

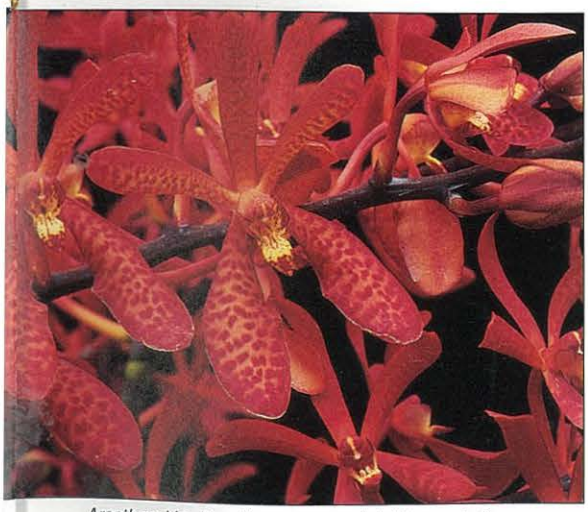
With the beginning of the new millennium, we would like to strengthen our orchid programme by going into new areas of research.

In breeding, we would like to create new colours and more lasting and showy hybrids . To do so, we have started a project to artificially induce polyploids. Most orchids have two basic sets (diploid, 2x) of chromosomes. Plants that contain more than the basic two sets of chromosomes are considered polyploids. The most common one is obtained by doubling the chromosomes of a diploid (2x) to tetraploid (4x). Tetraploid plants are generally more horticulturally desirable than their diploid counterparts. For example, flowers of a tetraploid tend to have better texture are bigger and have more intense colorations. So far, several tetraploid orchid species and hybrids have been produced.

Another programme is to use DNA finger-printing to determine the parentage of hybrids.

Finally, in the area of orchid conservation, we would like to increase the species population through seedling culture for planting, dissemination to other botanical institutions, individuals, and for introduction back to their natural habitats.

Yam Tim Wing
Orchidology Unit



Yam Tim Wing

Aranthera Lim Hng Kiang, our new hybrid named after the former Minister for National Development.

Continued from page 17

developed through these years of experience include: Vacin and Went basic salt supplemented with banana, coconut water and tomato juice, and Knudson C medium supplemented with banana and pineapple juice. The media used depend on the stage of development of the protocorms. For protocorm initiation, the Vacin and Went medium and the Knudson C medium have been found to be far superior to the others for apical shoot tip and axillary bud cultures. For most species and some hybrids, it is necessary to add NAA to induce protocorm formation. For protocorm multiplication and differentiation, the Vacin and Went medium supplemented with coconut water and sugar is best for most hybrids, especially for *Dendrobium* hybrids. Vandaceous orchids, however, have been observed to multiply and differentiate faster in the Vacin and Went medium supplemented with coconut water, banana and tomato. Most *Oncidium* hybrids fail to form roots in media containing tomato extract but satisfactory root formation is obtained in media containing pineapple juice

Lim-Ho Chee Len

Initiation of protocorms from flower bud culture of *Mokara* sp.

Phua Lek Kheng

Initiation of protocorms from leaf base culture of *Vanda* sp.

By the end of 1998, the tissue culture laboratory has successfully mericloned 624 hybrids/species of orchids, of which 269 are sympodial and 355 are monopodial. The effort to develop more effective culture media and mericloning procedures is being continued, in order to achieve even greater productivity and to overcome difficulties with known recalcitrant species.

CLONING SERVICE FOR LOCAL GROWERS AND SALES OF ORCHID PLANTLETS

In late 1978, the Gardens started a mericlone service to assist local orchid growers and breeders. We undertake experimental tissue culture propagation of parent plants sent in by the public. Orchid hybrids, which have been mericloned and supplied commercially on a large scale in the last few years include *Mokara* 'Willie How', *Dendrobium* 'Sedona' and some of the *Epidendrium* hybrids. To date, 15 growers have made use of this service to mass-produce their choice hybrids. A total of 100,000 plantlets of 25 hybrids have been produced under such contract service.

Orchid plantlets in flasks have also been offered for sale to the public in the laboratory since 1980. This service proved to be most popular, especially to tourists from Australia, New Zealand, Japan and Europe. With the opening of the National Orchid Garden in 1995 and the Visitor Centre in 1998, orchid plantlets are also being offered for sale at the Orchid Plaza next to the National Orchid Garden and the Garden Shop.

THE FUTURE

The research efforts in the near future will focus on two aspects: molecular diagnostics for quality control of tissue cultured orchids, and efficient, non-destructive tissue culture techniques.

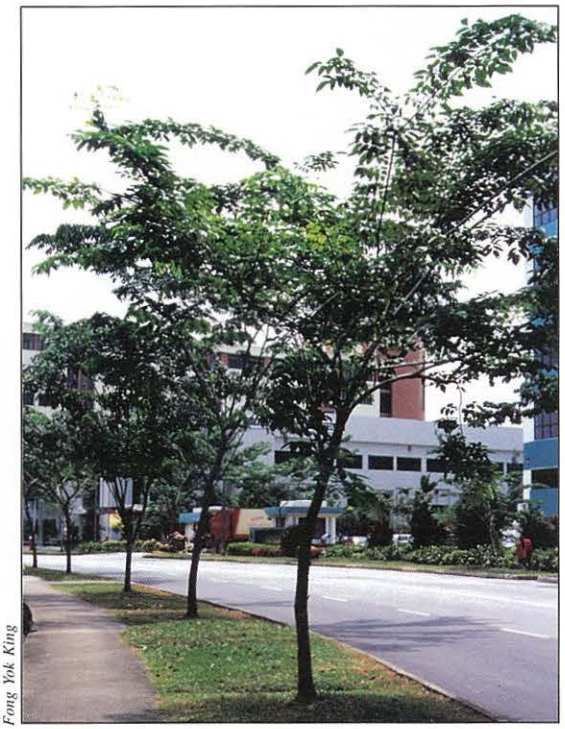
To develop a virus-free, mutation-free stock of culture in the Laboratory, we intend to adopt DNA and RNA-based techniques to detect virus infection and signs of genetic variations in parent plants and cultured plantlets.

The flower-bud culture developed has so far been applied to only *Mokara*, *Spathoglottis*, and *Oncidium*. This non-destructive method, if successfully developed, will significantly expand the opportunity for mericloning a wider variety of orchids.

Lim-Ho Chee Len
Koh-Low Neok Chein
Khoo-Woon Mui Hwang
Quek-Phua Lek Kheng, Jassy
Tissue Culture Unit

THE WILT OF THE BEAUTIFUL ANGSANA

The Angsana Wilt Disease was first observed in Malacca in Peninsular Malaysia from 1870 to 1880 and again in early 1900s in Penang, Tapah and Taiping (Perak) and Kuala Kubu and Kuala Lumpur (Selangor). The first disease incident in Singapore occurred in Pulau Brani in 1914. It then spread to Connaught Drive, Dhoby Ghaut, the Istana, Tanglin Barracks, and St John's Island. At that time, this devastating disease apparently wiped out most of the Angsanas *(Pterocarpus indicus)* in Singapore. After these episodes, there were no further records till the 1970s. In the late 1970s and in 1982, the disease re-surfaced in isolated areas including Tampines Road, Whitley Road, Lim Chu Kang Road, Choa Chu Kang Road, Newton Road and the Ulu Pandan Incinerator compound. During this period the disease killed many of the Angsanas along Tampines Road. However the implementation of rapid removal and disposal of infected trees, by burning and fungicide drenching of areas around infected trees and trees suspected of being infected, the spread of the disease appeared to be under control. No further incidence of the disease was reported until 1988 when a case was detected at Collyer Quay. From 1988, the disease appeared rampant in parts of Singapore. Between 1988 and 1994, over 800 Angsanas were removed as a consequence of the disease. These were mainly confined to Lim Chu Kang Road, Choa Chu Kang Road, Woodlands Road, Jalan Ahmad Ibrahim and Alexandra Park.



