BGO NEWSLETTER

THE BOTANICAL GARDEN ORGANIZATION

PRIME MINISTER'S OFFICE

Number 09 ISSN 1513-1696 September 2001

The Royal Annual Visit

HM Queen Sirikit paid the royal visit to the Queen Sirikit Botanic Garden on Friday 26 January 2001. On this occasion, HM the Queen planted *Dendrobium scabrilingue* Lindl., a species of fragrant wild Thai orchid, on a tree trunk.

Her Majesty was pleased with the progress of the "Fireflies Project", a project under her royal initiatives. (More on page 16.)

HRH Crown Prince Vajiralongkorn accompanied HM the Queen and presided over the opening ceremony of the Greenhouse Complex.

HRH Crown Prince Vajiralongkorn at the Aquatic Plant House.

SPECIAL EVENT: *HM Queen Margrethe II of Denmark and HRH Princess Mahachakri Sirindhorn of Thailand presided over the opening ceremony of the Symposium on Centenary Celebration of Thai-Danish Cooperation in Biodiversity.* *(See page 10)*

Director's Message

Since the establishment of the Botanical Garden Organization in 1993, the garden has been developing very fast and is in a satisfactory progress in targeting one of its key objectives that of being a Botanical Garden of international standard.

With the continued support of Her Majesty the Queen, as well as the Thai Government, the garden is expected to become a center for plant biodiversity conservation at the regional level. It is also my pleasure to mention the support of the Danish Government for the Capacity Building in the Field of Biodiversity Project at Queen Sirikit Botanic Garden.

We have made every effort to serve members of the community by providing an aesthetic venue for the general public, educating students, and collaborative work with other scientists.

This newsletter is intended to provide information to nature lovers and a guide to all readers who would like to follow up the latest developments at QSBG. Moreover, through this publication we would like to inform national and international scientists about the work undertaken at QSBG, and invite them to join forces with us for the conservation and sustainable use of biological diversity.

Weerachai Nanakorn, Ph.D.

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The BGO Executive Board

Editorial

This issue of the BGO Newsletter has a theme of "*cooperation*" with the emphasis on biodiversity research. We bring to you an overview of Thailand's long lasting cooperation with Danish scientists by presenting the royal keynote address given by HRH Princess Maha chakri Sirindhorn at the opening ceremony of the symposium on "Centenary Celebration of Thai-Danish Cooperation in Biodiversity", organized at the Queen Sirikit Botanic Garden during 10-11 February 2001.

Our feature article, "A Study on Diversity and Ecology of Fireflies in Thailand", a project under the patronage of Her Majesty Queen Sirikit is an excellent example of national collaborative research for the conservation of biological resources. Sincere appreciation is expressed to Dr. Manus Tittayawan, Project Committee Member, for his assistance in preparation of the article.

It is hoped that our readers find the contents of this newsletter useful, especially researchers who might be seeking information on potential areas of collaborative research with the Garden.

Please note that the official abbreviation of the Queen Sirikit Botanic Garden has been changed from QBG to QSBG.

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BGO Newsletter is published by the Botanical Garden Organization of Thailand. It is issued once a year and distributed without charge to members. Interested organizations, institutions, or individuals that would like to contribute articles for future issues, or receive the Newsletter please contact:

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Contents

New Minister

Dr. Krasae Chanawongse

Dr. Krasae Chanawongse has been appointed Minister to the Prime Minister's Office responsible for the Botanical Garden Organization since March 2001. Dr. Chanawongse graduated with a degree in medicine from Siriraj Medical School, Mahidol University in 1960. He obtained a Diploma in Tropical Public Health from London University, UK in 1968, and a Doctoral degree in Public Health from Columbia University in 1981. In 1985, Dr. Chanawongse received an Honorary Ph.D. in the field of Humanities from Baguio University, the Philippines.

Dr. Krasae Chanawongse has had important roles in both academic and political careers. He was the founder and director of many educational institutes and involved in teaching at national and international universities such as Mahidol University, Thailand, and Columbia University, USA. His political appointments include Minister of University Affairs in 1994, and Minister of Foreign Affairs in 1995.

New Chairman of the Board

Dr. Rongphol Charoenphandu, Deputy Permanent Secretary of the Prime Minister's Office has been appointed the new Chairman of the BGO Executive Board since January 2001. He replaced Mrs. Panit Nitithanprapas who passed on the post due to her demanding responsibilities as Permanent Secretary of the Prime Minister's Office.

Dr. Charoenphandu obtained his Ph.D. in Law from Australia. His positions prior to joining the PM's Office include Associate Dean of the Faculty of Law, and Director of the Graduate Studies, Faculty of Law, Thammasat University; Director of Foreign Law Division, Office of State, Permanent Law Councilor; and Deputy Secretary General of the Councilor of State.

Dr. Rongphol Charoenphandu

Her Majesty was taking a look at hemp fabrics.

On 18 January 2001, HM Queen Sirikit visited Ban Pag Sam, Amphur Wiang Haeng, Chiang Mai to observe the progress of various projects under Her Majesty's initiatives, including the hemp plantation which has been under the supervision of the QSBG. The research is aimed to find suitable cultivation techniques to produce hemp as textile material.

Hemp Plantation (foreground) at Ban Pag Sam.

Kanchong or **Industrial Hemp**
Cannabis sativa L. var. *sativa*
CANNABINACEAE

Native to the Caucasus, China, Iran and northern India. Its tough fiber, hemp, is made into rope, sails, and fabrics.

As well as its close relative - Kancha (Marijuana), *Cannabis sativa* var. *indica*. Kanchong contains delta 9-tetrahydrocannabinol the main psychoactive constituents. It is illegal to grow *Cannabis* in many countries including Thailand. The Royal Initiative "Kanchong Project" is conducted under the approval of the Office of the Narcotic Control Board (ONCB), for research only.

HRH Princess Bhajara Kitiyabha paid a private visit to the QSBG on 4 November 2000.

On 17 May 2001, Mr. Jigmi Yoeser Thinley, Bhutan's Foreign Minister (center), visited the QSBG on the occasion of his official visit to Thailand as a guest of the Thai Foreign Minister.

General Chavalit Yongchaiyudh, Deputy Prime Minister (left) visited the Garden on 14 July 2001. This picture shows him at the Lotus Collection.

Nelumbo spp. (Lotus) in the collection are gifts from Joh-Jakho Temple, Kyoto, Japan; and China Lotus Association Donghu Institue of Flowers and Potted Landscape, Hubei, China.

During 9-10 August 2001, the QSBG organized a symposium on "HM Queen Sirikit and Biodiversity Conservation in Thailand" at the Imperial Mae Ping Hotel, and at the Queen Sirikit Botanic Garden. More than 200 participants attended the symposium. Dr. Rongphol Charoenphandu, BGO Chairman, presided over the opening ceremony (pictured right).

The First Northern Guide Tour Training Workshop was organized during 14-15 September 2000. The aim of the workshop was to provide information on plant diversity and the importance of botanical gardens in plant conservation to the tour guides. The workshop was co-sponsored by the Tourism Authority of Thailand.

QSBG staff in front of the National Science Museum.

During 5-9 March 2001, staff of the Herbarium Unit, Biodiversity Unit, and Educational Unit went to Ta Madue Village, Kanchanaburi to observe the local community involvement in sustainable ecotourism, and help with identification of interesting plants in the area. Financial support from the CBBP (QSBG-DANCED Project) is highly appreciated.

Ms. Vipava Seamyam, Seed Conservation Unit, attended

the Asian Regional Training Workshop on Desiccation Tolerance of Tropical Forest Tree Seeds, held at ASEAN Forest Tree Seed Center, Muak Lek, Saraburi during 2-6 April 2001.

Participants in the workshop with QSBG lecturers.

To increase knowledge and experience in public education and services, the QSBG staff visited the Science Museum, Prathumthani, the Chulachomklao Royal Military Academy, and Muak Lek Botanical Garden, Saraburi during 15-17 September 2000.

Anisoptera sp. DIPTEROCARPACEAE - *one of the twin giant trees in the village.*

During 10-15 April 2001, Dr. Allen Coombes, an oak specialist from Sir Harold Hillier Gardens and Arboretum, U.K., along with Dr. Maricela Rodriguez, Botanical Gardens, Mexico, Dr. Zhakhun Zhou, Kunming Institute of Botany, Dept. of Phylctaxonomy and Phytogeography, China; and Dr. Saw Leng Guan, Forest Research Institute, Malaysia visited the QSBG and Doi Inthanon National Park. A meeting was held for the foreign experts and the Thai expert in Fagaceae, Dr. Chamlong Phengklai, to discuss with the QSBG staff for possible collaboration to establish an oak collection at the Garden. The meeting was a fruitful one. More future collaboration is expected. Thanks once again to the CBBP for the financial support of the local transport and accommodation for the oak specialists.

The QSBG staff celebrated the Songkran (water festival) on 23 April 2001 in northern tradition.

The 5th Parataxonomist Training Workshop was organized during 24-27 April 2001, at the Queen Sirikit Botanic Garden with field studies at Doi Inthanon National Parks.

The Parataxonomist Training Workshop is organized annually with the aim to support plant conservation by raising awareness in re evant issues of various aspects. For the effectiveness of field studies, the workshops will accommodate not more than 50 participants. Those who are interested please contact the Education Section, Technical and Research Department.

Tel: 298-171 ext. 1639 or 1208

Dr. Suyanee Vessabutr, Head, Technical and Research Department, along with Miss Savitree Sasirat, Biodiversity Unit, and Mrs. Scraya Norsangsri, Education Unit participated in "Policy Dialogue on Biodiversity and Education" organized by the Andaman Project of Kasetsart University and Thailand Biodiversity Center, at Phi Phi Island Cacana Hotel, Krabi, during 14-17 June 2001.

Welcome

Mr. Warren Townsden from Sydney, Australia, is now working as a foreign consultant for the Garden Department. Mr. Townsden has more than 20 years of experience in various fields of horticulture, including arboriculture, park management, and ecotourism. Prior to joining the QSBG, Mr. Townsden served as Senior Horticulturist at Taronga Zoo, Sydney. Welcome aboard Warren!

Farewell

The QSBG staff would like to bid farewell to Ms. Wannee Rodruengdej, Head, Marketing Department; and Mr. Sanya Pookphunt, Head, Garden Department, who are retiring by the end of September 2001. Their commitment during many years of service is noteworthy. We wish them good health and every happiness in life lying ahead.

Congratulations

- Mr. Charun Maknoi who recently recieved his M.Sc. (Ecology) from Prince of Songkla University. Mr. Maknoi conducted his research on "Diversity and Habitat Relationships of Zingiberaceae along Thai-Malaysian Border in Yala and Narathiwat Province" under the supervision of Professor Puangpen Siriruksa. Mr. Maknoi is pursuing his Ph.D. study in the same department. His Ph.D. dissertation is entitled: Taxonomy and Phylogeny of *Curcuma* with particular reference to its occurence in Thailand.

- Ms. Suchinda Sompood (Biotechnology Unit), Mr. Thanin Riyaphant and Mr. Worawit Chanapairin (Garden Department), and Ms. Rucheewan Siriwan (Co-ordination Department) who have recently received M.Sc. scholarships from the Capacity Building in Biodiversity Project (CBBP) supported by DANCED. All of them are pursuing their studies at Mae Jo University.