Fong Yok King

"Resistant" Angsana saplings at Toa Payoh Avenue 8. This location was known to contain *Fusarium oxysporum* in the soil. These healthy saplings were planted here 21 months ago.

The causal organism of Angsanas mortality has been confirmed to be the soil borne fungus, *Fusarium oxysporum*. In areas where the disease is already established, the spread of the causal organism is either by root graft or spores washed down from diseased trees into the soil. But in areas where there is no previous incidence of disease, the spread of the causal organism is by ambrosia beetles. Lightning injury has been determined as one of the major stress factors that predisposed the Angsanas to the disease. The **lightning — ambrosia beetle — *F. oxysporum*** complex accounted for 97% of the primary infection site during the 1993-1994 disease survey.

Although the origin of the disease is soil borne, initial spread of the fungus is by an insect vector.

Therefore control measures have to target the beetles and be implemented at the beginning of the primary infection cycle when the beetles first attack a lightning damaged Angsana.

The Angsana Wilt Disease control strategy has two main objectives: (1) to prevent the disease from becoming established in new sites, and (2) to slow down the progression of the disease in areas where infection has already established. There is no instant control for the disease epidemic. The success of the control strategy depends on slowing down the progress of the epidemic. Eventually this will result in the total control of the disease as the pool of inoculum becomes gradually reduced to below epidemic thresholds. Sporadic incidences of disease can then be mopped up.

The control strategy formulated aims to break the disease cycle by preventing the spread of *F. oxysporum* by the ambrosia beetles, to the lightning damaged Angsanas and subsequent establishment in the soil. The strategy is based on the following: (1) rapid removal of these lightning damaged trees, or chemical treatments in the form of sprays to prevent insect invasion of damaged trees and (2) sprays and injections to protect surrounding trees from invasion and infection. Details of the control strategy have been published in *The Gardens' Bulletin Singapore* (1998, Vol. 48, pages, 89-127).

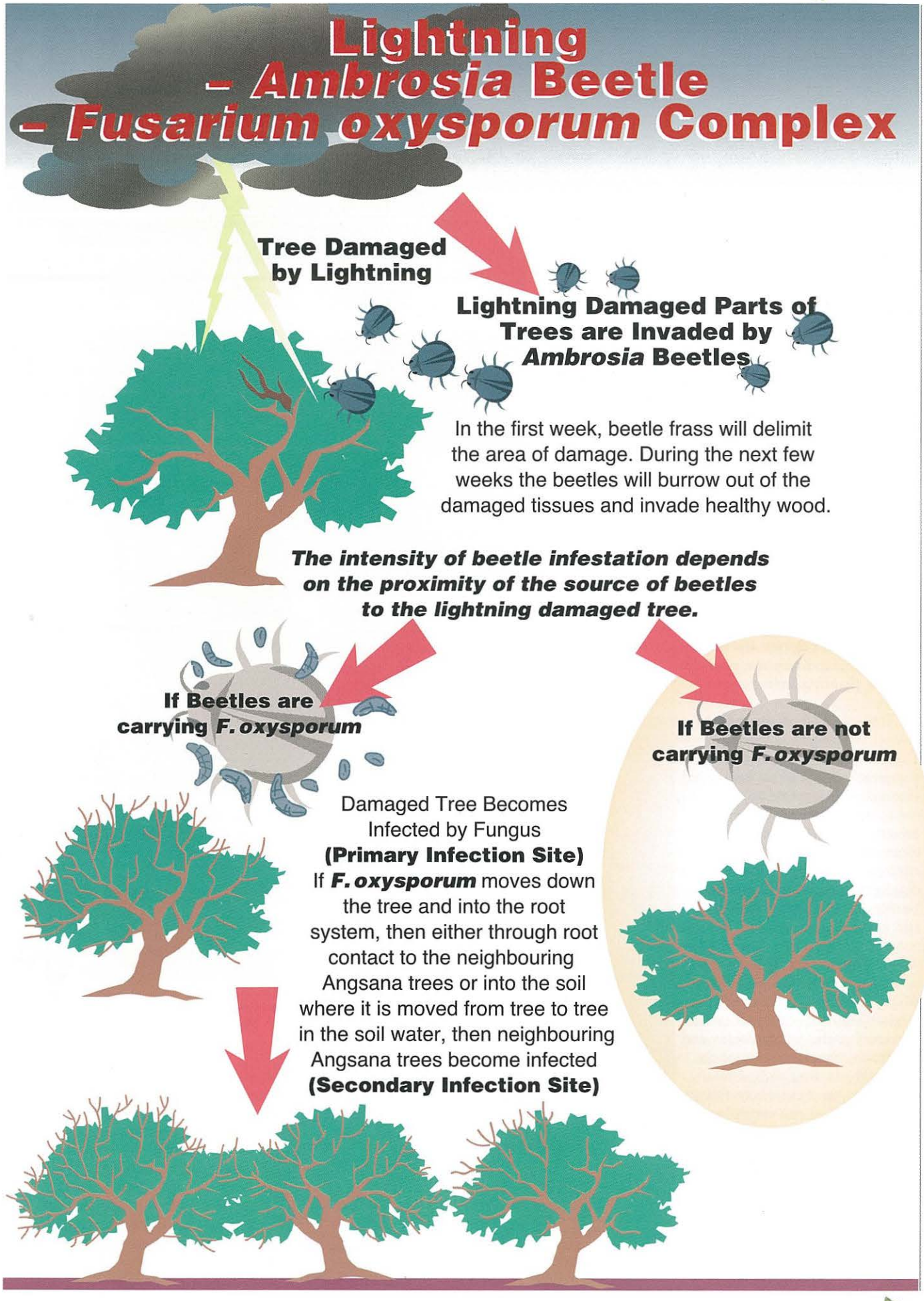
While the short-term aim of this pathological research was to develop a control strategy based on chemical control, the long-term aim is to identify lines of Angsana resistant to *F. oxysporum*.

Over 650 hardwood cuttings and 2,600 seedlings from 3,000 seeds of Angsanas collected from southeast Asian countries were screened for disease resistance. During screening, the research team was looking for a single gene resistance, which is expressed as an all-or-nothing reaction; resistant plants survive and susceptible plants die. All the "resistant" saplings obtained had been subjected to three disease screenings in the nursery. 115 of these saplings were planted in locations around Singapore known to be infested by *F. oxysporum*, for final field assessment for resistance.

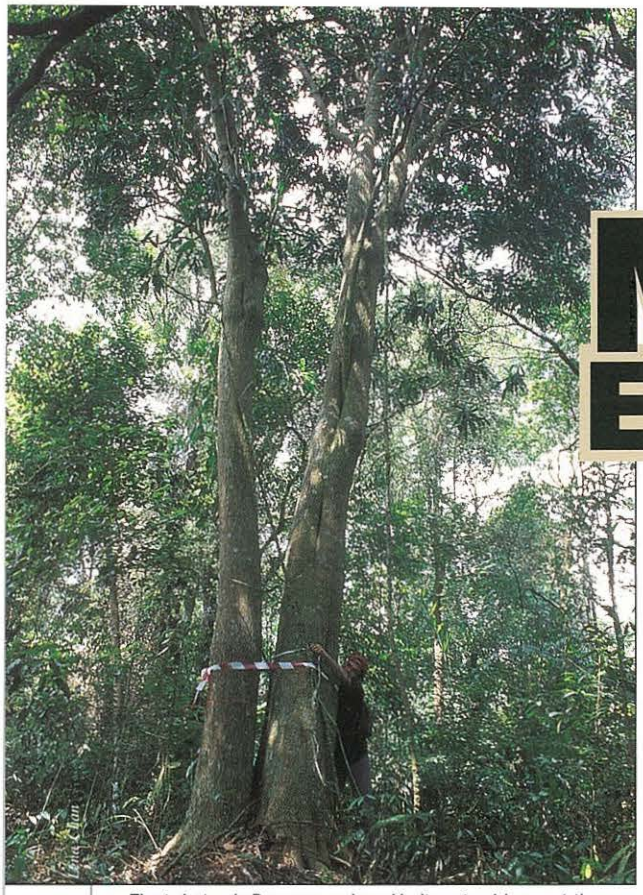
After growing in contaminated soil for 1 to 2 years, all the 115 saplings show no symptoms of the Angsana Wilt Disease and have grown tall and healthy. These saplings will be monitored closely for 3 years for disease symptoms to develop. Saplings that do not succumb to the disease after 3 years can be considered as "resistant" as susceptible saplings would have died within the first year after planting in contaminated soil. Propagations from these pioneers will be planted in areas affected by the Angsana Wilt Disease.