- Ms. Ratchada Pongsatayapipat, Technical and Research Department, who has met all the requirements for a Ph.D. scholarship granted by CBBP to study at Aarhus University, Denmark. Her research project is : Management of Palm Resources in Thailand with Special Emphasis on Species Occuring in the North.

  The QSBG Staff wish them best of luck in their studies!

- ☺ Healthy baby girl "Phalita" (nicknamed 'May') was born on 1 May 2001. The proud parents are Mr. Prachaya Srisanga, Botanist, Technical and Research Department, and Ms. Supara, Accountant, Co-ordination Department. Best wishes from all of us!

Thank You

- Volunteers through the arrangement of Involvement Volunteer–Thailand, namely Nadine Zephir from Sweden; Julia Smith from Australia; and Kerry Ponsford from the UK. The QSBG staff are thankful for their help in teaching English and sharing their experiences in medicinal and aromatic plants.
- Also, many thanks to Sarah and Fay Alikhani for their assistance in making this newsletter.

Centenary Celebration
of
Thai Danish Co-operation in Biodiversity
10-11 February 2001

During 10-11 February 2001 the QSBG hosted a symposium on the Centenary Celebration of Thai-Danish Co-operation in Biodiversity which received the greatest honour from HM Queen Margrethe II of Denmark and HRH Princess Mahachakri Sirindhorn of Thailand who presided over the opening ceremony of the Symposium.

More than 200 people participated in this successful event which was partially sponsored by DANCED (Capacity Building in the Field of Biodiversity Project at Queen Sirikit Botanic Garden).

Mr.Korn Dabbarangsi, the Deputy Prime Minister, received the royal party.

After the opening ceremony, HM Queen Margrethe II; HRH Prince Henrik, the Prince Consort; HRH Crown Prince Federik; and HRH Princess Mahachakri Sirindhorn, accompanied by the BGO Executive Board Members and distinguished guests, visited the QSBG Glasshouse Complex (pictured left).

HM Queen Margrethe II, HRH Prince Henrik, and HRH Crown Prince Federik at the Arid House.

Dr. Weerachai Nanakorn attending the Royal Party at theTropical House.

Keynote Address
by
Her Royal Highness
Princess Mahachakri Sirindhorn

Your Majesty, Your Royal Highnesses, Ladies and Gentlemen.

It is a privilege and a great pleasure for me to be here at the opening of the international symposium on the Centenary Celebration of the Thai-Danish Co-operation in Biodiversity. The centenary celebration coincides with Your Majesty's state visit to Thailand, it should therefore be considered most auspicious occasion to strengthen the relationship between our two kingdoms.

HRH Princess Mahachakri Sirindhorn presented a royal keynote address.

In 1778, the first Danish plant collector who came to Thailand was Johann Gerhard Koeing, a pupil of the renown botanist Linnaeus. He collected Thai plants from Ayutthaya, Bangkok, Chantaburi, and Phuket. He also wrote about the plants he collected. Unfortunately most of his specimens were lost at sea.

About a hundred years later Danish Botanical Society supported C.A. Fielberg to collect plant specimens in the Far East in the year 1868-1869. He returned to Denmark with approximately 400 herbarium specimens from Thailand.

In 1895 a Danish forester Castensjold was engaged by the Royal Thai Government to investigate the condition of flora in Thailand in order to establish the Royal Forest Department. Then in 1898 Admiral Richelieu on his visit to Denmark encouraged a young botanist, E. Johannes Schimdt who had just graduated from the University of Copenhagen to come survey the tropical plants in Koh Chang, an island in the eastern part of the Gulf of Thailand. Dr. Schimdt undertook the expedition in the years 1899-1900. 1,300 specimens collected during the expedition have been studied by botanists around the world.

I would like to mention an orchid specialist Gunnar Seidenfaden, the first Danish ambassador to Thailand whose uncle, Major Erik Seidenfaden, served in the Royal Thai Gendarmerie. Ambassador Seidenfaden had visited his uncle in Thailand and later when he came to Thailand again, he collaborated with Dr. Tem Smittinand, a Thai forest botanist of the Forest Herbarium. Another example of the Thai-Danish botanical studies on plant taxonomy is the publication of the "Flora of Thailand" in 1970 under the editorship of Prof. Tem Smittinand and Prof. Kai Larsen.

At this point I wish to talk about my personal involvement in the plant genetics conservation project.

My father has long been interested in conservation of plant species. Since 1961, he collected *Dipterocarpus alatus* which now grows into a big forest inside the palace. He also collected various plant varieties from every region of the country. He said children who would not have any chance to see these trees could come to the palace to learn about them. In 1985 he used the tissue culture technique to conserve the very old jackfruit tree, tropical almond (*Terminalia chebula* Retz.) which is supposed to be the descendant of the

Gunnar Seidenfaden at work - orchid identification.

one planted by one of my ancestors who was a traditional doctor as the fruit of this plant can be used as medicine, and other "historical" plants. In 1988 conservation and propagation of rattan (*Calamus sp.*) *in vitro* was initiated. The work was going to be widely extended so I have suggested an idea that it would not be possible to keep everything within the 1 square kilometer palace compound. It is not good either to have new buildings because the palace is supposed to be one of Bangkok's green areas or "Bangkok's lung". The result is that we built only a small building for germplasm and plant genetic data bank and links the data from many organizations namely Department of Agriculture, Royal Forest Department, Department of Agricultural Extension, and many educational institutes. We aim at having plant genetics database system which can communicate around the country.

Kai Larsen (center) and Tem Smitinand (right) during the 1st Thai-Danish Botanical Expedition on Phu Kradueng, Loei province in 1958.

The aims of the project are as follows:

1. To conserve endangered indigenous plants. We set up Plant Germplasm Bank which contains plant genetics that can be used to develop plant species in the future.

2. To use the technique of propagation by tissue culture and other means to preserve the plant genetic resources in the form of living plants, seeds, etc.

3. To study and evaluate existing plant genetics in terms of the morphology, physiology, anatomy, bio-chemistry, genetics, molecular biology, nutrition value, flavour, aromatic compounds, and utilization of these plants, etc. We make a study in DNA fingerprint in order to prepare the patent of these plants as national treasure.

I would like to cite some examples:

1. We explore the forest around the country in all floristic regions, and also look for trees and plants in the land under the responsibility of several government agencies, research centers, educational institutes, school, temples and the protected pieces of land belonging to the community. We do the registration, code the plant clones, pinpoint the locations of those plants, make studies as I already mentioned. We also mobilized and support the local volunteers. Researchers from universities and other research agencies help to conduct research. Certain species are being studied in detail for example: makieng (*Cleistocalyx operculatus* Roxb.var.*paniala*), bael fruit (*Aegle marmelos* Corr., *Nepenthes gracilis* Korth.) rattan (*Calamus* sp.)

2. We explore and collect plant genetics from the areas which will change due to the construction of reservoirs, roads or electricity wires.

3. We propagate and plant the species especially rare and endangered ones in "safe areas", for example at the Royal Development Study Centers (http://www.rdpb.go.th/english/english.html), research centers or experimental stations of the Department of Agriculture, special areas given for the purpose of conserving plant species. We have the seed storage and tissue culture lab.

4. Plant Germplasm Database Center at Chitralada Palace is working in collaboration with the herbarium of various organizations. The specimens are analyzed and studied by volunteer experts. Some parts of the information will be kept in book and CD Rom forms.

5. Creating the awareness of the population especially the new generation. To show that the study of botany can be very enjoyable, we have the school botanical garden program for primary and secondary all over the country both in the urban and rural areas.

Another project is to encourage villagers to work together in groups or in cooperatives to cultivate certain economic plants in or near the forest which can generate income and the members will not have to live on illegal logging.

6. The School Botanical Gardens.

6.1 Teachers and school children are encouraged to explore and look after plants and trees which already exist in the school compound, to find interesting plants in the area to grow at the school.

6.2 Make plant data cards. Each one

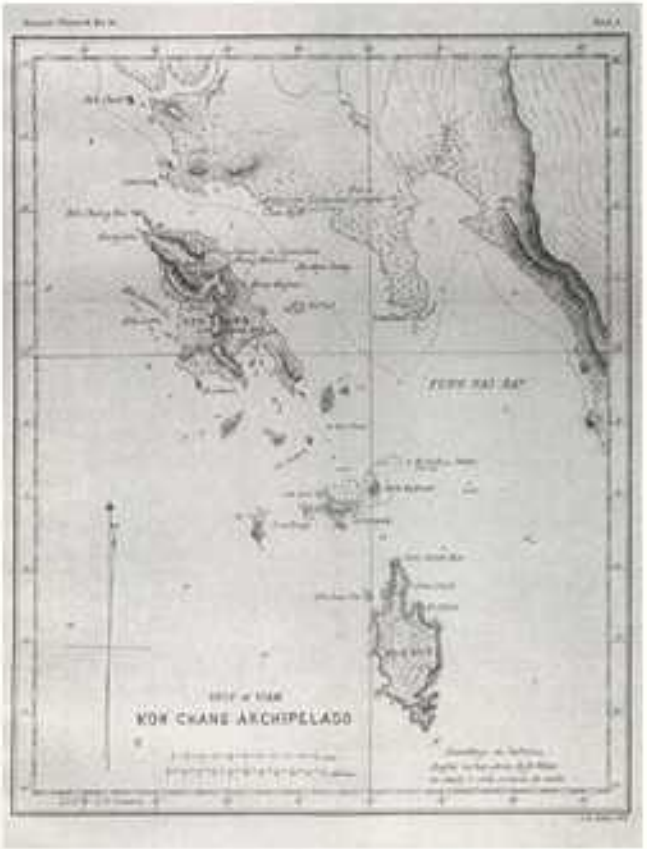
contains the information about local name, common name, botanical name, and other information, distribution, utilization, ethnobotanic features. The information can be found in books on botany which we donate to the school library or some occasions we have to invite experts on plant taxonomy to identify the plants.

6.3 Students can make detail studies of each plant: the growth, the development, its life cycle etc. They can interview their parents, their relatives or village elders about the use of these plants. This is the way to preserve the folk wisdom. The students will be taught to collect herbarium specimens in a systematic way. We supply also the forms to be filled.

In this way the students will have an opportunity to practise a scientific research and report writing. The information, the collected materials and reports are kept in libraries of the schools or in some schools there is a special room for the purpose.

6.4 Some of the schools are already the members of School Net so they are encouraged to put their finding in their homepages to share their knowledge with other schools (http://www.school.net.th).

6.5 We can link the study of botany with various other subjects. In addition to teaching science, teachers can teach Thai and foreign languages by encouraging students to write articles or poems about trees and flowers. Art teachers can teach their students to draw and paint trees and flowers which will lead to the art of scientific drawing and painting. Parts of some plants can be used to make art work or some small souvenirs which, in some places, the students may be able to sell to tourists.



6.6 In working like this, there is a close cooperation between schools and communities, teachers, students and parents.

My mother also initiated some conservation projects, for example "Forest Loves Water" and "Small Home in Big Forest" aiming at developing the quality of life by introducing villagers to earn a living from home industry, vegetable and animal products. The villagers are also motivated to protect their forest from logging, shifting cultivation and wildlife hunting. We also create awareness that forests can help regenerate rain.