Fong Yok King
Jolly Lim
Plant Pathology Unit

Lightning – *Ambrosia* Beetle – *Fusarium oxysporum* Complex



MOVING EXPERIENCES



The twin-trunk *Dracaena maingayi* in its natural home at the Upper Peirce Reservoir site.

Alan Tan

The planting pit.

Transplanting mature trees and shrubs into a newly developed landscape allows an almost instantaneous creation of an established landscape. There are as many ways of moving large plants as there are people who move them. It is much more than just removing the tree from its original position and putting the plant into another planting hole.

Transplanted plants may be either moved bare rooted or with a root ball. They can be moved with the root ball completely exposed or burlapped and secured with rope or wire netting. In the extreme, the root ball maybe boxed. Care varies from the extremely meticulous, such as one to two years of root pruning prior to the move and digging a large root ball with careful burlapping, transporting, preparation of site using a good quality soil mix and overseeing follow-up maintenance, to the extremely casual, like simply scooping out the plant and moving it. Whichever method used has its own merits. Transplanting success also depends on the plant species and its condition, characteristics of the original and final planting sites, climatic conditions, and especially follow-up care, as well as the transplanting method itself.

Before transplanting, it is important to assess the overall health of the plant and the potential problems associated with moving it from a particular site. For instance, plants are transplanted more easily from sites that are free of stones and other obstructions.

We had a recent experience in moving a large tree under difficult site conditions. A large specimen of *Dracaena maingayi*, about 20 m tall was found at the Upper Pierce site of the proposed Central Service Reservoir on top of a hillock. We decided that this beautiful and majestic tree be saved and transplanted to the new Singapore Botanic Gardens Visitor Centre.

Dracaena maingayi is an exceptional *Dracaena* that grows to a large size reaching 20 m tall. It produces pale yellow flowers and small orange-coloured fruits. Native to Singapore and Peninsular Malaysia, its natural habitat is the coastal forest. Transplanting this tree involved planning and co-ordination works between the Gardens, the Public Utilities Board, which manages the Central Service Reservoir project and the Traffic Police. The *Dracaena maingayi* was crown pruned to a height of 17 metres from 20 metres. It was then root pruned (by trenching) and the trench backfilled with sand and cocopeat to encourage root growth for a month before the move. Due to the tight schedule of development works at the Reservoir, we did not have the luxury of trenching for a longer period.

Just prior to moving, the trunks and main branches were wrapped in gunny for protection against abrasion. As this individual has twin trunks, it posed a special problem and extra care had to be taken to ensure that it did not split into two. The trunks were braced with stout poles and securely strapped together at several points.

Alan Tan

Preparing to lift the tree from its original site. Note the twin-trunks securely wrapped and strapped, the neatly bundled rootball and the iron pipes supporting the tree.

Finally, the tree was lifted by crane and loaded onto a long trailer on 24 June 1998. With the rootball, it weighed 25 tonnes. The diameter at breast height (dbh) of the trunks were 52 and 49 cm respectively. The size of the root ball was 3 metres across and 1.2 metres deep.

The most crucial part of the process was lifting and laying it down onto the trailer. Stakes of timber, more sacking material and bags of cocopeat were used to support the tree on the trailer so as to avoid damage. The tree was secured with manila ropes and metal chains. The next critical step was testing how secure the tree was on the slow drive down the steep slope of the hillock onto a tarmac road. The tree appeared snug and safe.

To conform to regulatory requirements and traffic conditions the trailer with its precious load was driven to the Gardens at about midnight under traffic police escort. It was parked at an open space within the Gardens. The following morning, operations continued and tension mounted. At one point, in negotiating a slope on an uneven road leading to the planting site, the heavily loaded trailer started tipping to one side. It could only proceed very slowly with an excavator putting a supporting arm on the tree.

To allow the trailer and crane to be positioned at the planting site, steel plates had to be laid on the soft ground. The pre-dug planting hole was 3m x 3m x 3m and well prepared with a porous mix of topsoil, cocopeat and washed sand. The tree was readied for lifting by careful removal of binding ropes and chains and attaching the lifting cables from the crane at three different points. This was to ensure that the tree would be lifted in an upright position.

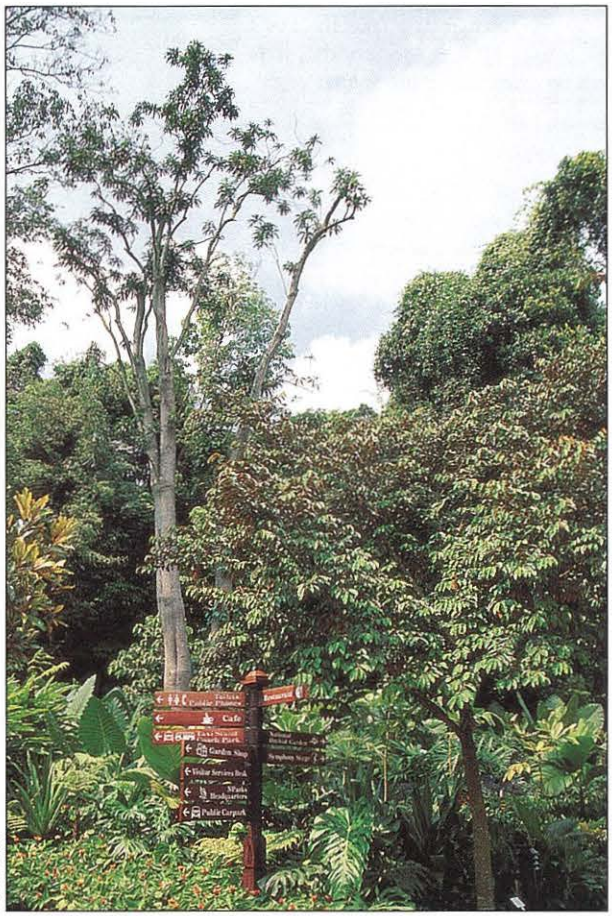
The tree was successfully lifted and placed into the planting hole; this took a while as the depth of the soil in the hole had to be readjusted so that the tree will sit at the right height with allowance for some settlement of the soil. The tree then had to be gently manoeuvred to its natural growing position while presenting its best face to future admirers as this new home is in a high profile area of the Gardens. Subsequently, the spaces left in the planting hole were filled in with gentle compaction. The tree was then staked with iron pipes; the parts of the tree against pipes being thickly wrapped with gunny. The base was mulched with shredded leaves and thoroughly watered.

Alan Tan

The tree resting comfortably on the trailer.

Alan Tan

An excavator was used to act as a restrain as the loaded trailer negotiated a curve on an uneven road.



Ali Ibrahim

A pride and joy of the Gardens. The transplanted *Dracaena maingayi* one year later. A result of careful planning, teamwork and dedication.

That was nine months ago, and the tree is now established with vigorous new growth.