In 1995, I visited Poquerolles Island in southern France to see the conservation work in the Conservatoire Botanique National de Porquerolles. There are collections of flowers, especially different cultivars of oleander, Mediterranean fruit, trees, and rare species. Everywhere there are charts explaining about environment degradation and the way to protect our natural heritage. When I returned


Flora of Koh Chang

Johannes Schmidt, conducted the expedition to Koh Chang Archipelago in 1899. Flora of Koh Chang was published in 10 parts between 1903 - 1916.

home I tried to find an island that I could do the same kind of work. I am interested in islands not only because of the study-tour to this French island, but in Thailand I have also noticed that there are very interesting fauna and flora on different islands I have been to. At first I found an island which was too far away to work on. Later the Royal Thai Navy cooperated in implementing this project in Samaesarn Archipelago in Chonburi. In less than one year, during my visit to the Samaesarn Island on September 3, 1998 I saw that work had progressed well in the study of biology and ecology of the island in:

- geology, topography, geohydrographic, and soil science
- water resources: physical and biological properties
- microbes: soil microbes, bacteria, fungi, mushroom, lichens
- soil invertebrates, insects
- amphibians, reptiles
- mammals
- diversity of birds
- diversity of coastal fauna
- diversity of flora (littoral vegetation, strand vegetation, mangrove vegetation, littoral dry evergreen forest 80-90% of the island)

This can be considered the second survey in this archipelago (the first one was done by Dr. J. Schmidt in 1899-1900 at Koh Chang, Trat Province).

In this survey some new plants were discovered and there were also some endangered species.

This island is too small to be able to support a great number of visitors but conducted group tours for educational purposes are possible. We have already collected specimens for a museum or a visitor center, published a book about trees (we hope to make a series), marked some nature trails, and trained volunteers as guides.

We would like to conserve the biodiversity, to develop our country in a sustainable way and to manage our natural resources efficiently. I wish to thank the various agencies both governmental and nongovernmental who enable me to be active in this field and hope that I shall have the pleasure to cooperate further with Danish botanical institutes. In the near future there might be more exchanges of personnel, researchers, and students between our two countries so that we have the opportunity to improve our technology in this field of studies. Last but not least, we all in this symposium would like to thank Your Majesty and Your Royal Highness for your kind attention. We humbly wish Your Majesty and Your Highness happiness, good health, and success in all your endeavors.

Botanical News

Halenia elliptica D.Don. (GENTIACEAE) found with a small population at Doi Inthanon during a plant survey of the QSBG's botanists in September 2000.

Vernacular name:	Reed Ngoi (Chiang Mai)
Ecology:	Open grassy slope in pine forest c 1,700-1,800 m. alt. Not so common in Thailand.
Distribution:	India (Sikkim), Bhutan, Nepal, China, Myanmar

The Sanga Sabhasri Research and Development Center at the QSBG was officially opened on 9 September 2000. Mrs. Panit Nitithanprapas, Permanent Secretary, the Prime Minister's Office presided over the opening ceremony.

The monument of the late Dr. Sanga Sabhasri was erected on the same day at the Natural Science Museum.

Executive Board Members, and Mrs. Sabhasri (center) at the monument.

Sanga Sabhasri

1933–1999

CONSERVE THE FORESTS TO MAINTAIN BIODIVERSITY FOR THE BENEFIT OF THE PEOPLE

The Center comprises the Herbarium Center which also houses the Sanga Sabhasri Library, the Natural Science Museum, and the Laboratory Center.

The latest meeting of the SSRF committee members was held on 9 June 2001. It was agreed that the profits from the sale of calenders, postcards, and books produced by the Foundation to be granted to the welfare of the QSBG staff.

A Study on Diversity and Ecology of Fireflies in Thailand

Excerpted from the progress report by
The Firefly Project Commitee

Many research projects related to nature and wildlife conservation in Thailand have been initiated by Her Majesty Queen Sirikit due to her interest in conservation of natural resources of the country. The project on "Diversity and Ecology of Fireflies in Thailand" was initiated during her royal visit to the Queen Sirikit Botanic Garden in April 1996. Since early 1997, the QSBG has coordinated with entomologists and specialists from various academic and government institutes.

The goals of the project are to study diversity of fireflies in every part of the country as well as their natural habitats, in order to understand their life cycle, which will lead to appropriate rearing techniques to increase the population and release them to their natural habitats.

"Firefly is an indicator of non-disturbed ecological systems. The Queen Sirikit Botanic Garden should conduct studies on the relationship between fireflies and plants in their natural habitats in order to know more about their life cycle"

HM Queen Sirikit's Remark
8 April 1996
The Queen Sirikit Botanic Garden,
Mae Rim, Chiang Mai

Introduction

Located in the tropical area, Thailand is rich with biological resources. Among the country fauna resources, insects are so numerous and diverse with an estimate of some 60,000 species. They play a vital role in the environment, yet not much comprehensive study has been conducted and many species await identification.

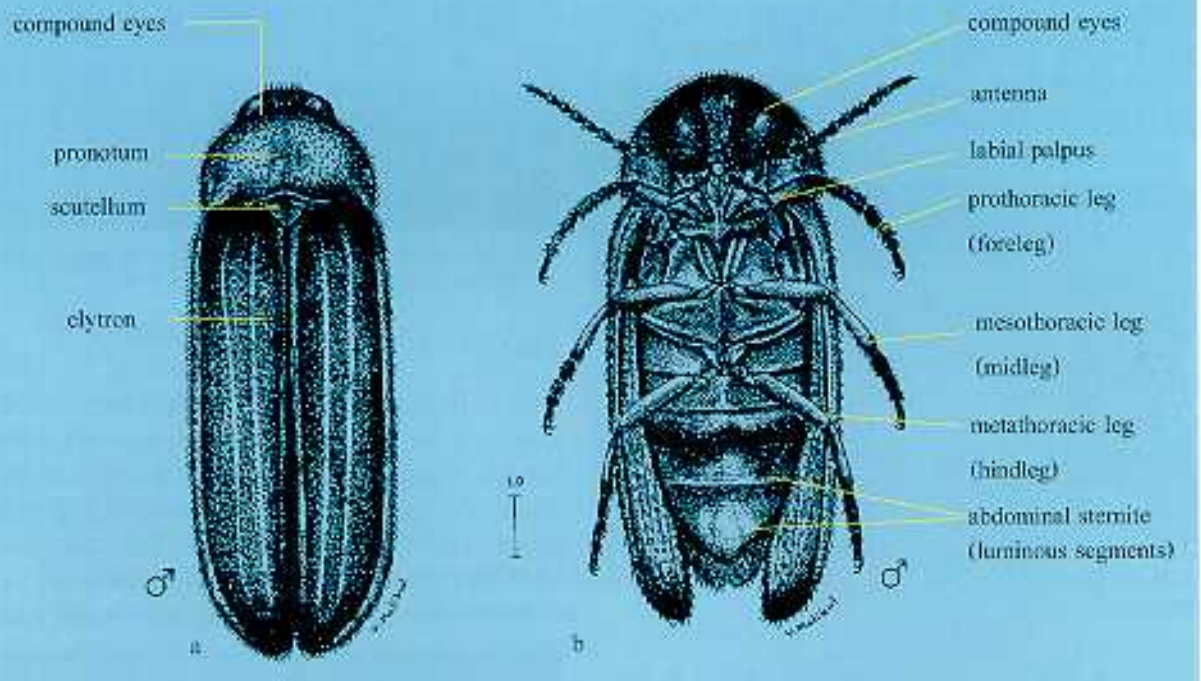
Firefly is one good example of insects that there is not much information available on almost every aspect of the species distributed in the country. Most information on fireflies in Thailand has been obtained from old documents of some foreigners who were in the country more than 50 years ago. The first firefly specimen in Thailand was collected in 1929 by a British Major W.R.S. Ladell, and was identified as *Luciola substriata* (Gorh.) by G.E. Bryant. Other information concerning their life cycle, behavior, usefulness, etc., come from specialists who have studied the insects in other parts of the world.

Luciola substriata (Gorh.), the first specimen of firefly in Thailand, now kept in Insect Museum of the Zoology and Entomology Division, Department of Agriculture, Bangkok.

Fireflies or "lightningbugs" are well-known for their green-yellow flashing light. They are not flies, but beetles of the family Lampyridae (distinguished by their generally soft body and wings). Worldwide there are close to 2000 species that have been formally named. Their light-producing organs are located beneath the skin of the segments near the end of the abdomen – often the 6th and 7th in male, and the latter segment in the female. The luminous segments can be easily recognized, even when they are not glowing, by their yellowish green color. The light is produced by the oxidation of a substance called luciferin, catalyzed by the enzyme luciferase in the presence of ATP (adenosine triphosphate) and magnesium ions (Borror *et al.*, 1989). Each species with luminescent organs has a characteristic flash code. These flashes may differ in number, length, frequency, or color. The light signals serve primarily as a means of attracting the opposite sexes for mating (Papi, 1969). Females of some species imitate the flashes of other species and lure males of those species to eat (Lloyd, 1989).

Structural Characters of the Firefly

A firefly is characterized by having an elongated and soft body. The pronotum extends forward over the head making the head largely or entirely concealed from above. The firefly wings (elytra) are soft, flexible and rather flat.



Luciola brahmina Bourgeois, male, a. dorsal view, b. ventral view showing luminescent segments

Note: Male fireflies have two segments of luminescent organs whereas female fireflies have only one.

Fireflies are useful as biological agents to control snails, which are mainly intermediate hosts of human parasites, and pests to crop plants. The enzyme luciferase, which is responsible for the firefly's luminescence, is widely used to assay adenosine triphosphate (ATP) levels in cells. Most firefly species are habitat-specific, hence their appearance and number indicates the status of ecology systems. Recently, there has been a lot of concern about an apparent decline in the firefly population. The reasons of their disappearance have been cited as the habitat destruction, pesticide use, and mass harvesting pressure.

Life Cycle

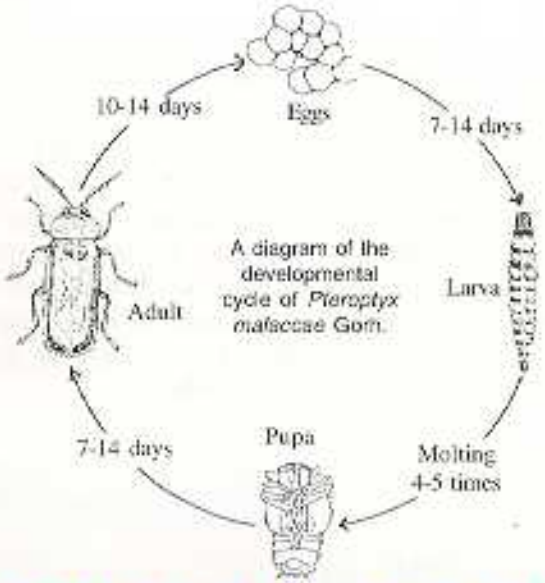
As with all beetles, fireflies have four stages in their life cycle: egg, larva, pupa, and adult. However, unlike other beetles, the eggs, larvae and pupae of some fireflies species are luminous to a variable degree (Richards and Davies, 1977). Although at these stages, their light is rather dim and a steady one – no flashing on and off !