Experience has shown that some species can be transplanted more easily than others. Easier ones include *Ficus superba*, *Ficus variegata*, *Cola gigantea*, *Bucida buceras*, *Khaya senegalensis*, *Terminalia ivorensis*, *Terminalia kaernbachii*, *Chrysophyllum cainito*, *Dillenia philippinensis*, *Clusia rosea*, *Sterculia coccinea*, and *Cratoxylum formosum*. The relatively more difficult species are *Maniltoa browneoides*, *Artocarpus integer*, *Pachira aquatica*, *Garcinia mangostana*, *Planchonella obovata*, *Dyera costulata* and *Gnetum gnemon*.

The methods of transplanting large trees depend very much on plant size and species, soil and site conditions, lead time between root pruning, moving and planting. It is also necessary to consider the distance between the original and new planting sites, available equipment, personnel and funds. Needless to say the larger and more sensitive a plant is, the harsher the weather and the greater the distance between the original and new planting sites, the more protective the methods must be. An important consideration which can affect success, is your feeling and passion for the tree. With some experience, you can follow your instincts and together with proper care, your transplanted tree will survive.

Camelia Marican
SBG Management Branch

The author would like to thank all her colleagues who assisted in this transplant; in particular Saiful, Puay Yok and Alan.

BIRD

Yellow-vented Bulbul *Pycnonotus goiavier* one of the most characteristic birds in the Gardens

Common Iora *Aegithina tiphia*, another of the delightful garden birds residing commonly in the Botanic Gardens. Not quite as easy to observe as the bulbul it jumps about inside the bushes and small trees always on the go in a constant search for small insects and larvae which it gleans off the foliage.

Two members of the starling family. White-vented Myna *Acridotheres javanicus* on the left and Philippine Glossy Starling *Aplonis panaysensis* fighting over a fallen fruit.

This was the title of an article in the very first introductory issue of Gardenwise 10 years ago 25 November 1989! That article was written by Dr Chris Hails, the photographs were supplied by... one of the undersigned! It is indicative of the fact that the management of the Botanic Gardens realizes that the gardens are not just about plants. All life depends on plants, that is true. But those higher life forms are often as fascinating as the plants themselves. And probably the most conspicuous, adaptable and easy to study of all are the birds.

Birds depend closely on the environment around them, and they react quickly to changes in it. That is one of the reasons why birdwatching is such a dynamic and exciting pursuit. Going back even further than the mid-1980s when Chris Hails studied birds here on behalf of the Ministry of the Environment, H.N. Ridley also studied the birds in the Botanic Gardens. That was around the turn of the century, and he published his findings in the Journal of the Straits Branch of the Royal Asiatic Society.

The Magpie Robin *Copsychus saularis* that Ridley describes in his piece as 'the bird best known to the residents here' is now all but gone from Singapore. Chris Hails tried to reintroduce it into the Botanic Gardens in the 1980s but the effort was not successful. A study in 1996 by a student from the National University of Singapore found 114 Magpie Robins on Singapore Island. She saw only 1 pair at Singapore Botanic Gardens. The Crested Serpent-eagle *Spilornis cheela* that Ridley found nesting regularly in the garden jungle today is down to a single pair in the country found inside the water catchment forest. Just like the White-rumped Shama *Copsychus malabaricus* that Ridley found 'in some numbers' frequenting 'the thicker parts of the woods', it is all but gone from Singapore today.

And gone completely is the Green Broadbill *Calyptomena viridis*, 'a lovely little green bird at times seen in the denser wooded spots' which has not been recorded in Singapore since 1941 and is now regarded as locally extinct. Ridley must have been one of the last people to see the Rhinoceros Hornbill *Buceros rhinoceros* in Singapore, he describes observing a pair in the garden. This species became locally extinct in 1898. In total an astonishing 57 resident birds have become locally extinct in Singapore during the last hundred years alone (since 1895). For details please see Lim, K.S. & D. Gardner (1997). Birds, *An Illustrated Field Guide to the Birds of Singapore*. Sun Tree Publishing, Singapore. It is available at the Botanic Gardens Shop.

But new birds have come into the country replacing these, taking advantage of new feeding and nesting opportunities. Ridley's observation that 'the absence of crows from Singapore seems very strange' rings somewhat funny today where the House Crow *Corvus splendens* is everywhere on the island picking up scraps from right under the noses of picknickers at the beach. It is even regarded as a pest that gun-toting controllers frequently have to cull.

And while the Philippine Glossy Starling *Aplonis panayensis* was already 'most abundant' at Ridley's time 'flying in large flocks and wheeling in masses like the English Starling' (=Common

S of the Singapore Botanic Gardens

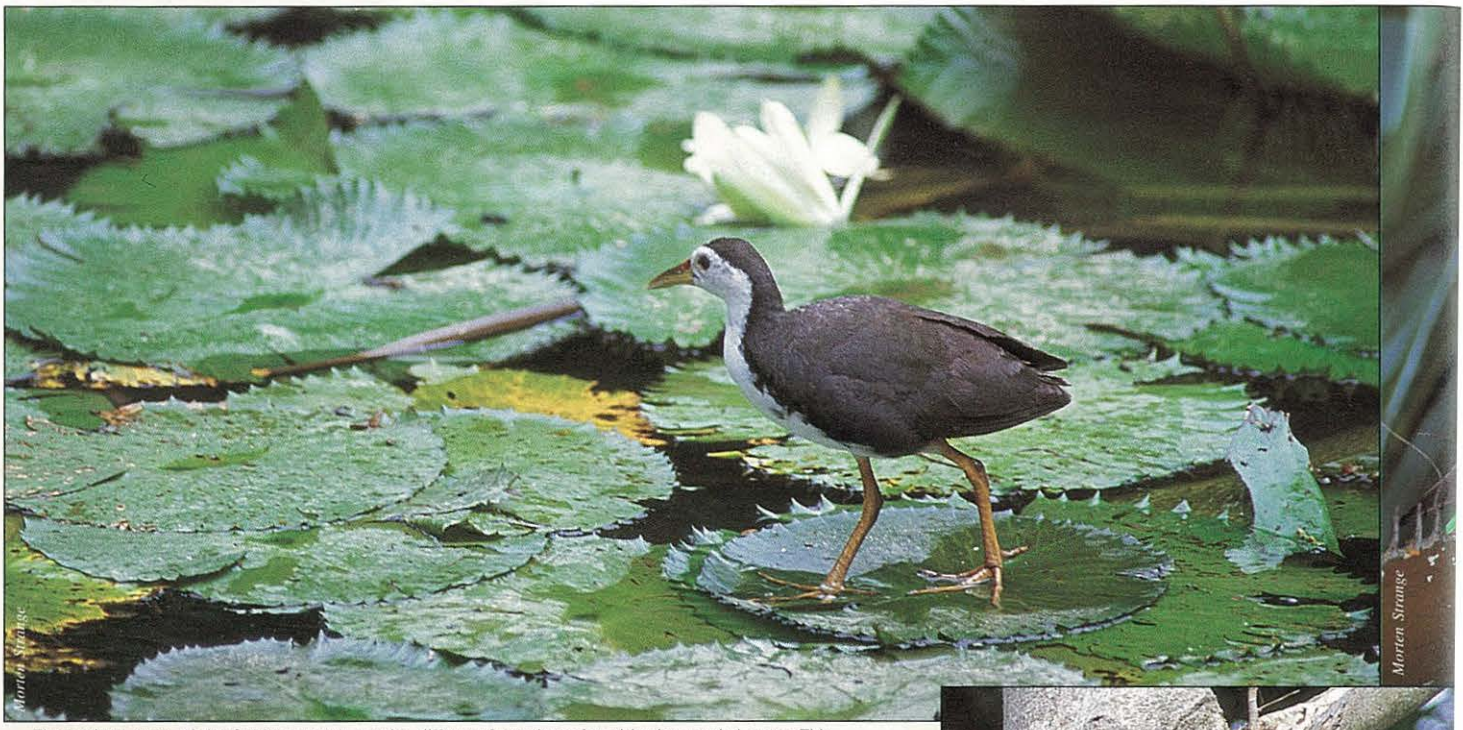
Another starling, the Hill Myna *Gracula religiosa*, is a forest bird and prefers the taller parts of the park around the rain forest patch. It also visits fruiting trees but moves high near the canopy. Its penetrating whistle can often be heard early in the morning.