After mating, the female lays eggs (on the ground or on leaves of floating plants, depending on its habitat). In 7-14 days, the eggs hatch and tiny larvae emerge. When at larva stage, fireflies are carnivorous. They eat snails, earthworms, small insects, and probably other tiny soft-bodied animals they can catch. Their method of feeding is very much like that of spiders. First, saliva is ejected through the grooved mandibles to paralyze the prey and predigests the tissue of the prey. Second, the liquid produces by predigestion is sucked in through the grooved mandibles, thus firefly larvae cannot chew and do not take in solid food. Firefly larvae and adults cannot bite human skin, and their saliva has no effect on human beings (USDA 1961).

A larva of *Luciola substriata* Goth., taking its prey *Filopaludina martensi* Frauenfeld.

A firefly larva goes through a specific number of molts then it pupates to produce a hard case around itself. Within 7-14 days, the pupa metamorphoses into a reproductively mature individual. At this stage, females of most species are wingless or having reduced wings, hence they resemble their larvae (being larviform). Adult feed only rarely but capable of imbibing fluid. The life-span of adults in the wild is not known, but the life-span of captive adults of some species ranges between 3-17 days (Ohba and Sim, 1994).

The complete life cycle requires 1 or 2 years, depending on the species.



Cryptozona siamensis Tomlin, a species of land snail which *Pyrocoelia* spp. and *Lamprigera* spp.,feed on.

Habitats

Firefly species differ in their habitats, which ranges from swamp mangroves to high altitude forests. Most fireflies are nocturnal (active at night). During the daytime, they hide themselves in dark crevices or underground. After night falls, they can be seen flying, flashing over meadows, grasslands, creek sides, or sea coasts. More than one species may be

A mangrove swamp at Samut Sakhon province, habitat of *Pteroptyx malaccae* Gorh. Mangrove snails live in tidal water and tree bed.

in the same area at the same time. Their unique flashing code prevents breeding between the species.

Naturally, fireflies live in undisturbed wet areas, i.e., having clean water with preys such as earthworms and snails. Therefore, contamination from herbicides a nd pesticides leads to decreasing population of both fireflies and their preys.

An association of fireflies in southeast Asia with "favorite" trees, especially mangrove species such as *Sonneratia*, is well recognized. According to Buck and Buck (1966), "firefly trees" did not give any indication that the insects were attracted by their flowers or fruits. Since most fireflies do not feed during adult life, trees may not be an objective in themselves but are involved incidently to some other activity of fireflies.

A small creak in the Queen Sirikit Botanic Garden, where a few species of firefly were found.

Diversity of Fireflies in Thailand

During 1997-2000, entomologists of the Firefly Project conducted surveys in thirty-five provinces throughout the country. Ten genera of the firefly have been identified, namely, *Diaphanes*, *Lamprigera*, *Lucidina*, *Luciola*, *Pteroptyx*, *Pyrocoelia*, *Pyrophanes*, *Rhagophthalmus*, *Stenocladius*, and *Vesta*. Over a hundred species has been estimated. They are nocturnal species. Further study is required to identify the species of Thai fireflies. Some constraints remain due to lacking of reference specimens for comparison.

The followings are the ten genera of Thai fireflies found during the 3 years survey.

1. *Diaphanes*

Distributed in central, northeastern, and northern part of the country. Also found at high altitude such as Doi Inthanon, Chiang Mai, which is the highest peak of Thailand. Relatively rare.

Diphanes sp.

2. *Lamprigera*

It is the genus of fireflies with the largest body size of all. Found in every part of the country, but mostly in the South. Adult female can reach 100 mm in body length. They are wormlike and wingless hence appear as giant glow-worms. Adult males is about 18 mm long , 6 mm wide, with well developed wings.

Lampogera spp., adult males

3. *Lucidina*

Considered very rare. The only specimen found has been deposited at the Insect Museum of the DOA, Bangkok. It was found on 13 April, 1968, at Amphur Wangsapoong, Loey Province. It is 15 mm in length and 4 mm in width, with triangular protonum, small compound eyes, and serrate antenna.

Lucidina sp.

Luciola circumdata Gorh.

Luciola indica Mots.

4. *Luciola*

The largest genus of fireflies in Thailand, with an estimate of more than 90 species. Their body sizes range from 4-12 mm in length, and 2-5 mm in width. Distributed in every part of the country, and different habitats such as fresh water and brackish water habitats. Larvae behaviour ranges from being terrestrial to aquatic, depending on the species. Adults of both sexes have well-developed wings. Males and females differ in number of luminous segments.

Pteroptyx malaccae Gorh., adult male.

5. *Pteroptyx*

Distribution found in central, southern, and eastern part of Thailand. Well-known for their unique characteristics of large aggregations and synchronous flashing. Adults are 5-7 mm long, and 2-3 mm wide. Both male and female have well-developed wings. The apex of elytra in male is folded inward. The characteristic of having hooked elytral tips of male *Pteroptyx* is the primary criterion for separating the genus *Pteroptyx* from *Luciola*.

Pteroptyx malaccae Gorh., pupal stage

Pteroptyx malaccae Gorh., adult female.

Pyrocoelia anais Fabricius

6. *Pyrocoelia*

Found in northern Thailand, including at Queen Sirikit Botanic Garden, Mae Rim, Chiang Mai. Adult females are wingless or having reduced wings (brachypterous). Adult females are 18-20 mm long, and resemble larvae. Adult males are about 13-17 mm long, and 4-7 mm wide, serrate antennae.

7. *Pyrophanes*

Small fireflies found in central and eastern part of Thailand. About 6mm in length and 3 mm in width. Having relatively short antennae and small compound eyes.