The Olive-winged Bulbul *Pycnonotus plumosus* is a close relative of the Yellow-vented but prefers denser cover and is not nearly as numerous. It has a similar bubbling call.

Starling *Sturnus vulgaris*) he made no mention of the Common Myna *Acridotheres tristis* or the White-vented Myna *A. javanicus*. Simply for the good reason that there weren't any around at the time. They only invaded Singapore in the 1930's, the brown-plumaged Common Myna came down along the Malay Peninsula aided by forest clearance. The all-black White-vented Myna escaped from captivity and is today Singapore's most numerous resident species.

Even in the relative short period since Chris Hails wrote his article birdlife in the Botanic Gardens has changed. We had the wonderful record of a Crested Goshawk *Accipiter trivirgatus* breeding right inside the garden high in a palm tree near the rainforest patch in 1988. Other true forest species like Changeable Hawk-eagle *Spizaetus cirrhatus* and Red-legged Crake *Rallina fasciata* have been found breeding. According to the *Handbook of Birds of the World* Vol. 3 p. 155 the Red-legged Crake's nest has never been described anywhere in the world, so here is a possible task for some observant visitor to the

The Pink-necked Pigeon *Treron vernans* is one of the most typical birds in Singapore, it has benefitted tremendously from the Garden City development and is abundant in many places - like the Botanic Gardens. Only the male has the pink breast, this is a female feeding on the Simpoh Air *Dillenia suffruticosa* which provides a stable diet for many of Singapore's pigeons, bulbuls and sunbirds.



The wetland areas of the Gardens attract species different from those found in the wooded areas. This White-breasted Waterhen *Amaurornis phoenicurus*, is often seen walking out onto the leaves of the water lilies around the Symphony Stage.

Birds, Continued from page 23

garden who wants to make a name for himself in ornithological circles.

Visitors to the gardens should however not let themselves get confused by the many escapee birds that also occur. In fact the gardens seem to act like a magnet for these birds. Some escape from the wildlife traders, some are released on purpose into the environment by the public. No, there are no cockatoos native to Singapore — those large white parrots only occur naturally in the Australasian region from Eastern Indonesia into Australia. But nevertheless both Yellow-crested Cockatoo *Cacatua sulphurea* and the smaller Tanimbar Cockatoo *C. goffini* can be seen flying freely about screeching loudly. As can, Palm Cockatoo *Probosciger aterrimus*, Red Lory *Eos bornea*, Great Hornbill *Buceros bicornis* and a host of other foreign aliens. Most of these are easy to pick out even without binoculars but you have to look very closely to distinguish the introduced Vernal Hanging Parrot *Loriculus vernalis* from the Blue-crowned Hanging Parrot *L. galgulus* which occurs naturally in the gardens, although in small numbers and usually just seen flying quickly across overhead.

With the development of the large new extension and the Eco Lake near the Bukit Timah Road more new native birds have turned up. Next time you walk down there look for the Purple Heron *Ardea purpurea*, in fact it should be fairly obvious. But also try to locate the more cryptic Yellow Bittern *Ixobrychus sinensis* inside the reed-covered banks of the lake. And you might also spot the uncommon Stork-billed Kingfisher *Pelargopsis capensis* as it perches inside one of the trees — or more likely as it flies low into another one, calling loudly. The Oriental Reed-warbler *Acrocephalus orientalis* may just be a common winter visitor from the north but it wasn't here before the Eco Lake was put in.

The Banded Woodpecker *Picus miniaceus* is also mainly a forest bird but it can quite easily be seen near the rain forest area where the trees are large and close. Listen for the penetrating call peew. Notice the strong legs showing clearly on this photograph.

Two female Brown-throated Sunbirds *Anthreptes malacensis* displaying, this one and the smaller Olive-backed *Nectarinia jugularis* are the two most common sunbirds in the Gardens.

There are plenty of escapee exotic parrots flying about in the Botanic Gardens, some still carry the rings around their legs from former imprisonment! But the Long-tailed Parakeet *Psittacula longicauda* is native. It has a small distribution range within the Sunda subregion, and does not do well in captivity.

Unlike most other barbets the Coppersmith Barbet *Megalaima haemacephala* is not a forest bird, it prefers the open park-like habitat that the Botanic Gardens offer in plenty. It is best seen when it visits fruiting trees or when it calls from a high perch like this one, the call is a distinctive and persistent took-took-took.

The Yellow Bittern *Ixobrychus sinensis* hates to come out into the open. With a bit of patience it can be seen around the Eco Lake but always inside or near the cover of dense reeds.

Occasionally new species are added to the list of birds in the Botanic Gardens — like this Oriental Reed Warbler *Acrocephalus orientalis* which is a winter visitor to Singapore from temperate East Asia and which was undoubtedly attracted by the wetland habitat around the Eco Lake where this photograph was taken in March 1999.

Several kingfishers occur in the Botanic Gardens, both White-throated *Halcyon smyrnensis* and Collared *Halcyon chloris* are established residents but the larger and rarer Stork-billed Kingfisher *Pelargopsis capensis* has only recently colonized the park, in 1999 a pair settled around the Eco Lake.

The Purple Heron *Ardea purpurea* usually requires extensive marshes to thrive but the Eco Lake in the new extension is just large enough for it. These normally shy birds are getting used to morning joggers and school kids using the trails around the lake and have become remarkably approachable

There is no doubt that these usually shy and elusive wetland birds are becoming used to harmless human traffic and much more tame and approachable than the birds you find in remoter rural areas of the island.

The new Visitor Centre of the Botanic Gardens has also attracted a lot of birds. It is probably the best place in the world to see the Long-tailed Parakeet. Every evening around 5 p.m. a small flock settles in the oil palm trees next to the cafeteria — visitors in the garden can have their tea while watching the parrots have theirs!

So get Lim Kim Seng's guide book to the birds, it is the first bird book on the market that covers all the species you can possibly see in the country. Then look at the plates and identify the different bird species as you come across them. Make a list. You can easily find 10-12 in one morning, maybe 20-30 over a few weeks. Chris Hails accumulated a list of almost 100 species during the 6 years he had an office in the Botanic Gardens.

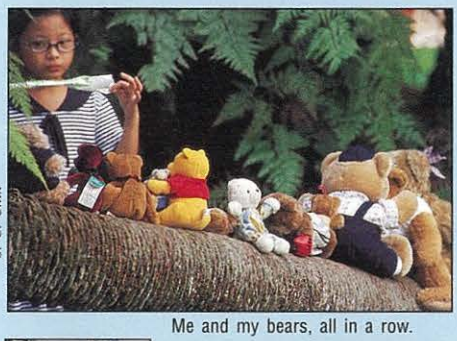
As you then travel to a different habitat or a different region you will notice how the composition of birds changes. But just watch out, because before you know it you might turn into one of these fanatic sighting collectors — so-called twitchers — who travel the world in a frantic effort to add new species to their world list. There are about 9,300 species to go for. The Botanic Gardens is a good place to start.

Morten Strange
Ng Bee Choo
Nature's Niche

A special thank you goes to Lim Kim Seng who is also chairman of the Records Committee of the Nature Society of Singapore's Bird Group and who provided us with the latest information about the avifauna in the Gardens. Thanks also to Huang Hsiao Ling for providing data on the Magpie Robin.

AROUND THE

BG becomes a Bear Garden



S. C. Chin

Me and my bears, all in a row.

Ian Turner

Wearing traditional sarong kebaya (with matching accessories), this bear and owner were prize winners in the 'Best Bear Dressed Like Its Owner' Competition.

Ian Turner

Bears of all shapes and sizes came for the picnic.

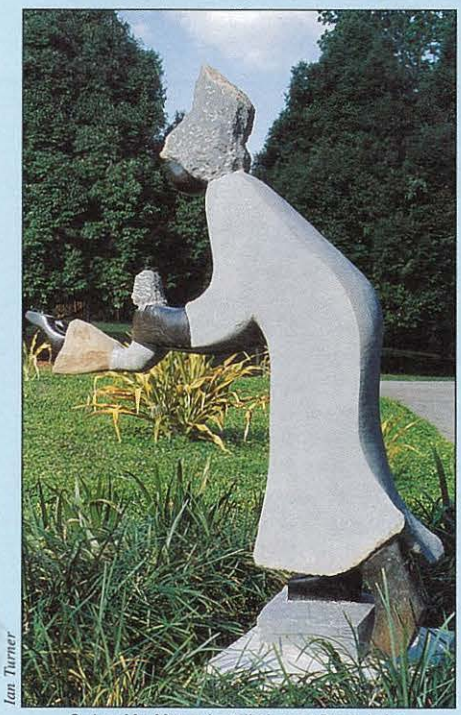
Where do Singapore Teddy Bears go for their picnics? The Singapore Botanic Gardens of course. The first official Teddy Bears' Picnic was held on 5th June 1999, and on that day the Gardens was soon crowded with bears of all shapes and sizes. There were even some V.I.Bs (Very Important Bears) among those joining the throng of picnickers. Singapore First Lady, Mrs Ong Teng Cheong, kindly let her teddy attend; as did Baroness Thatcher, former President of Singapore, Dr Wee Kim Wee, and Minister for Trade and Industry, Brigadier General George Yeo. BG Yeo and his family accompanied their bear to the picnic, which the Minister opened (we presume his bear was too shy to do it).

(Human) visitors were allowed to bring their own bears to the picnic and take part in a range of competitions including finding the best matched bear and owner, and the best bear family. Bears of all sorts were on display, and the bearless were able to adopt (at a price) some ownerless bears brought in specially by the organisers. It was estimated that about 10,000 bears and humans attended the event which began in the morning.

At six o'clock their mummies and daddies did take them home to bed because they were all tired (but happy) little teddy bears.

The event, organised by Sasha's and Company, raised $20,000 for the Children's Charities Association.

Singapore Rotarians Donate Artwork to the Gardens



Ian Turner

Swing Me Mama installed near Swan Lake.

Seventeen Rotary Clubs in Singapore joined forces to donate a work by Zimbabwean sculptor, Dominic Benhura, to the Botanic Gardens. The donation, termed 'A Singapore Legacy', was to mark the 90th Rotary International Convention being held in Singapore. The sculpture, entitled Swing Me Mama, was unveiled by Rotary International President Mr James L. Lacy on 10th June 1999, when it was formally presented to Gardens' Director, Dr Chin See Chung. Mr Lacy has made children the focus of his year-long presidency of Rotary International, and the sculpture, featuring mother and child, is a fitting emblem for the theme of the Singapore Convention — 'children are our future.' In accepting Swing Me Mama, Dr Chin also noted the donation as a very appropriate reminder of the importance of children to the Singapore Botanic Gardens.

The serpentine and springstone creation portrays a mother swinging a child in her arms in a very direct, fluid and delightful way. Purchase of this piece and transport from Zimbabwe was arranged and paid for by the Singapore Rotarians. The Singapore Botanic Gardens is very grateful for this extremely generous donation by the 17 Rotary Clubs. Swing Me Mama is already in place, gracing the shores of Swan Lake.

Ian Turner
Nature Conservation Branch

Our New

For the first time in its 140-year old history, the Singapore Botanic Gardens has a Visitor Centre. The Centre, accessed by a new entrance, Nassim Gate, features timber construction with expressive trusses and a shingled roof, is detailed to provide a rustic ambience. It was officially opened on 10th December 1998 by Mr Lim Hng Kiang, Minister for National Development and Second Minister for Finance. The significance of the Visitor Centre lies as much in its services and facilities as in its ambience.

The entrance porch is a proper drop-off and pick-up point for visitors. It leads to the Orientation Foyer where the Visitor Services Desk is located to provide friendly and useful information about the Gardens' on-going activities and up-coming programmes including performances. Housed within the Visitor Centre is an impressive Clock Tower, the design motif of which was inspired by the Gardens' icon, the Sealing Wax Palm.

Stepping out from the Orientation Foyer, one enters Palm Court, a peaceful oasis of palm trees and fountains, bordered by two wings of the

HIGHLIGHTS FROM

Botanical Drawing Course • 23rd - 26th Fe

Ten participants attended the course. Apart from the botanical artists from the herbaria at Kuching and Sandakan, the rest were neophytes selected because learning techniques of botanical drawing would enhance their work skills.

The course instructor, Rosemary Wise, is the botanical artist in the Plant Science Department, Oxford University, freelances for publications at Kew, and is author/artist of the award-winning book, *A Fragile Eden*, which illustrates endemic plants of the Seycelles. Besides her international reputation as an artist, Rosemary Wise is well known as an instructor having conducted several courses in the region.

The four-day course focused on pencil and ink drawing techniques, emphasising accuracy of drawing, composition, shading and the conventions used for publication.

Once basic techniques had been explored, drawing a herbarium specimen was tackled with emphasis on rigorous, scientific accuracy, followed by the more three-dimensional drawing of a live plant and microscopic dissections of flowers.

Improvement of skills was marked and Rosemary's assessment at the end of the course was that all participants had produced work of a standard that could be published. Indeed, one or two participants showed outstanding talent!

The Singapore Botanic Gardens is indebted to Mr Eng Bak Hern, who most generously sponsored the course, and to Rosemary Wise, who fitted the course into her busy schedule.

Ruth Kiew
Herbarium & Library

Botanical Illustration in the backgr

GARDENS

isitor Centre

Ali Ibrahim

The main waterfall at the Visitor Centre. Corner House sits on top.

Centre. One wing houses a café and the other the Garden Shop. Visitors can sit and linger under the shade of Oil Palm trees and be soothed by the sounds of the eight fountains while admiring the scenes all around. Crowning Palm Court is the Cascade Garden showcasing two waterfalls, one three-tiered, constructed of volcanic rocks and set amidst lush plantings.

Seated as if 'floating' above the waterfall is EJH Corner House which is now home to Au Jardin Les Amis (French for 'Friends at the Gardens'). This fine dining restaurant offers French cuisine for lunch and dinner.

Topping off all these, the Visitor Centre also offers coach and car parking facilities. It is certainly helping to make a visit to the Gardens a more relaxing and fulfilling experience. We welcome you to step in.

Wong Wei Har
SBG Management Branch

HE SCHOOL OF HORTICULTURE

ry 1999

Ali Ibrahim

The participants: Back row (left to right) Ali Ibrahim and Joseph Lai (Herbarium), Chew Ping Ting (Nature Conservation Branch), Chin See Chung (Director, Singapore Botanic Gardens), Janice Yau (School of Horticulture), Ubaldus Majawal (Herbarium, Sandakan), Tan Jiew Hoe (Patron, Singapore Botanic Gardens) Wan Omarshah Wan Putera (Herbarium, Kuching). Front row Deborah Tay and Halilah Ahmad (Sungei Buloh Nature Park), Rosemary Wise (Course instructor, Oxford University), Ruth Kiew (Herbarium).

Ali Ibrahim

Rosemary Wise teaching Joseph Lai.

Janice Yau

New & Exciting

S.C. Chin

The Ensete in the Gardens photographed on 29 May 1999. A plant to the right has produced an inflorescence.

Ensete superbum

A close relative of the Banana, Ensete with seven species likewise belongs to the family Musaceae. The genus is distributed from Africa to south China and parts of southeast Asia. It bears banana-like fruits which are dry and inedible.