Female *Rhagophthalmus* wrapping itself around the eggs

Rhagophthalmus, adult male

8. *Rhagophthalmus*

Distributed throughout the country except in the south which there has been no report yet. Population distributed in a very small number (2-3 fireflies/colony). Adult males are 7-10 mm long, and 2-3 mm wide. They have well-developed wings, but no luminous organs. Compound eyes are divided into upper and lower sections. Adult females are larviform. Every segment of the body glows.

9. *Stenocladius*

Found in every part of the country. Adult male is 5-9 mm long, with serrate antennae and well-developed wings. Adult female is larviform and wingless. Both sexes are almost non-luminescent, hence difficult to find them. Larvae feed on earthworms. Its distribution includes Khon Kaen in the northeast, Chantaburi in the east, Surat Thani in the south, and Chiang Mai (Queen Sirikit Botanic Garden) in the north.

Stenocladius sp., adult female

10. *Vesta*

A rare species of fireflies found at high altitude in the north and northeast of Thailand. Body length is about 20 mm long and 5 mm wide. Pronotum semicircular. Antennae flabellate.

Vesta sp.

Conclusion

The project has progressed steadily with a strong support from Her Majesty Queen Sirikit. Every year when visiting the QSBG, Her Majesty grants audience to the Firefly Project Committee in order to present the research progress. HM Queen Sirikit not only has been giving encouragement to the researchers, but also financially supporting the project by contributing one million baht in 1999, and another one million baht in 2001 to help with the research expenditure of the Firefly Project.

Success in raising *Pyrocoelia analis*, and some *Luciola* species under laboratory conditions to complete their life cycle have been reported by the researchers of the project. Mass rearing has not been accomplished so far and the studied specimens failed to breed in captivity. But, it is hoped that this problem will be solved in the near future. Efforts in mass cultivation of fireflies may help bring back some disappearing species. However, if habitat destruction of fireflies continues, not only the wild ones but the reintroduced fireflies from mass rearing will not be able to survive. Therefore, it is imperative that everyone in the society should be involved in protecting our valuable natural resources and the environment following Her Majesty's exemplary role model.

HM Queen Sirikit observed the progress of the project in 1997. Dr. Weerachai Nanakorn is seen explaining the poster exhibition to Her Majesty.

Dr.Yupa Hanboonsong (front), Dr.Angoon Liewanitch (middle), and Dr.Thawatchai Santisuk (back), the Firefly Project Committee Members, attend Her Majesty during the Royal Visit in 1999.

During the latest annual Royal Visit in 2001, Project Secretary, Dr. Suyanee Vessabutr, reported to Her Majesty on the expenditure of Her Royal contribution.

The Firefly Project Commitee Members

1.	The late Professor Sanga Sabhasri	Project Chairman (1996-1999)
2.	Dr. Weerachai Nanakorn	QSBG, Project Chairman (1999-present)
3.	Dr. Angoon Liewanitch	Entomology and Zoology Division, Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Deputy Chairman
4.	Mrs. Sommai Choenram	Entomology and Zoolgy Division, DOA, MOAC
5.	Dr. Manus Titayavan	Entomology Department, Faculty of Agriculture, Chiang Mai University
6.	Dr. Yupa Hanboonsong	Entomology Department, Faculty of Agriculture, Khon Kaen University
7.	Dr. Banpot Napompeth	National Biological Control Center
8.	Dr. Thawatchai Santisuk	Royal Forest Department
9.	Dr. Chaweewan Hutachareon	Royal Forest Department
10.	Dr. Wiroj Pimpimangoon	Royal Forest Department
11.	Dr. Somchai Taranisorn	Royal Palace Ground
12.	Dr. Suyanee Vessabutr	QSBG, Project Secretary
13.	Ms. Sininat Honhutra	QSBG, Assistant Project Secretary

Invited Specialist

Mr. Vichai Malikul	Smithsonian Institution, Washington DC, USA.

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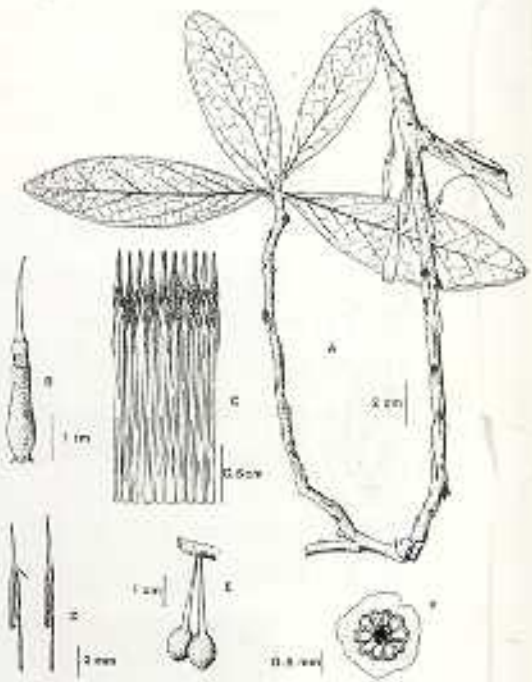
Agapetes thailandica S. Watthana
ERICACEAE

An epiphytic shrub on tree branches in mountain forest, distributed in the northwest of Thailand at altitude about 1500 m.

Manuscript on A new species of *Agapetes* (Ericaceae) from Thailand, by Santi Watthana, QSBG Botanist has been submitted for publication in *Edinb. J. Bot.*



Agapetes thailandica S. Watthana: A. branch with inflorescence (iso. *Watthana et al. 587*); B. flower; C. stamens; D. anthers showing different spur dispositions; E. fruits; F. ovary cross-section.