Ensete superbum is a native to India. It grows up to 12m high with a bulbous base consisting of enlarged leaf stalks. The large, bright green leaf blades with reddish midribs can reach a size of 1.8 x 1m. These striking leaves are borne on a trunk-like pseudo-stem formed of tightly packed petioles.

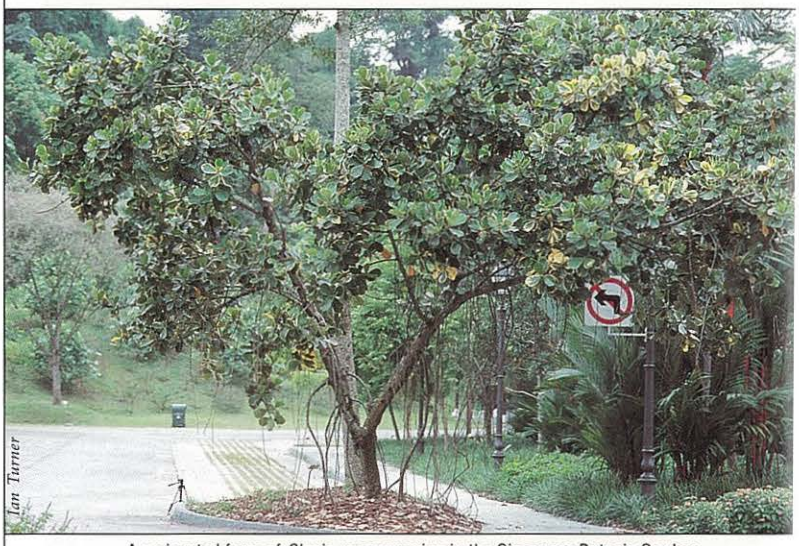
This easy to grow species likes full sun, plenty of water and a rich soil. Our plants were derived from 12 seeds presented by the Tropical Botanic Garden and Research Institute, Thiruvananthapuram, Kerala, India, on 24th May,1996. They were planted out on 10th January 1997.

Ohn Set
Plant Resource Centre

What's Blo

Clusia rosea

Imagine a cross between a mangosteen tree and a strangling fig and you get some idea of what a *Clusia* is like. The genus is closely related to *Garcinia*, the mangosteens, as can be recognized by the similar flowers, young fruits and yellow latex that oozes from cut parts. A major difference can be seen in the mature fruit. To eat a ripe mangosteen you must break open the leathery skin — a *Clusia* fruit splits naturally to reveal the seeds embedded in flesh. The *Clusia* plant is like a strangling fig (though not closely related) beginning life as an epiphyte growing on another tree and sending down roots to the ground. Epiphytes are prone to water shortage problems and many species of *Clusia* are physiologically similar to cacti and other succulents, possessing thick fleshy leaves that only open their stomata, the tiny pores in the leaves that allow the movement of air into the leaf, at night.



Ian Turner

A variegated form of *Clusia rosea* growing in the Singapore Botanic Gardens.

NATURE CONS

Biodiversity in the Nature Reserves

The Biosurvey of the Nature Reserves Project was coordinated by the Nature Conservation Branch from 1991 to 1997. The researchers presented the results of the survey at a seminar held in December 1997. Early this year, the proceedings of the Nature Reserves Survey Seminar were published in a special issue of *The Gardens' Bulletin* (Volume 49, Part 2), titled 'Biodiversity in the Nature Reserves of Singapore'.

The survey chalked up several new records for the Nature Reserves: 184 indigenous vascular plant species; 35 additions to the bird checklist; 17 new butterfly records; eight new records of semi-aquatic bugs; four new

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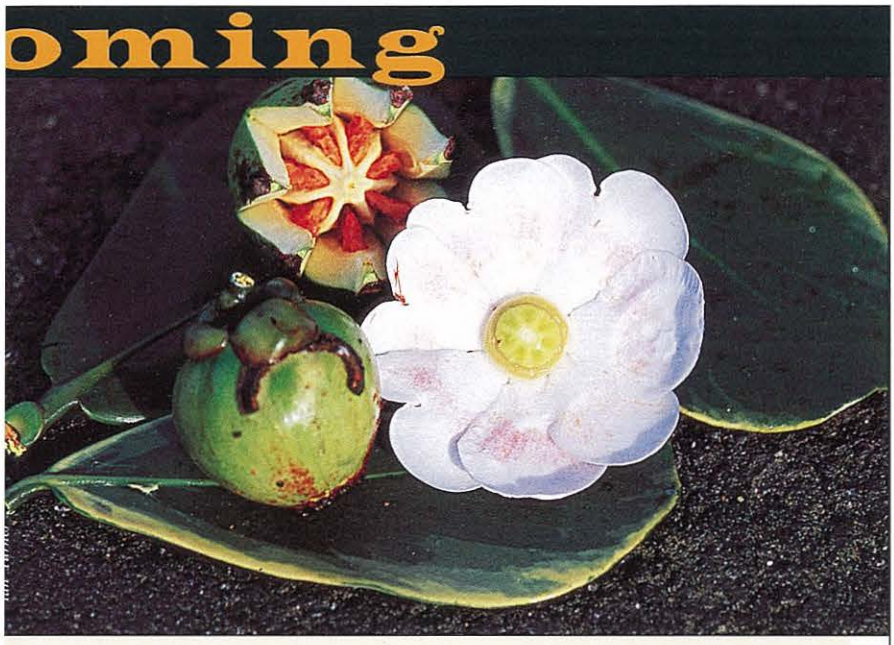


A flower, young fruit and mature fruit of *Clusia rosea*.

This reduces the amount of water lost during the uptake of carbon dioxide required for photosynthesis.

Clusia rosea is a handsome bushy tree with fleshy, triangular leaves and beautiful pink-and-white flowers. Several plants of *Clusia rosea* grow near the Nassim Gate at the Visitor Centre of the Singapore Botanic Gardens. Like all the species of the genus, it is native to tropical Central and South America. When the open flower is observed closely a brownish sticky ring can be seen around the stigmatic surface. This is a resin secreted by the plant as a reward for its pollinators. In the New World, these are small bees that collect the resin to use in the construction of their nests. Our cursory observation in Singapore showed no insect visitors to the *Clusia* flowers, yet the fruits contained seeds. This may indicate the production of seeds without pollination, a phenomenon also known in the mangosteens.

Ian Turner
Nature Conservation Branch

ERVATION NEWS

records for mammals; at least two new records for reptiles and three new amphibian records. Indeed, the merit of a long-term systematic survey cannot be over-extolled.

Since this volume compiles papers covering the biodiversity and conservation status of a diverse range of taxonomic groups, it functions as a convenient permanent record for monitoring and future comparisons of these groups: vascular plants, mammals, reptiles, amphibians, fishes, freshwater prawns and crabs, butterfly, stick and leaf insects, semi-aquatic bugs, water beetles, and dragonflies.

The data collected have already been put to good use. The foundation of the Recreational Masterplan for the Nature Reserves lies on the results of the biological survey. The formulation of biodiversity conservation strategies and management practices will now be based on the rich biological databases that have resulted from the biosurvey. These data will also serve as nature conservation educational resource materials. With this baseline data source, the charting of research priorities has a rational basis.

Lena Chan
Nature Conservation Branch

Key Visitors To The Gardens

JANUARY — JUNE 1999

NAME	FROM
Mrs Alan Richard	Wife of French Minister of Defence
Dr Andrew Henderson	New York Botanical Garden, USA
Dr J Bastmeeger	Rijksherbarium, Leiden, The Netherlands
H E Dr Bela Szabadi	State Secretary (Political) Ministry Of Agriculture and Regional Development, Hungary
Mr Chun Chul Hwan	Governor, Bank of Korea
Mr Dale Dixon	James Cook University, Australia
Drs David & Alice Edwards	Brunei University, Brunei Darussalam
Mr Ferry Elik	Rijksherbarium, Leiden, The Netherlands
Professor J A Raven	University of Dundee, UK
Mrs Jill Dodson	Wife of Major General Maurice Dodson,Chief of General Staff, New Zealand Army
Ms Kate Slack	Royal Botanic Garden, Kew, UK
Dr. Kim Hong-kyu	Associate Professor, Dept of Urban Planning and Engineering, Yonsei University, Seoul
Mrs Maria Almeida	Wife of Prime Minister of Cape Verde
Mr Marjan Senjur	Minister for Economic Relations and Development, Slovenia
Dr Michael Kiehm	University of Vienna Botanic Garden, Austria
Begum Kulsoom Nawaz Sharif	Wife of Prime Minister of Pakistan
Mr Om Yong Won	Deputy Managing Director Government Designing Authority, Seoul
Professor P B Tomlinson	Harvard University, USA
Mr Peter J Edwards	Royal Botanic Garden, Kew, UK
Dr Piya Chalermglin	Institute of Science and Technological Research, Bangkok, Thailand
Dr Piyakaset Suksathan	Queen Sirikit Botanic Garden, Chiang Mai, Thailand
Mr Richard Dearlove	Assistant Chief Director of Defence, UK
Professor Robert Johns	Royal Botanic Garden, Kew, UK
Ms Shoko Sakai	Kyoto University, Japan
Ms Siti Khatijah Rambe	Universiti Kebangsaan Malaysia, Bangi, Malaysia
Mr Somphong Mongkhonvilay	Vice president for State Planning Committee, Lao People's Democratic Republic
Dr Stuart J Davies	Universiti Malaysia Sarawak, Malaysia
Mr Suren Govil	Vice-Admiral & Regional Consultant, International Award Association, Australasia Region, India
Dr T C Whitmore	Cambridge University, UK
Mr Takeshi Numata	Governor, Chiba Prefecture, Japan
Mr Tatsuro Suga	Governor, Kagoshima Prefecture, Japan
Dr Tim Utteridge	Royal Botanic Garden, Kew, UK
Mr Tokutake Okajima	Director, Orchid Gardens, Nagoya, Japan

FROM THE ARCHIVES

Then & Now

Postcards provide an interesting insight into how visitors remember the Gardens. Even more fascinating are the old ones that give us a glimpse of the past. Some of the old postcards can be dated from the postmark or the message as on this one.

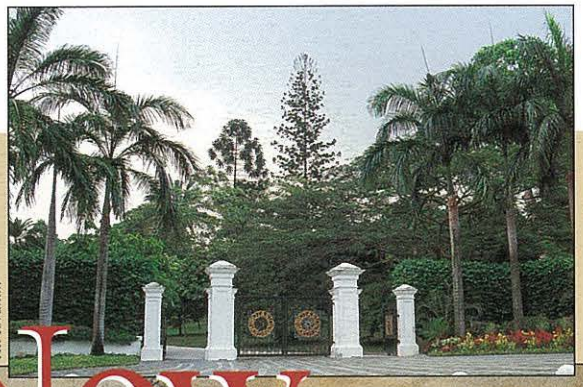
The Main Gate and Swan Lake appear on many of the old postcards. The Lake has hardly changed and visitors still pause to gaze pensively at the serene surface reflecting the tranquil treescape. Or, is the gentleman in the hat disturbed by the mud bank, an obvious sign of siltation? A problem controlled by a silt-pond today.

Stately nibung palms (*Oncosperma tigillarium*) still grace the island today. The suckering palms, nibung and sago (*Metroxylon sagu*, its fronds can just be seen on the extreme left of the Main Gate) are the oldest plants in the Gardens dating back to the original plantings. In contrast, the original trees have now outlived their lifespan and are replaced by a second generation, like the conifers to the right of the Main Gate.

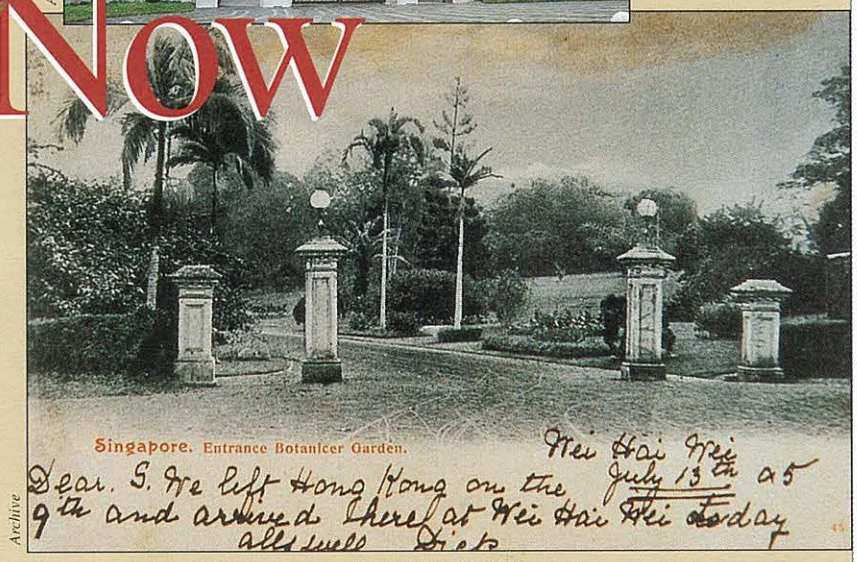
Note how widely spaced the gate posts were. In the old days, horses and carriages and later cars were permitted access to the Gardens.

The library has a small collection of original postcards, as well as two albums of photographs of old postcards, the latter presented in 1992 by Lim Kheng Chye. Two are shown here.

Ruth Kiew
Herbarium & Library

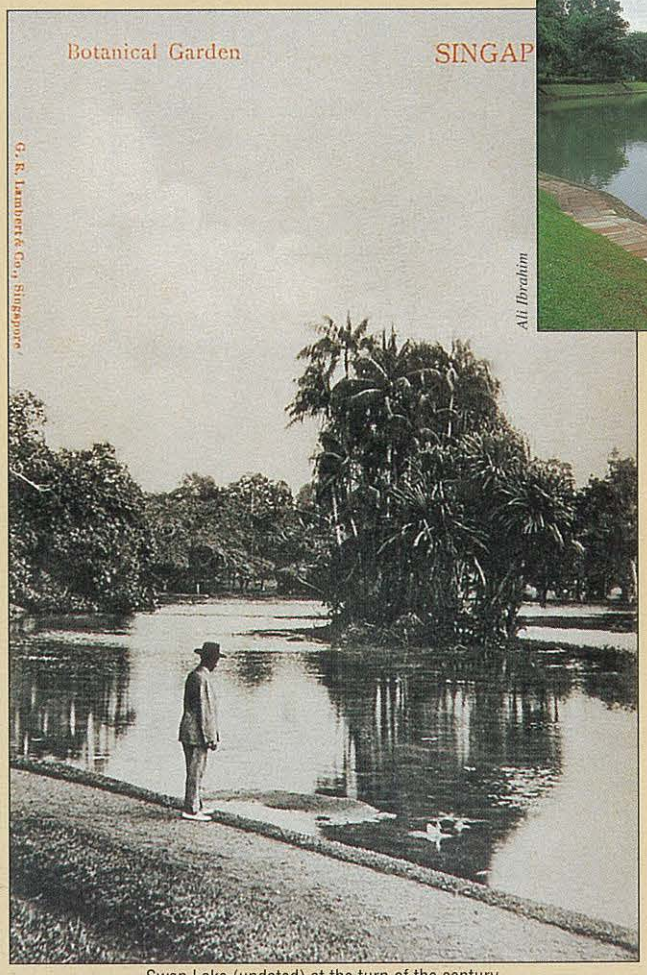


The Main Gate in 1999.



The Main Gate in 1905.
'Dear S. We left Hong Kong on the 9th and arrived here at Wei Hai Wei today. All's well. Dick'.

Swan Lake in 1999.



Swan Lake (undated) at the turn of the century.